DOI-13

Revised Section 3 (Proposed Project) of the Biological Assessment for Cachuma Project Operations and the Lower Santa Ynez River (June 13, 2000)

Provided as Separate Enclosure

REVISED SECTION 3 (PROPOSED PROJECT) OF THE BIOLOGICAL ASSESSMENT FOR CACHUMA PROJECT OPERATIONS AND THE LOWER SANTA YNEZ RIVER

Prepared for:

NATIONAL MARINE FISHERIES SERVICE
Long Beach, CA

Prepared by:

U. S. Bureau of Reclamation
Fresno, CA

June 13, 2000

EXHIBIT BOI-13

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June 13, 2000

The action being evaluated in this Biological Assessment includes the existing project operations described in Section 2.6, modification to these operations as presented below, and a number of measures to address potential impacts from Cachuma operations, as well as conservation measures intended to protect and enhance habitat conditions for steelhead. This section first reviews proposed changes in the operations of the Cachuma Project. This section then outlines the proposed actions including conjunctive operations of water releases for downstream water rights, fish passage, and enhancement of fish habitat in the mainstem Santa Ynez River. Several additional conservation measures have been designed to protect and enhance steelhead habitat on Reclamation property at Hilton Creek, as well as on tributaries that provide the majority of the spawning and rearing habitat available to anadromous steelhead. Reclamation and the Cachuma Member Units have reviewed the Proposed Operations and the associated conservation measures to protect steelhead, and fully endorse and support their implementation. The Santa Ynez River Water Conservation District supports the elements of proposed operations applicable to its functions, namely the conjunctive use of the downstream water rights releases with the Project releases to meet rearing target flows. Elements of the Proposed Operation and conservation measures are discussed below.

3.1 PROPOSED RESERVOIR OPERATIONS

The significant changes to reservoir operations (from the baseline condition) include the addition of a surcharge in spill years, rearing target flows in the mainstem, and the establishment of two environmental enhancement accounts (Fish Passage Account and Adaptive Management Account) to provide water for the protection of aquatic resources downstream of Bradbury Dam. Changes have also been made to existing emergency winter storm operations and CCWA delivery operations described below.

3.1.1 WATER SUPPLY AND WATER STORAGE

Cachuma Project Members will continue the baseline-level draft of 25,714 acre-feet (AF) per year from the Project for water supply (see Section 4.3 for discussion of higher shortages). Water storage levels in the reservoir should be similar to past levels with the exception of a higher starting level in years where surcharge is possible.

3.1.2 DOWNSTREAM WATER RIGHTS RELEASES

Under the Proposed Operations downstream water rights releases occur in a manner similar to the baseline operation. Because of the target flows for fish, smaller downstream releases to replenish the upper segment of the Santa Ynez riparian groundwater basin below the dam will likely not be needed in most years. The other main difference will be a formal ramping policy for the transition between downstream water rights releases and fish releases to minimize the potential for stranding.

3.1.3 Emergency Winter Operations

In very wet winters, such as 1998, the normally available space in the reservoir may be filled early in the winter and increase the likelihood of large, potentially damaging runoff events in the subsequent months. During these winters, modified operations can provide substantial health and safety benefits to the area downstream of Bradbury Dam. After the 1998 storms, Reclamation, the Member Units, Santa Barbara County Flood Control, the City of Lompoc, and the SYRWCD entered into discussions to formulate a program defining these operational modifications. As an outcome of these discussions, the Santa Barbara County Flood Control and Water Conservation District and Water Agency prepared a report of modified storm operations for Bradbury Dam (SBFCWCDWA 1998). The report summarizes operational changes to be implemented in the appropriate conditions to protect downstream health and safety.

The modified operations provide for releases of water through the spillway gates at Bradbury Dam (and past the areas downstream with flow capacity limitations) before or after the anticipated peak reservoir inflows. Three operation changes may be employed individually or in concert:

1. pre-storm reservoir drawdown of up to several feet, or "precautionary releases";
2. release of storm inflows up to a calculated maximum flow while holding reservoir below normal operational level, termed "pre-releases"; and
3. after lake reaches above-full condition, hold spillway gates to achieve extra reservoir surcharge, "gateholding".

The first two operational changes release water at Bradbury Dam before the peak inflow; the third holds water in the reservoir for release after peak inflow. Each of these techniques is discussed below.

3.1.3.1 Reservoir Drawdown Below Elevation 750 Feet. (Precautionary Releases)

Temporary evacuation of water to lower the lake elevation a few feet provides storage for initial detention of runoff from the expected storm. This allows subsequent runoff to occupy that space thus keeping reservoir water level from rising as much during the early part of the storm. Used in concert with releases of initial storm runoff ("pre-releases"), maximum lake level rise during the storm runoff event (thus gate opening) can be reduced.

3.1.3.2 Early Releases of Storm Inflow From Rainfall in Upper Watershed (Pre-Releases)

The concept of this second procedure is routing early storm runoff more quickly through the reservoir so as to reduce the maximum lake level during peak storm inflow, thus reducing peak storm release. This operational modification releases water at a rate greater than the historic rule curve during early phases of storm runoff and must be limited by accurate knowledge of downstream channel capacity and flow conditions. Since the release rate is determined from measurements of actual rainfall and watershed condition, there is no risk to water supply from this modification.

3.1.3.3 Temporary Surcharge (Gateholding)

Gate design and operation at Bradbury Dam allow surcharge of the reservoir. That means that the reservoir level can be controlled so that water level could be raised above the normal operation level at any gate opening (release rate) without overtopping the release works or embankment. This allows releases to be held significantly below inflow during the period of peak inflow. In conjunction with lake level lowering and early runoff releases, gateholding will maximize the reduction of the downstream flow rate. Since this operational modification occurs during a spill condition, there is no risk to water supply.

3.1.3.4 Integration of Operational Modifications

The three elements of modified operations discussed above exhibit synergy; they are more effective in reducing peak outflow when used together during the same storm than if used only singly or two together. Physically, these modifications reduce peak downstream flows by temporarily storing peak inflow in the reservoir and releasing it at a reduced rate. Precautionary releases and release of early storm inflow make additional storage available by releasing water from the reservoir before the peak storm inflow. This is accomplished by releasing water before and at greater rates than required by the original rule curve. Gateholding reduces and attenuates flood releases during peak inflow. Each of these techniques performed alone will reduce peak storm release. However, performed together, the reduction of peak release is greater than simply adding the expected effects together, because each technique allows the subsequent operation to start at a lower lake level. These operations will not affect the total volume of storm flow passing through the system, only its temporal distribution for a few days.

3.1.3.5 Factors Considered for Operational Decisions

To protect water supply and to be certain that modified operations do not add to peak downstream flows, several important factors are evaluated as part of and during the modified operations. These factors are:

- quantitative precipitation forecasts (QPF) for each storm.
- watershed conditions, particularly remaining watershed runoff.
- downstream tributary response to precipitation (both predicted and actual).

During two large storm events in February 1998, the historic operation of Bradbury Dam (Lake Cachuma) was modified to reduce downstream flow in the Santa Ynez River through a combination of these three changes to the "normal operations". The results of these modifications indicate that peak storm flows can be reduced up to 40 percent compared to the existing standard operations, thereby reducing coincidental flood damage downstream of Lake Cachuma.

Analysis of historic flow and precipitation data indicate that significant flows above Lake Cachuma needing this sort of modification occur relatively frequently (Table 3-1), but are not regular events. Since the dam began storing water in November 1952, there have been 14 storms during which the emergency winter operations would have been implemented. In seven of these

Table 3-1. Significant Flow Events in the Santa Ynez River at Los Laureles and Solvang Gages, 1952-Present.

Storms That Produced Flows Exceeding 20,000 cfs			
Year	**Date**	**Los Laureles (above Cachuma)**	**Solvang (below Cachuma)**
1966	December 6	X	
1969	January 21	X	
1969	January 25-26	X	X
1969	February 24-25	X	X
1978	February 10	X	
1978	March 4	X	X
1983	March 1-2	X	X
1992	February 12	X	
1995	January 10	X	X
1995	January 24-25	X	
1995	March 11	X	
1998	February 1-2	X	X
1998	February 6-7	X	
1998	February 23-24	X	X

storms, there was sufficient storage space in the reservoir to detain the bulk of the runoff and thereby reduce flooding downstream of the dam. In the remaining seven storm events, the modified operations could have substantially reduced flood peaks, thereby reducing the potential damage downstream.

These modified operations are possible because of advancements in technology, including rainfall and stream flow monitoring capability as well as a flood routing model developed by the Santa Barbara County Flood Control and Water Conservation District.

Modified operations will be considered during storm events where the predicted magnitude of inflow to Lake Cachuma exceeds 15,000 to 20,000 cfs. Actual implementation will depend on a variety of factors as previously discussed.

At the conclusion of a large spill event such as those described above, the recession of spills from Cachuma Reservoir can be ramped down gradually based on the projected inflow to the reservoir. The recession hydrograph of inflow to Cachuma Reservoir is relatively predictable and can be used in the reservoir operation to regulate the recession end of a spill. Under the proposed operation, the surcharge storage space should be utilized to ramp down the spills while creating the surcharge. For example, storage surcharge and ramp-down may begin at a discharge rate of approximately 300 cfs. Based on projected recession hydrograph of inflow, the storage and release from the surcharge can be used to regulate the ramping of spills down to about 30 or 50 cfs.

3.1.4 Maintenance Activities

Various maintenance operations must be conducted at regular intervals to ensure that the Cachuma Project can operate as designed and meet its obligations to the Member Units and the downstream accounts. These maintenance activities include:

- Inspect and test annually High Pressure Gate Assembly with Hydraulic Hoist located at Outlet Works Gate Chamber. Operate gates one at a time from full close to full open. Performed only when two hollow jet valves & butterfly value are closed.Annually test the two 30" hollow jet valves. Test from full closed to full open only when conduit is drained.
- Annually test 10" butterfly valve. Test from full close to full open only when conduit is drained.
- Annually lubricate fittings on machinery deck and trunnion.
- Test and calibrate meters
- Inspect trunnion anchor block four times per year (March, June, Sept, Dec)
- Weekly operate and test radial gate motors during spill release.

- Radial gates are left in open position until spill conditions then are operated/tested according to spill release.

These maintenance activities will not result in discharge to the river, except during spills.

Reclamation will sustain the low-flow crossing and will upgrade it as needed for future projects. Any upgrading would only occur between June and December and include sediment controls. This action would consist of placing washed small cobble (4 to 6 inches) in the Santa Ynez River. If needed for a specific project, vaulted culverts compatible with NMFS standards for culverts would be installed. Filter fences would be installed to trap displaced sediment during this operation.

3.2 Fish Enhancement Operations in the Mainstem

Reclamation is proposing to surcharge Lake Cachuma and use the surcharged water to provide habitat and fish passage enhancement in the lower Santa Ynez River. Implementation of the surcharge requires environmental review and compliance, and construction of flashboards to enable a surcharge. Because implementation of additional surcharge requires facility modifications, Reclamation has developed interim operations to provide increased habitat and passage opportunities.

Interim actions identified to protect and enhance habitat conditions for steelhead within the lower Santa Ynez River have been developed based on results of scientific investigations performed by the Santa Ynez River Technical Advisory Committee (SYRTAC) in combination with extensive hydrologic modeling to evaluate the feasibility and water supply impacts associated with various alternative interim actions. Field fisheries investigations have identified factors such as elevated summer water temperature in affecting habitat quality and availability, particularly for summer steelhead rearing. The investigations have also identified the best available habitat for juvenile steelhead rearing as the reach of the lower Santa Ynez River between Bradbury Dam and Highway 154, and within tributaries such as Hilton Creek. The interim plan of action is designed to protect and enhance these high-value habitat areas using resources and modifications to existing operations under the direct authority of the U.S. Bureau of Reclamation with support of the Santa Ynez River water users.

Based on the SYRTAC investigations a number of instream flow and non-flow actions have been identified that provide fisheries benefit, with specific emphasis on steelhead. Design and construction of the Hilton Creek watering system and the allocation of 2000 acre-feet of water stored in Lake Cachuma (Fish Reserve Account) for use by the SYRTAC for steelhead protection, habitat enhancement, and experimental investigations are examples of actions taken over the past several years to improve conditions on the lower Santa Ynez River for the protection of steelhead.

The proposed interim plan builds on the fishery actions already implemented within the Santa Ynez River to provide the greatest benefits possible to steelhead on a short-term basis within the constraints of reservoir facilities, hydrologic variability within Santa Ynez River watershed, and water supply operations. The fundamental objective of the

proposed program of additional interim actions outlined below, in combination with the fishery actions taken to date, is to protect the Santa Ynez River steelhead population at a level sufficient to avoid jeopardy.

Building on the foundation provided by the interim actions, the proposed project will then further enhance instream flow and non-flow actions within the Santa Ynez River as additional facilities (e.g., the facilities necessary to further surcharge Bradbury Dam) and other habitat improvements (e.g., construction of fish passage facilities within the tributaries) are developed as part of the longer term program of steelhead habitat enhancement. The additional facilities and operational flexibility provided through the long-term plan will substantially improve instream flow conditions for various life stages of steelhead in combination with the habitat improvement measures.

Together, these short- and longer-term actions are intended to (1) avoid jeopardy to steelhead, and (2) substantially enhance habitat conditions for steelhead in an effort to promote recovery of the Santa Ynez River steelhead population and its contribution to the Southern California Steelhead Evolutionarily Significant Unit (ESU).

3.2.1 SURCHARGE

The storage capacity in Lake Cachuma can be increased by surcharging the reservoir. The additional water stored will be dedicated to reducing the yield impacts of releases for fish habitat enhancement purposes. Currently, Reclamation can surcharge Lake Cachuma to 0.75 feet above elevation 750.0 feet, yielding approximately 2,300 acre-feet of additional storage in Lake Cachuma in years when the reservoir spills. About 5,500 acre-feet of storage is provided by a 1.8 foot surcharge. A surcharge of 3.0 feet would provide additional conservation storage of about 9,200 acre-feet above the reservoir full level (above water surface elevation of 750.0 feet). Operations modeling for the 1918 to 1993 period of record indicates that this level of surcharge would likely occur in 24 out of 75 years (32 percent of years).

For surcharge to occur, the environmental review must be completed, the flashboards must be constructed, and there must be an opportunity to surcharge the reservoir. Reclamation has resolved issues associated with the 1.8 foot surcharge. Surcharging the reservoir to 1.8 feet was evaluated in the EIR/EIS for the Cachuma Reservoir Contract Renewal (Woodward Clyde Consultants 1995). Surcharging the reservoir to a level higher than 1.8 feet (i.e. elevation 753 feet) will require disclosure of potential effects on the human environment, including flooding of some county park facilities, and effects on sensitive resources such as oak trees (NEPA compliance). Reclamation expects to complete resolution of the issues associated with the 3.0 foot surcharge during the five year interim period. Reclamation has already determined that it is feasible, from and engineering perspective, to make the appropriate spillway gate modifications for either the 1.8 or 3.0 foot surcharge (Reclamation 1998b). Evaluation of potential effects on the human environment, under NEPA, for the 3.0 foot surcharge will be evaluated by Reclamation. CEQA review will be accomplished by the EIR currently in process by the State Water Resources Control Board.

The long term operations will occur when the reservoir has surcharged to the 3.0 foot level, thus storing an additional 9,200 acre-feet of water. Reclamation has proposed operations changes to benefit steelhead and their habitats in the interim period. Reclamation anticipates that environmental review and construction required to implement the 3.0 foot surcharge will be in place by 2004 with the implementation of the long-term operations proposal expected in 2005, should the reservoir be surcharged in spring, 2005. Reclamation agrees to re-consult with NMFS if the 3.0 foot surcharge is not approved by the end of 2004.

3.2.1.1 Surcharge Interim Phases

Two interim phases of operations will occur prior to implementation of the longer-term operations proposed above. The two interim periods arise because of the phased approach anticipated for the implementation of the 3.0 foot surcharge. The first set of interim operations has already been partially implemented, and will be fully implemented on the release of the Biological Opinion. The first phase of operations uses a surcharge of 0.75 feet. It will continue until the flashboards are modified and there is sufficient rainfall to surcharge the reservoir to the 1.8 foot level. The second phase interim operations begins when 1.8 feet of surcharge water is available and concludes when the 3.0 foot surcharge is approved and there is sufficient rainfall to surcharge the reservoir to the 3.0 foot level.

Flashboard construction on the Bradbury Dam spillway gates is scheduled for summer 2001. The modifications will accommodate a surcharge up to 3.0 feet making either level of surcharge possible. Environmental review for implementation of the 1.8 foot surcharge has been completed (Woodward Clyde Consultants 1995). Implementation of the 3.0 foot surcharge may require additional actions to be identified through project design and environmental review. We anticipate that several years may be required to complete the environmental documentation for implementation of the 3.0 foot surcharge. When the reservoir spills, it will be surcharged to the maximum level permissible given the status of the environmental review and compliance. Table 3-2 summarize the anticipated implementation schedule for the three phases of proposed operations.

Table 3-2. Anticipated Implementation Schedule for the Interim and Long Term Proposed Operations

Operational Phase	Construction Date	Environmental Review Complete	Implementation Date
Interim Phase 1: 0.75 Foot Surcharge	Complete	Complete	Issuance of Biological Opinion
Interim Phase 2: 1.8 Foot Surcharge	2001	Complete	Spring 2002 or 1st spill thereafter
Long Term Operations: 3.0 Foot Surcharge	2001	2004	Spring 2005 or 1st spill thereafter

The existing surcharge capability of Bradbury Dam is 0.75 feet. This level of surcharge provides an additional 2,300 acre feet of storage in Lake Cachuma. With 1.8 feet of surcharge, 5,500 acre-feet of water is stored. Of the 5,500 acre-feet of surcharged water under Phase 2 of the interim operations, 2,500 acre-feet will be allocated to the Fish Passage Account with the remainder used to meet interim target flows at Highway 154.

The interim operations proposed to enhance rearing and passage for steelhead are described in detail in sections below. In addition to the habitat enhanced by water releases, a number of conservation measures will be implemented as described in Section 3.3.

3.2.2 Conjunctive Use and Mainstem Rearing Target Flows

3.2.2.1 Interim Mainstem Rearing Target Flows

During interim operations, rearing target flows will be established in the Santa Ynez River for the purpose of improving mainstem rearing habitat. These target flows will be structured to provide year-round rearing in the Highway 154 reach of the Santa Ynez River. The same rearing target flows will be in effect during both phases of the interim operations (0.75 and 1.8 foot surcharges). Additional water provided by the 1.8 foot surcharge under Phase 2 of the interim operations will be allocated to passage flow supplementation.

Interim target flows will be established at the Highway 154 Bridge. The flow targets will depend on the water year type and the storage in Lake Cachuma on the first of each month. Releases through the Hilton Creek supplemental watering system will be made to meet the flow targets. In years when the lake spills (when the storage in Lake Cachuma is above 120,000 AF) and the spill amount exceeds 23,000 acre-feet, a target flow of 5 cfs at the Highway 154 Bridge will be maintained (when no water rights release is underway). When the lake does not spill, or the spill amount is less than 23,000 acre-feet, and the storage in Lake Cachuma exceeds 120,000 acre-feet, a target flow of 2.5 cfs will be maintained. When lake storage recedes below 120,000 acre-feet, the target flow at the Highway 154 Bridge will be 1.5 cfs.

