LONG-TERM MONITORING IN THE LOWER SANTA YNEZ RIVER

Appendix I

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Since its inception in 1993, the Santa Ynez River Technical Advisory Committee (SYRTAC) has directed a series of monitoring efforts in Lake Cachuma, the lagoon, and the lower Santa Ynez River and associated tributaries. The purpose of these monitoring efforts has been to (1) develop an understanding of the rainbow trout/steelhead habitat utilization in the lower Santa Ynez River; (2) develop flow recommendations for maintenance of public trust resources in the lower river; and (3) develop a background from which to recommend a broad scope of management actions to protect public trust resources in the lower river. These studies have included: (1) water temperature and dissolved oxygen (DO) monitoring in Lake Cachuma and in the lower river from the Stilling Basin to the lagoon; (2) habitat quality evaluations in both the lower river and its tributaries; (3) flow requirements for fish passage in the lower river; and (4) fish surveys in both the lower river and its tributaries (SYRTAC 1994, 1996, 1997b, 1998, 2000).

Over time, the Consensus Committee and State Water Resources Control Board recognized a need for a longer-term study plan to provide additional technical information to policy makers. The purpose of the long-term study plan was to provide information to (1) determine potential management alternatives, and (2) make recommendations about which actions should be implemented. The Consensus Committee approved a long-term study plan developed by the SYRTAC Biology Subcommittee (SYRTAC 1997a). The plan provides the overall framework for the SYRTAC studies, which are devoted to acquiring technical information regarding:

- the diversity, abundance, and condition of existing public trust fishery resources within the lower river;
- conditions which may limit the diversity, abundance, or condition of public trust fishery resources within the lower river;
- non-flow measures which could be expected to improve the conditions that currently act to limit the diversity, abundance, or condition of public trust fishery resources within the lower river; and
- alternatives to the existing operational regime of the Cachuma Project which could be expected to improve the conditions that currently act to limit the diversity, abundance, or condition of public trust fishery resources within the lower river.

Results of the monitoring program have been published in a series of data compilation reports (SYRTAC 1994, 1996, 1997b, 1998, 2000).

1.1 LONG-TERM MONITORING PROGRAM GOAL

The proposed long-term monitoring program will complement the management actions outlined in the *Lower Santa Ynez River Fish Management Plan* (Plan). Results of the proposed monitoring program will be used to:

- adaptively manage the actions recommended in the Plan (*e.g.*, flow-related releases),
- evaluate benefits and impacts of the Plan's actions on downstream aquatic resources, and
- provide information for the long-term management of the southern ESU of steelhead.

Details of the monitoring program sampling protocols are provided in the long-term study plan (SYRTAC 1997a) and the data compilation reports (SYRTAC 1996, 1997b, 1998, 2000).

1.2 ORGANIZATION OF THIS APPENDIX

The next section describes the actions that will be undertaken as part of the long-term monitoring program. In addition to these actions, the monitoring described in the 1997 SYRTAC study plan (attached to this appendix) will also be continued as part of the long-term monitoring program.

Section 3 presents the minimization and avoidance measures provided by the National Marine Fisheries Service (NMFS) for implementation of the monitoring program. These practices have been taken from the Biological Opinion that covers all the actions proposed in the Fish Management Plan, including the monitoring program (NMFS 2000). Finally, Section 4 summarizes the reporting requirements included in the Biological Opinion as they pertain to the monitoring program.

The objectives of the long-term monitoring program are to further develop technical information concerning:

- the long-term patterns of diversity, abundance, and condition of existing public trust fishery resources of the lower Santa Ynez River (with an emphasis on endangered southern steelhead); and
- habitat quantity and quality (including water quantity and quality) which may limit the diversity, abundance, or condition of public trust fishery resources of the lower river.

In addition, a number of tributary enhancement measures are discussed in the Plan, and more projects may be added as opportunities become available. Project-specific monitoring plans will be implemented along with these projects to evaluate each enhancement measure and provide information for future enhancement work.

A brief description of key actions or actions that have been revised from the 1997 study plan are outlined below. Also, the long-term study plan is attached and provides additional information on monitoring that has already been occurring in the watershed. Each action is organized to provide the objective of each action and then a brief description of the procedures that will be employed in the monitoring.

The SYRTAC Project Biologist, with the assistance of the Adaptive Management Committee, will be responsible for implementation of the monitoring program. The Cachuma Project Biological Opinion (NMFS 2000) requires the project biologist to notify NMFS of any plans for changing monitoring locations or methods and obtain approval for these changes. The resumes of the project biologist and those implementing the monitoring program will be provided annually to NMFS.

Implementation of particular actions have additional project-specific monitoring requirements. Most of these requirements are included in the description below. Minimization and avoidance measures for construction of the tributary enhancement measures are discussed in Appendix C (Section 4, Implementation). Construction-related monitoring is included in that discussion as well and is not repeated below. A similar discussion of required monitoring for the fish rescue activities is included in Appendix D (Section 3.5, Fish Rescue Plan). The Biological Opinion also includes specific reporting requirements based on the monitoring program. These reporting requirements are described in Section 4 of this document.

2.1 WATER QUALITY MONITORING

2.1.1 MAINSTEM AND TRIBUTARY THERMOGRAPH NETWORK

Objective: To determine:

- 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; and
- vertical stratification and evidence of cool water upwelling in selected refuge pools.

Purpose: To determine if and where water quality is suitable for various fish species including steelhead trout.

Method: There are approximately 14 mainstem thermographs deployed at various locations throughout the mainstem Santa Ynez River, 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 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 1 foot below the surface and the bottom thermograph laying on the bottom of the habitat.

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

2.1.2 DIURNAL WATER QUALITY MONITORING IN THE MAINSTEM

Objective: To identify diel fluctuations in DO.

Purpose: To assess the extent to 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 1-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, 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).

2.1.3 Lake Cachuma Temperature and Dissolved Oxygen Profiles

Objective: To determine at what depth in Lake Cachuma that water quality is suitable for release through the Hilton Creek supplemental watering system (primarily temperature and DO).

Purpose: To provide the Adaptive Management Committee with the information needed to determine the depth of the intake structure for the Hilton Creek supplementation water facility. This action will create a historical record that documents the timing of stratification and turnover within the lake that will be useful in future management of the system.

Method: U.S. Bureau of Reclamation (Reclamation) personnel in an aeration study conducted between 1980 to 1984 measured temperature and DO profiles at three locations within Lake Cachuma. Reclamation originally chose the study sites to document oxygen depletion at the upper, middle, and lower portions of the reservoir. SYRTAC monitoring locations duplicate those of Reclamation to the closest extent possible. All measurements will be taken quarterly throughout the year by boat (with the boat anchored) at 1-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 and DO.

2.1.4 Santa Ynez Lagoon Water Quality Profiles

Objective: To track the water quality in the lagoon by monitoring seasonal, vertical, and longitudinal patterns.

Purpose: To provide information to assess the habitat suitability for various age classes of steelhead to rear and/or over-summer in the lagoon.

Method: Sample locations will correspond to sites used in the past Santa Ynez River studies: lower lagoon at Ocean Park, middle lagoon at 35th Street Bridge, upper lagoon at Santa Ynez River inflow. Water quality profiles will be measured in May, August, November, and February. Measurements will be conducted in the above locations at 1-foot intervals from the surface to the bottom.

Parameters to be measured include: temperature, DO, salinity, and conductivity.

2.2 SANTA YNEZ RIVER SANDBAR STATUS

Objective: To determine the status (open or closed) of the sandbar at the mouth of the river and how this relates to the water surface elevation in the lagoon.

Purpose: To provide the Adaptive Management Committee with information on the status of the sandbar at the mouth of the river so that decisions can be made regarding passage flow supplementation.

Method: A stage recorder will be installed directly upstream of the lagoon/ocean interface and will remotely monitor the water surface elevation of the lagoon. Data will be collected remotely within the equipment and downloaded manually once per week to couple the equipment readings with regular visual observations.

