Interagency 2015 Drought Strategy:
Update on the Biological Monitoring Actions

Introduction:
In water year (WY) 2014, various monitoring efforts were implemented to determine the effect of the drought and operations on threatened and endangered species, as well as to inform real-time operational management decisions. With persistent drought conditions, the five Agencies [National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (FWS), California Department of Fish and Wildlife (CDFW), U.S. Bureau of Reclamation (Reclamation), California Department of Water Resources (DWR)], as well as the State Water Resources Control Board (State Water Board), have recognized the need for continued improvements in the array of information that is collected to support management decisions. In the Interagency 2015 Drought Strategy, the Monitoring Plan[1] developed for Smelt and Anadromous fish species provided specifications for drought monitoring in WY 2015 that would improve our monitoring, increase our knowledge of fish behavior and survival, and improve our data collection and analysis. This document provides a review of the current status of those studies and monitoring efforts.

Table 1: Summary of Research and Monitoring to date:

Project	Water Year	Implemented?	2016 Status?
Smelt			
Expanded IEP Monitoring – Early Warning Sampling	2015	Yes	Undecided
Spectral Imagery of Submerged Aquatic Vegetation (SAV)	2015	Yes	Undecided
Otolith Microchemistry and Growth Rates	2015	Yes	Yes
Phytoplankton and Microcystis	2015	Yes	Undecided
Enhanced Flow, Water Quality, and Barrier Monitoring	2015	Yes	N/A
Anadromous Fish			
Additional trawling and beach seining when DCC gates are open, additional multiple-haul sampling at Jersey Point and Prisoner's Point for salmonids	2015	Yes	Undecided

[1] http://ca.gov/drought/pdf/DCP-2015-Monitoring-Plan_12-12-14.pdf

Increased Knights Landing/Tisdale Rotary Screw Trap Monitoring	2015	Yes	Yes
Increase salvage monitoring frequency	2015	No (but evaluated)	N/A
Enhanced particle tracking modeling	2015	Yes	Yes
Emergency barriers additional monitoring	2015	Yes	N/A
Winter run acoustic tag study (Sacramento River)	2015	Yes	Yes
Spring run acoustic tag study (Butte Creek)	2015	Yes	Yes
Central Valley Salmonid Predation Studies	2015	No (final decision pending)	N/A
Central Valley sturgeon	2015	Yes	Yes (Ongoing (through 2017)
Central Valley steelhead	2015	Yes (contract awarded)	Yes
PIT tagging feasibility study	2015	Yes (contract awarded)	No
Winter run redd temperature and DO monitoring	2015	Yes	Undecided
Recalibrate RAFT model	2015	Yes (in development)	Yes
Increasing Data Accessibility	2015	Yes (in development)	Undecided
Data Analysis Capacity	2015	No (SOW pending)	Yes
Future Research Needs			
Near real-time genetic testing	2016 +		Undecided
Post 2017 funding for Airport bridge sensor	2017 +		Yes (2016) Undecided (2017+)
LiDAR bathymetry mapping of winter-run spawning grounds	2016		Undecided

Smelt:

Expanded IEP monitoring – Early Warning Sampling

Proposed: Implement an "Early Warning Sampling" program to monitor Delta Smelt that migrate into the San Joaquin River which poses an increased risk of entrainment into the southern Delta. In coordination with NMFS request for central Delta salmonid monitoring (*Monitoring to Support and Evaluate Old and Middle River Flow Management*) the baseline early warning sampling was proposed for: at 2 locations (Jersey Point, station 809; and Prisoner's Point, station 815) using Kodiak trawl, with 10 min/tow, 15-20 tows/day, 1 day/week (each) from December 15 to May 15. Sampling would be increased to daily (alternating between sites) according to a weather triggers (expected precipitation) and operational triggers (consideration of an OMR flex). Sampling would return to baseline when catches return to, or below, baseline catches; and when OMR index returns to no more negative than -5,000 cfs.

Status: In Water Year 2015 the "Early Warning Sampling" consisted of 78 days sampled (out of 121). Baseline sampling was cut short (originally intended to continue until May 15) on April 1 due to concerns regarding the level of DSM take. FWS is the lead Agency.