Reclamation agrees to consult with NMFS in critical drought years to determine what, if any, actions will be taken for mainstem fishery resources. A critical drought year is defined as years when the Project water in storage has receded to less than 30,000 acre-feet in the reservoir. In the historical period analyzed in the Santa Ynez River Hydrologic Model critical drought years have occurred only 2% of the time. Reclamation proposes periodic releases from Bradbury Dam be made to improve water quality in the Stilling Basin and the Long Pool in these critical drought years. Thirty acre-feet per month will be reserved to provide refreshing flows.

Analysis of historical hydrology indicates it will be possible to meet target flows under most conditions. Figure 3-1 shows the daily exceedance flow for the Santa Ynez River at Highway 154 based on simulations of the Santa Ynez River model from 1918 to 1993. Flow at Highway 154 would exceed 1.5 cfs about 98% of the time, 2.5 cfs about 81% of

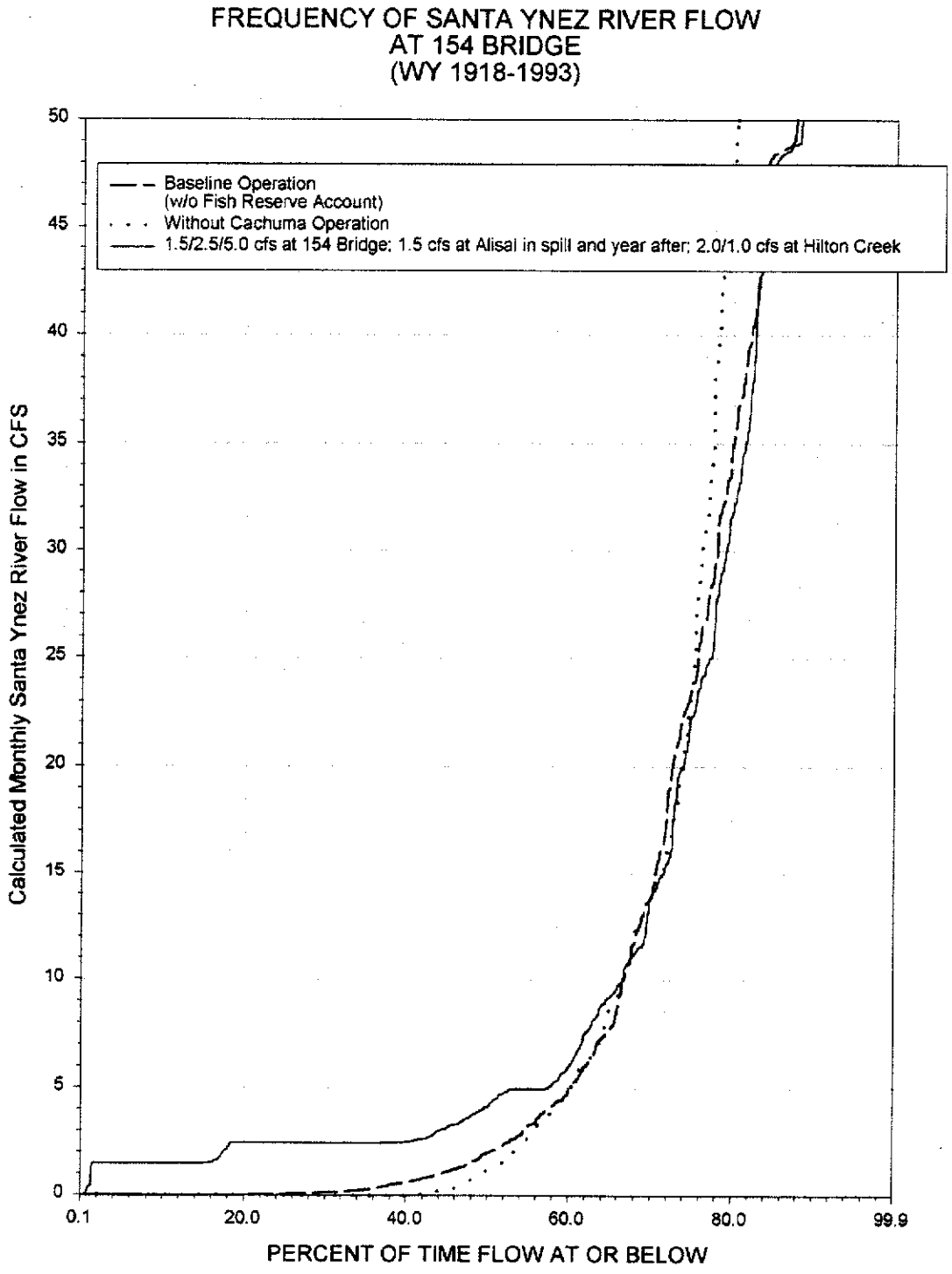

Figure 3-1. Flow at Highway 154 Under the Proposed Interim Operations

the time, and 5 cfs about 49% of the time. Some of this flow persists downstream to the Alisal Bridge in most years (Figure 3-2).

3.2.2.2 Long Term Mainstem Rearing Target Flows

As a part of the proposed operations, water will be made available within Lake Cachuma for the purpose of environmental protection and enhancement of habitat downstream of Bradbury Dam. The mainstem target flows have been designed to reflect annual and inter-annual variations in hydrologic conditions. For the purpose of reducing impacts to Project yield, Reclamation will surcharge the reservoir as described above.

Releases are made from Bradbury Dam to meet downstream water rights requirements (WR 89-18). These releases are typically made during the late spring and/or summer and early fall, using flow patterns designed to recharge the groundwater basin. In wet years, downstream water rights releases are generally not made because the aquifers have been sufficiently recharged by the heavy winter rains.

The objective of conjunctive operations is to extend the period of time each year when instream flows improve fisheries habitat for over-summering and juvenile rearing within

the mainstem river and Hilton Creek. First priority for flow enhancement will be given to Hilton Creek. The reach from the Hilton Creek confluence to Highway 154, will receive second priority. The third priority will be the area between Bradbury Dam and the Hilton Creek confluence, including the Stilling Basin and Long Pool, and fourth priority is given to the mainstem downstream from Highway 154 to the Solvang area.

These priorities have been established based on the quality of existing habitat, the results of extensive water temperature monitoring and modeling (Sections 2.3.1.1 and 2.3.1.2), and the likelihood for successful protection and improvement of steelhead populations. Temperature monitoring and modeling suggest that improved temperature conditions will not extend beyond the Highway 154 Bridge.

Target flows will be established in the mainstem and will vary in order to provide greater biological benefit. In years of higher flow, the mouth of the estuary will open and steelhead will be able to migrate up the mainstem. Under the proposed target flows, more water is provided in these years. In years of lower flow, the mouth may not open and migration up the mainstem may not be possible, but fish holding over from previous years must be sustained. By having a variable mainstem target flow, more water is available when it will support the most steelhead.

During winter runoff seasons, natural flow from tributaries generally provides instream flow in the mainstem of the Santa Ynez River. In wet years, instream flows continue into early summer. In addition, spills from Lake Cachuma tend to enhance and prolong the instream flows in the mainstem in wet years.

Target flows were established at two locations: at Highway 154 Bridge and at Alisal Bridge. Under the proposed conjunctive operation, releases will be made to maintain target flows based on lake level elevations at the beginning of each month. Releases of

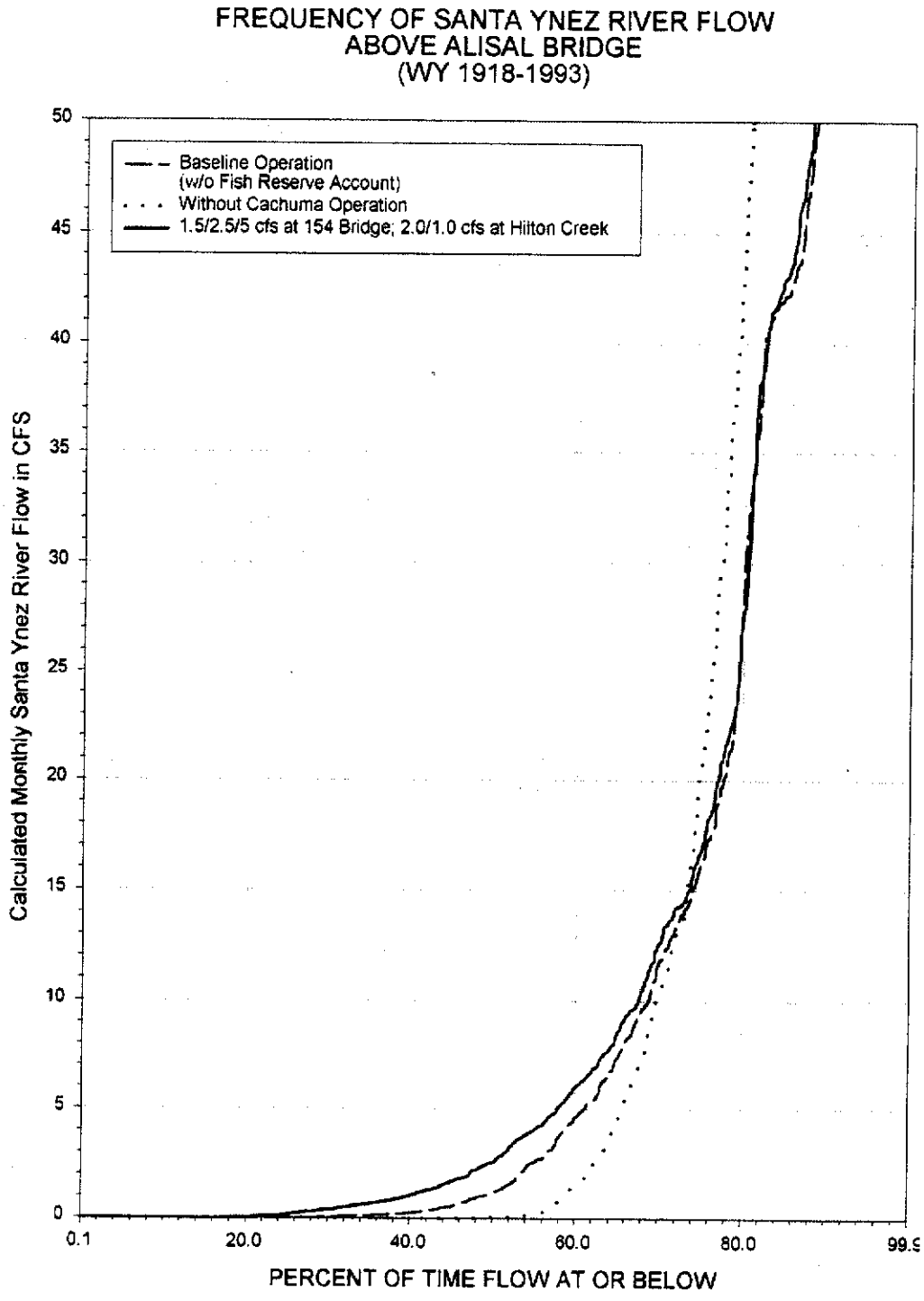

Figure 3-2. Flow in the Alisal Reach Under the Proposed Interim Operations

up to 10 cfs will be made from the supplemental watering system for Hilton Creek to meet these targets. These releases will be made both to Hilton Creek and/or the Stilling Basin based upon the criteria described in Section 3.3.1.1. In years when the lake spills (when the storage in Lake Cachuma is above 120,000 acre-feet) and the spill amount exceeds 20,000 acre-feet, a target flow of 10.0 cfs at Highway 154 Bridge will be maintained. When the lake does not spill, or the spill amount is less than 20,000 acre-feet, and the storage in Lake Cachuma exceeds 120,000 acre-feet, then a target flow of 5 cfs will be maintained. When lake storage recedes below 120,000 acre-feet, the target flow at Highway 154 Bridge will be 2.5 cfs.

Reclamation agrees to consult with NMFS in critical drought years to determine what, if any, actions will be taken for mainstem fishery resources. A critical drought year is defined as years when the Project water in storage has receded to less than 30,000 acre-feet in the reservoir. In the historical period analyzed in the Santa Ynez River Hydrologic Model critical drought years have occurred only 2% of the time. Reclamation proposes periodic releases from Bradbury Dam be made to improve water quality in the Stilling Basin and the Long Pool in these critical drought years. Thirty acre-feet per month will be reserved to provide refreshing flows.

In addition to Highway 154 Bridge targets, flow targets will be established at the Alisal Bridge. In years when the Lake Cachuma spill amount exceeds 20,000 acre-feet and steelhead are present in the reach, a target flow of 1.5 cfs will be maintained. A 1.5 cfs target will also be maintained in the year immediately following a spill year (a year with the spill amount exceeding 20,000 acre-feet) if steelhead are present, unless that year is a drought year.

Figure 3-3 shows the annual releases to meet the established mainstem target flows based on the Santa Ynez River model runs form 1918 to 1993. The average release for habitat maintenance is approximately 2,290 acre-feet under the proposed operations. Analysis of historical hydrology indicates that it will be possible to meet these target flows under most conditions. Figure 3-4 shows the daily exceedance flow for the Santa Ynez River at Highway 154 based on simulations of the Santa Ynez River model from 1918 to 1993. Flow at Highway 154 would exceed 2.5 cfs about 98 percent of the time, 5 cfs about 77 percent of the time, and 10 cfs about 39 percent of the time. Based on the capacity of the Hilton Creek supplemental watering system to deliver 10 cfs, the model shows that the 10 cfs target at Highway 154 was not met in its entirety in 34 out of the 185 months the 10 cfs target would have been in place. However, the model demonstrates that in those months where the 10 cfs target was not met, there would have been at least 8.5 cfs at Highway 154. The model showed that the other targets would have been met in all years based on historical watershed conditions.

Some of the flow targeted for Highway 154 persists downstream as far as the Alisal reach during most years (Figure 3-5). Flow at the Alisal Bridge would exceed 1.5 cfs about 75% of the time. Table 3-3 shows the minimum daily flow that would be observed during each year from 1942 through 1993 under the proposed conjunctive use operation based on daily simulations from the Santa Ynez River model. This table shows that the minimum daily flow during any year at Highway 154 would be less than 2.5 cfs during

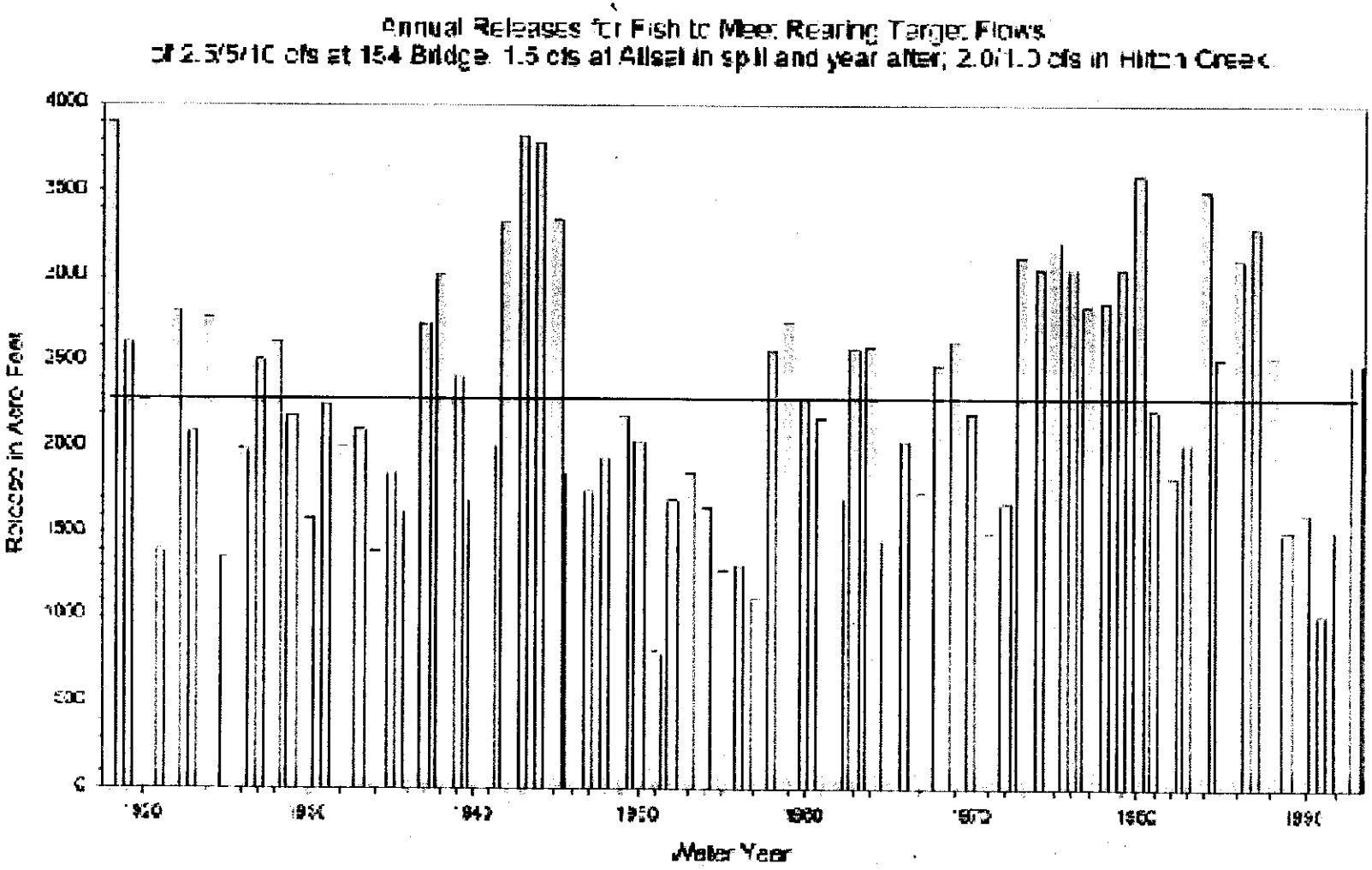

Figure 3-3. Annual Releases to Meet Long Term Mainstem Rearing Target Flows.