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

2.3 FISHERY SURVEYS

2.3.1 TRIBUTARIES MIGRANT TRAPPING

Objective: To determine the use of the tributaries by both adult (upmigrant) and smolt (downmigrant) rainbow trout/steelhead. Timing and abundance will be determined in the tributaries of Salsipuedes, Hilton, and Nojoqui creeks, along with any additional tributaries where access may be granted in the future.

Purpose: To determine fish use of the tributaries and track changes in the abundance, timing, and distribution of the migrating fish. In addition, this monitoring, in conjunction with the mainstem trapping, will be used to evaluate the movement of steelhead as it relates to storm events.

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. Traps will be checked every 4 to 6 hours. 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 are 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' federal collection permit, water

temperatures will be measured prior to handling captured steelhead. If water temperatures are greater than 20ºC (68ºF), 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.

2.3.2 MAINSTEM MIGRANT TRAPPING

Objective: To determine the timing and abundance of fish migrating in the mainstem upstream of the Alisal Reach.

Purpose: The information will be used to refine fish passage supplementation releases (*i.e*., fish travel time, the relationship of migration to storm hydrographs, flow levels required for passage).

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.

2.3.3 REDD SURVEYS

Objective: To determine the timing, numbers, geographic distribution, and preferred flow conditions of spawning adults in the mainstem and tributaries of the Santa Ynez River (where access is granted).

Purpose: Redd surveys are used to provide information about the habitat preference and use within the Santa Ynez River and also to provide information on the status of rainbow trout/steelhead. In addition, once specific passage enhancement projects have been completed, spawning surveys will be conducted upstream of the projects to evaluate if adult steelhead are able to negotiate past the instream fixes.

Methods: 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 Santa Ynez River. 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 tributaries of Hilton, Salsipuedes, El Jaro, Nojoqui, and San Miguelito creeks. Spawning surveys in the mainstem will account for nearly 10-river miles downstream of Bradbury Dam where mainstem spawning conditions can be evaluated.

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 to 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 flowing 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 water line.

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- to 30-random depth and velocity measurements between the excavation site and cover to determine if spawning steelhead are keying into certain instream cover components and/or instream velocity preferences.

2.3.4 SNORKEL SURVEYS

Objective: To track the number of steelhead (adult, juvenile, and young-of-the-year) and other fish in select habitat units.

Purpose: Snorkel surveys are conducted to provide information on the status of the downstream fishery. More specifically, snorkel surveys are done 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 Santa Ynez River;
- determine geographic distribution of steelhead inhabiting the lower Santa Ynez River downstream of Bradbury Dam;
- document fish species composition and relative abundance in each location; and
- document the success or failure of enhancement and restoration projects by evaluating steelhead use of project areas over time.

Methods: Snorkel surveys will be conducted three 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 over-summering rainbow trout/steelhead. The August survey will evaluate instream conditions during the critical time of the year for over-summering rainbow trout/steelhead. The October survey will evaluate the ability of rainbow trout/steelhead to successfully over-summer in both the mainstem and tributaries of the Santa Ynez River. 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.

Abundance estimates will be conducted using direct observation techniques. Depending on the size and water clarity of the habitats to be snorkeled, one or two observers will traverse the habitat a minimum of two 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 four to ten pool habitats per reach, whereas 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.

Tributary sample locations will include all core locations that have been sampled historically. Any tributaries that are re-habitat typed will include the core snorkel sites 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.

2.4 HABITAT MONITORING

2.4.1 PROPER FUNCTIONING CONDITION (PFC)

Objective: To determine the proper functioning condition of the mainstem and tributaries downstream of Bradbury Dam where enhancement actions may take place.

Purpose: To determine location enhancement measures likely to succeed (*i.e.*, be durable). When streams are functioning properly, they can withstand 25- to 35-year floods and recover from them quickly. Enhancement measures constructed in reaches that are not properly functioning are more likely to be damaged or washed-out in storms. A PFC analysis will help the Adaptive Management Committee determine the benefit of enhancement measures in a particular reach of stream (*i.e.*, purchase conservation easements, identify locations where riparian planting might be useful).

Method: The PFC methodology is an interdisciplinary approach whose team members include watershed specialists, geomorphologists, biologists, hydrologists, riparian ecologists, and soil scientists. A SYRTAC team has been trained in the use of PFC. The PFC inventory may be conducted in the lower Santa Ynez River and its tributaries where access is granted. Where access is unavailable, attempts would be made to conduct the PFC analysis from aerial photographs. A PFC analysis will be conducted in new reaches where tributary enhancements are proposed as future opportunities become available.

2.4.2 HABITAT INVENTORY

Objective: To determine the distribution, abundance, and quality of mesohabitats (*i.e.*, pool, riffle, and run), and how the various age classes of rainbow trout/steelhead utilize them.

Purpose: The purpose of the habitat typing will be to:

- track changes in overall habitat distribution in various reaches of the Santa Ynez River and tributaries, and
- identify snorkel survey locations to monitor distribution, abundance, and survival of over-summering rainbow trout/steelhead.

Method: Mainstem and tributary habitats will be inventoried every two to three 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 (CDFG) *Salmonid Stream Habitat Restoration Manual* (Flosi *et al.*, 1998). 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, 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.

2.4.3 HILTON CREEK HABITAT MONITORING

Objective: To determine the quantity of available habitat for rainbow trout/steelhead in Hilton Creek as it relates to flow.

Purpose: The Hilton Creek watering system provides the capability to manage the flows in this creek. Determining the relationship between flow level and habitat will provide the Adaptive Management Committee with information necessary to properly manage these releases.

Method: In order to accurately characterize the available habitat, transects will be installed every 100 feet through the lower 1,300 feet of Hilton Creek (downstream of the cascade/chute passage impediment). A minimum of five to ten depth and velocity measurements will be taken across the transect to establish a profile of the wetted channel. Transect measurements will be taken at approximately 1 cubic-feet-per-second (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 versus 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 five depth and velocity measurements across each transect.

2.5 WATER RIGHTS RELEASES (WR 89-18) MONITORING

2.5.1 STEELHEAD MOVEMENT DURING WR 89-18 RELEASES

Objective: To determine if rainbow trout/steelhead are moving downstream in response to water rights releases.

Purpose: To determine if further measures need to be taken to protect steelhead during these releases.

Method: Snorkel surveys will be conducted to determine numbers and species composition at sites known to contain rainbow trout/steelhead both upstream and downstream of the Alisal Reach. A study plan will be created and provided to NMFS for review and approval. After NMFS has approved the study plan, it will be implemented for the subsequent 3 years of water rights releases. The result of implementation will be reported each year to NMFS.

Surveys will occur before and after the peak release levels for WR 89-18 releases. Surveys will also occur in the same locations after the releases have ended. Such surveys will be conducted during all water rights releases events in the first three years after the Plan is adopted.

Abundance estimates will be conducted using direct observation techniques. Depending on the size and water clarity of the habitats to be snorkeled, one or two observers will traverse the habitat a minimum of two 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.

2.5.2 WR 89-18 RAMPING RATE

Objective: To determine if the ramping rate for water rights releases meets the "less than 1-inch change in stage per hour" criteria generally accepted for steelhead.

Purpose: To determine if the ramping rate needs to be revised to meet the generally accepted standard for protecting steelhead.

Method: The relationship between flow, stage, and wetted width during ramping events, and the next WR 89-18 release will be studied. A single transect and staff gages will be established at two locations within the mainstem. The locations are as follows:

- directly downstream of the Stilling Basin, and
- approximately 3.5 miles downstream of Bradbury (Refugio Reach).

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.

2.6 TRIBUTARY ENHANCEMENT PROJECT SPECIFIC MONITORING

Objective: To determine:

- the ability of fish to migrate through fish passage modifications;
- fish use of the habitat upstream and downstream of fish passage structures; and
- fish use of habitats created, protected, or enhanced.

Purpose: To determine that fish passage structures are functioning according to design (*i.e.*, hydrological monitoring) and provide information on any maintenance requirements. The results of this monitoring may also be used in refining the design of future enhancement actions.

Method: As each enhancement project is implemented, a project-specific monitoring plan will be developed.

2.7 TARGET FLOW COMPLIANCE MONITORING

Objective: To monitor the flow levels in the Santa Ynez River at the Highway 154 and Alisal Road bridges.

Purpose: To determine to what degree the target flows are being maintained at the Highway 154 and Alisal Road bridges, and to be used in the passage flow supplementation releases.

Method: Flows in the Alisal Reach will likely be monitored by the U.S. Geological Survey (USGS) Solvang gage. Modifications to this gage will be necessary to improve its ability to monitor low flows. This gage will also be used for the passage flow supplementation monitoring. Habitat maintenance flow targets have been established at the Highway 154 Bridge, where there was formerly a USGS gaging station. A number of options for monitoring the Highway 154 target flow compliance are being explored. The Member Units are in discussion with CalTrans, which has an easement at the Highway 154 Bridge, to allow access for gage installation and monitoring. In the interim, monitoring of the flow level at this site will occur weekly when flows have receded to the target flow levels. Flow will be monitoring using a standard protocol. A staff gage can be used to monitor flow once the water surface elevation to flow relationship has been developed and verified for at least one rearing season. Monitoring of the residual pool depth in the Refugio and Alisal reaches will occur if conditions warrant implementation of this action. Monitoring will occur weekly by reading the water surface elevation off a staff gage installed in representative pool habitats.

Some of the actions in the monitoring program, such as migrant trapping, snorkel, and bank observations, involve take of endangered steelhead. These actions will be conducted such that impacts to rainbow trout/steelhead are minimized. Such minimization measures are outlined in the current sampling permit held by the SYRTAC Project Biologist and the Cachuma Project Biological Opinion (NMFS 2000). Those from the Biological Opinion have been reproduced below verbatim (from Term and Condition #11):

- All ESA-listed fish handled out-of-water for the purpose of recording biological information must be anesthetized. Anesthetized fish must be allowed to recover (e.g. in a recovery bucket) before being released. Fish that are simply counted must remain in water but do not need to be anesthetized.

- ESA-listed fish must be handled with extreme care and kept in water to the maximum extent possible during sampling and processing procedures. Adequate circulation and replenishment of water in holding units is required. The transfer of ESA-listed fish must be conducted using a sanctuary net that holds water during transfer to prevent the added stress of an out-of-water transfer.

- ESA-listed juvenile fish must not be handled if the water temperature exceeds 21 degrees Celsius (70 degrees Fahrenheit) at the capture site. Under these conditions, ESA-listed fish may only be identified and counted. If any adult ESA-listed fish are captured incidental to sampling for juveniles, they must be released without further handling, and such take must be reported.

- Visual observation protocols (such as snorkeling and stream side surveys) must be used instead of intrusive sampling methods whenever possible. This is especially appropriate to ascertain whether steelhead are merely present.

- If there is any indication that the survival of ESA-listed fish will be affected by increasing water flows or other conditions, the traps must be removed from use until hazardous conditions have elapsed.

- Due caution must be exercised during spawning ground surveys to avoid disturbing, disrupting, or harassing ESA listed adult steelhead when they are spawning. Whenever possible, walking in the stream must be avoided, especially in areas where steelhead are likely to spawn.

- Tissues of ESA listed steelhead are the responsibility of Reclamation and remain so as long as they are useful for monitoring the effects of the Cachuma Project. The

transfer of tissues from Reclamation on other entities requires written approval from NMFS.

- Traps and live boxes must examined every 4-6 hours, at minimum to minimize delay and harm to steelhead. Reclamation shall redesign the migrant traps to provide additional habitat space for adult steelhead waiting to be released, prevent access by predators and prevent tampering by non-authorized persons. Trap design and staffing procedures are subject to NMFS approval.

The purpose of the monitoring program is (1) to provide data to the Adaptive Management Committee for implementation and evaluation of the actions proposed in the Plan and (2) to provide information for the long-term evaluation of the program. Formal reporting requirements have not yet been developed for these purposes. However, in addition to those needed for internal implementation and evaluation of the Plan, there are a number of reporting requirements included in the Cachuma Project Biological Opinion (NMFS 2000). The Project Biologist and the Adaptive Management Committee will be responsible for providing the required information to NMFS. A list of the required reports is found below.

Where quotations exist, the text was taken directly from the Cachuma Project Biological Opinion (NMFS 2000) unless otherwise noted.

- The result of the study to determine the habitat versus flow relationships in Hilton Creek (see Section 2.4.3 above) will be reported to NMFS in each year the study is conducted. *Term and Condition #2 (item 2)*

- The result of the monitoring of the downstream water rights releases (see Section 2.5 above) will be reported to NMFS in each year monitoring occurs. *Term and Condition #6 (item B) and #7 (item 2)*

- "yearly reports (unless otherwise noted) that include the data taken each year and preliminary data analysis. Especially important for monitoring the effects of the Cachuma Project will be monitoring of: steelhead movement during migration supplementation, successful access, spawning, and rearing of steelhead in previously inaccessible and/or access restricted tributary habitat, and mainstem flow targets and the condition of steelhead in the mainstem." *Term and Condition #11 (item 1)*

- "NMFS shall receive quarterly reports detailing water releases for fish and the achievement of flow targets (and pool surface areas) during the interim period (until the 3.0 surcharge is achieved) and for the first three years of long term operations. In later years, these reports may occur on a yearly basis." *Term and Condition #11 (item 6)*

- "plans for changes in monitoring locations and methodologies and obtain approval from NMFS prior to implementation." *Term and Condition #11 (item 7)*

- "identify to NMFS the personnel designated to conduct the monitoring activities described in this opinion prior to each monitoring season and confirm their experience through resumes or other evidence of their accomplishments." *Term and Condition #11 (item 8)*

- "If water releases to the mainstem and/or Hilton Creek fail, NMFS will be contacted immediately and Reclamation shall relocate any steelhead that may become stranded to appropriate habitats." *Term and Condition #12 (item 1)*

During the construction phase of implementing the enhancement projects, specific monitoring is to be conducted by the Project Biologist. A description of the best management practices for these construction projects is included in Appendix C. Below are the construction-related reporting requirements *(Term and Condition #8, items 13, 17, 18, and 19*) as quoted from the Biological Opinion (NMFS 2000):

- "Reclamation's fisheries biologist shall contact NMFS fisheries biologist Darren Brumback (562-980-4026) immediately if one or more steelhead are found dead or injured. If Darren Brumback is unavailable Reclamation shall immediately contact NMFS Protected Resources Division at 562-980-4020. If no one at Protected Resources is available, Reclamation shall immediately contact NMFS's Office of Law Enforcement at 562-980-4050. The purpose of the contact shall be to review the activities resulting in take and to determine if additional protective measures are required. Reclamation will need to supply the following information initially: The location of the carcass or injured specimen, and apparent or known cause of injury or death, and any information available regarding when the injury or death likely occurred."

- "provide a written monitoring report to NMFS within 30 working days following completion of any work activity. The report shall include the number of steelhead killed or injured during the work activity and biological monitoring; the number and size of steelhead removed; and photographs taken before, during, and after work activity."

- "provide a written report to NMFS describing the results of the revegetation task within 30 working days following completion of revegetation. The report shall include a description of the locations planted or seeded, the area (m^2) revegetated, a plant palette, planting or seeding methods, proposed methods to monitor and maintain the revegetated area, performance or success criteria, and pre- and post-planting color photographs of the revegetated area."

- "provide a written report to NMFS describing the results of the vegetation monitoring within 30 working days following completion of each fall inspection. The report shall include the color photographs taken of the work area during each inspection and before and after implementation of the work activities, and estimated percent of exposed soil remaining within each area affected by the work."

During predator removal projects associated with fish rescue activities, specific monitoring (see Appendix D, Fish Rescue Section) and reporting requirements (below) have been included by NMFS (*Term and Condition #9, items 1, 3D & 3F*) :

- From the letter cited in the Biological Opinion - NMFS 1998: "The report shall contain descriptions of the following:
    - Specific description of the removal/relocation activities performed.
    - Number of steelhead removed from the project area and the number transferred to each relocation site.
    - Number of steelhead killed or injured during the removal/relocation.
    - Description of any problems encountered during the project or when implementing special conditions.
    - Any effect of the project on steelhead that was not previously considered."

- "Reclamation's fisheries biologist shall contact NMFS fisheries biologist Darren Brumback (562-980-4026) immediately if one or more steelhead are found dead or injured." If Mr. Brumback is unavailable, then follow the same protocol identified under the first bullet under construction.

- "provide a written report to the NMFS within 4 weeks following completion of the proposed action. One report shall be submitted to the NMFS for each year that the project action is implemented. The report shall include the number of steelhead observed, handled (captured, collected, trapped), killed and injured during the proposed action; the estimated size of individual steelhead observed, handled, injured, or killed; a map delineating the location(s) where steelhead were observed or handled; a description of any problem encountered during the project or when implementing terms and conditions; and, any effect of the proposed action on steelhead that was not previously considered."

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 1998. *California Salmonid Stream Habitat Restoration Manual*. Third Edition. State of California, Resources Agency, Department of Fish and Game.

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NMFS. 2000. Biological Opinion. U.S. Bureau of Reclamation Operation and Maintenance of the Cachuma Project on the Santa Ynez River in Santa Barbara County, California. September 11, 2000.

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SYRTAC. 1997a. Proposed Investigations to Determine Fish-Habitat Management Alternatives for the Lower Santa Ynez River, Santa Barbara County. Prepared for the Santa Ynez River Consensus Committee, Santa Barbara, CA.

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SYRTAC. 1998. Data Compilation Report for 1996-1997. Prepared for the Santa Ynez River Consensus Committee, Santa Barbara, CA. Draft report.

SYRTAC. 2000. Data Compilation Report for 1998-1999. Prepared for the Santa Ynez River Consensus Committee, Santa Barbara, CA. Draft report.

APPENDIX I

ATTACHMENT 1

PROPOSED INVESTIGATIONS TO DETERMINE FISH–HABITAT MANAGEMENT ALTERNATIVES for the LOWER SANTA YNEZ RIVER, SANTA BARBARA COUNTY

1997 UPDATE

Prepared by

SANTA YNEZ RIVER TECHNICAL ADVISORY COMMITTEE
BIOLOGY SUBCOMMITTEE

JUNE 1997

PREFACE

The waters of the Santa Ynez River are put to a variety of uses, including the maintenance of public trust resources both within Lake Cachuma and downstream of Bradbury Dam, as well as consumptive urban and agricultural uses within the Santa Ynez Valley and along the coastal plain encompassing the City of Santa Barbara and its urban environs. Since 1993, the U.S. Bureau of Reclamation, California Department of Fish and Game (DFG), U.S. Fish and Wildlife Service (FWS), and various water project operators have been party to a "Memorandum of Understanding (MOU) for Cooperation in Research and Fish Maintenance" on the Santa Ynez River, downstream of Bradbury Dam ("lower river"). Parties to the MOU maintain a Technical Advisory Committee (TAC) whose ultimate goal is to "develop recommendations for long term fishery management, projects and operations" in the lower river.

The TAC was established in response to State Water Resources Control Board (SWRCB) actions dealing with Bradbury Dam and the lower Santa Ynez River that culminated in the SWRCB requesting flow recommendations for maintenance of public trust resources in the lower river. It was also established to broaden the scope of management options potentially available to protect public trust resources within the lower river, to attempt to accommodate the needs of all interested parties, and ultimately develop mutually acceptable management actions. Since 1993, the TAC has worked from year to year to undertake a variety of studies of the lower river. These studies have included: (i) water temperature and dissolved oxygen (DO) monitoring in Lake Cachuma and in the lower river from the stilling basin below Bradbury Dam to the lagoon; (ii) habitat quality evaluations in both the lower river and its tributaries; (iii) flow requirements for fish passage in the lower river; and (iv) fish population surveys in both the lower river and its tributaries (SYRTAC 1994, 1995).

Over time the parties and the SWRCB recognized a need for a longer-term study plan to provide additional technical information to policy makers. In March 1996 the Consensus Committee approved a long-term study plan developed by the TAC Biology Subcommittee (SYRTAC 1996). The plan provides the overall framework for the TAC studies, which are devoted to acquiring technical information regarding:

1. The diversity, abundance, and condition of existing public trust fishery resources within the lower river;

2. Conditions which may limit the diversity, abundance, or condition of public trust fishery resources within the lower river;

3. Non-flow measures which could be expected to improve the conditions that currently act to limit the diversity, abundance, or condition of public trust fishery resources within the lower river; and

4. Alternatives to the existing operational regime of the Cachuma Project which could be expected to improve the conditions that currently act to limit the diversity, abundance, or condition of public trust fishery resources within the lower river.

The studies described herein are designed to develop the information necessary for the TAC to recommend measures that will be considered and evaluated by the Consensus Committee. The Consensus Committee will then recommend specific management measures to the SWRCB for the purpose of achieving a reasonable allocation of Santa Ynez River water between public trust resources and competing consumptive uses consistent with the goals and objectives outlined below.

The 1996 study plan promoted the continuation of some ongoing investigations, cessation of studies that have already provided sufficient information within the context of this plan, addition of investigations required to augment existing information, and implementation of investigations necessary to support the analytical component of this plan's objectives. To assist in the overall planning process and management of the study program, the 1996 MOU required the compilation, synthesis, and analysis of information collected on the fisheries resources and habitat conditions during the 1993-1996 study period, which was presented in the Synthesis Report (SYRTAC 1997).

In light of the Synthesis Report's findings, the Biology Subcommittee organized several technical meetings in early 1997 to further develop and make fine-grained course corrections to the TAC studies. The meetings addressed technical issues of the TAC studies, such as the impact of lack of access to certain areas, development of habitat-flow relationships, protocols for field studies, and identification of potential management actions. This 1997 update of the long-term study plan incorporates the recommendations from these meetings.

As stated above, the ultimate goal of the cooperative effort is to develop management recommendations in preparation for the SWRCB hearing in the year 2000. It is therefore necessary to focus the studies on collecting data that will address environmental issues and aid development and evaluation of alternative management actions. Identification and preliminary assessment of potential management actions is underway in the Management Alternatives Report. This will highlight areas where data are sufficient and other areas where data are inadequate to evaluate the potential biological benefits associated with the management actions. The iterative process of refining and updating the long-term study plan will allow development of specific studies and opportunistic experiments to address these gaps.

GOALS AND OBJECTIVES

STUDY GOAL

The goal of this study is to identify reasonable flow and non-flow measures that will improve habitat conditions for fish populations in the lower Santa Ynez River within the context of overall management objectives and competing demands on the Santa Ynez River.

STUDY OBJECTIVES

The study objectives are to develop technical information concerning:

1. The diversity, abundance, and condition of existing public trust fishery resources of the lower Santa Ynez River;

2. Conditions – habitat quantity and quality, including water quantity and quality – which may limit the diversity, abundance, or condition of public trust fishery resources of the lower river;

3. Non-flow measures which could be undertaken to change existing conditions that act to limit the diversity, abundance, or condition of public trust fishery resources within the lower river; and

4. Alternative flow regimes for the Cachuma Project which could be expected to change the conditions that currently act to limit the diversity, abundance, or condition of public trust fishery resources within the lower river.

MANAGEMENT OBJECTIVES

Identification and evaluation of potential alternative management actions will be based, in part, on the following objectives:

1. Improve habitat conditions to maintain fish populations in good condition;

2. In particular, protect, maintain, and improve habitat conditions for species listed under the State and Federal endangered species acts or identified as California Species of Special Concern;

3. Improve the availability and suitability of stream corridor and channel habitat for a diversity of species of fish and wildlife.

Alternative management recommendations will be developed and evaluated in context with other management objectives for the river. The comparative feasibility of various alternative management actions in achieving these management objectives will be evaluated with respect to the following criteria:

- The proposed management action has a high probability of achieving the desired benefit;

- The management action can be reasonably implemented considering the constraints imposed by natural hydrologic conditions.

GENERAL APPROACH

Several study elements are proposed to obtain data on habitat conditions and fisheries resources in the lower Santa Ynez River. These include describing and monitoring physical habitat and monitoring water quality (temperature and dissolved oxygen) under varying flow

conditions; modeling habitat-flow relationships and water temperature; surveying habitat use by fish; and determining population stock structure of rainbow trout/steelhead.

Habitat and fish use information will be developed using a stratified sampling approach. Strata will be based upon large-scale features, such as gradient, substrate and accretion (reaches), and small-scale geomorphological features (habitat types). The studies of stream habitat fall into three approaches (typing, characterization, and modeling) and two types of data (monitoring and experimental/opportunistic), as depicted in the table below. Habitat typing is important for determining the analytical structure of the TAC studies. Characterization of conditions, both currently existing and under experimental variations, will provide empirical habitat information, which will also be used to supplement modeling efforts.

Approach	**Type and objectives of habitat data**	
	Describing current conditions	Experimental conditions
Typing	Determine habitat units to provide context for habitat sampling units (Job 1)	
Characterization	Monthly habitat monitoring (e.g. depth, width) (Job 3) Temperature monitoring (Job 4)	Field studies of habitat-flow relationships How do conditions change with flow? (opportunistic site-specific observations at different flow conditions) (Jobs 3, 4, 5 and 6)
Modeling		Modeling habitat-flow relationships How do habitats respond to changes in flow? (Job 3)

Habitat conditions and fish use will be monitored in various channel conditions, or habitat types, in each reach under different flow regimes. Different flow regimes could result from natural variation in hydrology, WR 89-18 releases, Fish Reserve Account releases, and potential modifications in routine operations at Bradbury Dam. Flow-habitat modeling sites will be selected from habitat types based upon function. Surveys of habitat availability and fish use (e.g., species composition, diversity, abundance, condition, and reproductive success) will include both the lower Santa Ynez River main stem and major tributaries. Genetic analysis of steelhead/rainbow trout will help determine stock origins of fish from different regions of the lower river basin.

The relationship between habitat quality and quantity and instream flow will be determined by integrating channel conditions and fish use information within the framework provided by a flow-habitat model. The Physical Habitat Simulation model (PHABSIM), developed by the FWS (Bovee 1982), will be used to relate fish use and habitat quantity and quality to flow. The study plan will also monitor and model stream temperature, in addition to monitoring other water quality parameters such as dissolved oxygen that affect habitat quality.

Based upon results of the proposed fisheries and water quality studies , various alternative management strategies can be developed and the associated biological benefits, operational feasibility and constraints, and potential adverse impacts to public trust resources and water supplies of the Santa Ynez River system can be evaluated. Results of these technical studies will provide the necessary foundation for developing a reasonable and balanced management program for the Santa Ynez River.

STUDY PLAN

JOB 1. Stream reach and habitat inventory

OBJECTIVE: To identify major stream reaches and determine distribution, abundance and quality of mesohabitats (e.g., riffles, pools, etc.) throughout the lower Santa Ynez River and selected tributaries.

PURPOSE: This information will be used to systematically subsample habitats within stream reaches for detailed investigation of fish-habitat relationships and to identify habitat quality with the potential for habitat restoration.

PROCEDURES: Two levels of stratification will be used to inventory available habitat throughout the lower main stem and tributaries. The first level consists of determining the major reaches of the main stem with regard to channel morphology. The TAC has already broken down the main stem into three major reaches for the fish passage study conducted in May 1995. These reaches correspond approximately to those described by Shapovalov (1946) with regard to substrate quality and steelhead/trout spawning: mouth to Salsipuedes Creek, Salsipuedes Creek to Solvang, Solvang to Bradbury Dam, with substrate quality increasing from downstream to upstream. Aerial photos will be reviewed, especially for regions where ground access is not available, as in the Highway 154 reach. Each tributary[1] will also be divided into major reaches, e.g. a high-gradient, boulder-controlled upper section vs. a low-gradient, alluvial lower section.

The second level of stratification consists of geomorphic habitat typing. Habitat types will be determined in each reach of the mainstem and selected tributaries. A modified DFG habitat survey methodology (Flosi and Reynolds 1991) will be used where the principal habitat component is mesohabitat, i.e., pool, riffle, run, etc. Habitat typing of the main stem and large tributaries such as Salsipuedes will be done by DFG staff using the aerial photographs taken in April 1995 and November 1996 as well as photos from T.R. Payne's 1992 survey.. Individual habitat units will be numbered from downstream to upstream. DFG staff will ground truth the mainstem during WR 89-18 releases and will train the TAC project biologist in habitat typing methods. The TAC biologist will habitat type the tributaries. While ground truthing selected units, data on habitat attributes will be

[1] Tributaries included for consideration based upon preliminary survey results dealing with flow and other habitat attributes are Alisal, Hilton, Nojoqui, Quiota, Salsipuedes-El Jaro, and San Miguelito creeks.

collected following the instructions in Appendix 1. Potential passage barriers will be identified during the field surveys.

Data from these surveys will be compared with past surveys done by Tom Payne and for the EIR/EIS.

SCHEDULE: Habitat typing of the main stem from photographs, and ground truthing of selected units in the mainstem and selected tributaries, will be done during June-July 1997.

JOB 2. Habitat function as reflected by fish use

OBJECTIVE: Identify species abundance, diversity and spatial and temporal distribution, and the potential function of available habitats within the mainstem Santa Ynez River and its tributaries with regard to spawning, rearing, and migration.

PURPOSE: This information will be used to evaluate the habitat representation of the transects for modeling flow-habitat relationships (PHABSIM) and determine habitat condition including potential for restoration. The migration component will also determine influences of flow and habitat condition on fish movement. Results of these surveys will also provide data on the species composition, abundance reproductive success and condition of the fish populations inhabiting the Santa Ynez River downstream of Bradbury Dam.

PROCEDURES AND SCHEDULES: A table of random numbers will be used to select four pools, and a minimum of three riffles and three runs, from each reach. These units will be sampled systematically to assess their function as spawning and rearing habitat.

Spawning

Selected habitat units in the mainstem and selected reaches in the tributaries will be monitored once every two weeks from December through May, when flow conditions provide for migration and spawning. Key tributaries for sampling include Salsipuedes, El Jaro, San Miguelito, and Hilton Creeks, and possibly Alisal and Quiota Creeks if access is granted. During wet years when the extent of potential spawning habitat is greater, it may be necessary to subsample in the tributaries. Units will be checked for spawner use/non-use by looking for spawning activity or recently constructed redds. The location of redds will be marked with rebar and flagging. Water depth and average column velocity will be measured at three locations over undisturbed gravel adjacent to the redd**.**

Rearing

Monthly snorkel surveys to assess distribution and abundance of fish were conducted in the mainstem from August 1995 to September 1996. The Biology Subcommittee recommended continuing the surveys, but at a lower level of effort.Abundance estimates will be made for each fish species in each unit twice a year: once in June when young-of-the year fish are available and once in October after the

period of low summer flows, high temperatures and potentially low DO. This will be done each year to census relative abundance of fish in the system.

Abundance estimates in pools and runs will be made by direct observation (Helfman 1983), when appropriate. Each unit will be traversed by snorkeling at least twice with a minimum of two observers. Each observer will be assigned a "sample lane," the width of which is dependent on water clarity. Lane width will be determined using the "fish-on-a-stick" method. A 10 cm long facsimile of a fish will be attached to the end of a stick and gradually moved away from the underwater observer until the fish disappears. The distance from the observer to the point where the fish reappears is the maximum lane width. Lane width can be narrower than the maximum if the total habitat unit width is less than the sum of the designated lanes; i.e. (no. observers * maximum lane width) < (total habitat unit width). Observers maintain proper lane width and traverse the habitat, from downstream to upstream, counting fish by species and estimating actual size, within their respective lanes. At least two passes will be made with a short (30 minute) interval between passes.

The following data will be collected: date; time; reach; habitat number and type; specific location; no. of each species by size class, by pass, and by lane; length of habitat sampled; lane width, maximum lane width (fish-on-a-stick distance), and number of lanes; and duration of each pass.

Lagoon Trapping

The lagoon may provide rearing and refuge habitat for steelhead. Passive traps (e.g. hoop nets) will be deployed in three different seasons to sample for steelhead. Six traps will be deployed throughout the lagoon to assess the presence of juvenile and adult rainbow trout/steelhead. The general principle is that fish swimming in the lagoon will encounter vertical panels (lead net or wing nets) that will cause the fish to turn and swim along the net. The fish will be directed to the mouth of the trap and funneled through a small opening into the hoop net section of the trap. The hoop net section has a series of small openings that allow the fish to enter but make it difficult for the fish to find their way back out. Once past the small openings in the hoop nets, the captured fish swim freely within the back holding area of the hoop net portion of the trap until they are removed.

The three traps will be deployed three times during the year for one-week periods. Trapping will occur during the following seasons:

1. Winter shortly after the lagoon mouth is breached (December or January)

2. Spring when juveniles migrate downstream (April-May)

3. Fall after the summer rearing period (September-October)

The traps will be distributed throughout the lagoon. Trap placement may be adjusted in seasons when directional movement by steelhead could be expected. For example, two traps may be placed side by side in the upper end of the lagoon,

approximately 0.5 miles upstream of the 35th Street bridge. At this location, one trap would face upstream and the other trap would face downstream. The side panels would form a barrier across a majority of the width of the lagoon to ensure capture of fish moving upstream and downstream.

The traps will be checked on a daily basis during each of the trapping periods. Checking of the traps will involve lifting up and opening the end portion of the hoop net. After removal of the captured fish, the end portion of the trap will be lowered back into the lagoon. All fish captured will be identified. The fish will be held in buckets of water filled from the lagoon awaiting data collection. Data collected for rainbow trout/steelhead will include fork length (mm), weight, description of appearance, scale and tissue samples. All fish will be released back into the lagoon. Life stage will be classified using the following criteria. *Fry* are newly-emerged fish, typically with at least a vestige of their yolk sac ("unzipped" or not "buttoned up"). *Parr* are darkly pigmented fish with characteristic oval- to round-shaped parr marks on their sides. *Silvery parr* have faded parr marks and a sufficient accumulation of purines in the scales to produce a silvery, but not fully smolted, appearance. *Smolts* have highly faded parr marks, or lack them altogether, a bright silver or nearly white color, and deciduous scales. During November–June, trout will be checked for ripe gonads by applying pressure to the abdomen. If milt or ova are extruded, the corresponding sex of the fish will be recorded. Scales will be collected from all adult trout and processed by TAC biological subcommittee representatives to evaluate life-history traits (e.g., growth, migratory history, etc.). A tissue sample (an approximately 1 cm piece) will be collected from the right pectoral fin, half for genetic analysis and half for the DFG regional biologist to archive.

Migration

Adult and juvenile steelhead/trout movements in relation to flow conditions will be monitored at key locations throughout the lower river system. Two-way trapping will be conducted on the main stem at a suitable location between the lagoon and Solvang (Alisal Reach); that is, downstream from the predicted primary spawning area. Additional opportunities for deploying another mainstem trap will be investigated. Two-way trapping will also be conducted in Hilton, Salsipuedes, El Jaro, Alisal, Nojoqui, Quiota, San Miguelito, and Alamo Pintado creeks, depending on stream flows and access to property.

Trap deployment in the mainstem and tributaries begins with the onset of the winter storm season. The first few storms typically do not create much runoff, but simply "charge up" the water shed. Once the watershed is charged, runoff from storms can be very flashy (i.e. high flows but short duration). Due to these flashy flows, both upstream and downstream migrant traps will be removed from the stream prior to or during the onset of rain to prevent loss of traps in high flows. Traps will be redeployed immediately following peak flow events. Traps will be installed before 1 January so that the start of both adult immigration and juvenile emigration will be bracketed. Tributaries will continue to be trapped into summer until trout movements cease. A staff gage will be installed near each tributary trap, and discharge will be measured at various flow levels to develop a standard curve. The mainstem trap will be maintained for as long as flow is

continuous to monitor trout movement during the rainy season, and WR 89-18 and experimental Fish Account releases.

The mainstem and tributary traps will be checked once or twice daily, depending on debris load and weather conditions. Field personnel first check the contents of the trap for any fish. If no migrants are captured, personnel will remove debris from the trap and panels to prevent accumulation of debris. Traps will be inspected for scour points and "holes," which will be repaired or plugged.

The following data will be collected each time a trap is checked: trap name or number; starting and ending date and time of trapping; staff gage elevation; and estimated proportion of flow fished by the trap. Each rainbow trout/steelhead captured will be PIT tagged (tagging protocol is under review). PIT tagging will facilitate study of fish movements throughout the lower basin. Personnel will record the fork length, weight, appearance, and sex. Each trout will be classified by life stage, using the following criteria. *Fry* are newly-emerged fish, typically with at least a vestige of their yolk sac ("unzipped" or not "buttoned up"). *Parr* are darkly pigmented fish with characteristic oval- to round-shaped parr marks on their sides. *Silvery parr* have faded parr marks and a sufficient accumulation of purines in the scales to produce a silvery, but not fully smolted, appearance. *Smolts* have highly faded parr marks, or lack them altogether, a bright silver or nearly white color, and deciduous scales. During November–June, trout will be checked for ripe gonads by applying pressure to the abdomen. If milt or ova are extruded, the corresponding sex of the fish will be recorded. . Scales will be collected from all adult trout and processed by TAC biological subcommittee representatives to evaluate life-history traits (e.g., growth, migratory history, etc.). A tissue sample (an approximately 1 cm piece) will be collected from the right pectoral fin, half for genetic analysis and half for the DFG regional biologist to archive. For any other captured fish species (e.g. largemouth bass, sculpin, etc.), fork length and weight will be recorded.

JOB 3. Habitat-flow relationships for spawning, rearing, and migration

OBJECTIVE: Determine the relationship between stream flow and habitat quality and quantity for each fish species life-stage function, using modeling and empirical data.

PURPOSE: Results of this model will be combined with empirical information on habitat use to develop stream-flow versus habitat availability relationships. These relationships will provide the basis for determining flow requirements for various species-life stages and eventually an important analytical tool for evaluating various management actions, including associated flow regimes and habitat restoration.

PROCEDURES: Survey transects will be established in each habitat unit for modeling flow-habitat relationships using PHABSIM (Bovee 1982). Data will be collected for model building at representative spawning and rearing habitat units under low, moderate, and high flow conditions. Data regarding fish passage were collected at two flow levels during May and June 1995. The same protocol for data collection used at the passage study sites will be used at the spawning and rearing units.

Fish Passage

Modeling and field observations will be used to determine the location of critical passage reaches and to evaluate passage conditions as a function of flow in the mainstem. Transect selection and stage and velocity versus discharge data collection to evaluate fish passage conditions were begun in May 1995 at several sites in the main stem where barriers to fish passage likely develop under low-flow conditions. Sites were selected from the aerial photographs taken in April 1995. DFG models will be used for passage analysis in the mainstem, incorporating reach-specific flow data and existing barrier survey data. The data decks will be run and stage-discharge relationships will be verified. Thompson criteria will be applied to the models. Sensitivity of passage to depth criteria will be analyzed for 0.4, 0.5 and 0.6 feet. For the tributaries, habitat surveys will be used to identify potential barriers (Job 1).

PHABSIM

Existing PHABSIM analysis (199 DWR) will be redone using re-evaluation of habitat mapping data, reach-specific hydrology, and Southern California Steelhead Habitat Suitability Criteria. Available hydraulic conditions will be simulated as a function of flow using existing hydraulic models. Hydrology data will be used to identify reach-specific flows, given a specific release at the dam, on a monthly time step.

Development of suitability criteria for southern steelhead will be included within the framework of examining habitat-flow relationships. Suitability criteria may be developed by reviewing published criteria for other streams, requesting input from qualified personnel, conducting a workshop with steelhead experts, and by reaching consensus within the TAC. The workshop participants will review existing steelhead suitability criteria (suitability curves on velocity, depth and substrate for each lifestage), make suggestions to modify the curves based on professional judgment, and agree on final suitability index curves for use in the Santa Ynez River.

SCHEDULE: These data collections will occur opportunistically during the ensuing study period as flow conditions allow. The southern steelhead habitat-suitability workshop will be scheduled in fall 1997. The PHABSIM model will be rerun in winter 1997-1998.

JOB 4. Temperature modeling and dissolved oxygen (DO) monitoring

OBJECTIVE: Model the relationship between temperature and stream flow, channel conditions, and other manageable influences on water temperature. Determine the seasonal and geographical distribution of water temperature and DO for various fish species life stages. Identify portions of the Santa Ynez River that would have suitable water temperatures for steelhead/rainbow trout under alternative flow management options.

DO monitoring will address three specific problem areas: seasonal DO depressions that may affect the quality of fish habitat in the main stem of the lower river; the extent of

diel DO depressions in refuge pool habitat; and DO profiles in Cachuma Reservoir that may affect downstream resources through flow releases.

PURPOSE: This information will be used to evaluate various management actions on the temperature and DO conditions within the lower river. Influences of flow regime and habitat/channel restoration will be evaluated relative to achieving water temperature and DO criteria.

PROCEDURES: Studies of water temperature and DO will include monitoring of current conditions, experimental or opportunistic observations of water quality at different times or flows, and modeling of stream temperature.

Temperature and DO Monitoring

Continuous temperature monitoring (Optic Stowaway temperature monitoring units) will be continued at a core group of monitoring locations in the mainstem (7 stations), lagoon (2), Hilton Creek (1), Salsipuedes Creek (2), El Jaro Creek (1), Nojoqui Creek (1), and San Miguelito Creek (1). The thermograph units will be serviced and data downloaded on a monthly basis to avoid data loss from mechanical malfunctions and vandalism. Other monitoring sites may be added as necessary.

Seasonal vertical profiles will be conducted in Lake Cachuma (temperature and DO) and the lagoon (temperature, DO, and salinity). Measurements will be taken at one-foot intervals. Air temperature will be monitored at several locations for use with the temperature model (locations to be determined).

Diel fluctuations in DO

Surveys will be conducted to identify diel fluctuations in DO and to assess the extent to which DO concentrations may be limiting refuge habitat. The abundant algae in the Santa Ynez River can contribute to substantial diel variation in DO concentrations. During the day algal photosynthesis can saturate the water with DO, while during the night algal metabolism and animal respiration can deplete DO. Surveys will occur monthly during the late spring through early fall, when algal growth is high. The vertical profile of DO and temperature will be measured using one-foot depth intervals in the pools during the pre-dawn period and in the late afternoon. Measurements will be made from at least six sites (e.g. Long Pool, Refugio X at mile 3.4, Alisal 7.9, Alisal 9.5, Buellton 13.9) between Bradbury Dam and Buellton, in three habitat units (one each pool, run, riffle) per site (except the Long Pool), including habitat units with and without cool water upwelling.

Temperature Modeling

The SSTEMP model developed for the EIR/EIS will be used to integrate flow, channel geometry, and various other, manageable influences on temperature with meteorological conditions in order to identify portions of the Santa Ynez River that would have suitable temperatures for and evaluate potential temperature management actions. The model will be updated with new data (hydrology, climate, stream temperature) when

they become available. Additional data for use in the model will be obtained from aerial photos taken at various flows (top width), and the 1996 riparian study (shading). The model will be verified with new stream temperature monitoring data.

SCHEDULE: Water temperature monitoring will be maintained in the main stem and tributaries on a continuous basis, with monthly visits to the stations to download data. Vertical profiles of Lake Cachuma and the lagoon will be measured approximately quarterly. Surveys of diel fluctuations in DO will occur monthly during the period of algal production (late spring through early fall). Experimental studies of water quality will occur opportunistically depending on flows and releases.

JOB 5. Tributary-main stem relationships

OBJECTIVE: Determine habitat use including quantity and quality in tributaries relative to dynamics of the fish populations within the lower river.

PURPOSE: This information will be used to assess the degree to which individual tributaries function as independent steelhead/trout rearing habitats by answering the following questions: Do steelhead/trout spawned in tributaries that typically dry up have a tendency to "escape" to the main stem as stream flow decreases and water temperature increases seasonally (see Erman and Leidy 1975)? Conversely, do those spawned in perennial tributaries remain there to rear until ready to emigrate? Can any significant benefit be gained from flow augmentation in tributaries, such as that proposed for Hilton Creek? How would habitat management activities in the tributaries influence overall management of the lower Santa Ynez River system including influences on flow and other potential modifications in the lower river?

PROCEDURES: Habitat potential in the tributaries will be identified during habitat surveys described in Job 1, including passage barriers, rearing habitat, and potential opportunities for improvements (structural or land use).

The activities described in Job 2 will provide the data necessary to evaluate the habitat use in the tributaries. Trapping and tagging will detect the movement of spawners in the stream. Redd monitoring in selected habitat units will determine the location of spawning activity. Snorkeling in the selected habitat units will provide abundance estimates on fry and parr over time as stream flow and water temperature change. Trapping will determine the magnitude and timing of emigration in relation to streamflow and temperature changes. Flow-habitat evaluations in Hilton Creek, the only tributary that can receive flow augmentation, would be evaluated.

SCHEDULE: See schedules under Job 2.

JOB 6. Verification of habitat-flow relationships

OBJECTIVE: Verify streamflow relationships developed in Jobs 3 and 4.

PURPOSE: Determine if the streamflow versus habitat availability/use relationships based upon consideration of flow ranges (Jobs 3) and temperature conditions (Job 4) accurately predict the response in habitat conditions/use.

PROCEDURES: Seasonal, WR 89-18, and Fish Reserve Account releases from Bradbury Dam will be used to empirically verify flow versus habitat relationships identified for target fish species/life stages. Special study elements will be added if needed to answer specific questions.

Reach-specific flows will be determined during releases from Bradbury Dam. Habitat data will be collected at low and intermediate flows (between 5 and 35 cfs) to compare with existing data at higher and lower flows. Observers will record when various reaches of the river go dry during the summer.

In reaches where ground access is not available, existing aerial photos will be reviewed to identify surface area of different habitat types (1994 @ 140 cfs and 1996 @ 50 cfs). Additional aerial photos will be obtained at lower flows (less than 50 cfs). Habitat conditions in these inaccessible regions will be examined using data from the T. Payne/DWR study and the 1996 Jones & Stokes riparian study.

Habitat measures

Habitat units for study will be selected using the geomorphic habitat data (aerial photo analysis from Job 1) to subsample units from the snorkel survey sites. A fixed reference point will be established at each habitat unit with a staff gage so measurements at different times (= flows) would be at the same place. Some features that are fairly stable over time, barring flood flows (canopy cover, bank composition, and substrate, unit length) will only be measured once in a water year. Pebble counts should be used to estimate substrate composition. Other habitat features that vary with flow (depth, top width, velocity percent unit cover) will be measured during each survey at different flows. Ten fixed transects will be distributed uniformly along the unit's length, including transects at the upper and lower boundaries. During each flow condition, measurements will include (1) velocity in the thalweg for each transect, (2) five depth measurements across the transect, and (3) assessment of percent cover for the entire habitat unit.

Algae flushing

Dense algal growth during the late spring to fall can negatively impact water quality (e.g. low dissolved oxygen (DO) at night). Flows to flush algae from the upper mainstem reaches to Solvang will be tested during the summer. Several pools with low DO (vertical profile measured before dawn) will be selected between the Dam and Solvang. DO (pre-dawn vertical profile) and percent algal cover will be measured prior to the experimental release. The exact amount and duration of release(s) will be determined for each study, but will likely range from 10-30 cfs (as measured by releases at Bradbury), raised at increments of 5 cfs. At each study pool, flow and percent algae cover will be measured for each release level. Once flushing is complete, experimental releases will be

ramped down (5 cfs/day) to baseflow. After a three day equalization period flow, DO, and percent algal cover will be measured again. The final ramp-down and post-release measurements may not occur if the study is immediately followed by the WR 89-18 release.

SCHEDULE: Flow-habitat conditions will be evaluated as soon as practicable after completion of PHABSIM modeling. Flow-specific habitat measures to be recorded prior to or during ascending limb of WR 89-18 releases (summer 1997 and possibly summer 1998) or opportunistically during other releases. Algae flushing studies will be conducted in summer 1997 and possibly repeated in summer or fall 1998.

JOB 7. Molecular genetic analysis of steelhead/rainbow trout

OBJECTIVE: Conduct molecular genetic analysis of tissue samples from rainbow trout/steelhead collected in Job 2.

PURPOSE: Examine the population structure and stock origins of rainbow trout/ steelhead in the lower Santa Ynez River and tributaries.

PROCEDURES: Tissue samples will be collected for genetic analysis from adult rainbow trout/steelhead collected in the upstream trapping program, from juvenile rainbow trout/steelhead collected during downstream migration trapping and lagoon trapping, and during other opportunities (e.g. fish rescue operations). An approximately 1 cm piece of tissue will be taken from the right pectoral fin and air dried. Half of the sample will be used for genetic analysis and half will be given to the DFG regional biologist to archive. Samples will be delivered periodically to Dr. Jennifer Nielsen at the Hopkins Marine Station. If subsampling is necessary, characteristics such as year and month when collected, location, size class, and physical appearance (e.g. clubbed fins suggestive of hatchery origin) will be considered to ensure a comprehensive analysis.

Genetic analysis will be conducted by Dr. Nielsen. The tests will examine the variability of mitochondrial DNA (mtDNA) and microsatellites. Mitochondrial DNA has been used in previous studies of steelhead/rainbow trout from the upper Santa Ynez River above Juncal Dam, Hilton Creek and Salsipuedes Creek. NMFS is also using mtDNA in their status review of steelhead to differentiate distinct population segments or "Evolutionarily Significant Units" (ESUs). Microsatellite analysis will also be conducted to improve resolution of the stock assessment. Genetic data from fish collected during the TAC studies will be compared with previous data from the Santa Ynez River and other rivers (Nielsen et al. 1994).

SCHEDULE: Tissue sampling will occur opportunistically during migrant trapping (approximately January-June) and other activities (e.g. trapping in the lagoon). Analysis of the preserved tissue samples will conducted in summer 1997.

JOB 8. Coordination and collaboration with other study activities

OBJECTIVE: Coordinate TAC studies with other investigations being conducted in the Santa Ynez River watershed, and to incorporate, as appropriate, pertinent data and results.

PURPOSE: Through coordination, eliminate redundancy in efforts, and through collaboration, attain results beyond the scope of the TAC study plan alone.

PROCEDURES: TAC members will gather information on other study activities being conducted in the Santa Ynez River watershed. Study objectives and methods will be compared with those of the TAC's study plan to identify potential duplication of effort or sources of supplemental information. For example, riparian vegetation monitoring along the lower river (mandated in the SWRCB's Water Right Order WR 94-5) may include a habitat mapping element that may overlap or complement that specified in this plan.

Further, the TAC and FWS biologists implementing field data collection will be available to collaborate in activities, with TAC approval, outside the scope of the long term study plan, but which may produce a result of mutual benefit to both TAC study objectives and those of the external agency. Examples are conducting whole or tissue collections of fish for genetics work, such as that being conducted by the Federal government in connection with the steelhead listing process; and DFG-directed management activities in the lower river, such as fish rescues.

SCHEDULE: These activities will be scheduled as they arise.

JOB 9. Annual reporting and evaluation

OBJECTIVE: Summarize and report study results, evaluate study plan implementation, and revise the study plan as needed.

PURPOSE: To keep information development up-to-date, and to provide the opportunity to make midterm evaluations and adjustments to the study plan, as necessary.

PROCEDURES: Each year, the TAC biologist will prepare a draft report that will summarize the results of the year's work. The draft report will undergo TAC review and comments will be incorporated to produce a final annual report. This review process will provide the TAC an opportunity to evaluate the efficacy of study elements in achieving their desired objectives, and to amend the study plan as needed in an attempt to improve or modify future studies.

SCHEDULE: The draft annual report will be due by 1 October of each study year, and review completed by 1 November. The final annual report and proposed changes to the study plan will be due by 1 December.

JOB 10. Management action analysis

OBJECTIVE: Analyze the various, potential management actions relative to meeting the goals and objectives defined in this proposal and develop a technically-based management

recommendation in the context of the evaluation criteria discussed above for consideration by the TAC.

PURPOSE: To summarize through analysis the results of the proposed study in the form of a range of potential management actions for fish populations within the lower Santa Ynez River system.

PROCEDURES: Analytical tools developed to evaluate habitat quantity and quality versus flow, and non-flow habitat, and temperature modifications will be used to identify various alternative management actions and predicted influences (both negative and positive) on fish habitat needs and other uses of the lower Santa Ynez River system. Various scenarios will be contemplated for optimizing fish habitat, including steelhead/trout restoration in the lower river and its tributaries, implementation of non-flow habitat improvements, tributary flow and non-flow habitat based improvements, minimal changes intended only to accommodate existing fish populations in the lower river and the maintenance of a steelhead/trout population in tributaries and the system upstream of Bradbury Dam, and no-action.

Identification of a range of potential management actions and preliminary assessment of biological benefits, operational constraints, and feasibility will be presented in the Management Alternatives report, which will also assess data needs for final evaluation of actions and thus guide refinement of the long-term study plan. This report will form the basis for the final synthesis report to the Consensus Committee in 1999. The final synthesis report detailing the approach and information used to identify a recommended management action will be completed through iterative review by the biological subcommittee and the TAC.

SCHEDULE: The Management Alternatives report will be prepared in summer 1997. The final synthesis report will be completed before the end of 1999.

SUMMARY SCHEDULE FOR LONG-TERM STUDY PLAN

Job	Activity	Schedule	Investigator
Job 1: Habitat inventory	Habitat typing main stem	May-July 1997	DFG, TAC and FWS scientists
	Ground truthing main stem	June-July 1997	DFG, TAC and FWS scientists
	Habitat typing tributaries	June-July 1997	DFG, TAC and FWS scientists
Job 2: Habitat function	Redd survey	Every two weeks Feb 1996–May 1996, Dec 1996–May 1997, Dec 1997–May 1998	TAC and FWS biologists
	Juvenile rearing survey	Monthly, May-Aug 1996 Twice yearly: June & Oct 97-99	TAC and FWS biologists
	Main stem trapping	Daily Dec-May 1996-99	TAC and FWS biologists
	Tributary trapping	Daily Jan-June 1996-99	TAC and FWS biologists
Job 3: Habitat-flow relationships	Data collection for PHABSIM	Opportunistically with suitable flows	TAC and FWS biologists
	PHABSIM modeling	TBA following data collection	DFG, TAC and FWS biologists
Job 4: Temperature and DO work			
	Further data collection	Continuously thru summer 1999	TAC and FWS biologists, Hanson Environmental
	Temp modeling	TBA	TBA
Job 5: Trib-mainstem relationships	Adult trapping, redd monitoring, juvenile surveys, emigrant trapping	See Job 2	See Job 2
Job 6: Flow verification	Water releases, Job 2 activities	Opportunistically, following development of recommended flows	TAC
Job 7: Coordination and collaboration	Coordinating with other study activities in SYR	Ongoing, as information becomes available	TAC, TAC and FWS biologists
Job 8: Genetic analysis	Collect tissue samples for analysis	Opportunistically with migrant trapping	TAC and FWS biologists
	Conduct molecular genetic analysis	Summer 1997	Dr. J. Nielsen
Job 9: Annual reporting	Reporting and evaluating each year's work	Final report and study plan changes due by 1 Dec 96–98	TAC and FWS biologists, TAC Biology Subcomm.
Job 10 - Management action analysis	Preliminary identification and assessment of potential actions	Management Alternatives Report summer 1997	TAC
	Final data synthesis, reporting, and analysis of management actions	Before the end of 1999 (exact date yet to be established)	TAC

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