Spectral Imagery of Submerged Aquatic Vegetation (SAV)

Proposed: Take and use hyperspectral imagery throughout the Delta during the fall to assess the location and densities of floating and/or submerged vegetation. The proposal for 2015 is based on methods applied to WY2014; specifically that CDFW would contract with UC Davis to conduct a study analyzing SAV coverage in the Delta using next generation Airborne Visible Infrared Imaging Spectrometer (AVIRIS). Ultimately the hyperspectral images obtained of the Delta would then be used to quantify the density and distribution of SAV. The main objective of this study is to map the distribution of different types of aquatic vegetation during the peak growing season throughout the Delta. Study results should be available in June 2015. The spectral imagery could also be used to evaluate the spatial distribution of WY 2015 *Microcystis* blooms.

Status: Due to contracting delays the 2014 study wasn't conducted until November of 2014. A final report was submitted to CDFW in June 2015. The UC Davis contract was amended to conduct the study again in 2015, with current flights and field work expected to occur in mid-late September. A final report focusing on analysis of 2014 and 2015 data compared to data collected from 2004 to 2008 should be available in June 2016. CDFW is the lead Agency.

Phytoplankton & Microcystis

Proposed: Collect water samples for continued analysis of phytoplankton and *Microcystis* concentrations throughout the central and southern Delta. Those samples were then to be used to quantify the potential toxicity due to cyanobacteria by measuring concentrations of microcystin, saxitoxin, and anatoxin-a in the particulate organic matter. The study would also attempt to identify the origin of *Microcystis* species in the water system, the sources of

organic matter and the nitrogen source for the bloom using carbon and nitrogen stable isotopes and delta 15-N of dissolved nitrate and particulate organic matter. Abundance of toxin producing cyanobacteria and the relative amount of *Microcystis* to total cyanobacteria in the water column would be quantified using quantitative PCR (Polymerase Chain Reaction).

Status: CDFW funded this analysis in coordination with DWR in 2014, but not in 2015. DWR is the lead Agency conducting this work in 2015.

Otolith Microchemistry and Growth Rates

Proposed: Collect otoliths from Delta Smelt and Longfin Smelt taken in CDFW surveys [e.g., Summer Townet (STN), Fall Midwater Trawl (FMWT), and Spring Kodiak Trawl (SKT) surveys] in order to analyze habitat use and growth rate information. Given the continuing drought, there is a unique research opportunity with a "worst case scenario" set of environmental conditions for Delta Smelt, and as such, fish collected during this period should provide a worst case baseline set of data for growth, reproduction, and general health. Otoliths collected during 2011 provided the other extreme, a wet year with more favorable rearing conditions. Information gained from the otoliths will provide specific information regarding how previous wet conditions and current drought conditions have affected the demographics of this threatened fish species.

Status: Fish processing and analysis of the STN surveys is still ongoing. A new contract has been developed with U.C. Davis (S. Teh) to continue collection and flash freezing of delta smelt from the 2015 FMWT and 2016 SKT, and 2016 STN. An additional contract is also under development to pay J. Hobbs to analyze the growth of smelt from these studies. CDFW is the lead Agency.

Enhanced Flow, Water Quality, and Barrier Monitoring

Proposed: Should WY 2015 operations call for installation of emergency drought barriers, a water quality monitoring plan will be required; and it will consist of two components: 1) continuous water quality and flow monitoring, and 2) discrete sampling for chlorophyll and nutrients. This action was proposed based on the possibility of installing physical barriers (emergency drought barriers) at Steamboat and Sutter Sloughs and West False River to reduce saltwater intrusion and protect export water quality.