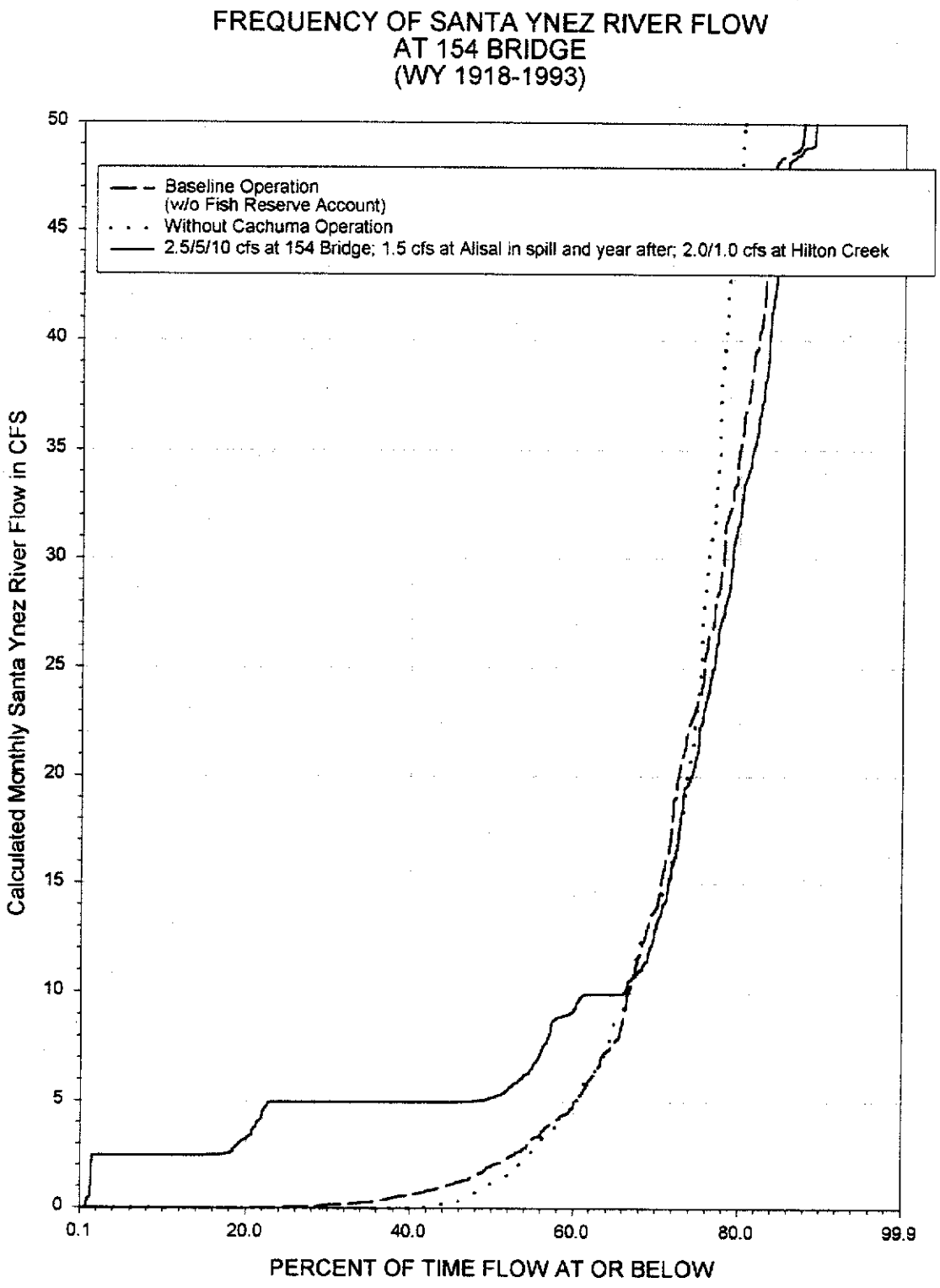

Figure 3-4. Flow at Highway 154 Under Proposed Long Term Operations.

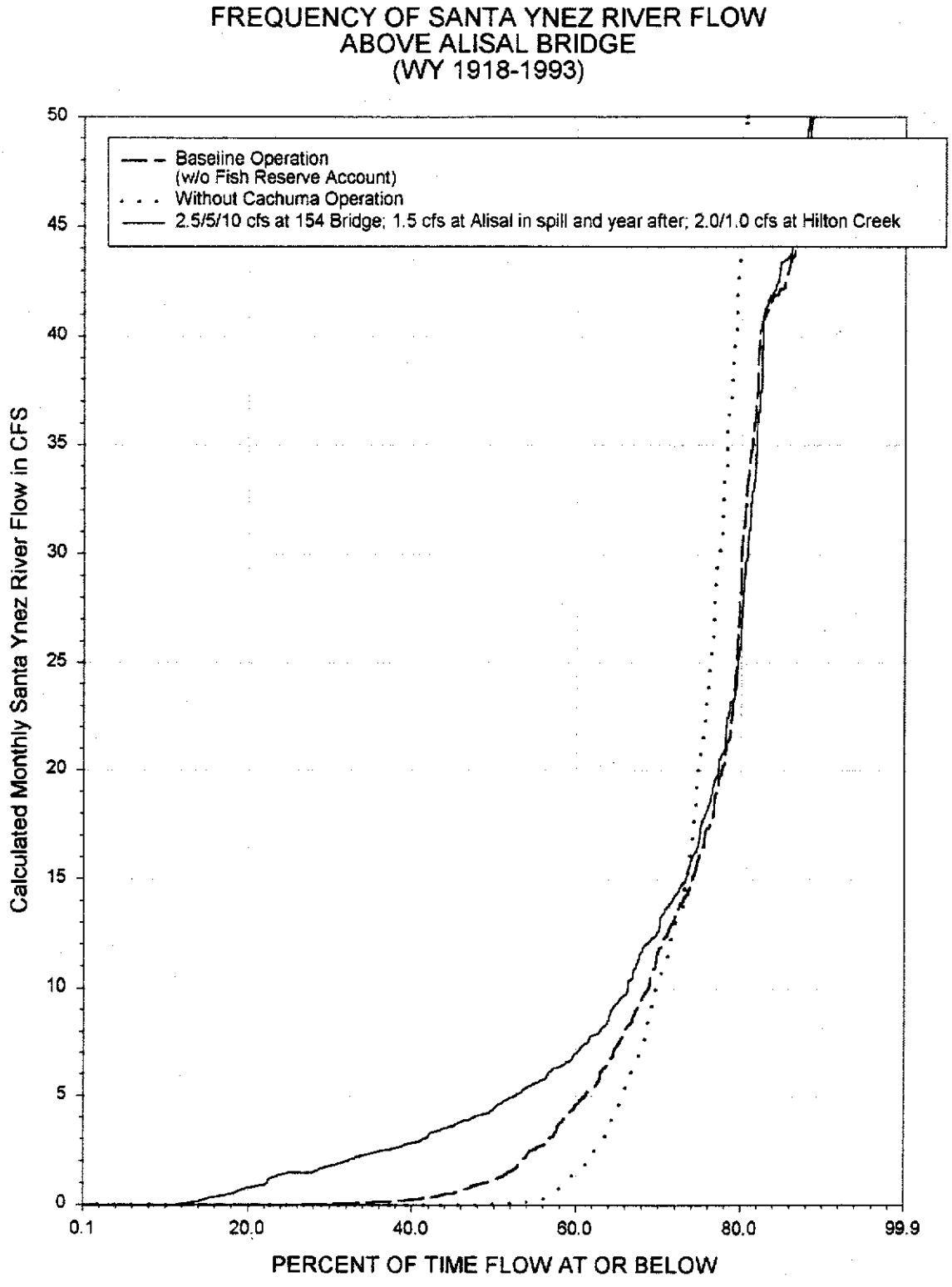

Figure 3-5. Flow at Alisal Bridge Under Proposed Long Term Operations.

Table 3-3. Minimum Daily Flow Under Proposed Long Term Operations, Water Years 1942-1993

Water Year	Location			Water Year	Location		
	Below Hilton Creek (cfs)	Highway 154 Bridge (cfs)	Alisal Bridge (cfs)		Below Hilton Creek (cfs)	Highway 154 Bridge (cfs)	Alisal Bridge (cfs)
1942	2	5	3	1970	3	5	1.5
1943	6	5	0.5	1971	3.5	5	2
1944	4.5	5	1.5	1972	3	5	0
1945	2.5	5	0.5	1973	2	2.5	0
1946	2.5	5	2	1974	2	5	2.5
1947	5.5	5	2	1975	2	5	1.5
1948	3.5	2.5	0	1976	4.5	5	0.5
1949	2	2.5	0	1977	3.5	2.5	0
1950	2	2.5	0	1978	2	2.5	0
1951	0	0	0	1979	2	5	1.5
1952	0	0	0	1980	2.5	5	0.5
1953	2	5	1.5	1981	2	5	1
1954	2	5	1.5	1982	2	5	2
1955	2	2.5	0	1983	2	5	2
1956	1	2.5	0	1984	4.5	5	3
1957	2.5	2.5	0	1985	5	5	1
1958	2	2.5	0	1986	2	5	1.5
1959	2	5	1.5	1987	3.5	5	0.5
1960	3.5	2.5	0	1988	4.5	5	0.5
1961	3.5	2.5	0	1989	3	2.5	0
1962	1	2.5	0	1990	3.5	2.5	0
1963	2	5	0.5	1991	0	0	0
1964	3.5	2.5	0	1992	2	2.5	0
1965	2	2.5	0	1993	5.5	5	3
1966	1	2.5	0				
1967	2	5	2				
1968	4.5	5	1.5				
1969	6	5	2				

three water years (1951, 1952 and 1991), all of which occur at the end of prolonged droughts. During these years, releases will likely be made to refresh refuge habitat.

This conjunctive operation will occur through coordination among Reclamation, the SYRTAC, and SYRWCD, which has committed to participate in conjunctive use operations.

3.2.2.3 Ramping

The duration and rate (including initial rate) of water right releases will vary, depending on whether water is released for the purpose of recharging only the above Narrows area or both above and below Narrows areas together. For example, combined releases for the above and below Narrows areas may begin at the rate of 135-150 cfs and are maintained at a steady rate for about 12-15 days before it is gradually decreased to lower flow rates. During the initial period of 12-15 days, the flow moves at the rate of less than three miles per day (or less than 0.2 ft/sec). At a given location, the flow would gradually ramp up as the recharge rate decreases further upstream. As the recharge rate decreases in the river bed, the release rate is also gradually reduced. Changes in release rates are generally attenuated in the river. In essence, the release rates are maintained at such rates that water would disappear in the lower reaches of the Santa Ynez River channel. The reduced releases could extend two to three months and then would be gradually ramped down to match scheduled releases to maintain mainstem rearing flow targets. Releases for the above Narrows areas are made for shorter duration and lower initial rates compared to the above releases, but follow the same principles.

Operation of water rights releases, in conjunction with releases for mainstem target flows, will be managed to avoid stranding of rainbow trout/steelhead and other fish species. Since 1994, water rights releases have been ramped down voluntarily at the termination of the WR 89-18 releases in accordance with recommendations of the Biological Subcommittee of the SYRTAC. Water rights releases were ramped down to about 5 cfs. This practice will be continued under the proposed operations using the ramping schedule outlined in Table 3-4. A schedule for ramping flows upward is unnecessary as the travel time of water in the river will attenuate the rate of increase as described above.

Table 3-4. 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

In general, managed releases provide opportunities for improved maintenance of fisheries habitat over longer periods of time than have occurred in the past several decades. These releases can be made from the Bradbury Dam outlet (WR 89-18 releases) and/or via the Hilton Creek supplemental water supply facility (WR 89-18 releases and target flow releases). The benefits are discussed in Sections 4.1.1 and 4.2.1. These can include increased amount of aquatic habitat, improved dissolved oxygen conditions from flushing of accumulated algae, and generally reduced water temperatures in reaches close to Bradbury Dam. Conjunctive operation of water releases will be made to improve habitat conditions and build the rainbow trout/steelhead population during wet years, while maintaining the rainbow trout/steelhead population and other fishery resources in dry years.

3.2.2.4 CCWA Water Release

CCWA will make deliveries to Lake Cachuma and ID#1, as described in Section 2.6.5. When there are no downstream releases from Lake Cachuma through the outlet works at Bradbury Dam, the Santa Ynez Pumping Facility will directly pump State Water Project (SWP) water into Lake Cachuma. If it is necessary to make deliveries simultaneously with downstream water rights releases, delivery will be made to the Stilling Basin in lieu of Cachuma water.

When SWP water is released to the Stilling Basin, this release would be subject to specific temperature and mixing requirements to avoid potential impacts to steelhead. The release of SWP water into the Santa Ynez River may have the potential to affect steelhead trout because this water may be warmer than Project water and may contribute to thermal loading in the system. In addition, DFG raised concerns that releases to the river containing SWP water may cause an imprinting problem for young steelhead, which could affect their ability to home in on the Santa Ynez River as adults returning from the ocean. Imprinting would not be a problem, howeyer, since any SWP water releases made to the river in the course of WR 89-18 releases would normally be made in the summer months, not during the juvenile outmigration season. The potential temperature and imprinting impacts were addressed in informal consultation with NMFS, FWS, and DFG for CCWA deliveries in 1997 and in an Environmental Assessment prepared for the CCWA Project (Reclamation 1994).

Specific guidelines for the release of SWP water to the Santa Ynez River were developed in consultation with NMFS and DFG to eliminate the potential effects of these releases, and will be included in the upcoming Habitat Conservation Plan (B. Brennan, CCWA, pers. comm. 1999). When Reclamation is releasing water from the dam outlet works and CCWA is delivering SWP water, to the lake, CCWA water will be diverted to the river as part of the downstream release because the inlet works of CCWA and the outlet works for Bradbury Dam share the same conduit. When releases of less than 10 cfs are to be made, these will occur from the Hilton Creek water supply system, via the Hilton Creek channel and/or the Stilling Basin release point. When this occurs, CCWA deliveries would not be interrupted. During periods when CCWA is delivering water simultaneously with releases from Bradbury Dam, CCWA will blend its SWP water with released Cachuma water in a proportion to meet the temperature target as agreed upon by NMFS and DFG (B. Brennan, CCWA, pers. comm. 1999).

When releases from Lake Cachuma and CCWA deliveries into Lake Cachuma are scheduled simultaneously, CCWA will contact and notify the CDFG, USFWS, and NMFS that SWP water

will be entering the Santa Ynez River. CCWA staff will meet the release temperature constraints (release water 18° C or less).

Temperature confirmation for both lake and SWP water will be undertaken daily. Reclamation staff currently take daily temperature readings of the lake release water. Reclamation staff will also monitor the temperature of the river downstream of the Stilling Basin daily when releases are made. Raw and treated SWP water temperatures are taken by CCWA at the Polonio Pass Water Treatment Plant every four hours, providing advance warning of any changes in water temperature entering the pipeline. Weekly water temperatures are also taken at each tank and turnout along the pipeline route. CCWA's experience thus far indicates that water temperature increases approximately 1°C along the length of the SWP Water Pipeline. CCWA staff will take daily SWP water temperature readings at the Santa Ynez Pumping Facility when downstream releases are occurring and will be responsible for analyzing all pertinent temperature data. CCWA staff will immediately suspend pumping when the temperature of the mixed water exceeds 18°C.

Discharges of pumped SWP water to the river below Bradbury Dam coincidental with scheduled releases of downstream water rights from Lake Cachuma will be treated as downstream water rights account water scheduled for release from Lake Cachuma. Pumped SWP water will be measured by a meter installed by the CCWA immediately downstream of the Santa Ynez Pumping Facility. Water released from Lake Cachuma is measured by the Reclamation venturi meter on the outlet works at Bradbury Dam. In addition, CCWA has installed an ultrasonic meter on the Reclamation outlet works at Bradbury Dam which measures the flows in either direction (releases from Lake Cachuma or SWP water pumped into Lake Cachuma). The sum of the pumped SWP water measured immediately downstream of the Santa Ynez Pumping Facility and water released from Lake Cachuma measured by the Reclamation venturi meter or the CCWA ultrasonic meter should represent the amount of water released for downstream water rights releases.

CCWA is obligated to deliver water into Lake Cachuma every month, if possible. Because of downstream water rights releases, Fish Reserve Account releases (during 1998 only), and/or reservoir spill, CCWA may be unable to match delivery requests on a month by month basis. CCWA intends to complete the annual deliveries by the end of each calendar year. During periods when no water is being released from the outlet works of the dam, CCWA will, after consultation with the dam tender, deliver the requested entitlement water along with any undelivered water from previous months into Lake Cachuma, if possible.

3.2.3 PASSAGE FLOW SUPPLEMENTATION

3.2.3.1 Interim Passage Flow Supplementation

Passage flow supplementation will begin under the second phase of the interim operations, once the reservoir has surcharged to 1.8 feet. A portion of the additional water provided by the 1.8 foot surcharge, 2,500 acre-feet, will be allocated to the Fish Passage Account. Water will be released from the Fish Passage Account in years following the 1.8 foot surcharge event in accordance with the criteria described for long term operations in Section 3.2.3.2.

The quantity and frequency of passage releases under Phase 2 of the interim operations (1.8 feet of surcharge) were calculated using USGS gaged daily stream flows at Solvang for the 40 years of post-Cachuma construction (1958-1998). Passage releases under the interim scenario occur generally one to two years after a year in which the reservoir is surcharged. Table 3-5 tabulates the releases for supplementation of passage by year and shows how releases from the Fish Passage Account would be implemented under this interim proposal. The flow supplementation scenario may be adjusted to provide greater benefit to steelhead.

Analyses based on stream flow records and calculated supplementation releases were undertaken to estimate the total passage days at Solvang in the months of January through May. Passage days with and without supplemented flows are shown for the thirteen years in which supplementation would have occurred (Table 3-6). In these thirteen years, about a third of the years analyzed, 12 additional days of passage per year occur on average. The passage supplementation proposal would thus increase the average number of passage days from a 19 (baseline conditions) to a total of 31 (with supplementation).

3.2.3.2 Long Term Passage Flow Supplementation

Upstream migration is an important event in the steelhead lifecycle. Steelhead, like the other anadromous salmonids, are born in freshwater and live there for generally one or two years before migrating to the sea. While at sea, they grow to sexual maturity and then return to the stream in which they were born to spawn. If passage from the ocean to their spawning grounds is prevented, the steelhead cannot complete its lifecycle and spawn the next generation. When this happens the steelhead may spawn in another stream or wait for another year to spawn. Unlike salmon who die after spawning, steelhead are capable of spawning several times (in different years) under the right conditions (Shapovalov and Taft 1954).

Prior to steelhead migrating upstream in the river itself, they must first be able to enter the river from the ocean. The mouth of the Santa Ynez River is frequently closed by the presence of a sandbar. This bar forms during the summer when flows are low and wave energy is also low. It is breached in the winter by a combination of higher river flows and greater wave energy. Winter runoff from Salsipuedes Creek appears to be sufficient to breach the bar before enough flow is available in the mainstem. No passage flow supplementation will occur until the sand bar has been breached by natural events. The sandbar will be visually inspected each week during the migration season to determine its status and a water level recorder will be installed in the lagoon to monitor ponding conditions (see Section 3.4).

