DEPARTMENT OF THE INTERIOR/DEPARTMENT OF COMMERCE TASK FORCE ON THE CALIFORNIA BAY-DELTA NEAR-TERM SCIENCE STRATEGY JUNE 9, 2010

On May 3, 2010, the Secretaries of the Interior and Commerce issued a letter to their fellow members of the Federal Bay-Delta Leadership Committee, committing to a joint Department of the Interior (DOI) and Department of Commerce (DOC) initiative to develop a single integrated Biological Opinion (BiOp) that would address the Bay Delta Conservation Plan (BDCP) and related operations of the Federal Central Valley Project (CVP) and California's State Water Project (SWP). The letter created a DOI/DOC Task Force that would develop and implement a Near-Term Science Strategy and an Integrated BDCP BiOp Strategy. The Task Force was formed in May 2010 with staff from the Bureau of Reclamation (Reclamation), U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS) and U.S. Geological Survey (USGS).

Two documents have been prepared in response to the Secretaries' letter: the "Near-Term Science Strategy" and the "Integrated BDCP BiOp Strategy". The first document identifies an initial list of near-term scientific research issues arising from the National Academy of Sciences report entitled, "A Scientific Assessment of Alternatives for Reducing Water Management Effects on Threatened and Endangered Fishes in California's Bay Delta" (NAS Report). The second document identifies analytical methods and modeling tools, responsibilities, integration of independent peer review, and critical science gaps that need to be addressed to successfully complete an integrated BDCP BiOp. While these documents address different aspects of the science challenge the Federal agencies face, they are not independent of one another.

The documents are initial steps in the creation of an integrated science strategy to address the needs articulated by the NAS Report and the need for a sound scientific foundation for the BDCP. It is important to emphasize that the science strategy outlined in these documents is preliminary and subject to revision on an ongoing basis. While a timeline is given for each element, there are interdependencies among elements, and no attempt has been made to establish internal priorities other than by expected completion date. Consequently, additional work is intended to develop priorities, study sequencing, coordination and other details needed to ensure efficient implementation and the best outcome. These efforts will require a careful review of related scientific activities occurring outside the Federal agencies and the BDCP cooperating entities, and independent scientific expert review of the science strategy itself.

The agencies have consulted with the state in preparing these documents and intend to solicit outside advice in the refinement of these activities. This will help ensure that the integrated strategy complements and is coordinated with related scientific actions undertaken by other entities and that it encourages other entities to undertake scientific actions that support and enhance the integrated BDCP BiOp strategy. As the Near-term Science Strategy is refined, a funding plan to undertake elements that are not already funded will be developed.

This Near-Term Science Strategy includes development and analysis of additional science to address issues raised by the NAS Report, with regard to the FWS and NMFS BiOps on water

project operations. The strategy includes data-gathering, modeling, monitoring, and sampling, focused on the triggers for water management constraints and potential adaptive management actions that could affect such constraints and triggers. In this strategy, we identify a set of activities that are expected to support decision-making in implementation of the BiOps starting in water year 2011.

Recognizing the inherent time lag between initiating ecological, biological or physical studies, and applying the results of those studies to management, we identify multiple lines of inquiry that must begin immediately so that results from these studies can be used in a timely manner to guide better management of the system. In the Integrated BDCP BiOp Strategy, we identify other science actions that are underway or should be initiated immediately to support the Integrated BDCP BiOp Strategy. We recognize that some of these studies will take several years to complete, and therefore are not likely to contribute directly to the creation of the integrated BiOp. However, the results from these studies (and others that will inevitably follow) are expected to provide information that will contribute to the subsequent implementation of the BiOp and adaptive management of the system into the future. Where tasks may have both immediate benefit and longer term use, we cross-walk the two task lists and identify how such tasks may be employed for each purpose.

It is important to note that the BDCP Steering Committee also is engaged in a process to identify a "BDCP Near-Term Conservation Strategy" that will include near-term science actions. That effort is somewhat larger in scope; it is aimed at identifying information and tools to guide the transition from existing water operations to anticipated long-term operations that will utilize a new conveyance system. The draft list below could be seen as a subset of the larger BDCP effort. Our list specifically identifies information that is expected to be used in the coming year, as well as those efforts that need to begin now in order to provide timely information and knowledge in the near future. As part of our ongoing effort to coordinate with our partners, we will be working in the coming weeks to ensure that this list captures and/or complements other actions that our partners have identified as priorities.

