PRELIMINARY STUDY PLAN for Hood-Mokelumne Channel (5/16)

Possible Elements of Fish Facilities and Fisheries Study Plan

This phase of the evaluations would start by gathering some basic technical input which would be sufficient to make some policy decisions about the basic features of the Hood facility and the operating criteria to be met. This could narrow the studies considerably in relation to those described below. The studies described below maybe broader studies than necessary or possible to achieve within the allotted time. The deadline for this element of the program should be 6 (3?) months after management approval of the program.

A fully developed North Delta diversion facility could include a fish screen, upstream fish passage facilities (locks, ladders, screen openings, etc.), fish bypass facilities (including fish lifts), fish return facilities, channel diversion pumps, and various configurations of control structures to control the volume of water entering the conveyance channel. The operating rules for these facilities would depend on the requirements for both upstream and downstream migrating fish, and on their impacts on habitat shifts resulting from increased flows in the eastern Delta on Delta species. (*Is the latter premise valid? Increased flows will undoubtedly cause some ecological changes, but the changes are likely to be impossible to predict and perhaps even to measure. Are there any hypothesized changes likely to be significant enough to warrant this concern?)*

In general, initial assessments and studies would include modeling and analyzing the impacts of a various configured diversions. Much of the evaluation will draw from information either already being gathered (or that will be underway shortly). An initial step in the program will be inventorying existing programs and identifying such links. These and other efforts are described below.

Specific Facility Components and Fishery Issues

To develop adequate studies and evaluations, we must first identify the criteria to be used and the range of proposed facilities or features we are considering. Any proposed facility would have to be designed with the following criteria in mind:

- Survival goals for juvenile fish and criteria to achieve the goals(including screen and fish lift if applicable): 95% or greater survival (not including indirect losses) of salmon (all runs) and steelhead. The facility will also require criteria for American shad, sturgeon and delta smelt(?). Incidental protection of other species will be provided using the criteria set for these species.

- Eggs and Larvae Entrainment: Design of screen facilities for E&L will not be considered. Diversion may be reduced or shut off during E&L pulses if necessary. For a through-Delta alternative, this may is not a significant issue unless E&L are damaged as a result of passage through the screen (or pumping plant if applicable).

- Upstream Passage Goals: "Insignificant" delay to migrating salmon, steelhead, shad, striped bass, sturgeon. Possible screen opening passage for these and other fish based on "real-time" monitoring (for instance, delta smelt may not pass a ladder well so pass them operationally). Fish passing to the "wrong side" of screen structure may have a difficult time getting back to their stream of origin. Possible passage opportunities back to their stream of origin should be investigated or considered. *(The last two sentences pertain to an issue that is impossible to evaluate or manage. For example, there is no way to distinguish which system a fall run salmon is from unless it is marked, so you just have to assume it is from the system it chooses to go to. Even if you could tell, there would be no practical way to assure guidance to the correct system. What hypothesis would lead us to conclude that this is a significant issue?)*

Listed below in no particular order of importance are a number of issues or project features that will need to be investigated:

- Predation of juvenile salmonids at the fish screens and in the canal behind the screen. Conduct investigations to determine if fish predators accumulate at the project screens and if high diversion rates attract striped bass into the conveyance channel behind the screens. *(This is an EBMUD request. We fully expect striped bass to migrate via the conveyance channel and propose a condition the project must meet is to convey them past the screen. Also we know that some enhancement of predation is common around structures both by bass and other species, although predation will likely be more significant in front of the screens than in the back. Both of these considerations contribute to the skepticism the fishery agencies have expressed about the Hood-Mokelumne channel, but is there any viable way of doing the investigation EBMUD requests?*

- Investigate the potential impact on survival of Mokelumne origin juvenile salmon and steelhead migrating through the Delta that may result from the Hood diversion by measuring survival with the Delta Cross Channel open and closed. *(This is another EBMUD request for which a couple of years of measurements could probably be made.)*

- A North Delta diversion may have to operationally deal with significant seasonal pulses of eggs and larvae. However, entrainment may not be a significant issue if the larvae are not damaged by passage through the facility (since this is a "through-Delta" option).