The purpose of the passage flow supplementation is to improve the opportunity for steelhead to migrate from the Santa Ynez lagoon to the tributaries in the Santa Ynez River downstream of Bradbury Dam and to the mainstem reach upstream of the Highway 154 Bridge. The proposed operations provide frequent passage opportunities for migrating steelhead in wet years (spill years). In these years, tributary and mainstem habitat is accessible and of good quality. In dry years, there is a limited number of passage opportunities. Low flows in the tributaries can limit access to tributary habitat and this habitat is of lower quality in these years. In other years, passage opportunities may be limited while tributary habitats are suitable for occupancy. The passage flow supplementation plan proposed here promotes good passage conditions in years

Table 3-5. Proposed Interim Releases for Passage Supplementation (1958-1998)

YEAR	Allocation to Fish Passage Account	Years from Surcharge	Releases from Fish Passage Account	End-of-Year Fish Passage Account Balance
1958	2,500		0	2,500
1959		1	740	1,760
1960		2	1,760	0
1961		3	0	0
1962	2,500		0	2,500
1963		1	2,500	0
1964		2	0	0
1965		3	0	0
1966		4	0	0
1967	2,500		0	2,500
1968		1	2,500	0
1969	2,500		0	2,500
1970		1	2,500	0
1971		2	0	0
1972		3	0	0
1973	2,500		0	2,500
1974	2,500		0	2,500
1975	2,500		909	2,500
1976		1	1,811	689
1977		2	0	689
1978	2,500		0	2,500
1979	2,500		0	2,500
1980	2,500		0	2,500
1981		1	1,170	1,330
1982		2	1,330	0
1983	2,500		0	2,500
1984	2,500		0	2,500
1985		1	0	2,500
1986		2	957	1,543
1987		3	0	1,543
1988		4	1,543	0
1989		5	0	0
1990		6	0	0
1991		7	0	0
1992		8	0	0
1993	2,500		0	2,500
1994		1	2,500	0
1995	2,500		0	2,500
1996		1	2,500	0
1997		2	0	0
1998	2,500		0	2,500

Table 3-6. Passage Days with and without Proposed Interim Passage Supplementation Operations (January through May, 1958-1998)

YEAR	Stream flow Record (Baseline)			Interim Supplementation Proposal		
	Hydrologic Year Type[1]	Total # of Passage Days[2]	Indicator of ≥ 14 days	Total # of Passage Days[2]	Days Provided by Proposal	Indicator of ≥ 14 days
1959	normal	36	yes	36	0	yes
1960	dry	9	no	21	12	yes
1963	dry	9	no	30	21	yes
1968	dry	12	no	35	23	yes
1970	normal	11	no	29	18	yes
1975	normal	78	yes	81	3	yes
1976	dry	3	no	15	12	yes
1981	normal	15	yes	22	7	yes
1982	normal	8	no	15	7	yes
1986	wet	28	yes	33	5	yes
1988	dry	2	no	14	12	yes
1994	normal	8	no	27	19	yes
1996	normal	27	yes	45	18	yes
Average		19		31	12	
Number of years with ≥14 days of passage			5 38%			13 100%

[1]A 'wet' year is the third of the years analyzed with the greatest inflow into Lake Cachuma, 'normal' years were the middle third of years, and 'dry' years were the third of years with the lowest inflow into Lake Cachuma.
[2]A 'passage day' is defined as flow at the Solvang gage of greater than or equal to 25 cfs.

after steelhead have likely been highly productive in the system. A complete description of the passage supplementation proposal follows.

3.2.3.2.1 Fish Passage Account

For the purpose of supplementing passage flows, Reclamation will create a Fish Passage Account in Cachuma Reservoir. The Fish Passage Account will be filled in years when the reservoir surcharges and released in subsequent years to enhance passage opportunities by augmenting the storm hydrographs. The Fish Passage Account will be allocated the majority of the additional water provided by surcharging over the 1.8 foot surcharge level required to meet the rearing flow targets, or 3,200 acre-feet of water. The Fish Passage Account will be filled when the reservoir is surcharged. Any water captured by the reservoir over elevation 751.8 will be allocated to the Fish Passage Account, up to 3,200 acre-feet of water. The Fish Passage Account water will be released starting in the year after the reservoir surcharges to a level above 1.8 feet, and in subsequent years until there is no more water in the Fish Passage Account.

Fish Passage Account water stored in Lake Cachuma will not diminish by evaporation or seepage losses. Any unused portion of the Fish Passage Account will be carried over to following years until the reservoir surcharges again. In the event of a spill, the Fish Passage Account will be deemed to spill and the account will be reset to a new allocation of 3,200 acre-feet. If only a partial surcharge is possible (not the complete volume between 1.8 and 3.0 feet) then the Fish Passage Account would receive the surcharge amount in excess of the 1.8 foot surcharge, plus any carryover in the account with the total not to exceed 3,200 acre-feet. Simulations with the Santa Ynez River model indicate that when the reservoir spills, the surcharge space between 1.8 and 3.0 feet is always completely filled, although in theory, a partial surcharge is possible.

There is limited data on mainstem fish migration in the Santa Ynez River system and a spotty record of tributary migration. The record is incomplete because of difficulty in installing and maintaining mainstem traps and because of the need to remove traps during storm periods. Because of uncertainty regarding the movement patterns of migrating steelhead, the passage flow supplementation proposal will be adaptively managed. The migrant trapping program will continue and an additional trap will be installed in the Refugio reach to monitor mainstem migrants (see Section 3.4.3). Reclamation will establish an Adaptive Management Committee that will be responsible for adaptively managing the Fish Passage Account releases. These releases will be based on the following passage supplementation regime although modifications may be made based on further biological data, dam operational requirements and, and prior hydrologic events.

3.2.3.2.2 Passage Supplementation Criteria

Releases for fish passage supplementation will be made in years following a surcharge year until all of the water in the Fish Passage Account has been released. Releases will be made to augment storms in January through May. The first storm in January will not be supplemented as it is considered to be a recharge storm and will prime the lower watershed for future releases. If there is a second storm in January, then this storm will be

supplemented. All storms in the passage period will be supplemented unless (1) flows at Solvang reach 25 cfs within 7 days from a prior Fish Passage Account release (the second storm will not be supplemented), (2) the Adaptive Management Committee determines that there is a greater biological benefit to not supplement a particular storm, or (3) there is no water left in the Fish Passage Account.

For the purpose of fish passage supplementation, a storm is defined as flows of 25 cfs or more occurring at the Solvang USGS gage. The 25 cfs criteria was selected for three reasons. First, 25 cfs provides passage flow in the Alisal reach and passage at these riffles should indicate that passage is provided over critical riffles upstream to the dam (SYRTAC 1999b). Second, a flow of 25 cfs at Solvang indicates that the tributaries upstream of Solvang (Quiota and Hilton Creeks) are flowing and will provide steelhead access to these habitats. Finally, 92% of the time when there is a flow of 25 cfs or more at the Solvang gage, there is at least 15 cfs flowing in the Santa Ynez River upstream of the confluence with Salsipuedes Creek indicating there is continuity of flow throughout the system. Passage over the critical riffle at the Lompoc Narrows is achieved 92% of the time there is 25 cfs at Solvang indicating passage flows for adult steelhead exist upstream to Bradbury Dam.

The passage flow supplementation will take the form of enhancing the storm hydrograph at the Solvang gage. A decay function for the hydrograph recession at the Los Laureles gage above Cachuma Reservoir has been calculated. Figure 3-6 compares the average storm recession hydrograph for the Los Laureles and Solvang gages. The Solvang gage recedes at a faster rate than the Los Laureles gage primarily because the Solvang gage measures flow from a smaller watershed in the absence of spills at Bradbury Dam. The decay rates begin to diverge at about 150 cfs. The Los Laureles decay function from 150 cfs to 25 cfs takes approximately 14 days. Fourteen days was considered to be a reasonable, continuous passage event for migrating fish. The combination of the divergence, the 14 days of passage flows, and the operational maximum release from the Bradbury Dam outlet works, also 150 cfs, determined the flow trigger for the fish passage releases.

Flow supplementation will begin when the unsupplemented storm hydrograph at Solvang recedes from its peak to 150 cfs. From 150 cfs to 25 cfs, releases will be made from the Fish Passage Account to mimic the Los Laureles decay curve at the Solvang gage. From 25 cfs to baseflow, releases will be made based on the mainstem ramping rate (Table 3-4 above). Figure 3-7 shows how basin input and Fish Passage Account releases would combine to provide additional passage days under this flow supplementation scenario (Example #1). In the event that storm peaks at the Solvang gage are less than 150 cfs but greater than 25 cfs, then releases will be made from Bradbury Dam to supplement not only the decay curve of the storm hydrograph, but also the peak storm discharge. Thus, up to the outlet works capacity of 150 cfs will be released to boost up the peak storm discharge to 150 cfs at Solvang and then the Los Laureles decay function will be applied as stated above. An example of this type of passage supplementation is also shown in Figure 3-7, Example #2. Releases for fish passage supplementation will generally come from the outlet works at Bradbury Dam although a portion of the releases ($\leq$ 10 cfs) may come through the Hilton Creek supplemental watering system.

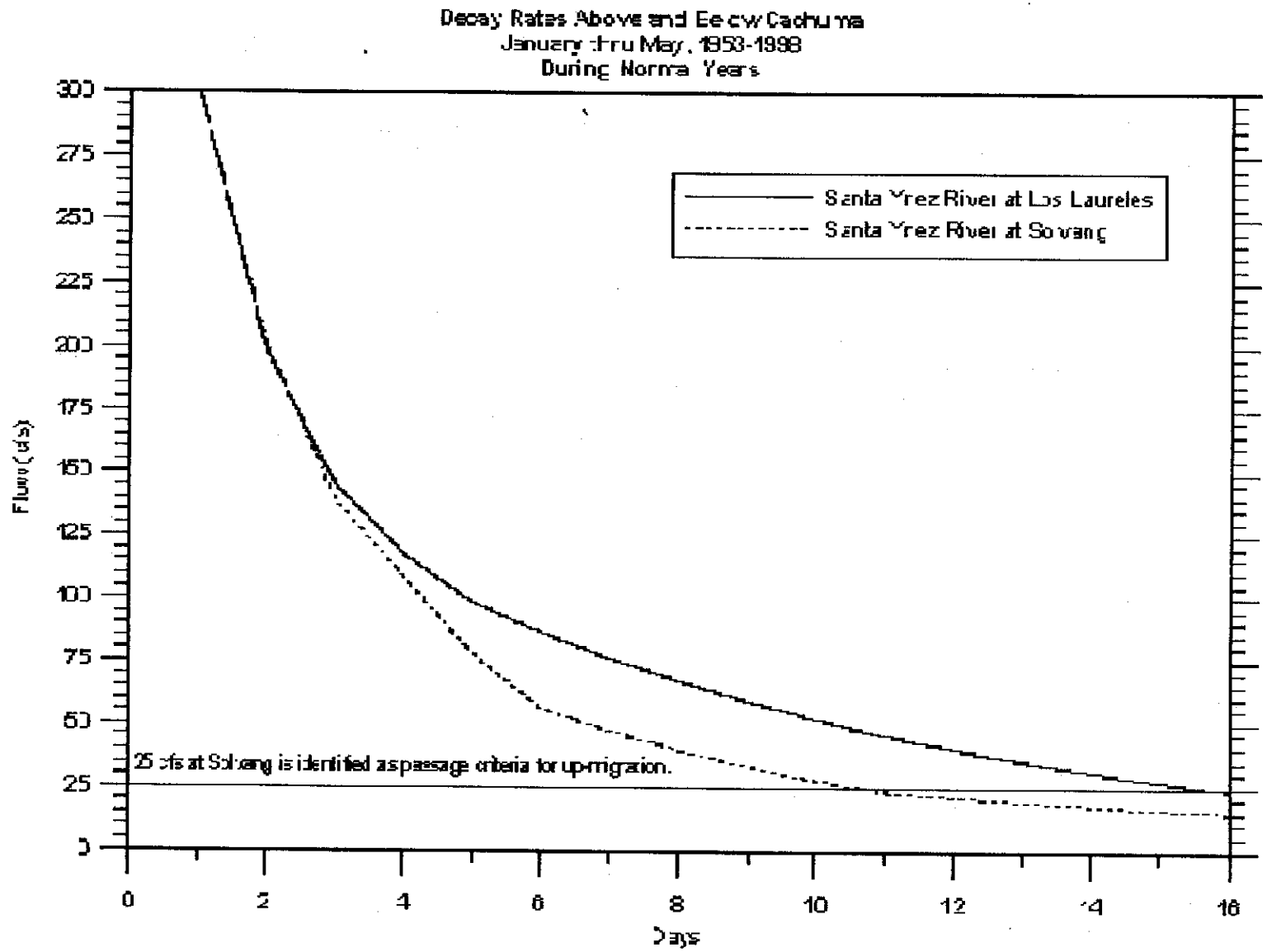

Figure 3-6. Inflow Decay Rates at the Los Laureles and Solvang Stream flow Gages

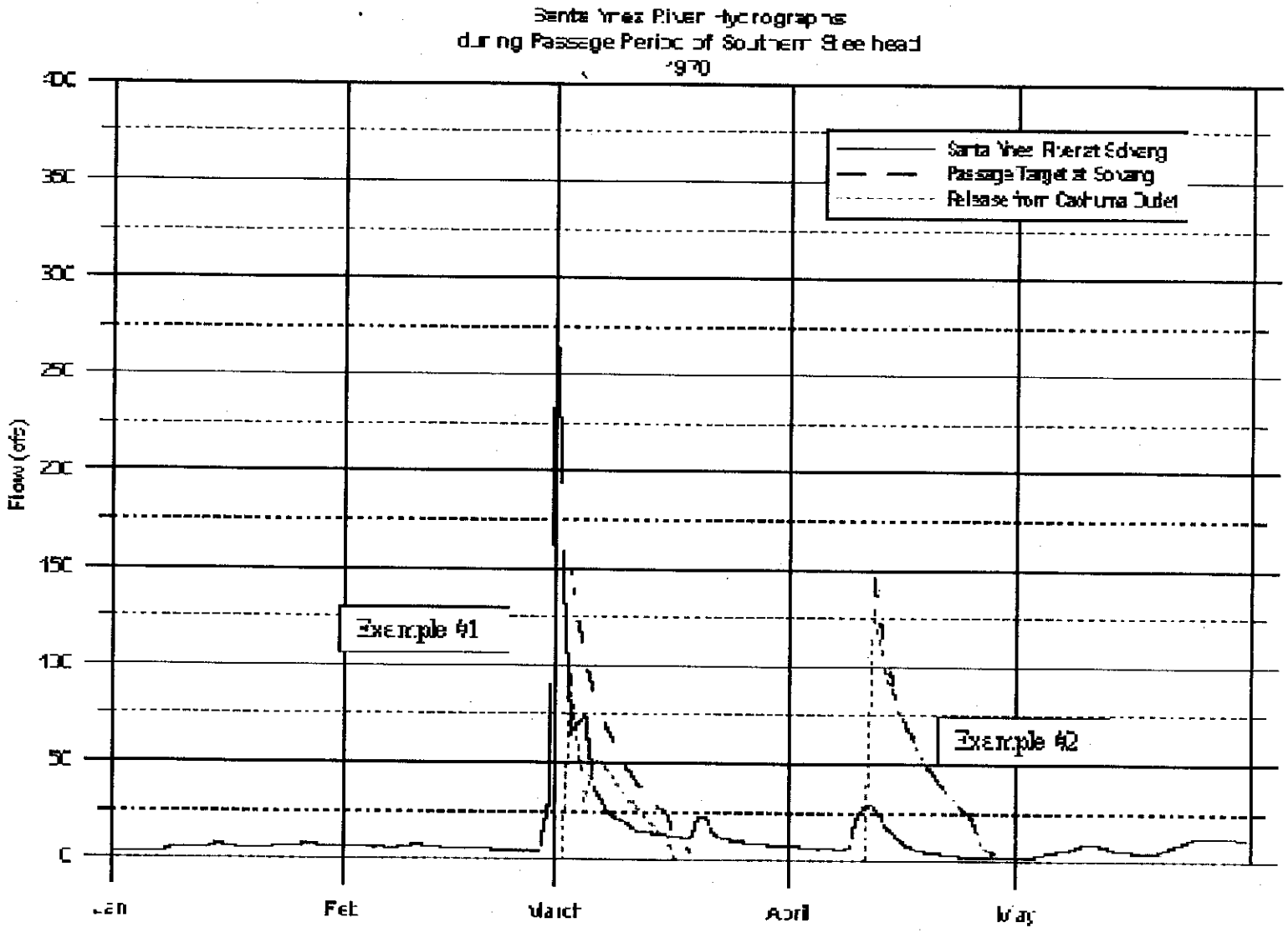

Figure 3-7. Gaged and Modeled Stream flow at the Solvang Gage with Proposed Passage Supplementation Releases.

The quantity and frequency of passage releases under the proposal were calculated using USGS gaged daily flows at Solvang for 40 years post-Cachuma construction (1958-1998). Flows required to provide passage supplementation for individual storm events are estimated to range from 300 to 1,800 acre-feet per year. Passage releases would occur starting in the year after the Fish Passage Account is filled by a surcharge event up to, on average, two to three years after the surcharge but could occur up to eight years after the surcharge event. Table 3-7 tabulates the releases for supplementation of passage by year and shows how the operation of the Fish Passage Account (3,200 acre-feet) would be implemented. In those years when the Fish Passage Account is released in a single year, it is generally because there were a number of small storms whose peaks were boosted and then the recession curve applied. Application of the adaptive management program could extend the use of water in these years if the Adaptive Management Committee decides that boosting only a portion of these smaller storms would increase the biological benefit of passage flow supplementation in additional years.

Analyses based on stream flow records and calculated supplementation releases were undertaken to estimate the total passage days at Solvang in the months of January through May, including the passage days resulting from supplementation releases and the passage days resulting from naturally occurring flows. Table 3-8 shows both the total passage days with and without supplementation for the sixteen years in which supplementation would have occurred. In these 16 years, or more than one third of the years analyzed, there were 11 additional days of passage per year on average, increasing the average number of passage days, on average, from 22 (baseline conditions) to 43 (with supplementation). In addition, in these same sixteen years, the number of years in which there was a passage opportunity of 14 or more days increased from 7 to 16 years.

3.2.3.2.3 Adaptive Management of the Fish Passage Account

The protocol set forth above will be used to supplement passage flows and will be monitored closely to provide information to the adaptive management team. However, operating criteria have to be put in place for monitoring peak storm flows at Solvang and concurrent releases at Bradbury Dam for the purpose of implementing the passage flow supplementation.

Based on the results of these experimental releases, the Adaptive Management Committee will manage the Fish Passage Account releases to maximize the biological benefit to steelhead. The Fish Passage Account water will always be used for the purpose of fish passage supplementation. Initially, all storms will be supplemented as described above. As data are gathered on passage releases and fish movement within the system, modifications to the release scenario might be made. Generally modifications within the range of the adaptive management program will be designed to increase the number of storms and years when passage supplementation water will be released to enhance fish migration. Such modifications may include changing the trigger flow level, changing the definition of a storm, and selecting to boost storm peaks that are less than 150 cfs to different levels. Releases in the month of May might also be modified as more out-migrant information is developed. These modifications will likely be similar to those used to extend the water supply availability and might also include extending the tailout for longer periods of time.