In the coming year, it is our intent to work within the operational flexibility of the existing BiOps and to expedite scientific investigation and analysis on key issues that have the potential to affect operational flexibility. The areas of flexibility within the BiOps relate to management of Old and Middle River (OMR) flows and implementation of the fall X2 action.

The following activities have the potential to improve real-time decision-making during the implementation of the FWS and NMFS Biological Opinions on CVP and SWP water operations by providing additional data to the Smelt Working Group (SWG) and the Delta Operations for Salmonids and Sturgeon Technical Team (DOSS). Many of these actions or tools have been under development for several years, and with limited additional investment can be made available for use in the coming year.

1. Integrated Annual Review of BiOp Implementation

The Secretaries' May 3, 2010 letter commits the FWS, NMFS and Reclamation to an Integrated Annual Review of the BiOps, focused on the prior year's real-time water operations decisions

and real-time species information underlying those decisions. The NMFS' BiOp Reasonable and Prudent Alternative (RPA) requires Reclamation and NMFS to host a workshop no later than November 30 of each year to review the prior water year's operations and to determine whether any measures prescribed in the RPA should be altered to incorporate new information and lessons learned from the prior years' operations or research. In light of the joint Secretaries' letter and comments of the NAS panel, FWS, NMFS and Reclamation are expanding the scope of the review to include implementation of the FWS BiOp.

The intent of this annual review is to inform FWS and NMFS as to the efficacy of the prior year's water operations and regulatory actions prescribed by the RPA, and to determine if there is any justification for amending specific measures in the RPA to reflect new information, provided that such amendments are consistent with the BiOp's underlying analysis and conclusions and do not limit the effectiveness of the RPA in avoiding jeopardy to listed species or adverse modification of critical habitat. Outcomes of this process may include changes to monitoring and data used for decision-making (e.g., improvements in turbidity monitoring), or refinement of the triggers, thresholds and other criteria used by the technical groups in making recommendations. The goals of this process will also be to develop lessons learned, incorporate new science (including the science described below), make appropriate scientifically justified adjustments to support the subsequent year's real-time decision making, and identify strategies to better integrate the NMFS and FWS RPAs as they are currently implemented.

The Delta Science Program will coordinate with NMFS, FWS, Reclamation, the California Department of Fish and Game (CDFG) and the California Department of Water Resources (DWR) to gather information and data and to host a workshop on the implementation of the BiOp RPAs.

Timeline: The workshop will occur no later than November 15, 2010.

Water Supply Implications: The Integrated Annual Review should result in better integration and more efficient implementation of the RPAs. Although it is difficult to predict any change in water supply reliability that may result from this action, written materials prepared for the reviews and presentations and discussions at the reviews should improve understanding of the information on which the prior year's recommendations and determinations were based, providing Reclamation and the DWR better information on which to base future operations and allocation projections. An annual review of the previous year's operations and measures prescribed in the RPA could inform implementation decisions on operations required for the protection of listed species.

2. Improvements to Turbidity Monitoring and Analysis

An increase in turbidity and/or Delta inflow (as occurs in first-flush conditions) is thought to be an important cue for delta smelt pre-spawning migration. The existing FWS BiOp RPA relies in part on turbidity thresholds to determine when entrainment protection should be imposed. During the winter when adults are migrating and staging in the Delta, the hypothesized underlying mechanism for smelt migration appears to be an increased willingness on the part of smelt to move when they are surrounded by turbid water. In the spring, when larval and juvenile

delta smelt are present, the species is likely using areas with higher turbidity to increase feeding success on copepods and decreasing success of predators feeding on them.

A pilot study of turbidity and delta smelt migration was conducted last winter by the USGS and the University of California's Marine laboratory in Bodega Bay, in collaboration with the CDFG. This preliminary study monitored delta smelt migration in the Sacramento River as a function of first-flush conditions (when sediment and turbidity are high) and allowed collection of data to be used in the planning of the full study to take place next winter. Biologists have hypothesized that delta smelt migrate with and at times of high turbidity. The study planned for next winter will explicitly test this hypothesis and provide valuable information about the relationship between delta smelt migration and turbidity. The pilot study provided an opportunity to collect some preliminary turbidity-smelt data to help in the planning of next winter's full study. This work addresses the needs for additional analyses to refine thresholds and triggers used to modify OMR flow targets that were identified in the NAS Report.