- Salmon and steelhead fry will have to be protected, but these fish should pass the area quickly since there is little rearing habitat available on the Sacramento River near Hood and flows are generally good. *(This should end with the word "protected" in first sentence. While fry may move through the area quickly at times, they can be expected to rear all along the river.)*

- The facility must include upstream passage facilities for adult fish including salmon, steelhead, delta smelt, splittail, sturgeon, striped bass, and American shad. A variety of options are necessary including fish lifts, false weir ladders and permanent or periodic screen openings. The performance of these facilities, however, is largely unknown for most of the species of concern (especially delta smelt that might be there in dry years and splittail). Also of concern is the additional risk of fish wandering the Central Delta and resisting passage through the conveyance facility or straying as a result of this facility is largely unknown. *(What does the last sentence mean, and is it really significant?)*

- On-river screens will be considered if the maximum diversion is no larger than 4000 cfs and is operated according to established hydraulic criteria and flows in the Sacramento River. The screens shall have uniform hydraulic flows under all possible river and diversion conditions.

- Off-River screens with juvenile collection facilities may be considered for options that include permanent screen openings for upstream migrants. *(Dan questions the relationship between the two.)*

- A low head canal pumping plant behind the screened diversion might be considered to control the diversion and screen hydraulics. Operations will need to be defined in the initial assessment process. Without a pumping plant, operation of the channel may be significantly constrained during periods of diminished or reversed flows due to tidal action. *(Dan points out that repeated evaluations have concluded that a pumping plant will be needed.)*

- A flow control structure in the channel may have to be considered if the diversion will be limited to 4000 cfs and there is no pumping plant to control flows. *(Dan points out that this has been*

considered several times and rejected. Is there any reason for believing that the flood control and fish passage issues which led to earlier rejections have changed?)

- Maintenance access to screen units will be provided under all river conditions if screened diversion is required.
- Wedgewire screens will be used.
- Surface booms (with underwater deflectors) to deflect floating debris (and possibly even juvenile fish) away from the screen will be considered.
- Screen brush cleaners or comparable cleaning devices will be provided.
- Sediment removal and/or resuspension systems will be considered for all facilities.

Specific Action Plans to Investigate Fisheries/Facilities Impacts

This section needs to be more fully developed and commented on.

Planning Studies that can or should begin immediately – (and are actually feasible to quickly initiated):

Collect Site Specific Data near Hood (see other section for fisheries studies)

- Review the river bathymetry, mathematical model and physical model (1:50 and 1:240) reports from UC Davis Hydraulic Laboratory authored by Amarocho and Devries.
- Determine availability of bathymetry and flow data from USGS, then proceed with remaining bullets as needed.
- Survey the river bathemetry (needed for modeling)
- Analyze historic hydraulic data (needed for modeling and boundary conditions)
- Set up additional water quality and hydraulic monitoring stations on the Sacramento River at Hood or on the lower Mokelumne River if necessary
- Collect suspended sediment and bed load information

Conduct Delta Operations (and System) Modeling with a Proposed Diversion Facility

- DSM2 and CALSIM modeling
- Investigate Flood Control Issues (Flooding of Interior Delta Area?)
- Conduct particle tracking analysis
- Investigate various flow splits (diversion conveyance)
- Investigate operations scenarios (flow restrictions/channel control with gates or pumps/water quality triggers/fish triggers/etc.)
- Look at tide phasing changes in the Delta
- Look at modeled water quality changes
- Investigate head available to possibly drive a bypass system (if needed)

Conduct 2-D Numerical Hydraulic Modeling

- Review earlier studies at Hood to evaluate available information and proceed with the following as shown necessary

- Look at alternative facility configurations and function under various flow conditions

- Analyze range of flows, velocities, and head differentials around the proposed facility that might be occur

- Investigate potential sediment transport/deposition issues

- Investigate River Hydraulic Degradation Potential

Conduct Physical Modeling

- Review earlier physical modeling work and determine if new work is necessary

- Using boundary conditions and operations scenarios from the numerical models, set up model of the Sacramento River diversion

Conduct site specific fisheries monitoring of the North Delta and Mokelumne area:

