W&AR-03 and W&AR-16

Temperature Model Meetings No. 2

June 26, 2012

From: Staples, Rose
Sent: Thursday, July 26, 2012 4:39 PM
To: Alves, Jim; Anderson, Craig; Asay, Lynette; Aud, John; Barnes, James; Barnes, Peter; Beniamine Beronia; Blake, Martin; Bond, Jack; Borovansky, Jenna; Boucher, Allison; Bowes, Stephen; Bowman, Art; Brenneman, Beth; Brewer, Doug; Buckley, John; Buckley, Mark; Burt, Charles; Byrd, Tim; Cadagan, Jerry; Carlin, Michael; Charles, Cindy; Colvin, Tim; Costa, Jan; Cowan, Jeffrey; Cox, Stanley Rob; Cranston, Peggy; Cremeen, Rebecca; Damin Nicole; Day, Kevin; Day, P; Denean; Derwin, Maryann Moise; Devine, John; Donaldson, Milford Wayne; Dowd, Maggie; Drekmeier, Peter; Edmondson, Steve; Eicher, James; Fargo, James; Ferranti, Annee; Ferrari, Chandra; Fety, Lauren; Findley, Timothy; Fuller, Reba; Furman, Donn W; Ganteinbein, Julie; Giglio, Deborah; Gorman, Elaine; Grader, Zeke; Gutierrez, Monica; Hackamack, Robert; Hastreiter, James; Hatch, Jenny; Hayat, Zahra; Hayden, Ann; Hellam, Anita; Heyne, Tim; Holley, Thomas; Holm, Lisa; Horn, Jeff; Horn, Timi; Hudelson, Bill; Hughes, Noah; Hughes, Robert; Hume, Noah; Jackman, Jerry; Jackson, Zac; Jennings, William; Jensen, Art; Jensen, Laura; Johannis, Mary; Johnson, Brian; Justin; Keating, Janice; Kempton, Kathryn; Kinney, Teresa; Koepele, Patrick; Kordella, Lesley; Lara, Marco; Lein, Joseph; Levin, Ellen; Lewis, Reggie; Linkard, David; Looker, Mark; Loy, Carin; Lwenya, Roselynn; Lyons, Bill; Madden, Dan; Manji, Annie; Marko, Paul; Marshall, Mike; Martin, Michael; Martin, Ramon; Mathiesen, Lloyd; McDaniel, Dan; McDevitt, Ray; McDonnell, Marty; McLain, Jeffrey; Mein Janis; Mills, John; Minami Amber; Monheit, Susan; Morningstar Pope, Rhonda; Motola, Mary; Murphey, Gretchen; O'Brien, Jennifer; Orvis, Tom; Ott, Bob; Ott, Chris; Paul, Duane; Pavich, Steve; Pinhey, Nick; Pool, Richard; Porter, Ruth; Powell, Melissa; Puccini, Stephen; Raeder, Jessie; Ramirez, Tim; Rea, Maria; Reed, Rhonda; Richardson, Kevin; Ridenour, Jim; Robbins, Royal; Romano, David O; Roos-Collins, Richard; Roseman, Jesse; Rothert, Steve; Sandkulla, Nicole; Saunders, Jenan; Schutte, Allison; Sears, William; Shakal, Sarah; Shipley, Robert; Shumway, Vern; Shutes, Chris; Sill, Todd; Slay, Ron; Smith, Jim; Staples, Rose; Steindorf, Dave; Steiner, Dan; Stone, Vicki; Stork, Ron; Stratton, Susan; Taylor, Mary Jane; Terpstra, Thomas; TeVelde, George; Thompson, Larry; Vasquez, Sandy; Verkuil, Colette; Vierra, Chris; Wantuck, Richard; Welch, Steve; Wesselman, Eric; Wheeler, Dan; Wheeler, Dave; Wheeler, Douglas; Wilcox, Scott; Williamson, Harry; Willy, Allison; Wilson, Bryan; Winchell, Frank; Wooster, John; Workman, Michelle; Yoshiyama, Ron; Zipser, Wayne
Subject: Don Pedro Reservoir Temperature Model April 10 2012 Meeting Notes
Attachments: April 10 2012 Reserv Temp RP Mtg_120726r.pdf

Attached please find Meeting Notes from the Don Pedro Project Relicensing *W&AR-03 Reservoir Temperature Model* meeting held on April 10, 2012.

Action items for the Districts that came out of the meeting are addressed within the notes and model development is proceeding. As requested by the Relicensing Participants, the Districts have postponed the next meeting (originally scheduled for September 18) until mid-October (now scheduled for October 26, 2012) when the Districts will present model verification/calibration, as well as conduct training in use of the model.