Improvements to turbidity monitoring and modeling to date include (a) the installation and operation of continuously telemetered turbidity gauges at more than a dozen new locations in the Delta; (b) improvements to 3-dimensional hydrodynamic modeling of the Delta that include the creation of a preliminary representation of turbidity by John DeGeorge at RMA Associates and preliminary models of delta smelt behavior by DeGeorge and others; and (c) initial reviews of turbidity dynamics captured by the enlarged monitoring array during the winter and spring of WY 2010, and improved conceptual modeling of turbidity effects by Jon Burau, Dave Schoellhamer, and others at USGS. These improvements have allowed more detailed visualizations of turbidity distribution and the ability to predict how turbidity would move in the Delta in response to changing hydrological conditions. Modeling has revealed that a "low-turbidity bridge" of relatively clear water often exists between the central and southern Delta, creating a zone that smelt are less likely to cross. Maintenance of a low-turbidity bridge is thought to reduce the risk of smelt entrainment at the pumps. Implementation of a suspended sediment model by Dave Schoellhamer is expected to begin this year, and is expected to more accurately capture turbidity dynamics and enable better prediction of the effects of potential turbidity management strategies.

In WY 2011 and beyond, increased knowledge of turbidity in the Delta could be quite valuable in helping to more effectively manage delta smelt entrainment protection. If more direct links between delta smelt and turbidity can be shown, we should be able to predict turbidity distributions in response to proposed actions during winter and spring operations, thereby reducing entrainment of delta smelt through better informed management of the system. In addition, these improvements could give us the capability to investigate the effectiveness of new structures and/or operations that have been or could be proposed to manage turbidity in the Delta. This technology would also be used for the delta smelt habitat studies that are discussed in the Attachment to the Integrated BDCP BiOp Strategy.

Near-term turbidity objectives:

a. Develop and provide better visualizations and prediction of turbidity dynamics in the Delta for use by the SWG. The lead agency for this effort is USGS, who will also provide assistance to the smelt biologists in interpreting turbidity information.

   Timeline: Immediate, with incremental improvements to turbidity data products over time. Early information from these efforts is possible because USGS and others have been working on these improvements for the last two years.

   Water Supply Implications: May result in some increase in winter and spring export pumping if it is found that maintaining a low-turbidity barrier is effective and conditions exist to manage for the barrier. There is a potential for increased operational flexibility later in the winter and spring if managing turbidity results in a decreased entrainment risk to delta smelt.

b. Develop improved turbidity modeling capability in the Sacramento-San Joaquin Delta to evaluate the response of the turbidity field to proposed actions (water project operations, gates, barriers, etc.). These activities will be led by USGS and include (a) field measurement of boundary conditions and calibration and validation data, (b) improvements to a suite of models including a hydrodynamic model, a wind wave model, a sediment transport model, and a delta smelt behavior model, and (c) collection of data needed to estimate parameters of the sediment model.

   Timeline: One to three years, with implementation of major elements expected to begin in 2010.

   Water Supply Implications: When largely complete, these activities should result in substantial improvements in our ability to assess and implement turbidity management strategies that may affect delta smelt entrainment. The ability of the SWG to effectively manage smelt entrainment would likely be improved, and these activities are expected to make it possible to evaluate other turbidity management approaches.

3. Tidally correct delta smelt sampling data

Fish abundance and distribution data have been collected in the Delta for decades and provide important information on long term trends as well as distribution throughout the year. SWG uses this information in real time decision making to determine, for example, the distribution of delta smelt and thus their risk of entrainment from project pumps. Tides have the potential to influence our understanding of distribution, especially if the fish are following or "surfing" the tide. Surveys have not traditionally recorded tidal data and are conducted irrespective of tides. Tidal stage data should be added to survey and other monitoring data to help explain presence/absence in catches, spatially reference water quality measurements, and provide insight into the fish responses to tidal conditions. This will assist SWG and DOSS in interpreting trawl/survey data and further analysis of these corrected data will provide insight into the relationship between fish distribution and tidal cycle. This work in part will address the NAS

Report's recommendation to improve monitoring to refine the thresholds and triggers used to modify OMR.

These tidal updates have both near- and long-term benefits. Adding tidal stage information will improve the value of current Interagency Ecological Program (IEP) data sets and increase our knowledge of habitat conditions, excursion ranges, and the potential source/fate of samples collected. Spatially referenced survey data could then be incorporated with other environmental data to allow for a thorough evaluation of physical conditions in the system and their influence on fish.

Integrating tidal data with survey data sets could also result in changes to future survey protocols; for example, fewer stations could be sampled, with more replicates over a longer time period. This type of information is critical to help IEP review and refine its survey programs to meet its monitoring objectives. Future changes to existing survey protocols could be implemented based on the interpretation of these new data and upon further IEP program review.

Questions that could be addressed with tidally corrected smelt sampling data:

a. How does tide stage/velocity/direction affect catch data in IEP surveys?
b. What is the true range of fish caught by a given survey at any point in time under different movement/migration behaviors?
c. Given this new tidally corrected data set, how can we further integrate water quality monitoring stations, diel cycles, and seasonal patterns to explain presence/absence in catches?

Tidal stage data should be added to historical survey data sets and incorporated into all future survey recording protocols. Because of the effect of river flows, export levels, and weather on tide stage simple tide table information is not sufficient to accurately describe observed field conditions. The DSM-2 model estimates tidal stage and velocity information for a series of locations (nodes) in the delta. The model can be used to generate estimates of tidal stage and velocity for the historic conditions. Past model runs have created data sets of tidal stage and velocity for historic conditions in the delta. In order to merge these tidal data with survey data each survey location will need to be assigned to a DSM-2 node. Each sampling event could then be linked to the DSM-2 tidal data by referencing the date, time, and DSM-2 node. This process would be accomplished through writing a script that can access the DSM2 data based on the survey information.

Timeline: The process for updating these data has already begun for the FWS beach seine data and Chipps Island Trawl data as part of the Turbidity/Migration Project Work Team. If the data are in a readily available format, work could begin immediately with results potentially available in late 2010.

Water Supply Implications: This action likely has limited potential to improve water supply and water supply reliability in the near term. However, it may allow for refinement of existing triggers for actions to protect listed species.

4. Studies of Non-physical Barriers

The State is conducting investigations related to the potential benefits of non-physical barriers and focused predation reduction to improve San Joaquin River salmonid outmigrant survival. Non-physical barrier studies currently underway will provide additional information relative to the application of this new technology to improving fish protection at key junctions without physically blocking water flow. This year's non-physical barrier studies include application of an improved understanding of the importance of predation around the non-physical barriers on the net effectiveness of this technology, and should increase our understanding of how to apply this technology effectively in future years. The State is also proposing to conduct studies of other focused predator removal and predation reduction actions to determine the potential for such actions to reduce predation and increase survival of juvenile salmonids in the Delta.

Timeline: Some activities in this element will be completed during WY 2011, while others will require as much as several years to yield reliable results.

Water Supply Implications: This action may improve the precision for triggers, thresholds, and criteria for OMR flows and the San Joaquin River Inflow/ Export ratio and other protective actions. Depending on the outcome of the investigation the use of this technology has some potential to improve water supply and water supply reliability.

5. Refine and Utilize Biological and Ecological Modeling Tools

Like other reviewing bodies before it, the NAS Report concluded earlier this year that modeling of the biological and physical dynamics of the Bay-Delta ecosystem is insufficiently developed. In particular, the panel observed that coupled biological-hydrodynamic modeling efforts have high potential pay-off and have not yet received the attention they should. In addition, the panel identified the need for extending the modeling framework to include fish life cycle features. Some efforts to improve modeling in these areas are underway.

Life Cycle Modeling

Planning Level Delta Smelt Life Cycle Model. DOI agency staff scientists have initiated efforts to develop a planning level life cycle model for delta smelt that uses the CALSIM II and DSM2 outputs described above and recent species-specific information in a life-cycle context. This will create a simple model intended to allow a more explicit comparison of the effects of project alternatives to natural sources of mortality and their interactions.

Timeline: The model development is anticipated to begin during summer 2010 and take approximately three months.

Hierarchical Time Series Delta Smelt Life Cycle Model. A second quantitative life history model for delta smelt is currently under development. This model is a hierarchical time series model with at least two levels, a state process model and an observation model, which are fit to existing data using statistical methods. The state process model will be used to predict abundances of delta smelt at different life history stages (e.g., spawning adults, post-larval stage

fish, juveniles, and pre-spawning adults) and in two or more regions including the western Delta, north and eastern Delta, and southern Delta. The observational model is intended to link data collected from multiple aquatic species surveys (at least the Spring Kodiak trawl survey, the Fall Midwater trawl survey, the 20 mm survey, and the Summer Townet survey) to the corresponding unobserved abundances by life stage. These quantitative tools will allow us to model population dynamics of these fish, to quantify the effects of different factors on dynamics, and to predict the effects of management actions. The work is being led by Dr. Ken Newman of the FWS and involves scientists from the recent IEP-National Center for Ecological Analysis and Synthesis collaboration.