- Analyze existing database and old studies in the North Delta area. *(Dan offers the observation that most of the following studies will not be needed, or will be limited in scope. I agree with him. I do not think any are needed for the decision 3 years from now. If anything, their value would be to set the stage for post project evaluation, and much of that could probably be done between the time the decision is made to proceed and the completion of construction.)*

- Conduct sampling to investigate the temporal distribution of fish in the North Delta area. *(Rick's comment asking that this and the next study be added to the list on page 3 is contrary to the judgment I expressed above, and to the assumption about not needing additional studies of downstream migrants.)*

- Conduct fisheries sampling in the Hood area to investigate vertical and horizontal distributions of adult and juvenile (down and up) migrating fish that may be in the area to help in planning facility layouts.

- Investigate timing and spawning/movement triggers of downstream migrating egg and larval in the Hood area (including delta smelt, striped bass, American shad, splittail, and sturgeon).

- Investigate the potential damage to migrating fish and greater exposure to predators, poor water quality, and pumping plants in central and southern Delta by doing more control studies of marked and released fish.

- Compare habitat conditions for juveniles and adult fish and evaluate threats of the possible new fish routes for various flows and residence times for various hydrology.

- Radio tag or monitor juvenile fish movements in the North Delta more intensively to investigate potential fish residence in Delta, downstream migration, and potential for recirculation of fish around or near a fish screen.

- Control experiments using CWT or radio tagged fish to look at the effect of lower net downstream flows below Hood on migration, timing, and success. *(Dan strongly recommends analysis of this question. The first step is obviously pulling together results of ongoing studies. Given the year's of data already collected, we'll need to carefully*

evaluate the need for additional data. One consideration will be the fact that the question to be addressed probably can not be simulated with the existing system. I. e. The assumption is we are interested in the effect of withdrawing water at Hood versus withdrawing the same amount of water at the Delta Cross Channel. Total flow below the DCC would be the same in both instances, although it would be distributed somewhat differently because of differential flow splits into Sutter and Steamboat sloughs. Given that can we measure the effect of concern?)

- Conduct some pilot studies of delta smelt spawning habitat enhancement in the eastern Delta area (on the Mokelumne side of the proposed diversion channel) in anticipation of having to mitigate for not being able to pass these fish upstream around a screen.
- Expand fisheries sampling at the Delta Cross Channel to better understand gate operations.

Complete Fish Screen Criteria Development for Juvenile Fish – Analyze fish movement and survival along long screens: *(Note that proposed policy assumptions assume that this work will be done independent of this program. Dan points out need for sturgeon work in treadmill and for completion of some work at GCID.)*

- Evaluate studies underway to address salmon and steelhead passage along long screens being conducted at GCID starting in summer 2000.
- Evaluate data from the UC Davis Treadmill studies. This already being done.
- Coordinate studies at the TFTF for application to the North Delta. This should not require much of a change in work scope.
- Consider additional testing for juvenile sturgeon if they may be potentially listed. Consider lab tests at UC Davis Treadmill
- Investigate potential damage to entrained larval and juvenile fish passing through a screen system - mesh size considerations. This should be done in a lab environment and with the TFTF studies.

Initiate Fish Passage and Ladder Investigations

- Analyze (research) various locks and ladders around the world that are designed to pass fish species similar to Delta species.
- Conduct scaled model lab experiments to look at various ladder configurations and velocity profiles of various ladder options that may be considered for Delta Species. *(Shouldn't this include options other than ladders. More fundamentally, how could this be done to support a decision date 3 years from now? If it isn't feasible to complete in 3 years, what does it say about the scope of viable options? More specifically, is any option other than leaving an opening in the screen for upstream passage feasible?)*

Fish Release Studies - If fish bypass pipes are considered at Hood, various release strategies must be considered. Hood would use a long pipe, instead of a truck or barge, and release directly into river downstream.

- Lab studies could investigate passage problems in long pipes for Delta species
- Expand studies at GCID and the TCCA Red Bluff screens focusing on salmon passage in pipes.

- Expand TFTF release site study to look at predation, fish accumulation at various release sites and possible release pipe configurations

Fish Bypass Lift Evaluations – If salvage/collection facilities are necessary *(Dan says: "I am not sure about these.")*

- Evaluate data from Red Bluff Research Pumping Plant and proposed TFTF studies on fish lifts. Include data on larval fish survival. Data needs are similar so not much change in work scope is anticipated.
- Install new fish lift in Bay #4 at Red Bluff RPP to investigate long term pump reliability issues.
- Investigate passage of adult fish through the fish lifts including salmon, sturgeon, splittail, and delta smelt (since they could get into bypasses) since they could be entrained. This could be accomplished at the RBRPP or the TFTF.
- Evaluate proposed facilities and operations under a range of flows

Studies of Upstream Attraction/Passage Issues Needed to Determine Feasibility of Hood Diversion

Initial studies could be implemented without constructing a new Hood channel, but these investigations might require construction of monitoring facilities and reoperation of the Delta Cross Channel. These changes might require additional environmental documentation and operations agreements before implementation or studies. *(Dan considers all of these studies to be feasible but believes hydroacoustic techniques would yield the best data. I am not as optimistic. We could get some useful data from the studies, particularly at the Delta Cross Channel, but I am not sure it will get us a long ways beyond a judgment that a lot of upstream migrants could turn up in a Hood-Mokelumne channel and we must be prepared to deal with them. I am skeptical that observations in the Deep Water Channel would be applicable to Hood. Tagging enough fish in Suisun Bay to get estimates of proportions attracted to the Delta Cross Channel at different flows seems unrealistic. In that case, would the study give us much more information than was learned in radio tagging studies of salmon in the lower San Joaquin River by Hallock or earlier tagging with regular tags. Hallock found salmon migrating to the Sacramento River via the lower San Joaquin, and I believe earlier tagging had demonstrated the same thing before the Delta Cross Channel was constructed. Presumably they were using Georgiana Slough.)*

Possible attraction issue studies could include:

- **Delta Cross Channel Investigations** – This facility might give the best insight into Delta fish migration issues and incremental water quality changes. The DCC is close in proximity to the proposed Hood Diversion. Although this channel is considered a navigation channel, the study and corresponding facilities could be developed and operated when the gates might otherwise be closed.
- Construct large fish trap downstream of the Delta Cross Channel gates. Control flows into the DCC from 1000 to 4000 cfs (net daily) by cracking the gates and investigate the numbers of salmon that might be attracted into the fish traps during and following a change in flow. It might be appropriate to investigate different configurations of fish trap entrances. These insights might help in channeling adults into a future ladder, lock, or simple passage through a screen opening.
- Investigations might also include tagging adult salmon caught above Hood or in Mokelumne, then transported back to Chipps Island and released. These fish could then be followed to look at their passage back upstream through the Delta (with Cross Channel

open to some degree). These studies would investigate the potential delay or the inadvertent passage of non-Sacramento fish over the barrier (DCC). (Do Sacramento Fish only go up the Sacramento River, or do they wander through the Delta channels? Do Mokelumne fish travel up the Sacramento, then cut across?) *(As mentioned above, we know that some Sacramento salmon have always gone through the lower San Joaquin River. One could tag salmon in the Sacramento below the DCC to see if any go to the Mokelumne, but given the relative number of salmon in the two systems and the probability of salmon following that route to the Mokelumne, the probability of documenting the magnitude of it is probably low. The experimental design of the proposal to move fish from above Hood back to Chipps Island seems questionable, without even considering the stress associate with capture and transport.)*

- **Sacramento Deep Water Ship Channel Ladder** - Evaluate passage/attraction at the SDWSC Locks adjacent to Sacramento. There is already a known attraction issue there due to lock leakage. Construction of a pilot facility here could be beneficial to that areas water quality and fish attraction problem. I would also be relative to the Delta attraction issue. Allowing some water to enter the channel might help determine the influence of various flows into the channel.

- **Radio Tagging of Adult Salmon** – Conduct an extensive fish tagging effort that will look at passage of adult fish through the Delta. Fish could be tagged in the Suisun Bay area.

Ladder and Lock Investigations in the Field

- Install pilot lock or ladder facility in the Delta using various attraction flows. This could be constructed at the Delta Cross Channel after some initial study on the attraction issue. An alternate location for a pilot facility would be at the SDWSC locks.