Status: A decision was made to do an emergency installation of the West False River salinity barrier only. CDFW issued an ITP that included WQ monitoring requirements. Specifically, the ITP included requirements for DWR, the Permittee, to develop a monitoring plan to monitor the associated changes in water quality and flow resulting from the barrier location. It required the Permittee to install the necessary number of permanent water quality and/or flow monitoring stations to assess water quality and flow changes in Fishermans Cut, Franks Tract (interior, and at its connections with the San Joaquin River and Old River), Sherman Lake, and the San Joaquin River upstream of Fishermans Cut. The stations were to

monitor constituents including electrical conductivity (EC), dissolved oxygen (DO), temperature, and flow velocity and direction. The Permittee was also required to monitor changes in submerged aquatic vegetation distribution within Franks Tract. Removal of the barrier started in early September 2015 and will be complete by November 15, 2015.

Anadromous Fish:

Monitoring to Support and Evaluate Old and Middle River Flow Management

Proposed: Use additional Kodiak trawl monitoring stations in the central Delta, as a way of assessing salmonid presence and the risk of entrainment into the south Delta. This action was proposed in such a way as to coordinate monitoring efforts in the central Delta already targeting Delta smelt (see: *Expanded IEP monitoring – Early Warning Sampling*).

Status: Monitoring ended in early April (originally intended to continue until May 15), due to concerns regarding the level of DSM take. In total, this sampling consisted of 78 days sampled. The proposal acknowledged that the proposed baseline sampling (I day/week at each location) would not be sufficient to estimate the risk of entrainment of the anadromous fish species, and could at best provide information regarding the presence of species. Although a full analysis of the data has yet to occur, the vast majority of Chinook salmon caught at Jersey and Prisoner's Point occurred in an 11-day period (2/12/2015 – 2/22/2015)[2] (13 of the 16 ad-clipped; 343 of the 394 fall-run; 4 of the 10 spring-run; 2 of the 3 winter-run).

Monitoring Salvage at Tracy Fish Collection Facility (CVP) and Skinner Fish Facility (SWP)

Proposed: The Delta Operations for Salmon and Sturgeon (DOSS) technical advisory team, in coordination with the Smelt Working Group (SWG), will (convene a subgroup to) consider and make a recommendation on whether fish salvage counts at the Tracy Fish Collection Facility and Skinner Fish Facility need to be increased to a minimum 60 minutes for every 2 hours of operational time during drought years. The recommendation(s) will be submitted to the RTDOT no later than December 15, 2014. NMFS' BiOp, RPA Action IV.4.3(1) requires sampling at the fish facilities for fish salvage counts no less than 30 minutes every 2 hours (25 percent of operational time).

Status: The topic was discussed at DOSS with considerable input from staff at the Tracy Fish Collection Facility. The conclusion was that longer salvage counts can be made but that it really would not provide any new information. This conclusion was largely based on concerns that the gain in certainty by increasing sampling may be small relative to other uncertainties associated with the estimated daily loss densities and that the experienced

[2] Tidally filtered OMR from 2/11/2015 to 2/17/2015 was allowed to be more negative than -5,000 (up to -6,250) as per "OMR flex" request: http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/nmfs_determination_on_omr_flexibilities_-_february_10__2015.pdf.

extreme debris or high incidental fish numbers are likely to reduce count times under any sampling regime. Increased counts would also not provide any additional information regarding losses associated with the Clifton Court Forebay. This information was forwarded to RTDOT on 12/15/14.

Enhanced Particle Tracking Model (PTM)

Proposed: Implement a pilot application of the enhanced Particle Tracking Model (ePTM) for real-time operations in 2015 as an initial trial of the collective modeling and analytical efforts and techniques required for rapid response. Retrospective analyses of model results and drought-related fish tagging studies would inform any further refinements of the model. With increased focus and dedicated staffing at NMFS, the NMFS-SWFSC, and DWR (modeling staff), this pilot application is intended to inform operational decision making between March 1 and May 31, 2015. The goal was to provide periodic (e.g., weekly, bi-weekly) output that can inform DOSS and the RTDOT in real-time decisions.

Status: The ePTM pilot application was implemented "early," starting in February instead of the initial March 1 proposed start date. Also, instead of biweekly output on conditions, the ePTM pilot application was implemented twice in real-time and in consideration of two requests to temporarily modify the limit to OMR. A summary of the 2015 ePTM pilot application and the model itself has been submitted to the Independent Review Panel pursuant to the annual review of the long-term operations of the CVP/SWP.