Timeline: A testable model is anticipated to be available by the end of 2010, with additional work to further develop and refine the model continuing in to the following year.

Salmonid Shiraz model. Shiraz is a multistage Beverton–Holt model that describes the production of salmon from one life stage to the next by incorporating detailed information on metrics such as density-dependent population growth, habitat attributes, hatchery operations, and harvest management (Scheuerell et al 2006, Scheuerell and Hilborn 2009). NMFS Southwest Science center is working to adapt the Shiraz model to Central Valley and Delta salmonids for the purposes of evaluating various operational and restoration scenarios (see Integrated BDCP BiOp Strategy). By modeling physical and biological attributes, such as water temperature, flow, and habitat and the biological attributes of fish populations over time, the expected changes in fish abundance can be estimated. Shiraz is a detailed life history model that is ideal for estimating the effects of environmental changes on life stages and populations of salmon.

Timeline: The preliminary model application will be completed by the beginning of water year 2011, and the final model results will be completed by May of 2012.

Life cycle modeling workshop. NMFS is coordinating with the Delta Science Program to organize a life cycle modeling workshop that will explore the steps needed to develop and usefully apply integrated life cycle models of anadromous fish species. Lessons learned from that workshop will have applicability to all modeling efforts underway (smelt and salmonids).

Timeline: Workshop expected by September 30, 2010, with follow-up actions as appropriate depending on conclusions.

Ecological Models. The IEP, the Delta Science Program, and others have funded development of ecological models that may be useful in assessing water project effects and restoration opportunities within the Bay/Delta Estuary. Several of these models have or will soon reach sufficient maturity to usefully inform the SWG, the DOSS, and others by allowing them to explore the potential consequences of management choices. These models have the potential to be useful in the near term and should be further evaluated for their potential application. Additionally, they may prove useful for the BDCP effects analysis process and related BiOp. The list of models includes:

- SacEFT (http://www.essa.com/tools/saceft/index.html)
- DeltaEFT (http://www.essa.com/tools/SacDeltaEFT/index.html) (ESSA Technologies)
- OBAN (http://www.r2usa.com/oban/) (R2 Resource Consultants, Inc.)

- Delta Migration Pathway Model (http://www.fishsciences.net/projects/delta_migration.php), (Cramer Fish Sciences)

Timeline: Exploration of the various models is anticipated to take 3 months, with additional actions as appropriate depending on conclusions.

Water Supply Implications of Modeling Activities: Incremental improvement to topical models described above may allow for substantial improvements in our ability to assess and implement management strategies that protect listed species and ecosystems while supporting water conveyance and delivery. The development of useful full life cycle models will greatly expand opportunities to evaluate the effectiveness and efficiency offered by combinations of protective actions taken at different life stages, allowing further refinement of water project operations to provide reliable conveyance and delivery while protecting listed species.

6. Conduct Delta Smelt Fall Habitat Evaluations

The NAS Report concluded that it was critical that the adaptive management requirements to meet Fall X2 targets (FWS RPA Component 3) be implemented in light of the uncertainty about the biological effectiveness of the action and its possibly high water costs. As part of its efforts to guide implementation of those requirements, the Habitat Study Group (HSG) is collaborating with the IEP Pelagic Organism Decline (POD) Work Team on a program to examine the effects of fall X2 on delta smelt habitat (as described in FWS RPA Component 3). Integration with the IEP POD investigations is critical because fall habitat impacts must be considered within the broader context of other factors likely affecting delta smelt abundance. Understanding the effects of fall X2 relative to other factors will be an important consideration in managing FWS RPA Component 3.

Timeline: The HSG is developing a multi-faceted study and many of its elements are likely to provide information within the next one-to-two years. Other elements may take considerably longer.

Water Supply Implications: Implementing Fall X2 requirements has the potential for considerable water supply impacts. The outcome of this investigation has some potential to improve water supply and water supply reliability in the years when the Fall X2 action could be triggered.