Table 3-7. Proposed Long Term Releases for Passage Supplementation (1958-1998)

YEAR	Allocation to Fish Passage Account	Years from Surcharge	Releases from Fish Passage Account	End-of-Year Fish Passage Account Balance
1958	3,200		0	3,200
1959		1	740	2,460
1960		2	2,460	0
1961		3	0	0
1962	3,200		0	3,200
1963		1	3,200	0
1964		2	0	0
1965		3	0	0
1966		4	0	0
1967	3,200		0	3,200
1968		1	3,200	0
1969	3,200		0	3,200
1970		1	2,813	387
1971		2	387	0
1972		3	0	0
1973	3,200		0	3,200
1974	3,200		0	3,200
1975	3,200		909	3,200
1976		1	1,811	1,389
1977		2	0	1,389
1978	3,200		0	3,200
1979	3,200		0	3,200
1980	3,200		0	3,200
1981		1	1,170	2,030
1982		2	1,298	732
1983	3,200		0	3,200
1984	3,200		0	3,200
1985		1	0	3,200
1986		2	957	2,243
1987		3	0	2,243
1988		4	1,670	573
1989		5	0	573
1990		6	0	573
1991		7	573	0
1992		8	0	0
1993	3,200		0	3,200
1994		1	2,759	441
1995	3,200		0	3,200
1996		1	2,716	484
1997		2	484	0
1998	3,200		0	3,200

Table 3-8. Passage Days with and without Proposed Long Term Passage Supplementation Operations (January through May, 1958-1998)

YEAR	Stream flow Record (Baseline)			Interim Supplementation Proposal		
	Hydrologic Year Type[1]	Total # of Passage Days[2]	Indicator of ≥ 14 days	Total # of Passage Days[2]	Days Provided by Proposal	Indicator of ≥ 14 days
1959	normal	36	Yes	36	0	Yes
1960	dry	9	No	26	17	Yes
1963	dry	9	No	33	24	Yes
1968	dry	12	No	41	29	Yes
1970	normal	11	No	30	19	Yes
1971	normal	71	Yes	72	1	Yes
1975	normal	78	Yes	81	3	Yes
1976	dry	3	No	15	12	Yes
1981	normal	15	Yes	22	7	Yes
1982	normal	8	No	15	7	Yes
1986	wet	28	Yes	33	5	Yes
1988	dry	2	No	14	12	Yes
1991	normal	12	No	17	5	Yes
1994	normal	8	No	28	20	Yes
1996	normal	27	Yes	46	19	Yes
1997	normal	28	Yes	31	3	Yes
Average		22		33	11	
Number of years with ≥14 days of passage			7 44%			16 100%

[1]A 'wet' year is the third of the years analyzed with the greatest inflow into Lake Cachuma, 'normal' years were the middle third of years, and 'dry' years were the third of years with the lowest inflow into Lake Cachuma.
[2]A 'passage day' is defined as flow at the Solvang gage of greater than or equal to 25 cfs.

The decay rate strategy will continue to be applied unless there is data to suggest a more effective release strategy for passage flow supplementation. The data for this type of change will be reviewed by both NMFS and Reclamation biologists.

Early in the year, water in the Fish Passage Account will be used to supplement every storm meeting the requirements. For releases in late April and in May, however, the committee may begin to consider the storage in Cachuma Reservoir and the likelihood of a surcharge in the following year, the balance of the Fish Passage Account, the current and prior storms, and expected baseflow recession levels in deciding whether supplementation is warranted. An example of an adaptively managed scenario is when a series of storms in March and early April provide, consecutively, 60 days of passage flows and 10 days later another storm peaks at 35 cfs. The Adaptive Management Committee may decide that supplementing the 35 cfs storm would not provide much additional benefit to steelhead. The committee may instead decide to reserve the water in the Fish Passage Account for supplementation of storms in May.

3.2.4 Adaptive Management Account

The Santa Ynez River system is still under study and new information about many of the operations proposed in this document will be gathered over the course of implementing and monitoring these measures. Many components of the Proposed Operations will be managed by the Adaptive Management Committee established by Reclamation.

Reclamation can foresee potential scenarios where small amounts of additional water could provide a substantial biological benefit in this adaptive management program. These scenarios, however, are based on the convergence of a number of factors that can not be predicted, with any regularity or certainty. For the long-term operation of the project an Adaptive Management Account will be established. In order to capitalize on these occurrences, the Account will contain a quantity of water that the Adaptive Management Committee can use to provide additional benefits to steelhead and their habitat.

The Adaptive Management Account will be filled in years when the reservoir surcharges to the 3.0 foot level. The 3.0 foot surcharge would provide 3,700 acre-feet more water than the 1.8 foot surcharge. Of the additional 3,700 acre-feet provided by the 3.0 foot surcharge, 3,200 acre-feet is allocated to the Fish Passage Account. The remaining surcharged water (500 acre-feet) will be allocated to the Adaptive Management Account. This account will be maintained using the same guidelines as the Fish Passage Account. The Adaptive Management Account will not experience evaporation or seepage losses; the unused portion will be carried over to the next year; and in the event of a spill, the Adaptive Management Account will be deemed to spill and the account will receive a new allocation from the surcharged water.

The Adaptive Management Account will be used at the discretion of the Adaptive Management Committee to increase the biological benefit to steelhead and their habitat as opportunities arise. The account water can be used to increase releases for mainstem rearing, provide additional flows to Hilton Creek, or to provide additional water for passage flow supplementation. For instance, perhaps the last storm of the season was the first week in

May and that storm was supplemented by water from the Fish Passage Account. However, monitoring data from trapping is demonstrating that a number of smolts are attempting to out-migrate but are having difficulty because of low flows in the mainstem. Water from the Adaptive Management Account could be released to provide additional flow for these fish.

3.2.5 Summary of Proposed Fish Enhancement Operations

Table 3-9 summarizes the releases that will be made to enhance fish habitat and fish passage in the mainstem Santa Ynez River below Bradbury Dam. The operations are discussed in detail in the above sections.

3.3 Conservation Measures to Protect Steelhead

3.3.1 Hilton Creek

Hilton Creek is a small stream located just downstream of Bradbury Dam that goes dry in early summer. SYRTAC studies have documented the migration of adult steelhead into Hilton Creek, spawning activity, and successful reproduction (SYRTAC 1995, 1997, 1998). Usually, however, the fry are lost when the stream dries up and they are stranded or forced to move downstream to the mainstem Santa Ynez River, where their vulnerability to predation is increased.

Modifications to improve fisheries habitat within Hilton Creek are a high priority. The reach of Hilton Creek to be enhanced is located on lands owned and controlled by Reclamation, and hence implementation of habitat improvement measures can be made without requiring access to private lands or authorization and approvals by agencies outside of those involved in the direct implementation of these conservation measures. Because Hilton Creek is within the jurisdictional authority of Reclamation and the Member Units, and because it naturally supports good steelhead habitat, Reclamation and the Member Units believe that Hilton Creek is an excellent opportunity to provide significant benefits to steelhead through a variety of enhancement measures (Figure 3-8). These measures include:

- Stream flow augmentation from Lake Cachuma.
- Construction of an extension channel (up to 1,500 feet long) at the lower end of Hilton Creek.
- Construction of upstream passage facilities at a partial impediment at the cascade and bedrock chute.
- Construction of upstream passage facilities at a complete impediment at the Highway 154 crossing.
- General habitat enhancements within the existing channel of Hilton Creek.

Table 3-9. Summary of Proposed Interim and Long Term Operations for Rearing and Passage Enhancement in the Mainstem

Project Operations Phase	Proposed Operations for Mainstem Rearing and Passage
Interim Phase 1 0.75 Foot Surcharge	**Rearing** *Highway 154 Flow Targets* • 5 cfs flow target at Highway 154 in years when the lake spills at least 23,000 AF • 2.5 cfs flow target at Highway 154 in years when the lake does not spill but storage exceeds 120,000 AF or when the lake spills less than 23,000 AF • 1.5 cfs flow target at Highway 154 in years when lake storage recedes below 120,000 AF but greater than 30,000 AF • Releases to refresh the Long Pool and the Stilling Basin may be made (limited to 30 AF per month or as needed)
Interim Phase 2 1.8 Foot Surcharge	**Rearing** *Highway 154 Flow Targets* • 5 cfs flow target at Highway 154 in years when the lake spills at least 23,000 AF • 2.5 cfs flow target at Highway 154 in years when the lake does not spill but storage exceeds 120,000 AF or when the lake spills less than 23,000 AF • 1.5 cfs flow target at Highway 154 in years when lake storage recedes below 120,000 AF but greater than 30,000 AF • Releases to refresh the Long Pool and the Stilling Basin may be made (limited to 30 AF per month or as needed) **Passage** • 2,500 AF allocation to the Fish Passage Account in surcharge years
Long Term Operations 3.0 Foot Surcharge	**Rearing** *Highway 154 Flow Targets* • 10 cfs flow target at Highway 154 in years when the lake spills at least 20,000 AF • 5 cfs flow target at Highway 154 in years when the lake does not spill but storage exceeds 120,000 AF or when the lake spills less than 20,000 AF • 2.5 cfs flow target at Highway 154 in years when lake storage recedes below 120,000 AF but greater than 30,000 AF • Releases to refresh the Long Pool and the Stilling Basin may be made (limited to 30 AF per month or as needed) *Alisal Bridge Flow Targets* • 1.5 cfs flow target at the Alisal Bridge in years when the lake spills at least 20,000 AF and steelhead are present in the Alisal reach • 1.5 cfs flow target at the Alisal Bridge in years following a year when the lake spills at least 20,000 AF and steelhead are present in the Alisal reach **Passage** • 3,200 AF allocation to the Fish Passage Account in surcharge years **Adaptive Management Account** • 500 AF allocation to the Adaptive Management Account in surcharge years

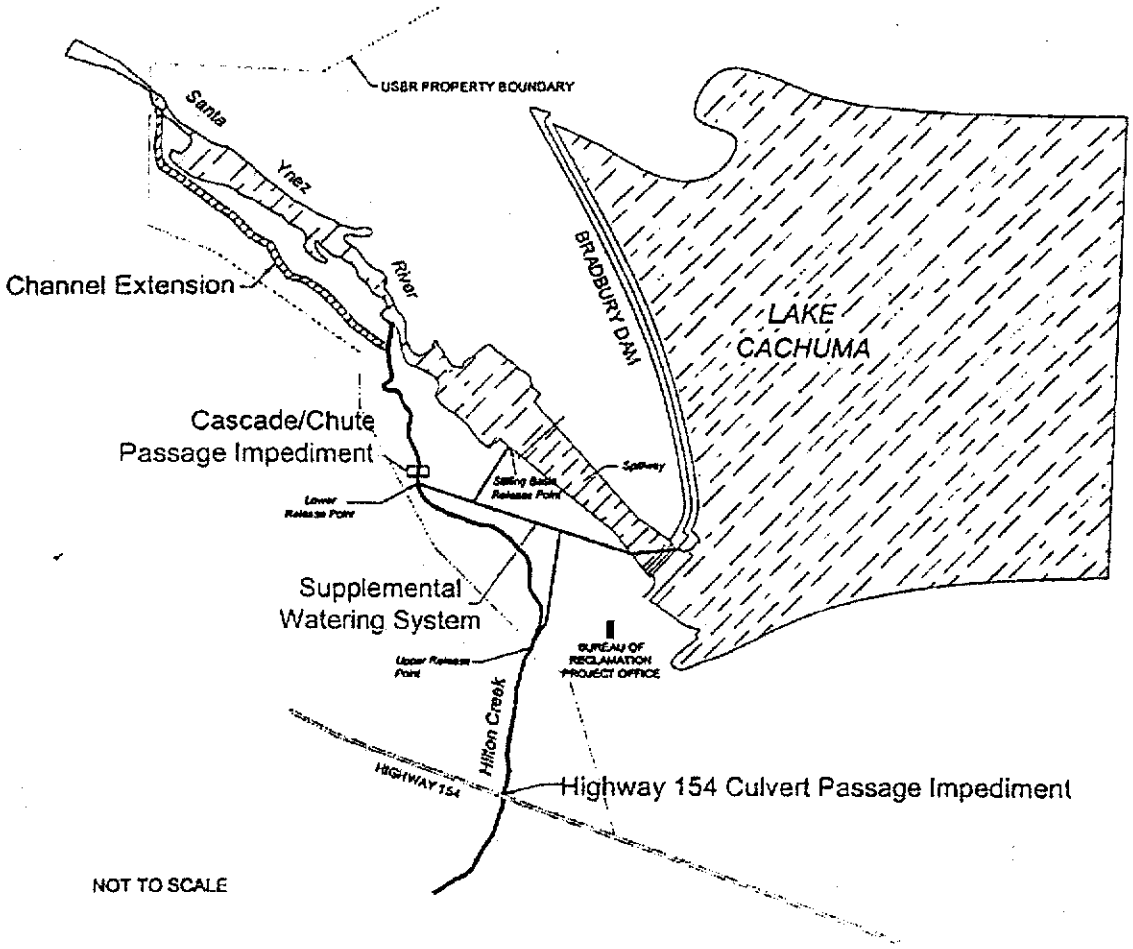

Figure 3-8. Conservation measures in Hilton Creek.

3.3.1.1 Supplemental Watering System

Facilities

Because of Hilton Creek's proximity to Bradbury Dam, it is possible to augment creek flow with water from the reservoir. The feasibility of this approach was demonstrated in 1997, when a temporary watering system successfully provided water from Lake Cachuma to Hilton Creek (released in the bedrock chute just above the chute pool) from early summer through the end of December. Reclamation and the Member Units are currently completing the installation of a permanent supplemental watering system that will be able to provide suitable water in most years. This system will incorporate: (1) a basic facility with pipelines to make releases at three different locations (completed), (2) pumps to ensure reliable water deliveries at lower lake elevations, and (3) an adjustable intake pipe to obtain cool water deep in Lake Cachuma. Releases can be made at three sites: two in Hilton Creek and one to the Stilling Basin (Figure 3-8).

The upper release site in Hilton Creek is located near the Reclamation property boundary at elevation 680 feet, approximately 2,980 feet upstream of the Santa Ynez River. The lower release site is located just above the chute pool, approximately 1,380 feet upstream of the river at elevation 645 feet. The pipeline was designed to have a total capacity of 10 cfs. This capacity could be obtained through simultaneous releases at all three release sites. At each release point, an energy dissipation/aeration structure would maintain dissolved oxygen concentrations near saturation.

The capacity of the permanent watering system will vary with lake level. The system will operate by both gravity flow and pumped flow depending on flow targets and lake surface elevation. A secondary, fuel-powered pump system will located on site in the event of a malfunction of the existing pumping system (e.g. a power outage). Having both the gravity-flow and pump systems will ensure consistent water deliveries to Hilton Creek.

Steelhead/rainbow trout require cool water. Lake Cachuma is thermally stratified during spring and summer, with warm water near the surface (the epilimnion layer) and cold water at deeper levels (the hypolimnion). Vertical thermal profiles measured during the summer indicate that water should be obtained from a minimum depth of 65 feet (20 meters) below the lake's surface in order to obtain water measuring 18°C or cooler (SYRTAC 1997). The planned gravity system will have a variable intake line (snorkel) to regulate the depth from which water in Lake Cachuma is drawn.

Operations

Releases into Hilton Creek will be made to maintain flows generally be between 1.5 and 5 cfs depending on the water year type, natural flow in Hilton Creek, and the amount of water stored in the lake. Some or all of the releases made to meet the mainstem target flows (see Section 3.2.2) will be made via Hilton Creek. In addition, a portion of releases made for downstream water rights and for passage flow supplementation may also go through Hilton Creek. At each release point, an energy dissipation/aeration structure will maintain dissolved oxygen concentrations near saturation.

During drought situations, when the elevation of Lake Cachuma declines below 665 feet (2 percent of years), the watering system will not be able to deliver water to Hilton Creek. Migrating steelhead, however, are not expected to reach Hilton Creek in drought years. When such a situation occurs, Reclamation will reconsult with NMFS to determine what, if any, actions should be taken to protect fishery resources in Hilton Creek. A fish rescue would likely be performed in Hilton Creek assuming any steelhead spawned within that year.

A ramping schedule is proposed for Hilton Creek to protect rainbow trout/steelhead. The proposed ramping schedule is shown in Table 3-10. During the first year of the interim period, managed flow changes will be made during daylight hours and the creek will be monitored for stranding during ramping events.

Table 3-10. Hilton Creek Ramping Schedule

Release Rate (cfs)	Ramping Increment (cfs)	Ramping Frequency (no more than once every...)
10 to 5	1	4 hours
Less than 5 cfs	0.5	4 hours

Releases through the water supply system to meet the target flows at the Highway 154 and Alisal Bridges will be managed by the Adaptive Management Committee to maximize the biological benefit to rainbow trout/steelhead. Of the two release points in Hilton Creek, the Adaptive Management Committee expects to make releases primarily from the upper release point in most years. The water delivery system has been designed, and will be operated, to meet temperature and dissolved oxygen criteria appropriate for steelhead/rainbow trout. The two release points provide greater flexibility in adjusting the amount of water delivered to the different reaches of the creek. During operation of the temporary watering system in 1997, where water deliveries were made at the lower release point, water quality conditions were suitable throughout the lower Hilton Creek. Water released at the upper release point could experience greater warming as it travels through the channel, or it may temporarily go subsurface at the open alluvial area before rising again at the bedrock chute. If this is a problem, releases could be shifted to the lower release point. Monitoring of water temperature, flows, dissolved oxygen, and fish use will be conducted in order to adjust operations of the two release points as necessary. The releases to Hilton Creek within and among years will be managed by the Adaptive Management Committee.

Management of both the distribution of water among the release points and the amount of water to be released (i.e. the potential use of the Adaptive Management Account) will be based on a number of factors including, but not limited to, presence of spawning adult steelhead/rainbow trout, presence of rearing juveniles, reservoir storage, water quality (e.g. temperature and dissolved oxygen), system maintenance requirements, the relationship

between flow and available habitat, water losses, water temperature at the intake depth in Lake Cachuma, and natural flow in the system.

One operational scenario that could be used for a wet year, when there is good winter runoff and migrating adults can ascend Hilton Creek to spawn, releases might be made to Hilton Creek in the spring or early summer once natural flows recede to about 3 to 5 cfs. The objective is to maintain rearing habitat for the resulting young-of-the-year through the summer. In extremely dry years, when no adult rainbow trout/steelhead can enter Hilton Creek to spawn, releases may be limited to periodic flows to refresh the Stilling Basin and Long Pool. A fish rescue operation will be conducted in those situations when water is not available to prevent stranding or exposure to harmful habitat conditions (as described below in Section 3.3.2).

Monitoring of Hilton Creek will provide the data necessary to make management decisions about flow releases. Flow and temperature data will be collected to determine the influence of the release points on water temperatures and water quantity in lower Hilton Creek. Fish use of the habitat both above and below the lower release point will be studied. The relationship between the quantity and quality of habitat available at different flow levels will be determined. Ramping events will be monitored for potential stranding during the first year of ramping. Monitoring will occur at different flow regimes and release rates to provide a basis for the adaptive management process although the release rates will not be altered for the purpose of these studies.

3.3.1.2 Channel Extension

Reclamation and the Member Units plan to leverage the benefits of the supplemental watering system by creating an additional stream channel that can also be watered to provide habitat. The lower reach of the Hilton Creek channel will be modified to provide additional fishery habitat within an extension approximately 1,500 feet long (Figure 3-9) (Stetson Engineers and Hanson Environmental 1997). The channel extension will be constructed on Reclamation property and will approximately parallel the Santa Ynez River before joining the river at the Long Pool. The channel extension will be designed and constructed to include a series of pools, riffles, and a sinuous thalweg. The channel itself will be built to accommodate flows of up to 15 cfs. The upstream end of the extension channel will include a flow control structure to prevent flood damage to habitat.

The SYRTAC is currently evaluating two possible alignments for the channel extension across the Santa Ynez River floodplain. One possible alignment uses a portion of a relic overflow channel with a riparian corridor of mature sycamore near the southwest Reclamation property line. This alignment has the advantage of already having a well-developed riparian canopy. The second possible alignment being studied is closer to mainstem Santa Ynez River and would be constructed across the alluvial floodplain. Site-specific information on percolation and expected groundwater conditions will be collected during 2000 prior to finalizing the channel alignment and design.