NOTE: A copy of this announcement, and the accompanying attachment, are also being uploaded to the INTRODUCTION/ANNOUNCEMENT section of the relicensing website www.donpedro-relicensing.com.

From: Staples, Rose
Sent: Thursday, October 18, 2012 6:19 PM
To: 'Alves, Jim'; 'Anderson, Craig'; 'Asay, Lynette'; 'Barnes, James'; 'Barnes, Peter'; 'Beniamine Beronia'; 'Blake, Martin'; 'Bond, Jack'; Borovansky, Jenna; 'Boucher, Allison'; 'Bowes, Stephen'; 'Bowman, Art'; 'Brenneman, Beth'; 'Brewer, Doug'; 'Buckley, John'; 'Buckley, Mark'; 'Burt, Charles'; 'Byrd, Tim'; 'Cadagan, Jerry'; 'Carlin, Michael'; 'Charles, Cindy'; 'Colvin, Tim'; 'Costa, Jan'; 'Cowan, Jeffrey'; 'Cox, Stanley Rob'; 'Cranston, Peggy'; 'Cremeen, Rebecca'; 'Damin Nicole'; 'Day, Kevin'; 'Day, P'; 'Denean'; 'Derwin, Maryann Moise'; Devine, John; 'Donaldson, Milford Wayne'; 'Dowd, Maggie'; 'Drekmeier, Peter'; 'Edmondson, Steve'; 'Eicher, James'; 'Fargo, James'; 'Ferranti, Annee'; 'Ferrari, Chandra'; 'Fety, Lauren'; 'Findley, Timothy'; 'Fuller, Reba'; 'Furman, Donn W'; 'Ganteinbein, Julie'; 'Giglio, Deborah'; 'Gorman, Elaine'; 'Grader, Zeke'; 'Gutierrez, Monica'; 'Hackamack, Robert'; 'Hastreiter, James'; 'Hatch, Jenny'; 'Hayat, Zahra'; 'Hayden, Ann'; 'Hellam, Anita'; 'Heyne, Tim'; 'Holley, Thomas'; 'Holm, Lisa'; 'Horn, Jeff'; 'Horn, Timi'; 'Hudelson, Bill'; 'Hughes, Noah'; 'Hughes, Robert'; 'Hume, Noah'; 'Jackman, Jerry'; 'Jackson, Zac'; 'Jauregui, Julia'; 'Jennings, William'; 'Jensen, Art'; 'Jensen, Laura'; 'Johannis, Mary'; 'Johnson, Brian'; 'Justin'; 'Keating, Janice'; 'Kempton, Kathryn'; 'Kinney, Teresa'; 'Koepele, Patrick'; 'Kordella, Lesley'; 'Lein, Joseph'; 'Levin, Ellen'; 'Lewis, Reggie'; 'Linkard, David'; Loy, Carin; 'Lwenya, Roselynn'; 'Lyons, Bill'; 'Madden, Dan'; 'Manji, Annie'; 'Marko, Paul'; 'Marshall, Mike'; 'Martin, Michael'; 'Martin, Ramon'; 'Mathiesen, Lloyd'; 'McDaniel, Dan'; 'McDevitt, Ray'; 'McDonnell, Marty'; 'McLain, Jeffrey'; 'Mein Janis'; 'Mills, John'; 'Minami Amber'; 'Monheit, Susan'; 'Morningstar Pope, Rhonda'; 'Motola, Mary'; 'Murphey, Gretchen'; 'O'Brien, Jennifer'; 'Orvis, Tom'; 'Ott, Bob'; 'Ott, Chris'; 'Paul, Duane'; 'Pavich, Steve'; 'Pinhey, Nick'; 'Pool, Richard'; 'Porter, Ruth'; 'Powell, Melissa'; 'Puccini, Stephen'; 'Raeder, Jessie'; 'Ramirez, Tim'; 'Rea, Maria'; 'Reed, Rhonda'; 'Richardson, Kevin'; 'Ridenour, Jim'; 'Robbins, Royal'; 'Romano, David O'; 'Roos-Collins, Richard'; 'Roseman, Jesse'; 'Rothert, Steve'; 'Sandkulla, Nicole'; 'Saunders, Jenan'; 'Schutte, Allison'; 'Sears, William'; 'Shakal, Sarah'; 'Shipley, Robert'; 'Shumway, Vern'; 'Shutes, Chris'; 'Sill, Todd'; 'Slay, Ron'; 'Smith, Jim'; Staples, Rose; 'Steindorf, Dave'; 'Steiner, Dan'; 'Stone, Vicki'; 'