Appendix K

Draft Habitat Monitoring Plan

(Initial Draft Scope of Work From Anadromous Fish Restoration Program Website, June 2001)

SCOPE OF WORK

MERCED RIVER SALMON RESTORATION ACTION
Robinson Restoration Site Pre/Post Habitat Monitoring

1. Scope of the Project

The proposed project is to quantify features of fall-run Chinook salmon spawning and rearing habitat, before and after restoration, in the Robinson restoration project, located at RM 42-43.5 on the Merced River. The primary fishery objective of the project is to evaluate whether the Robinson restoration project on the Merced River increases spawning habitat (and thus potentially increases spawning success) and rearing habitat (and thus potentially increases juvenile survival) as measured and quantified by the method described in this Statement of Work. The tasks comprising this project are: 1) project management; 2) field reconnaissance and site selection; 3) hydraulic data collection; 4) construction and calibration of hydraulic and habitat simulation models; and 5) biological validation of the habitat simulation model. The latter four tasks will be conducted both before and after restoration of the Robinson project. Analytical procedures will involve the application of a two-dimensional hydraulic and habitat simulation model (River2D, Steffler 1999). The deliverable for this project will be a final report comparing the amount of spawning and rearing habitat present, over the range of flows of 100 to 2500 cfs, before and after restoration. Pre-restoration activities will be conducted in FY-2000, while post-restoration activities will be conducted in FY-2001 or 2002, depending on the schedule for restoration, and after the first and second channel-forming flow events (greater than 5000 cfs).

2. Justification and Benefits of the Project

Project benefits will target the Merced River fall-run Chinook salmon. The primary fishery objective of the project is to evaluate whether restoration projects produce increased spawning and rearing habitat.

Specific project biological/ecological objectives/benefits are:

Primary Project Objectives/Benefits

- Increase spawning success through increased spawning habitat associated with habitat restoration
- Increase juvenile survival through increased rearing habitat associated with habitat restoration

Project objectives address the following:

Primary Ecosystem Restoration Stressors:

- Identified Stressor #1 - Channel Form Changes
  Alterations of channel form have resulted in declines in spawning and rearing habitat in the Merced River. The proposed study will evaluate the extent to which the Robinson Restoration Project reverses this decline.

Millions of dollars are being spent on large-scale channel restoration projects throughout the Central Valley. One emphasis of these activities is to improve spawning and rearing habitat conditions for salmon and steelhead. No one monitoring tool can definitively document the benefits of these efforts. Usually numerous monitoring tools over varied time scales are required to evaluate efficacy of restoration activities. This monitoring activity will help identify and quantify the level of physical habitat improvement for chinook salmon over a range of flow conditions and after a series of channel adjustments. This effort will infer changes in chinook salmon habitat by predicting physical habitat quality based on several resource axes. These include water depth, velocity, adjacent velocity, cover and substrate. We will statistically test the strength of this inference thorough comparing predictions about high quality habitat to that which fish actually use for spawning and rearing. A potential benefit of testing this tool to evaluate habitat changes and fish use is that of economy. Being able to make predictions about quantity and location of “habitat” over a large flow range provides potential large savings in time and money associated with documenting beneficial results of channel restoration activities. Measures used to validate these predictions will help evaluate the potential future utility of the application on a larger scale.

The use of this two-dimensional model will be in addition to more standard fish monitoring metrics such as indices of salmon production and survival from and through the project site, both before and after restoration. Geomorphic and floodplain and riparian metrics will also be monitored as part of the project to help assess overall benefits of the restoration. All other monitoring elements are funded by CALFED and will be implemented by both the Department of Fish and Game and Water Resources.

3. Monitoring and Data Evaluation

The entire extent of this project is monitoring and evaluation of the Robinson restoration project. The monitoring and evaluation is to achieve the project objective and benefits, i.e. evaluating whether the Robinson restoration project has increased spawning and rearing habitat for fall-run chinook salmon. The main hypothesis to be tested by this project is that restoration activities will increase the amount of spawning and rearing habitat for Chinook salmon in the Merced River. There is a high potential for coordination with other monitoring and evaluation activities, such as geomorphology and monitoring of habitat use, of the Robinson restoration project. The monitoring

should also be useful in evaluating whether restoration projects alter the flow needs for Chinook salmon in the Merced River. It is anticipated that the results of this project will be incorporated into a manuscript to be submitted for publication in a peer-reviewed scientific journal.

4. Work to Be Performed and Deliverables by Task/Phase

Listed below are the tasks needed to fully complete the Robinson Restoration Site Pre/Post Habitat Monitoring Project. The general work to be completed is as follows:

OVERALL PROJECT TASKS

 Indicates a deliverable.

1. Project Management (Initiated)
   Overall project management and administration including overseeing project coordination meetings, managing project finances (budgets, contracts, etc.), and preparing project progress reports.

    Annual Progress Reports will be submitted covering work completed, future work, and financial aspects.

2. Modeling of Spawning and Rearing Habitat in Restoration Site Prior to Restoration Actions

   2.1 Field Reconnaissance and Study Site Selection
   Three to four study sites will be selected in the Robinson restoration area. The sites will be made as large as possible, consistent with the density of points needed to represent the variability within each site. The sites will be selected to include all of the mesohabitat types present in the restoration area. To the extent possible, sites will be selected so that pre and post-restoration measurements are taken at the same general locations. A small team of technical advisors will be used to assist in selecting study sites.

   2.2 Hydraulic Data Collection
   Data will be collected on water surface elevations, bed topography, cover and substrate distribution for input into a 2-dimensional hydraulic and habitat model. Water surface elevations will be taken at three flows (probably around 200, 400 and 1000 cfs). Bed topography data will be collected using a total station at a low flow by a series of lines across the channel and extending far enough onto the floodplain to include the entire area which would be inundated at 2500 cfs. Each line will include a point

at each change in bed slope, substrate or cover. The lines will be spaced close enough so that bed slope, substrate and cover uniformly change between the lines. The bed elevation and horizontal location of each point will be determined using a total station, and the substrate and cover of each point will be recorded. An independent dataset of 50 random points will be collected for each site, to validate the physical predictions of the model. The bed elevation and horizontal location of each validation point will be determined using a total station, the depth and velocity at each validation point will be measured, and the substrate and cover at each point will be recorded. If possible within the existing budget and the duration of flows, validation points will be collected at three flows.

2.3 Construction and Calibration of hydraulic and habitat simulation models. The data from Task 2.2 will be used in a 2-dimensional hydraulic model (River2D, Steffler 1999) to predict the velocities and depths present in the study sites over the range of flows of 100 to 2500 cfs[1]. The topographic data will first be processed using the R2D_Bed software (Steffler, 1999), where breaklines are added to produce a smooth bed topography. The resulting dataset will then be converted into a computational mesh using the R2D_Mesh software (Steffler 1999), with mesh elements sized to reduce the error in bed elevations resulting from the mesh-generating process to 0.1 feet where possible, given the computational constraints on the number of nodes. The resulting mesh is used in River2_D to simulate depths and velocities at the flows to be simulated.

A PHABSIM transect at the bottom of the site will be calibrated to provide the water surface elevations at the bottom of the site used by River2D. A second PHABSIM transect at the top of the site will be calibrated to provide the water surface elevations used to calibrate the River2D model.

The initial bed roughnesses used by River2D will be based on the observed substrate sizes and cover types. A multiplier will be applied to the resulting bed roughnesses, with the value of the multiplier adjusted so that the water surface elevations generated by River2D at the top of the site match the water surface elevations predicted by the PHABSIM transect at the top of the site[2]. The River2D model will be run at the flow at which the validation dataset was collected, with the output used in GIS to determine the difference between simulated and measured velocities,

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[1]Discharges will be modeled under steady-state conditions. The Robinson restoration area does not include any areas with supercritical flow.

[2]This will be the primary technique used to calibrate the River2D model.

depths, bed elevations, substrate and cover. If significant differences are found, the bed topography will be adjusted to correct the observed errors, and the models will be rerun. The final report will include these differences, how well the model predicts observations before modification of the bed topography, and implications of interpretation based on potential bed topography adjustments.

The depths and velocities simulated by the River2D model, along with the substrate and cover distribution in the site and Habitat Suitability Criteria previously developed on the Merced River or other streams, will be used to predict the amount of spawning and rearing habitat present over a range of discharges in the Robinson restoration site prior to restoration actions. We have sufficient data to use criteria from the Merced River for spawning, but have no data to develop rearing criteria on the Merced River.

2.4 Biological validation of habitat simulation models.

The sites will be snorkeled once with a weighted tag dropped at each location where juvenile chinook salmon are observed. The snorkeler will record the number of juvenile salmon in different size categories and the cover present at the location. After the snorkeling has been completed, bed elevation, horizontal location, depth, and velocity data will be collected at each tag location using the same methods used for the physical validation dataset. The above data will be used to test the hypothesis that the compound suitability predicted by the River2D model is higher at locations where juveniles are present versus locations where juveniles are absent. This hypothesis will be statistically tested with a Mann-Whitney test. This effort will be expanded to sampling at several flows if additional funding is available.

The sites will be waded in early November with the same measurements described above (except that substrate data will collected instead of cover data) taken at each redd location. This data will be used to test the hypothesis that the compound suitability predicted by the River2D model is higher at locations where redds are present versus locations where redds are absent. This hypothesis will be statistically tested with a Mann-Whitney test.

3. Modeling of Spawning and Rearing Habitat in Restoration Site After Restoration Actions

3.1 Field Reconnaissance and Study Site Selection

Three to four study sites will be selected in the Robinson restoration area. To the extent possible, these will be the same sites selected in Task 2.1. However, rerouting of the channel during restoration activities may make it impossible to do so, if the sites selected in Task 2.1 are no longer in the channel. New sites will be made as large as possible, consistent with the density of points needed to represent the variability within each site. The new sites will be selected so that the sites in total include all of the mesohabitat types present in the restoration area.

3.2 Hydraulic Data Collection

Data will be collected on water surface elevations, bed topography, cover and substrate distribution for input into a 2-dimensional hydraulic and habitat model. Data collection will be the same as described in Task 2.2. Data will be collected three times: once following completion of the restoration project and once after each of the first two channel-forming flows (greater than 5000 cfs) after the completion of the restoration project.

3.3 Construction and Calibration of hydraulic and habitat simulation models.

The data from Task 3.2 will be used in a 2-dimensional hydraulic model (River2D, Steffler 1999) to predict the velocities and depths present in the study sites over the range of flows of 100 to 2500 cfs[1]. Model construction and calibration will be the same as described in Task 2.3. This output, along with the substrate and cover distribution in the site and Habitat Suitability Criteria previously developed on the Merced River or other streams, will be used to predict the amount of spawning and rearing habitat present over a range of discharges in the Robinson restoration site after restoration actions are complete. The modeling will be conducted three times: once following completion of the restoration project and once after each of the first two channel-forming flows (greater than 5000 cfs) after the completion of the restoration project.

3.4 Biological validation of habitat simulation models.

The sites will be snorkeled once (after completion of the restoration construction) with a weighted tag dropped at each location where juvenile chinook salmon are observed. The snorkeler will record the number of juvenile salmon in different size categories and the cover present at the location. After the snorkeling has been completed, bed elevation, horizontal location, depth, and velocity data will be collected at each tag location using the same methods used for the physical validation dataset.

The above data will be used to test the hypothesis that the compound suitability predicted by the River2D model is higher at locations where juveniles are present versus locations where juveniles are absent. This hypothesis will be statistically tested with a Mann-Whitney test. This effort will be expanded to sampling at several flows if additional funding is available.

The sites will be waded (after completion of the restoration construction) in early November with the same measurements described above (except that substrate data will collected instead of cover data) taken at each redd location. This data will be used to test the hypothesis that the compound suitability predicted by the River2D model is higher at locations where redds are present versus locations where redds are absent. This hypothesis will be statistically tested with a Mann-Whitney test.

- Final Report, comparing the amount of rearing and spawning habitat present in the Robinson restoration area before and after restoration actions over a range of discharges, and giving results of biological validation.