The selection of the alignment will depend on groundwater levels and potential seepage loss. The soil along the Hilton Creek channel extension is alluvial, and the seepage rate may be

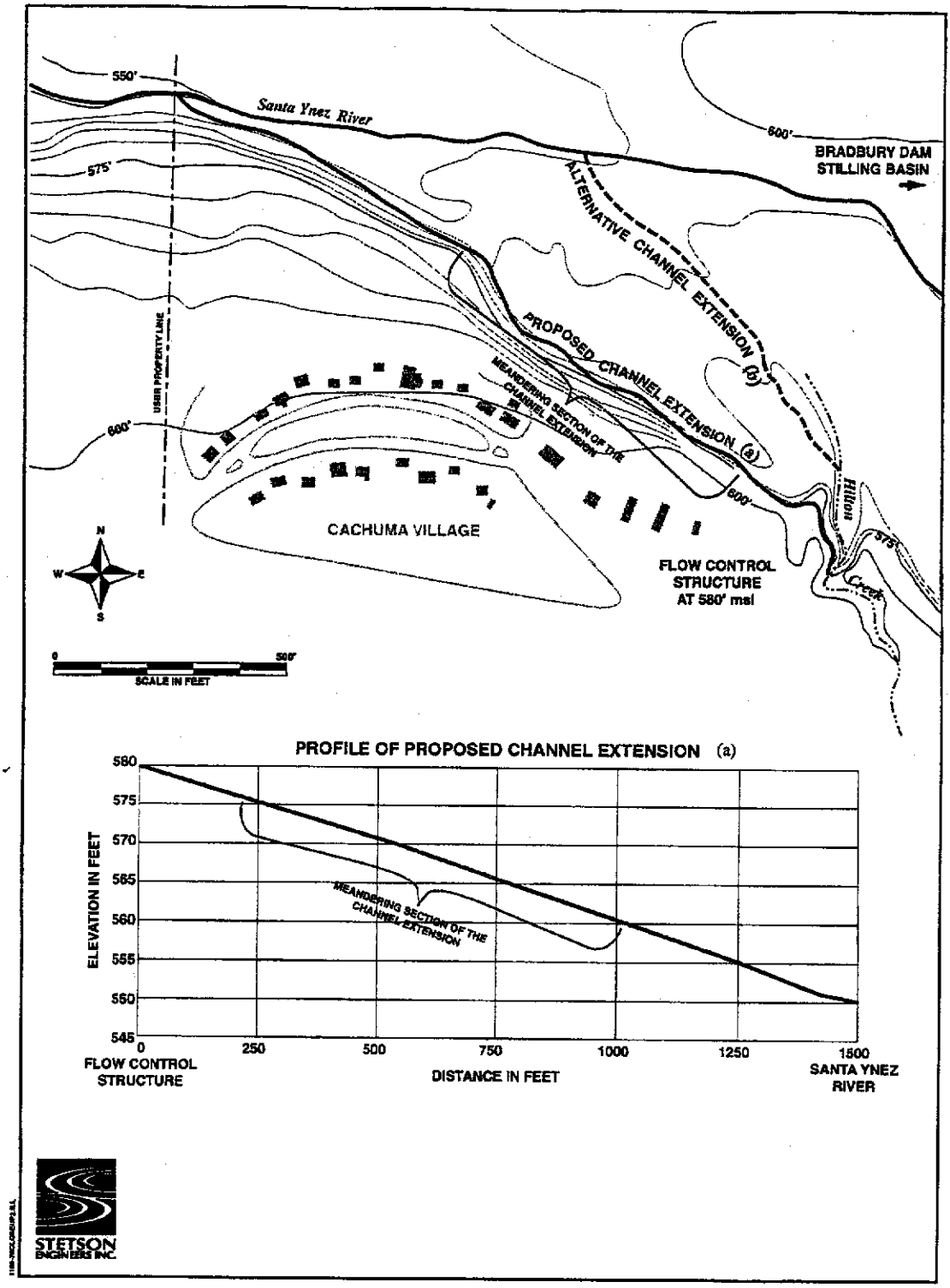

Figure 3-9. Hilton Creek Channel Extension.

high. To maintain the flow in the channel, it may be necessary to use zone B material in constructing the channel. This will be more easily accomplished along the second alignment. The channel bed would be made of a 6-inch layer of zone B material (impervious or low hydraulic conductivity material). Layers of sand, gravel, and cobble would be placed on top of the channel bed material, to a depth of about 1 foot, to prevent channel bed erosion. The extent of channel lining that may be necessary to prevent seepage and the planting design for supplemental streamside vegetation to provide shading will be planned at the same time.

The channel extension will serve as the low-flow channel. Flows will typically be 1 to 5 cfs, but the channel will be constructed to accommodate flows up to 15 cfs. The channel that was cut in Hilton Creek by the 1998 storms will continue to serve as the overflow channel to convey Hilton Creek flow into the Santa Ynez River during large rainstorms. During winter high flows, migrating adult steelhead/rainbow trout will be able to enter Hilton Creek through either this high flow channel or the channel extension.

The flow control structure will consist of two parts: (1) a submerged boulder weir to direct low summer flow and releases into the channel extension and (2) a limiter log structure to prevent high flows from entering the extension. A low boulder weir will be constructed across Hilton Creek 20 feet downstream of the head of the channel extension to create a back water. Under normal operations, this structure will direct the rearing flows in Hilton Creek to the channel extension. High storm flows will pass over the boulder weir within the natural course of the creek to accommodate the migration of steelhead/rainbow trout from the mainstem of the Santa Ynez River to Hilton Creek. Riprap or boulders will be placed to stabilize the stream bed near the mouth of the extension. High stream flow will be prevented from entering the Hilton Creek extension by use of a limiter log at its upstream entrance (Limiter log structures have been successfully used in restoration of Lee Vining Creek, Mono County; W. Trihey, pers. comm.) This type of flow control structure is constructed of natural materials (boulders and logs) but performs as a fixed plate orifice.

The stream bed and banks will be constructed of large boulders, available at the site, for a distance of two channel widths. Approximately one fourth the distance into this armored section one or more large logs will be placed across the channel, limiting the cross sectional area between the bottom of the log and the armored streambed and stream banks. The cross sectional area would be calculated to pass no more than 10 cfs beneath the limiter log without pressure flow developing. The cross section will be large enough to accommodate adult steelhead migrating upstream through the channel extension into Hilton Creek.

The Hilton Creek channel extension will be constructed using boulders, woody debris, suitable gravel and vegetation to create high value stream habitat. Boulders will be placed in the channel to increase shelter areas for steelhead and meandering of the stream flow. Riparian vegetation will be planted along the channel to provide shading and reduce increases in water temperature. Willow cuttings from nearby plants will be used, in addition to other appropriate native riparian species such as sycamore, cottonwood, and oak. A drip irrigation system will be installed to establish the plantings. Placement of boulders and planting of riparian vegetation will be consistent with the DFG's *California Stream Habitat Restoration Manual*, Section VII (Flosi et al. 1998). The final design of the channel extension will be subject to approval by DFG and NMFS.

The channel extension will be monitored to assess its performance and determine the need for any maintenance activities. Following a high flow year, it may be necessary to repair the channel where it meets the Santa Ynez. Sediment transport through the channel extension is expected to be minimal, since high flows will be directed to the current Hilton channel. Habitat monitoring will be used to determine if sediment supplementation or removal of fine sediments may be necessary in following years. The success of riparian plantings will also be assessed and corrective measures taken.

3.3.1.3 Passage Facilities at the Cascade and Bedrock Chute

A rocky cascade and bedrock chute are passage impediments for migrating steelhead. The cascade is approximately 7 feet high and located just above the chute pool, about 1,380 feet upstream from the confluence with the river. The bedrock chute immediately above the cascade is about 100 feet long. Passage can be difficult at this location during large flows because of high velocity and at low flows because of the shallow jump pool below the cascade.

Providing passage around a partial impediment to steelhead migration at the chute pool will improve fish access to approximately 2,800 feet of stream channel up to the culvert at the Highway 154 crossing, which is a complete passage barrier. The habitat immediately above the chute pool consists of 400 feet of poor habitat (100 feet of bedrock chute and then about 300 feet of open channel), followed by 2,400 feet of good quality habitat up to the culvert. SYRTAC biologists and engineers have designed structures that will enable fish passage at flows of 5 cfs or more. Passage over the cascade will be improved by installing a weir at the downstream control of the chute pool to effectively decrease the height of the cascade and deepen the jump pool. Passage through the bedrock chute will be facilitated by creating a small resting pool at the top of the cascade and installing a number of channel obstructions to decrease the water velocity and create resting areas for migrating steelhead. Figure 3-10 is a schematic diagram of the proposed improvements. The final design is being developed in consultation with fish passage experts from DFG and NMFS in a manner consistent with the DFG's *California Stream Habitat Restoration Manual* and the ESA.

3.3.1.4 Passage Facilities at the Highway 154 Culvert

Where Highway 154 crosses Hilton Creek, approximately 4,000 feet above the confluence with the Santa Ynez River, there is a culvert that is a complete passage impediment. Providing passage at this impediment and the cascade/chute impediment will make the upper reaches of Hilton Creek available to rainbow trout/steelhead. Anecdotal reports suggest that trout were historically present in upper Hilton Creek above Highway 154 prior to the re-routing of the creek during construction of Bradbury Dam.

Passage at the Highway 154 culvert is difficult at both high and low flows. At high flows the smooth surface inside the culvert can become a velocity barrier. At low flows the culvert and concrete apron can be dry or have very shallow depths that block passage. Further study will be required to develop a plan for making the impediment passable by steelhead. Current discussions suggest that baffles or large boulder could be installed in the culvert to slow the water down. Raising the water surface elevation in the downstream pool would flood the concrete apron allowing fish to pass. Upstream of the culvert is another apron and a debris plug

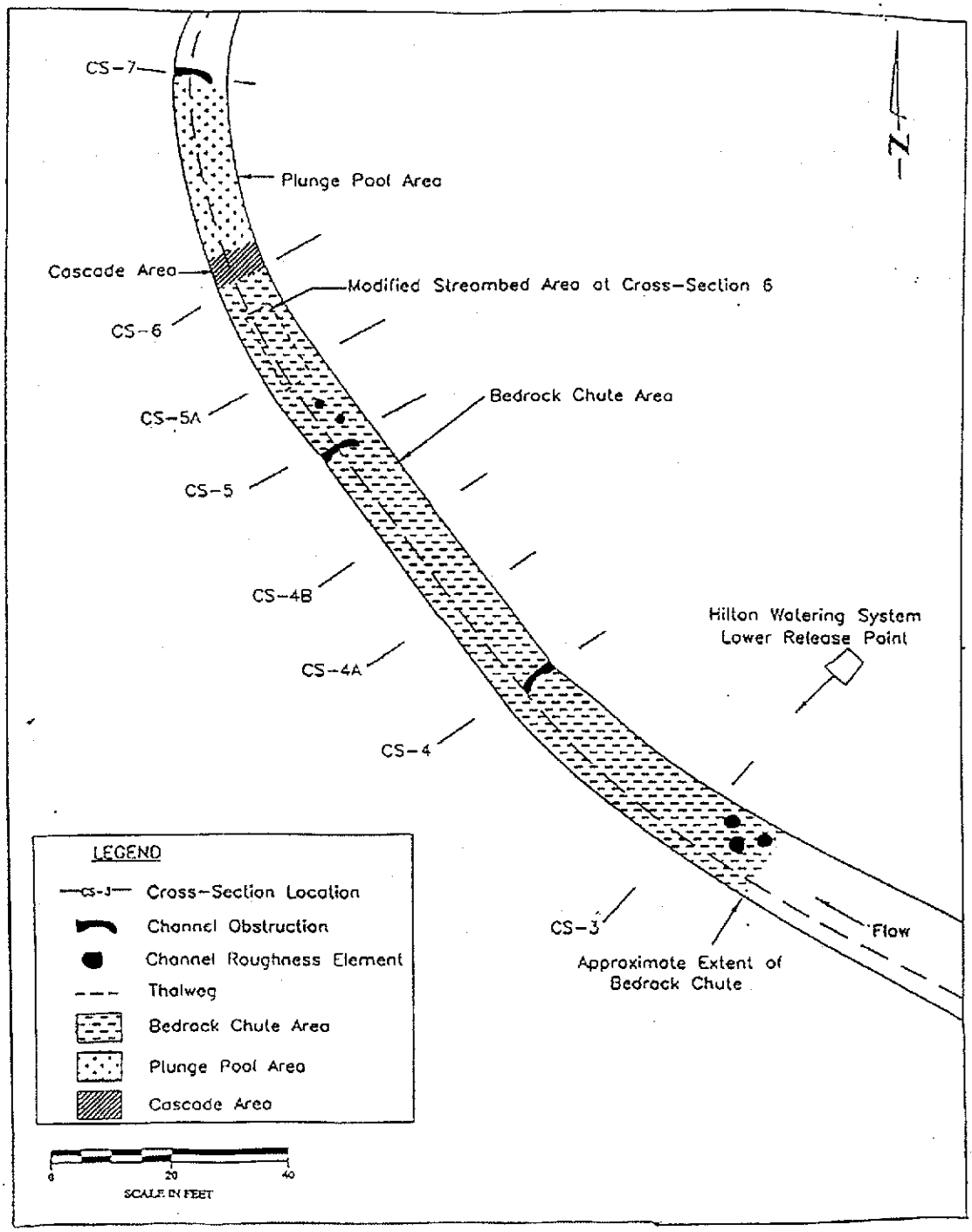

Figure 3-10. Conceptual diagram of fish passage enhancement at the cascade/chute impediment on Hilton Creek.

that would also require modifications to allow migrating rainbow trout/steelhead to continue into the upper reaches of Hilton Creek. Project design is limited by the need to work within the 120 foot CalTrans easement for the Highway 154 bridge. Preliminary designs for the culvert modification have been completed and are under review and revision. On-going discussions with CalTrans, DFG, USFWS, NMFS, and SYRTAC scientists will determine the final project design.

3.3.1.5 Physical Habitat Enhancement

In addition to the measures above, other habitat modifications will include, but not be limited to, improvements to riparian vegetation (this may be limited by existing soil and bedrock conditions), improvements to instream pool and riffle habitat to create additional spawning and over-summering areas, and spawning gravel augmentation.

3.3.2 FISH RESCUE

While the supplemental water supply system will provide flow to Hilton Creek in most years, in dry or critically dry years or in years when lake level falls to near 665 feet, it would not be feasible to provide stream flow throughout the summer and fall months. As the season progresses, flow decreases, water temperatures increase, and dissolved oxygen levels may drop to stressful or harmful levels. In the past, fish have been restricted to isolated pools as flows in Hilton Creek declined. In these pools, rainbow trout/steelhead were vulnerable to predation by both fish and birds; desiccation, and exposure to elevated water temperatures (in a number of instances exceeding acute lethal temperature thresholds for steelhead). In drought years, Reclamation agrees to consult with NMFS to determine what, if any, actions will be taken to protect downstream fishery resources. Reclamation believes that under these circumstances, it may become imperative to move fish residing in Hilton Creek to more suitable habitat if they are to survive. This type of operation is referred to as a fish rescue.

Hydrologic analysis indicates that a fish rescue operation will likely be necessary in approximately 2 percent of all water years. During most of these years, however, it is likely that the river mouth would not open during the winter, and thus there would be no spawning in Hilton Creek by anadromous steelhead, although resident rainbow trout may still spawn there. Additionally, juvenile steelhead from the previous year may still reside in the stream, if there has not been enough flow to cue them to emigrate. Fish rescue operations have been successfully conducted in Hilton Creek in 1995 and 1998. In June 1998, about 831 young-of-the-year rainbow trout/steelhead and 3 adults were successfully moved from Hilton Creek to the mainstem Santa Ynez River above the Long Pool (676 fish) and San Miguelito Creek (153 young-of-the-year). During 1998, specific protocols were developed for determining when fish rescue operations would be initiated. These protocols may not be appropriate for all years, but 1998 provided a template for coordination and cooperation between the SYRTAC, DFG and NMFS which will make similar efforts in the future successful.

The fish rescue plan for Hilton Creek has two parts: (1) monitoring to determine whether and when a fish rescue should be initiated; and (2) the protocols for capture and transfer of fish. Monitoring of flow levels and water temperatures within Hilton Creek will provide the primary information on when a fish rescue operation should be considered. If flow seems likely to

become substantially diminished or temperature approaches stressful levels, then the project biologist will consult with the SYRTAC, DFG and NMFS to determine if a fish rescue should be implemented. Once the potential need for a fish rescue has been identified, the creek will be monitored daily for signs of additional stress.

One of the conditions necessary for a successful fish rescue operation is the availability of a suitable place to relocate the fish. If it seems likely that a fish rescue operation will be necessary, the project biologist will investigate likely relocation areas to determine if they have conditions (adequate stream flow, temperature) which are favorable to steelhead. If a suitable relocation area is available, a survey of fry/juvenile density will be performed, to determine if there is any available space for more fish. Potential relocation sites include the Long Pool and mainstem just below Bradbury Dam, and certain tributary reaches.

To minimize predation losses of relocated young-of-the-year rainbow trout/steelhead, warmwater fish (largemouth, bass, smallmouth bass, and bullheads) may be removed from the receiving site if they are abundant. These fish can increase the mortality rates of young rainbow trout/steelhead both directly through predation, and indirectly by forcing young fish to occupy less suitable areas where they may have slower growth rates, lower fitness, or be exposed to other predators. Predator removal could provide localized benefits to native fish in the mainstem pools although these benefits will be temporary because of recolonization from other areas (other stream reaches and/or Lake Cachuma). Predator removal will be most valuable as refuge pools become isolated during the summer.

Predators will be selectively removed from key pools using physical capture methods. The primary methods would be fyke nets (also called box traps) in larger pools and runs, and seines in smaller pools. Captured native fishes will be returned to the stream. The operations will be conducted by fishery biologists or volunteers directly supervised by a fishery biologist.

Once a suitable location is found, the fish rescue could proceed using protocols similar to those used in 1998, although specific details will need to be decided on a case by case basis, as conditions may change. Operations will occur in the morning when the stream is coolest and will cease when water temperatures exceeds 18°C. Fish will be captured using seines and nets as much as possible, and held and transported in chilled aerated water. The temperature of transport and release water will be equalized prior to release.

Fish rescue and predator control operation will be undertaken on a case-by-case basis in consultation with NMFS and DFG. Fish rescue operations could also be conducted in other stream reaches that are drying and/or have stressful temperatures that are not on Reclamation property. The decision to conduct fish rescues in these areas will be made on a case-by-case basis based on the landowner's permission and in consultation with the resource agencies.

3.3.3 Conservation Easements: Habitat Protection and Enhancement

The tributaries on the south side of the watershed have good potential as fish habitat because these streams generally have perennial flow through the summer, at least in their upper reaches. Habitat quality can range from good quality in upper reaches (i.e. perennial flow, good canopy cover, suitable water quality) to poor just above the confluence with the mainstem Santa Ynez

River (i.e., intermittent or no flow in summer, little canopy cover). Conservation measures directed at tributary habitat will focus on protecting habitat that is already in good condition and enhancing habitat that is in fair condition. Efforts will not be expended on poor quality habitat where conditions cannot be feasibly improved.

All tributaries in the lower basin, except lower Hilton Creek, are on private property. Therefore, voluntary participation by the landowner will be necessary for implementation of protective and enhancement measures along these streams. The Member Units will obtain conservation easements from landowners to protect property and to implement and monitor appropriate enhancement actions. Priority areas for seeking conservation easements will be identified according to the persistence of flows, suitability of habitat (or potential for enhancement), and absence of downstream passage barriers.

Several landowners have approached the Member Units about establishing conservation easements. The Public Education and Outreach Program (Section 3.3.6) will complement this action by educating landowners about "fish friendly" land management practices and encouraging others to participate in conservation easements.

3.3.3.1 Habitat Protection

Habitat protection will focus on obtaining conservation easements from private landowners along stream corridors. A conservation easement is a legal agreement between a landowner and a non-profit group or government agency, such as Reclamation and the COMB. Conservation easements will entail purchasing the rights to manage a strip of property along streams from the property owner. The owner retains ownership of the property, but is paid for loss of use. In exchange, Reclamation and the Member Units would be able to implement fish conservation measures within the easement, as described in the following section. Conservation easements can either be a permanent purchase of the specified management rights or a long-term lease (typically 20 years) of those rights.

In most agreements, landowners allow certain activities to be performed on their property in exchange for monetary or other benefits. Conservation easements can be effective at fostering habitat improvement, both where land use is negatively affecting riparian and aquatic habitat or where frequent access to the stream is required for the maintenance of projects. Conservation easements can foster natural recovery of habitat over time, as well as enhance the success of active intervention through other actions, such as planting riparian vegetation.

Reclamation and the Member Units will also work with landowners to develop land use practices that protect steelhead and their habitat without adversely affecting the operation of the landowners' property. Such practices may include exclusionary fencing to keep cattle from the stream or out of riparian vegetation, creation of catchment ponds to settle fine sediments and other materials from runoff waters before they enter the stream, streambank protection, and vegetative buffer strips.

The general process for establishing conservation easements starts with discussions between the landowner and Reclamation/COMB. Field surveys will be conducted to evaluate the potential of the stream as steelhead habitat and to assess land use practices that may affect the stream. An

action plan will be developed from this information, which will outline site-specific habitat enhancement measures and land use practices. An appraisal will be done by an independent appraiser familiar with assessing property values for conservation easements. The landowner and Reclamation/COMB will determine the terms and conditions for sale or lease of the conservation easement, which will be funded by Reclamation/COMB and transferred to an approved land trust organization, such as the Santa Barbara County Land Trust. The Member Units will then implement the habitat enhancement actions outlined in the action plan and conduct monitoring to adaptively manage the conservation easement.

Reclamation and the Member Units are in discussion to obtain conservation easements on several properties in the El Jaro Creek drainage, which will protect about 10 miles (52,800 ft) of lower El Jaro Creek and its tributaries. The landowners and COMB have entered into contracts to pursue investigations and negotiations for conservation easements. Preliminary surveys of the properties in question demonstrate that the El Jaro Creek habitat is mostly fair quality habitat with some in good condition. There are localized sediment input sources that would be addressed by habitat enhancement projects (see below) once the management agreements are in place. Reducing the sediment input to the stream would improve the habitat quality for spawning and rearing steelhead. Juvenile rainbow trout/steelhead are known to use this habitat to oversummer and adult steelhead have access to this habitat currently (access will be improved by the modification of the impediment at Highway 1). The three landowners have recently met with SYRTAC representatives to discuss the conservation easements and all are very interested in proceeding. Appraisals need to be conducted and the full agreements are expected to be in place by 2003.

3.3.3.2 Habitat Enhancement

Habitat improvements might include structural modifications to instream habitat such as the creation of additional pool and riffle areas and augmentation of spawning gravel. Boulders and large woody debris could be used to create additional habitat features within selected reaches of the mainstem and the tributaries. Access to private lands and the results of field fisheries surveys and habitat typing, in combination with results of water temperature monitoring, will be used as a basis for identifying specific locations for habitat protection and improvement.

For the three properties described above, existing fair steelhead habitat will be enhanced primarily by implementing a number of small bank stabilization projects. Localized livestock management, riparian restoration, and instream enhancements may also be warranted.

Addition of Instream Structures

Physical modifications of the channel through addition of instream structures would be used to create more oversummering pool habitat. Habitat complexity has been positively correlated with fish density. Methods for physical enhancement include: (1) improving the quality of pools by increasing cover and complexity, and (2) increasing the amount of pool habitat by increasing depths in existing pools or scouring new pools.

The first step of a pool enhancement program will be to identify areas where opportunities exist for enhancement measures to be successfully implemented. Surveys will be conducted of

existing permanent pools to determine their habitat characteristics, as well as to identify additional areas where pools could be created that would likely persist. Site selection would take into account accessibility, channel hydraulics, geomorphology (e.g. bankfull width, depth, gradient, sinuosity, sediment load, and substrate size), stream flow regime, and availability of structural materials. Sites with relatively stable stream bed, stable banks, and woody riparian vegetation will afford the greatest opportunities, while sites with steep streambanks, non-cohesive sandy soils, little riparian vegetation, and high stream gradients present greater challenges to the successful use of instream structures.

Once suitable sites have been identified, a conceptual enhancement plan can be developed. A feasibility analysis will be performed to evaluate factors such as continued site accessibility, structural stability, cost, and longevity prior to developing final engineering plans for the proposed enhancements. Although the instream habitat improvements will be designed to withstand damage due to flood flows to the maximum extent practicable, periodic maintenance will be required to correct problems such as unsuitable scouring of cover structures or in-filling of pools with excess sediment.

Cover elements in pools may be naturally formed by overhanging riparian vegetation, undercut banks, exposed root wads or logs. Structures typically added to pools to enhance cover include logs, root wads, boulders and cobbles. These structures will need to be secured to stable locations to prevent wash-out. Boulders and cobbles can be placed into pools to create interstitial spaces that provide cover. Consideration should be given to using boulders and cobbles that are large enough to minimize entrainment and transport during high flows. This may require somewhat larger bed materials than those which are currently found in the river.

Pool depth can also be increased by installing instream structures to increase scour, by direct excavation, and/or by manipulating channel geomorphology. Instream structures such as log and boulder weirs, deflectors, and/or digger logs could be used to constrict the channel, increase flow velocities, and thereby scour pools. The objective being to promote self-maintaining pools and to create back-water conditions during periods of low-flow.

Riparian Enhancement

Riparian zones perform a number of vital functions that affect the quality of aquatic habitats, as well as provide habitat for terrestrial plants and animals (Spence et al. 1996). Fallen leaves and branches are an important source of food for aquatic macroinvertebrates and nutrients for aquatic vegetation, while fallen terrestrial insects are valuable prey for fish. The roots of riparian vegetation maintain bank structure and provide cover via undercut banks. Overhanging branches also provide cover. The riparian canopy can reduce water temperatures by shading the stream. Large woody debris that falls into the stream further increases cover and creates areas of scour which increase water depth. Riparian vegetation can also reduce water velocities and create refuge areas of relatively low velocity during storm flows.

Propagation of native riparian vegetation can improve stream habitat through the mechanisms described. The Plan will enhance and restore riparian vegetation at specific pools along the Santa Ynez River. This type of restoration effort is relatively inexpensive and easy to perform, as long as permission can be obtained from landowners to access these areas to plant vegetation

or conduct other enhancement activities and to protect new plants. Planting or enhancement of riparian vegetation may be useful at sites where the canopy cover is low and the stream channel is not too wide. Where possible, deep-rooted vegetation such as sycamore or cottonwood would be preferable to shallow-rooted vegetation such as willow. The species of vegetation selected for propagation can have a measurable effect on stream flow. The enhancement or expansion of streamside vegetation will likely increase water loss due to transpiration within the stream corridor, although this would be balanced by decreases in evaporation due to improved shading.

3.3.4 Tributary Passage Barrier Modification

Under current conditions, manmade and natural structures may impede steelhead movements in the tributaries of the lower Santa Ynez River, especially under low and moderate stream flows. Since habitat availability may be a primary factor limiting the steelhead populations in the watershed, it is imperative to improve accessibility to existing aquatic habitat by modifying or removing impassable barriers. These efforts will serve to expand the available habitat for spawning and rearing steelhead; thereby expanding the carrying capacity of the lower river.

The tributaries of primary interest are Salsipuedes-El Jaro, Hilton, and Quiota Creeks, since they have perennial flow, at least in their upper reaches, and can support spawning and rearing. Passage enhancement measures for the two passage impediments in Hilton Creek are described above in Section 3.3.1. Impediments on the other tributaries are manmade barriers such road crossings, bridges, and culverts (Table 3-11). All of the impediments listed in Table 3-11 will be modified to provide for fish passage migration assuming access agreements can be reached.

Access to habitat within Salsipuedes and El Jaro Creeks by anadromous steelhead is limited by two low flow passage barriers, associated with bridges or road crossings (SYRTAC data). These barriers are thought to impede the passage of both adult and juvenile fish primarily during periods of low flow. The Highway 1 Bridge #51-95 on lower Salsipuedes Creek is located about 3.6 miles upstream from the Santa Ynez River. This bridge has a 3 to 4 foot drop from the concrete apron into a pool downstream of the bridge. Pool depth may not be sufficient to allow fish to negotiate the apron. Reclamation and the Member Units have received a $25,000 grant to modify the concrete apron to provide low flow passage for migrating steelhead. Preliminary designs for the proposed modification are complete and SYRTAC scientists and engineers will be working to finalize those designs with NMFS and DFG specialists.

Road crossings, such as those in Quiota and El Jaro Creeks, can also be an impediment to fish movement. El Jaro Creek has a road crossing and concrete apron about 1/3-mile upstream of the confluence. It is an old ford on a private, unused road, with a 3-foot drop below. Refugio Road crosses Quiota Creek many times beginning about 1.8 miles upstream from the mainstem Santa Ynez River. All nine crossings are shallow-water Arizona crossings, with concrete beds and, at several sites, a 2 to 3-foot drop downstream of the concrete apron. Refugio Road is maintained by the County of Santa Barbara.

Arizona crossings are typically concrete aprons placed across the streambed to permit vehicles to drive through the stream on a firm surface during periods of low or no stream flow, and permit debris and sediment to pass downstream during periods of high stream flow. Generally these crossings require little maintenance to provide access across the stream. However, they often

Table 3-11. Passage Impediments on Tributaries

Creek	Location of Impediment	Structure	Type of Impediment	Jurisdiction
Salsipuedes	3.6 miles above Santa Ynez River	Bridge crossing on Highway 1	Low-flow passage impediment	State road
El Jaro	1/3 mile above Salsipuedes confluence	Road crossing	Low-flow passage impediment	Abandoned private road
Nojoqui	3.5 miles upstream of Santa Ynez River	Culvert	May be an impediment	
Quiota	1.8 to 3.3 miles above Santa Ynez River	6 Road crossings	Low-flow and high-flow passage impediments	County road
Hilton	1,380 feet above Santa Ynez River	Rocky cascade & bedrock chute	High-flow passage impediment	Reclamation
	Underneath Highway 154	Concrete culvert	Velocity impediment	State road

flatten the local stream gradient upstream, gradually developing a broad shallow channel (filled in by sediment). Downstream an incised channel often develops (scoured by high velocity flows). Upstream migrants have difficulty swimming across the Arizona crossing due to shallow depth or in some instances the amount of downstream incision requires fish to jump onto the crossing.

Migration barriers associated with Arizona road crossings can be eliminated by either replacing the crossing with a small bridge or by constructing jump pools in the downstream reach. Relatively inexpensive bridges can be made from retro-fitted railroad flat cars and pre-fabricated, modular bridges. In some locations, large boulders can be used downstream of the crossing to construct weirs that form backwater pools which typically only hold water during periods of high stream flow. Steelhead migrating during periods of moderate to high stream flow can jump and swim between the backwater pools until they reach the crossing and swim across it. Modifying the depth of flow across these crossings would reduce their utility at some flow levels making travel inconvenient. The County of Santa Barbara and Member Units will team together to develop more fish-friendly crossings, as the County makes plans to repair three of these crossings.

Surveys of other potential passage impediments and barriers will be conducted to determine the benefits and feasibility of modifying them to enhance fish passage. For example, there is a culvert on Nojoqui Creek that may be an impediment about 3.5 miles upstream of the Santa Ynez River, but further assessment is required (SYRTAC data). Box culverts under state and county roads can impede migration. The concrete bottom of the box culvert forms a broad shallow barrier during low flow and often acts to form a barrier downstream of the grade control because of a drop in the streambed elevation. Downstream boulder weirs can often provide adequate backwater during high stream flows to drown the culvert outfall and provide passage. If site conditions prevent use of backwater weirs, then the bottom of the box culvert might be modified by adding large roughness elements, or the culvert could be replaced with a bridge or arch culvert.

Preliminary engineering designs will be developed for low to moderate flow fish passage facilities in consultation with the bioengineering staffs of the NMFS and DFG. The preliminary engineering designs for fish passage facilities will be used as a basis for estimating costs for final design and construction, the range of flow conditions for which the passage facilities would provide benefit, identification of permitting requirements and preparation of environmental documentation, and requirements for access to private lands for the construction of fish passage facilities.

3.3.5 POOL HABITAT MANAGEMENT

Results of the 1993-1998 fisheries investigations have demonstrated the importance of existing deeper water pool habitats within the mainstem as refugia for rainbow trout/ steelhead during low flow summer conditions. Pools are known to support rainbow trout/ steelhead throughout the management reach. These pools are particularly important for larger fish (>6 inches), but less so for small fish since smaller fish are easily preyed upon by introduced predatory fish species. Factors which may impair production in these pools include high temperatures, low dissolved oxygen content, lack of structure, and presence of predators.

Water quality in these pools will be maintained via conjunctive operation of water releases, as discussed above in Section 3.2.2. In addition to water releases, non-flow related measures may be taken to improve the habitat complexity of pool habitat on Reclamation property. Habitat improvements could include structural modifications to instream habitat such as augmentation of spawning gravel or installation of boulders and large woody debris to provide cover. To the extent that willing private landowners can be located, these improvements may be made elsewhere as well.

3.3.6 Public Education and Outreach Program

Reclamation and the participating agencies will develop a Public Education and Outreach Program to explain the activities related to the protection and enhancement of steelhead populations and their habitat, as well as other sensitive resources in the lower Santa Ynez River system. It will describe the programs designed to maintain or restore steelhead, and solicit volunteer actions from private property owners to improve steelhead habitat in the mainstem of the river and its tributaries downstream of Bradbury Dam. The Member Units will finance the program activities, and coordinate comments and suggestions received from the public.

Because the majority of land in and along the lower Santa Ynez River is privately owned, the Public Education and Outreach Program will stress the voluntary part of the Plan. It will be broad-based but will particularly target riparian landowners, keeping them informed of river-related activities designed to help maintain and restore steelhead, and soliciting their voluntary participation in habitat improvement programs. These programs may include riparian planting, spawning gravel augmentation, passage barrier removal, creation of additional habitat features, "fish friendly" land management practices, and other measures to benefit steelhead and other aquatic resources. This information program will emphasize sections of the river and tributaries under the control or management of the landowners, but will also draw upon the successes from Reclamation property and from other watersheds, as well. The Public Education and Outreach Program will provide technical assistance for implementing these measures and will fund or co-fund these type of enhancements.

Public involvement activities will be initiated in order to keep the public informed of the progress of the conservation measures undertaken to protect and restore steelhead and its habitat. These activities will include the following outreach activities:

- Annual public workshops to invite suggestions from the public on reasonable conservation measures for steelhead, and to keep them informed of the progress of the restoration effort. The first of these meetings was held in June, 1998, to solicit input on management alternatives being considered for an overall fish management plan.

- Issuance of periodic news releases to the *Santa Barbara News Press*, the *Lompoc Record*, and the *Santa Ynez Valley News* to ensure that program successes are relayed to the news media.

- Establishment of a free "800" phone message line with regular updated messages concerning the progress of instream habitat improvements and the effect of those

improvements on the various life stages of the steelhead. The public will also have the opportunity to leave messages.

- Issuance of annual newsletters summarizing the previous year's enhancement activities on the Santa Ynez River and its tributaries, habitat conditions, fish populations, successes, failures, future milestones, and schedule of upcoming events. They might also include a "highlight" piece on related topics, such as: voluntary measures undertaken by landowners that have aided in creating additional habitat or improving existing habitat; successful, cooperative fish programs between landowners and public agencies; ability of cattle and fish to successfully coexist along the river; the cost of the steelhead restoration measures; sources of funding and technical assistance available to landowners to implement habitat improvement measures.

- Establishment of a web page with updated messages and photographs, along with information who to contact with comments, questions, or suggestions.

- Seasonal field trips led by project biologists to give interested landowners a real-life perspective on the enhancements that are being made in the river and the benefits they provide to the steelhead.

- Establishment of an expert speaker's group to provide informed speakers to local organizations. This group might also include local landowners who have initiated innovative measures to help restore steelhead habitat.

- Annual "Steelhead Restoration" slide shows at local bookstores advertised through fliers posted in local shops and restaurants.

The Public Education and Outreach Program will be developed on an adaptive management basis; activities that are successful will be continued, and improvements to the Program will be continually sought.

3.3.7 Schedule for Implementation of the Tributary Enhancement Measures

Reclamation has created a schedule that summarizes the anticipated completion date for the proposed tributary enhancement measures (Table 3-12). Given the expected implementation dates for the interim and long-term operations, it is expected that the Hilton Creek fish passage enhancement at the bedrock cascade and chute will be completed during Phase 1 of the interim operations. During Phase 2, seven of the remaining ten tributary enhancement measures will be implemented.

3.4 Watershed Monitoring Program

Since 1993, the Santa Ynez River Technical Advisory Committee (SYRTAC) has cooperatively studied the fish, habitat, and hydrology of the SYR. The ultimate goal of the SYRTAC is to develop the information necessary to identify and evaluate potential management actions that will benefit fishery resources in the lower SYR downstream of Bradbury Dam. The participants of the SYRTAC are comprised of Cachuma Member Units (water purveyors), resource agencies

Table 3-12. Schedule for the Cachuma Project Enhancement Measures

Enhancement Measure	Anticipated Implementation
Cascade/Chute Fish Passage Enhancement	2000
Reservoir Surcharge Flashboard Construction	2001
El Jaro Creek Streambank Stabilization Projects	2001
Highway 1 at Salsipuedes Creek Fish Passage Enhancement	2001
Hilton Creek Watering System Pump and Flexible Intake	2002
Highway 154 Culvert Fish Passage Enhancement	2002
Conservation Agreements	2003
Quiota Creek Fish Passage Enhancement	2003
Hilton Creek Channel Extension	2004
El Jaro Creek Abandoned Road Fish Passage Enhancement	2005
Nojoqui Creek Culvert Fish Passage Enhancement	2005
Habitat Improvements*	2004, 2005, & 2006

*several small scale projects on conservation easements and other tributaries

(California Department of Fish and Game, US Fish and Wildlife Service, Reclamation), and local environmental groups who are interested in the resources of Lake Cachuma and the public trust resources downstream of Bradbury Dam.

In 1997 the SYRTAC drafted a long term study plan to guide the monitoring program in the Lower Santa Ynez River. The monitoring program below is based on this long-term study plan. The original plan is expanded in a number of areas including enhancement project specific monitoring, a multidisciplinary watershed assessment, mainstem migrant trapping, and lagoon water level monitoring.

3.4.1 WR 89-18 MONITORING

Monitoring of the ramp-down of the next WR 89-18 release will be conducted to determine the rates of change in stage and wetted width.

METHOD: In the first year water rights releases are initiated, a single transect and staff gages will be established at three locations within the mainstem. The locations are as follows:

- Directly downstream of the Stilling Basin
- Directly downstream of the Long Pool
- Approximately 3.5 miles downstream of Bradbury

Transects will be established in run habitats. Once flow decreases are initiated, field personnel will man each transect location, recording measurements every 15 minutes to establish the change in wetted width and depth over time.

The following data will be collected: Time, wetted width, and staff gage depth.

3.4.2 WATER QUALITY MONITORING

3.4.2.1 Mainstem and Tributary Thermograph Network

The objective of the monitoring is to evaluate:

- Seasonal patterns of water temperature, in both the mainstem and tributaries downstream of Bradbury Dam
- Diel variations in water temperature
- Longitudinal gradient in water temperatures downstream of Bradbury Dam
- Vertical stratification and evidence of cool water upwelling in selected refuge pools
- Determine water quality suitability for various fish species including steelhead trout

METHOD: There are approximately 14 mainstem thermographs deployed at various locations throughout the mainstem SYR, extending from Bradbury Dam down to the lagoon. The thermograph network will continue at its present level of effort with the core mainstem thermographs located at: Spill Basin (1), Long Pool (2), pool at mile 3.4 (2), pool at mile 6.0 (2), pool at mile 7.8 (2), pool at mile 10.5 (1), run at mile 13.9 (1), run at mile 24 (1), lagoon (2). An additional pool habitat will be picked for a vertical array thermograph monitoring location to increase the level of monitoring in the Alisal Reach. The additional monitoring site will be

located at approximately mile 8.0 downstream from Bradbury Dam. Tributary locations include Hilton Creek (2-3), Nojoqui Creek (1), Quiota Creek (1), Salsipuedes Creek (2), El Jaro Creek (1), and San Miguelito Creek (1). Deployment locations are in both run and pool habitats. Run habitats have the thermograph laying on the bottom of the habitat while pool locations generally have a vertical array with the surface connected to a float suspended one foot below the surface and the bottom thermograph laying on the bottom of the habitat.

3.4.2.2 Diurnal Water Quality Monitoring in the Mainstem

During late spring and extending into early fall, the SYR exhibits tremendous algae production in most of its surface waters. During the day when photosynthesis is taking place, algae growth can saturate the water column with dissolved oxygen (DO). Conversely, at night, algae metabolism, bacterial decomposition, and invertebrate respiration can remove significant amounts of DO from overlaying water causing oxygen depletion. Diurnal water quality surveys will continue to be conducted to identify diel fluctuations in DO and to assess the extent which DO concentrations may be limiting refuge habitat.

METHOD: Diurnal water quality surveys will be conducted a minimum of *twice* per month beginning in May and continuing through September. Measurements will be made in consecutive run, riffle, and pool habitats at one-foot intervals throughout the water column. Measurements will be conducted in the core locations that have been monitored since 1997. All mainstem monitoring locations correspond to sites where thermographs are deployed. Additional sites will be chosen in the Alisal Reach for more detailed monitoring. Mainstem monitoring sites are located at: mile 3.4, mile 6.0, mile 7.8, mile 8.0, mile 10.5, and mile 13.9.

The following data will be collected at each monitoring site: time of measurements, depth of measurements, temperature (C), and DO (mg/L).

3.4.2.3 Lake Cachuma Temperature and Dissolved Oxygen Profiles

Lake Cachuma has routinely experienced severe hypolimnetic oxygen depletion during the summer when the lake stratifies. The purpose of the monitoring program is to gather information on:

- Depth of water quality conditions preferable for steelhead in relation to operations of the Hilton Creek watering system
- Depth of anoxic conditions that develop in the lake
- Longitudinal and vertical water quality conditions at the monitoring locations
- A historical data base documenting the timing of stratification and turnover within the lake

METHOD: Reclamation personnel in an aeration study conducted between 1980-1984 measured temperature and dissolved oxygen profiles at three locations within Lake Cachuma. The Reclamation originally chose the study sites to document oxygen depletion at the upper, middle, and lower portions of the reservoir. The SYRTAC monitoring locations duplicate those of the Reclamation to the closest extent possible. All measurements will be taken quarterly throughout the year by boat (with the boat anchored) at one-meter intervals from the surface to the bottom of

the lake. Station #1 is located directly upstream of Bradbury Dam at the deepest portion of the lake (lower lake), Station #2 is located within the deep river channel of Tequepis Point (middle lake), and Station #3 is located within the deep river channel directly opposite of the Tecolote Tunnel (upper lake).

Water quality parameters to be measured include: temperate, DO

3.4.2.4 Santa Ynez Lagoon Status and Water Quality Profiles

Water quality measurements will be taken quarterly in the SYR lagoon to monitor seasonal, vertical, and longitudinal patterns. Additionally, the information will be used to assess the habitat suitability for various age classes of steelhead that rear and/or oversummer in the lagoon. Water level in the lagoon and the status of the sandbar at the mouth of the lagoon to pinpoint:

- When does the lagoon open?
- What are the conditions that dictate the opening of the lagoon?
- When does the lagoon close?

METHOD: Sample locations will correspond to sites used in the past SYR studies: lower lagoon at Ocean Park, middle lagoon at 35th Street Bridge, upper lagoon at SYR inflow. Water quality profiles will be measured in May, August, November, and February. Measurements will be conducted in the above locations at one-foot intervals from the surface to the bottom. A stage recorder will also be installed directly upstream of the lagoon/ocean interface and will remotely monitor the water surface elevation of the lagoon. Data would be collected remotely within the equipment and downloaded manually once per week to couple the equipment readings with regular visual observations. Relating this information to migrant trapping data can help determine the opportunities steelhead have entering and exiting the SYR watershed.

Parameters to be measured include: temperature, DO, salinity, and conductivity, lagoon water level and status of the sandbar at the mouth of the lagoon (open/closed).

3.4.3 Fishery Surveys

3.4.3.1 Tributaries Migrant Trapping

Migrant trapping will be conducted in the tributaries to document the timing and abundance of migrating adult steelhead upstream to spawn, and juvenile smolts migrating downstream to the ocean in relation to flow and water quality conditions. Migrant trapping will be conducted in the following tributaries: Salsipuedes, Hilton, and Nojoqui Creeks, along with any additional tributaries where access may be granted in the future.

METHODS: Both upstream and downstream traps will be deployed in January so that the start of both adult immigration and juvenile emigration will be bracketed. Due to the extreme flashy nature of the watershed, both migrant traps will be removed prior to storm events to prevent trap loss during high flows. Traps will be re-deployed once flows recede to the point where effective trapping can be conducted. Traps will be cleaned of debris and checked daily for migrating fish in the morning. Depending on debris load and stream conditions, traps may be checked multiple

times over the course of a day. After traps are checked for fish, field personnel will inspect the traps and panels for scour points or holes, which will be repaired or plugged.

The following data will be collected daily: trap name, time, date, temperature, DO, and staff gage elevation. If any migrating steelhead is captured the following data will be collected: length (mm), scale sample, tissue sample, brief description of migrant, photograph and measured flow. As part of the handling protocol required by NMFS's federal collection permit, water temperatures will be measured prior to handling captured steelhead. If water temperatures are greater than 20 °C (68 °F), captured migrants will be enumerated and immediately released without data being collected (size estimated).

In areas where specific construction projects address passage barrier fixes, monitoring will be conducted to evaluate the success of each project. In areas where property access is available, migrant traps will be deployed upstream of passage fixes to determine if upstream migrating adults are able to negotiate through the project sites. If migrant trapping is not possible, success will be determined using bank observations (spawning surveys) or snorkel surveys to verify presence of various age classes of steelhead.

3.4.3.2 Mainstem Migrant Trapping

As an additional component to the regular tributary monitoring, both an upstream and downstream migrant trap will be placed in the mainstem approximately mile 3.5 downstream of Bradbury Dam. The primary purpose of the migrant traps in both the mainstem and tributaries will be:

- Determine the timing, overall numbers, and geographic distribution of steelhead migrating into and out of the SYR watershed
- Evaluate the time it takes for steelhead to migrate to the trap location as related to lagoon opening and closing
- Evaluate the movement of steelhead as it relates to storm events

METHOD: The protocol described under "Tributary Migrant Trapping" will be used for mainstem trapping. Deployment of the mainstem trap will coincide with the lagoon opening to accurately assess the time it takes for migrating steelhead to traverse the mainstem river.

3.4.3.3 Redd Surveys

Redd surveys (spawning surveys) will continue at their present level of effort to determine timing, numbers, geographic distribution, and preferred flow conditions of spawning adults in the mainstem and tributaries of the SYR. Spawning surveys will be conducted bi-monthly beginning in January and continuing through May in each of the mainstem reaches: Highway 154, Refugio, Alisal, and Avenue of the Flags, and in the following tributaries: Hilton, Salsipuedes, El Jaro, Nojoqui, and San Miguelito. Spawning surveys in the mainstem will account for nearly 10 river miles downstream of Bradbury Dam where mainstem spawning conditions can be evaluated.

Once specific passage enhancement projects have been completed, spawning surveys will be conducted upstream of the passage projects to evaluate if adult steelhead are able to negotiate past the instream fixes.

METHODS: In order to accurately describe spawning conditions in the mainstem, an inventory of the known spawning locations will be conducted. Transects will be established across known mainstem spawning areas (as observed during 1999-2000) to determine wetted width and redd location in relation to flow conditions during the spawning season of 2001 and beyond. Redd locations will be monitored throughout the spawning season during various flow regimes to evaluate if flow conditions are affecting the spawning availability (i.e., are known spawning locations above the water line at certain flows). Transects will be broken into quarters and pebble counts (n=50/quarter) will be conducted within each quarter to accurately describe available spawning material at different flows. Spawning gravel embeddedness will also be evaluated. This information coupled with water inflow data into Lake Cachuma and reservoir outflow (decay rates) will be used to determine if water releases, including those proposed to provide for upstream migration, is affecting spawning availability. Since additional water into the river during the spawning season will positively affect steelhead, negative affects will be determined if flow regimes are creating conditions where suitable spawning locations are above the waterline.

When conducting redd surveys, surveyors will proceed in an upstream direction. Once redd excavations or spawning activity is identified, flagging with the date and redd number will be attached to vegetation adjacent to the site. Length and width of the excavation will be measured to the nearest foot. Four depth and velocity measurements will be made at the excavation: one at the head of the excavation, and three across the egg deposition area. Additionally, surveyors will measure the distance to the nearest instream cover likely used by the spawning steelhead including 15-30 random depth and velocity measurements between the excavation site and cover to determine if spawning steelhead are keying in on certain instream cover components and/or instream velocity preferences.

3.4.3.4 Snorkel Surveys

Snorkel surveys will be conducted 3 times per year (June, August, and October) in both the mainstem and tributaries. The June survey will take into account baseline conditions (initial fish numbers) prior to the critical summer period by documenting numbers and locations of oversummering steelhead/rainbow trout. The August survey will evaluate instream conditions during the critical time of the year for oversummering steelhead/rainbow trout. The October survey will evaluate the ability of steelhead/rainbow trout to successfully oversummer in both the mainstem and tributaries of the SYR. Cover utilization and upwelling evidence will be recorded for all habitats where steelhead are observed. If upwelling zones are observed, a thermograph array will be deployed in the habitat to monitor water temperature conditions during the critical summer period.

The primary purpose of snorkel surveys is to:

- Determine if successful spawning occurred by observing young of the year

- Determine presence or absence of juvenile and/or adult steelhead rearing over the summer in the mainstem and/or tributaries of the SYR
- Determine geographic distribution of steelhead inhabiting the lower SYR downstream of Bradbury Dam
- Document fish species composition and relative abundance in each location
- Document the success or failure of enhancement and restoration projects by evaluating steelhead use of project areas over time

METHODS: Abundance estimates will be conducted using direct observation techniques. Depending on the size and water clarity of the habitats to be snorkeled, 1 or 2 observers will traverse the habitat a minimum of 2 times with a short 30 minute interval between each pass. The following data will be collected: date, time, habitat number and type, number of each species by size class (3 inch size categories) and pass, length of habitat snorkeled, average width of habitat snorkeled, and duration of each pass.

Mainstem sample locations will include all core locations that have been sampled historically. There are usually between 4-10 pool habitats per reach where under the new monitoring plan, all pools will be sampled. In addition to the pool habitats sampled, adjacent run and riffle habitats to the pool habitat will also be sampled. If conditions are too shallow to allow for snorkeling, bank observations will be conducted instead of direct observations.

Tributaries sample locations will include all core locations that have been sampled historically. Any tributaries that are re-habitat typed will have the core snorkel sites included in them in order to provide a historic perspective with respect to steelhead usage. New tributaries or areas where access may be granted will be habitat typed and a table of random numbers will be used to select pools, riffles, and runs to be sampled.

3.4.4 HABITAT MONITORING

3.4.4.1 Proper Functioning Condition (PFC)

Reclamation and the SYRTAC will use a consistent repeatable methodology to accurately characterize instream and riparian habitats in both the mainstem and tributaries of the SYR below Bradbury Dam. In discussions with NMFS, Proper Functioning Condition (PFC) was a recommended methodology that could accurately characterize baseline conditions in a consistent, repeatable, quantitative manner that will facilitate evaluation of steelhead habitat conditions and the effects of proposed enhancement and restoration actions.

Riparian-wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high water flows, thereby reducing erosion and improving water quality; filter sediments, capture bedload, and aid floodplain development; improve flood-water retention and ground water recharge; develop root masses that stabilize streambanks against cutting action; develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity. The functioning condition of riparian-wetland area is a result of interaction among geology, soil, water, and vegetation (TR 1737-9, 1993).

PFC methodology is an interdisciplinary approach whose team members include watershed specialists, biologists, hydrologists, riparian ecologists, and soil scientists. The goals of instream and riparian habitat inventories is to track the overall condition of habitat in the mainstem and tributaries, track the results of habitat protection and improvement measures, and identify other areas where habitat protection and improvements projects can take place.

A team is currently being assembled for a training workshop scheduled for the first or second week of June 2000. Members of the team will include fisheries biologists, hydrologists, rangeland ecologists and managers, soil scientists, riparian ecologists, and interested landowners. The PFC inventory will be conducted in the lower Santa Ynez River and its tributaries where access is granted. Where access is unavailable, attempts will be made to conduct the PFC analysis from aerial photographs.

3.4.4.2 Habitat Inventory

Utilizing the PFC approach does not negate the need for detailed habitat inventories to determine the distribution, abundance, and quality of mesohabitats (i.e., pool, riffle, and run), and how the various age classes of steelhead/rainbow trout utilize them. Aquatic habitats play an integral role in fisheries management. Their use is critical in predicting such things as the impacts of habitat alterations, potential fish production, and probable limiting factors. Habitat measurements also make it possible to classify aquatic habitats into similar groups so that research and management results may be generalized.

The purpose of the habitat typing will be to:

- Track changes in overall habitat distribution in various reaches of the SYR and tributaries
- Identify snorkel survey locations to monitor distribution, abundance, and survival of oversummering steelhead/rainbow trout

METHOD: Mainstem and tributary habitats will be inventoried every 2-3 years to monitor changes in overall mesohabitat distribution (i.e., the number of pools, riffles and runs). If significant storm events occur that alter the habitat composition along specific study reaches, then the habitats will be inventoried again that year. Habitat typing will use a Level III classification as described in the California Department of Fish and Game *Salmonid Stream Habitat Restoration Manual*. Habitat types will be identified by riffle, run, and pool (scour and dammed), and glide.

- Riffles are characterized by turbulent flow with a typical coarser substrate than units directly upstream or downstream. Substrate is usually cobble dominated, some of which may be partially exposed

- Runs are fast water areas with shallow gradient, typically with a substrate ranging in size from gravel to cobble with no major flow obstructions. Runs are usually deeper than riffles and appear to have little or no turbulent flow.

- Scour pools are characterized by areas of sediment removal, slow water velocities and a highly variable substrate with the greatest depth typically at the head or middle of the

pool. Dammed pools are characterized by the material causing the impoundment. These pools are typically deepest at the tail of the pool and have more fines than scour pools and fill with sediment at a more rapid rate

- Glides are characterized by a uniform channel bottom, low to moderate flow velocities, and little or no turbulent flow. Substrates are usually cobble, gravel, and sand.

Additional information that will be collected includes: habitat unit length, width, depth, maximum depth, residual pool depth, percent instream shelter, percent total canopy, right and left bank dominate vegetation types, and any relevant comments with respect to landmarks, landslides, barriers, or changes in channel substrate.

3.4.4.3 Hilton Creek Habitat Monitoring

Information will be gathered to determine the quantity of available habitat for steelhead/rainbow trout in Hilton Creek as it relates to flow. In order to accurately characterize the available habitat, transects will be installed every 100 feet through the lower 1300 feet of Hilton Creek (downstream of the cascade/chute passage impediment). A minimum of 5-10 depth and velocity measurements will taken across the transect to establish a profile of the wetted channel. Transect measurements will be taken at approximately one cfs flow intervals from 1 cfs to 10 cfs to provide the data necessary to evaluate the habitat availability. This study will take advantage of natural and supplemented changes in flow rate to determine the flow vs. habitat relationships. Flow from the Hilton Creek watering system will not be specifically modulated for this study.

The following data will be collected: flow, habitat type, wetted width, and a minimum of 5 depth and velocity measurements across each transect.

3.4.5 Tributary Enhancement Project Specific Monitoring

A number of enhancement projects are proposed on the tributaries in the lower Santa Ynez River system. Project specific monitoring plans will be individually developed for each of these projects as they are implemented. The monitoring plans will include study of the following elements:

- ability of fish to migrate through fish passage modifications;
- fish use of habitat upstream and downstream of fish passage structures;
- fish use of habitats created, protected, or enhanced;
- hydrological monitoring to determine that fish passage structures are functioning according to design; and
- monitoring and maintenance of tributary enhancement project sites.

3.4.6 Target Flow Compliance Monitoring

Habitat maintenance flow targets have been established at the Highway 154 bridge, where there was formerly a USGS gaging station. The gaging station at Highway 154 has been discontinued and Reclamation does not currently have access to this site. Reclamation is currently exploring a few options for monitoring Highway 154 target flow compliance. Reclamation is examining the

possibility of installing a gage at Highway 154. Another option is using the flow record of the discontinued USGS gage and create an empirical relationship between the flows at this gage, and flows at an existing gage on Reclamation property approximately 0.7 miles below Bradbury Dam. The empirical relationship may be used in conjunction with the existing gage on Reclamation property to monitor flow levels at Highway 154. In addition, a gage will be installed in the lower reach of Hilton Creek to monitor flows in this tributary. Finally, flows in the Alisal reach will be monitored by the USGS Solvang gage.