Winter-Run Redd Temperature and Dissolved Oxygen Monitoring

Proposed: In 2014, the California Department of Fish and Wildlife (CDFW) deployed 50 temperature loggers and 20 temperature/dissolved oxygen (DO) loggers that were placed in the Sacramento River in and around winter-run spawning and rearing areas. In 2015, the temperature/DO loggers will be placed within winter-run redds and monitored.

Status: In consideration of the continuing poor conditions CDFW opted not to put DO/temp meters within WR redds and instead placed sensors adjacent to active WR redds again this season. Last year DO levels were not deemed to be an issue for redds based on the data collected. CDFW has prepared a summary report for the 2014 effort, *Drought Monitoring of Water Quality for Spawning Chinook Salmon in the Upper Sacramento River in 2014*[3]. Also the CDEC gages at KWK, CCR, BSF, BND and Airport road all have DO as a real time metric. CDFW has also deployed temp only loggers in year round positions as follows: from Keswick at RM 302 to Cow Creek at RM 280-every 2 miles; from Cow Creek to RBDD at RM 243 -every 4 miles; from RBDD downstream to Princeton at RM 160-every 10

[3] Available at: http://www.calfish.org/ProgramsData/ConservationandManagement/CDFWUpperSacRiverBasinSalmonidMonitoring.aspx

miles. In summary; temperatures in the Sacramento River are now well documented between CDFW's effort and the CDEC stations from Princeton to Keswick (142 miles).

Recalibrate Sacramento River Temperature Forecasts

Proposed: NMFS and USBR agreed to organize a technical meeting to discuss the level of effort involved in "recalibrating" the USBR temperature model and to develop a better understanding of its use and limitations as a temperature/water operations planning tool for fisheries. Also to be considered during these technical discussions is the possibility of incorporating the NMFS-SWFSC short-term temperature forecasts for the Sacramento River in real-time offered through the RAFT model and website (http://oceanview.pfeg.noaa.gov/raft/).

Status: NMFS and Reclamation have had a number of scoping meetings intended to set priorities for a technical team to address in the recalibration of the WY 2015 temperature modeling and forecast, and an evaluation of the existing Sacramento River Water Quality Management Model (SRWQM). The intent was to have any recalibration completed and available prior to the WY2016 February forecast however; Drought and Shasta operations in WY 2015 have delayed model recalibration. Also related; in March Reclamation provided its initial hindcast of temperature performance for water operations in 2014[4].

Monitoring to Support and Evaluate DCC Gate Operations

Proposed: Similar to the expanded monitoring implemented in 2014, additional monitoring was proposed in 2015 in the Sacramento region to inform the use of the "Matrix of Triggers for Delta Cross Channel Gate Operations" (Attachment G to the DOP[5]). The proposed 2015 monitoring would consist of continuous 24 hour sampling at Knights Landing RST starting when a flow event at Wilkins Slough occurs, and 3 days prior to a DCC gate opening and throughout the time that the gate is open, trawl sampling at Sherwood Harbor and Sacramento beach seine sampling will be increased to daily.

Status: For the period of December 1, 2014, to May 20, 2015, (roughly the period DCC is closed according to D-1641) the beach seines used to calculate the Sacramento Beach Seine Index (SBCI) were sampled an additional 14 days beyond what was expected in the Delta Juvenile Fish Monitoring Program (DJFMP). The DJFMP was also prepared to expanded its' trawls in the Sherwood harbor region of the Sacramento River, in response to a possible DCC gate opening but that effort was not necessary in WY 2015.

Emergency Drought Barriers

[4]http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/2015/sac_river_hindcast_usbr_2014.pdf

[5] http://www.ca.gov/drought/pdf/2014-Operations-Plan.pdf

Proposed: A monitoring plan is required as part of any proposal to install an Emergency Drought Barrier, similar to what was identified in the Delta Smelt section (*Enhanced Flow, Water Quality, and Barrier Monitoring*). Some specifics were identified such as the monitoring of parameters like dissolved oxygen, turbidity, salinity (EC), river stage, and flow velocity; as well as the use of DIDSON cameras to monitor passage (if any).

Status: DWR implemented an emergency installation of the West False River salinity barrier only. CDFW issued an ITP that included permanent protection and perpetual management of compensatory habitat necessary and required pursuant to CESA to fully mitigate Project related impacts of the taking on the Covered Species. The permanent protection and funding for perpetual management of compensatory habitat is complete and included:

Smelt/Salmonid - Permittee shall purchase 4.90 acres of smelt/salmonid credits from a CDFW-approved mitigation or conservation bank prior to initiating Covered Activities.

Giant Garter Snake - Permittee shall purchase one acre of GGS credits from a CDFW-approved mitigation or conservation bank prior to initiating Covered Activities.

Removal of the barrier started in early September 2015 and will be complete by November 15, 2015.

Winter-Run Acoustic Tagging Study

Proposed: Continuation of the last of the NMFS-SWFSC 3-year acoustic tagging study, initiated in 2013 to determine reach survival of hatchery winter-run throughout the Sacramento River and Delta. Real-time acoustic tag receivers are available and will be deployed at specific locations to augment other monitoring and help inform the (real-time) effects of operations and their influence on the timing and distribution of salmonids (and specifically winter-run) as they emigrate down the Sacramento River and into and through the Delta. Real-time monitoring receivers will be established at the Tisdale and Knights Landing RST locations, and at the upstream and downstream ends within the DCC and Georgiana Slough. The location of additional real-time monitoring receivers will be coordinated with NMFS and CDFW.

Status: The WY 2015 Study was successfully implemented with 2 releases of tagged (LSNFH) WR; the first group with 251, and the second with 321 fish (571 total). Funding for implementation in 2016 has been secured through an interagency agreement between NMFS-SWFSC and Reclamation.

Butte Creek Spring-run Acoustic Tagging Study

Proposed: The NMFS-SWFSC proposes to leverage existing acoustic tagging infrastructure and partnerships to explicitly monitoring the survival and reach specific movement of wild Butte Creek spring-run Chinook salmon during their outmigration to the ocean. The SWFSC

propose to tag 200 Butte Creek spring-run Chinook salmon smolts (*i.e.* fish greater than 80 mm) to provide information on downstream migration of fish that migrated from the upper watershed as fry/parr in January and February and reared in the Sutter Bypass. These fish will be tagged earlier in the season to avoid any stress caused by warm water temperatures. Data relating to movement and survival of these fish will inform biologists and water managers of three important metrics: (1) migration timing, (2) preferred habitat types; thanks to the array of receivers deployed in the Sutter Bypass, in different parts of the Delta and the Bay we will be able to know which paths the fish are taking to go to the Ocean (*e.g.* North or Central Delta) and whether drought could impact the accessibility to some habitats and (3) the locations of reaches with high mortality; this is indeed important to have an idea of where the high mortality reaches are located for spring-run juveniles and whether these reaches could be avoided for different water flow and temperature conditions.

Status: The project was implemented starting in March of 2015 when 141 of Butte Creek fish were tagged. Tagging was cut short of the intended 200 fish due to flow in the Sutter Bypass was too low which prevented the screw trap from operating correctly. The SWFSC is in the process of analyzing data, and therefore does not yet have any survival estimates.

Central Valley Salmonid Predation Studies

Proposed: CDFW is reviewing a $1 million solicitation for proposals focused on research projects regarding predation on one or more fish species listed under the federal and/or California Endangered Species Acts. The geographic area of interest includes the Delta and the anadromous reaches of the Sacramento River and San Joaquin River watersheds. Studies funded through the competitive grant will improve the understanding of predator-prey relationships and be considered in adaptively managed efforts to reduce predation effects on populations of listed species and aid in their recovery.

Status: A solicitation was sent out in the Fall of 2014. CDFW received 7 project applications. The projects have all been reviewed by an independent science panel. No final decision or approval has been made about project selection.

Central Valley Sturgeon Monitoring

Proposed: Using 2014-2015 drought funding, CDFW has entered contractual agreement with researchers from UC Davis and NOAA-SWFSC to undertake the following research and monitoring tasks: capture, acoustically tag, and monitor the movements of juvenile sturgeon; measure environmental metrics of those areas with juvenile and adult sturgeon; estimate the number of adult green sturgeon within the Sacramento River during their spawning period of May and June; explain how physical characteristics of sturgeon riverine habitat explain occupancy; and provide a time series of the number of adults in the sDPS of green sturgeon revealing the current status of this imperiled population.

Status: These contracts were finalized in May 2015, totaling $530K. Initial activities include: UC Davis deploying up to 16 receivers in the lower Sacramento River and Delta to

track up to 200 young of the year and yearling sturgeon from March 2015 – February 2017; NOAA to do depth surveys in the Sacramento River from April – October during 2015 and 2016; and NOAA to do surveys to estimate sturgeon abundance in the Upper Sacramento River from May – July during 2015 and 2016.

Central Valley Steelhead Monitoring

Proposed: Based on a 3-year implementation plan (Fortier *et al*. 2014) to monitor steelhead in the California CV, CDFW has proposed to implement the elements identified in "Year 1" of the implementation plan. This includes establishing monitoring infrastructure and personnel costs for 2 years of monitoring.

Status: The Central Valley Steelhead Monitoring Program (CVSMP), under contract with PSMFC, has completed its staff selection and the necessary purchases of vehicles and boats. During the first two weeks of October 2015, up to seven fyke traps will be installed (closed) on the Sacramento River until river temperatures are at or below 72°F, at which time the traps will then operate seven days a week. Staff will PIT tag, take scale samples, operculum punch for tissue samples, and record fork length of all steelhead captured. All hatchery steelhead will also be floy tagged. Adult steelhead will be transported by skiff downstream and released for mark recapture study. All other species captured in fyke traps will be numerated and immediately released at the trap location.

CDFW-Red Bluff staff are building resistance board weirs for video and DIDSON/ ARIS monitoring stations that will be installed in Clear and Bear creeks in October. PIT tag antenna arrays will be built and installed on Clear, Mill, and Battle creeks this year.

PIT Tagging Feasibility Study

Proposed: CDFW has secured $800,000 to establish a PIT tag feasibility study in the Central Valley system. CDFW is collaborating with NMFS to develop a study that balances the detection efficiencies at various locations with the ability to answer ecological and management questions. CDFW is soliciting proposals for a study that could be aimed at gathering the following performance metrics: smolt-to-adult survival; route selection and survival of juveniles during seaward migration; return adult route selection and spawning locations. Identifying resources to continue this infrastructure development and bolster data collection for long-term PIT tag monitoring should be considered for WY 2015 and beyond.

Status: This contract was finalized in May 2015 at a cost of $824K. Initial project tasks include deployment of PIT tag receivers at three locations (Grant Line Canal, Caswell Weir on the Stanislaus River, and release sites in the upper estuary where fish salvaged from the South Delta pumps) during the months of May 2015 – September 2015.

Increasing Data Accessibility

Proposed: Establish an internet data hub to house (or provide links to) all data sources. Data currently downloaded onto websites could easily link to the hub, and those data that are currently disseminated via e-mail distribution lists should be input or linked to the internet data hub.

Status: NMFS, with USFWS and CDFW, have met with water contractors (SLDMWA, Metropolitan) and web developers 34north to discuss development of an online data repository through their existing web portal Bay Delta Live. Although the "Database Dashboard" is not yet up and running, the group expects that the web portal will be available in WY2016. The ultimate goal is to have a single site for all data related to Delta conditions and ESA/CESA fish. The table below identifies the data to be made accessible on the site.

Table 1. Key Elements of the DOSS Data Stream

Dataset	Sampling location	Sampling gear	Data source
Fish monitoring			
Jersey Point trawl	Jersey Point	Trawl	FWS
Prisoners Point trawl	Prisoners Point	Trawl	FWS
Chipps Island Trawl	Chipps Island	Trawl	FWS
Sacramento Trawl	Sherwood Harbor	Trawl	FWS
Sacramento Trawl Catch Index (STCI)	Sherwood Harbor	Trawl	FWS
Sacramento Beach Seines	8 sites[1]	Seine	FWS
Sacramento Beach Seine Catch Index (SBCI)	8 sites[1]	Seine	FWS
All DJFMP beach seine data	>8 sites[2]	Seine	FWS
Mossdale Trawl	Mossdale	Trawl	FWS/DFW
Knights Landing RST	Knights Landing	Rotary screw trap	DFW
Knights Landing Catch Index (KLCI)	Knights Landing	Rotary screw trap	DFW
Tisdale RST	Tisdale	Rotary screw trap	DFW
Glenn-Colusa Irrigation District (GCID) RST	GCID	Rotary screw trap	GCID
Red Bluff Diversion Dam (RBDD) RST	RBDD	Rotary screw trap	FWS
[1]Verona, Elkhorn, Sand Cove, Discovery Park, American River, Miller Park, Sherwood Harbor, Garcia Bend			
[2] For details, see "Metadata" document at: *http://www.fws.gov/stockton/jfmp/*			
Environmental conditions (flow, turbidity, water temperature)			
Mill Creek flow	Mill Creek near Los Molinos (MLM on CDEC)		
Deer Creek flow	Deer Creek near Vina (DCV on CDEC)		
Wilkins flow	Sacramento River below Wilkins slough (WLK on CDEC)		
Knights Landing water temperature	currently pull from KL RST datasheets		
OMR	Old and Middle River flow (OMR on CDEC)		
OMR index & OMR gage data	OMR reports at: *http://www.usbr.gov/mp/cvo/index.html*		

Data Analysis Capacity

Proposed: NMFS-SWFSC will develop a Study Plan to use existing telemetry, CWT, and/or monitoring data to develop models and analyses informative to the DOSS and interagency managers for near-term operations. The primary objective of the deliverables should be to support weekly and intra-seasonal decision making by providing greater information about temporal and spatial population abundance and spatial distribution risks. These tools may be useful in adaptive management studies to increase fish protection and operational flexibility.

Status: NMFS and USBR have secured an interagency agreement for the funding of data analysis at the SWFSC. NMFS-SWFSC is currently crafting a statement of work that will be available at the end of October 2015.

Future (WY 2016) research and monitoring:

Near real-time genetic testing:

Consider: It is recommended that the five Agencies consider implementing an expedited process for handling the genetic identification of Chinook salmon to determine run assignments. Given current drought conditions where rapid changes in operations may be necessary, but where salvage of even one winter-run sized Chinook salmon at the export facilities can trigger a 5-day reduction in exports, there is broad interest in increasing the speed of the genetic analyses. In 2015 NMFS approved a request from DWR to process tissue samples collected for Chinook salmon genetic run assignment analysis using an alternate laboratory, as needed, between February 10 and April 30, 2015, and to employ a rapid genetic assessment protocol. This rapid genetic assessment protocol should be considered again in WY 2016 at those sampling locations where run assignment has the greatest potential to affect operations (export facilities, Wallace Weir etc.).

Post 2017 funding for Airport road bridge sensor:

Consider: In the WY 2014 Winter-run drought contingency plan, installing a permanent temperature monitoring station at Airport Road Bridge was identified as a key action for enhanced temperature and egg survival monitoring. Subsequently, CDFW secured the necessary funding for three years of implementation of the gauge at Airport Road Bridge. The five Agencies should consider the means necessary for continuing operation and maintenance of the gauge at Airport Road Bridge beyond 2017.

LiDAR bathymetry mapping of Winter-run spawning grounds:

Consider: Accurate accounting of the effect of flow changes on the relative water height would require the collection of high resolution (10 centimeter scale) bathymetry data for the Sacramento River. It is possible to collect the data using aerial LIDAR surveys and the best

time to collect this data would be this fall when flows are the lowest in the river. This sort of data would be helpful towards predicting the probability of dewatering redds due to a drop in flows from Keswick. Given the how important it is to account for the risk to winter-run redds associated with changing water operations the five Agencies should consider the collection of high resolution bathymetry data from Keswick to Red Bluff.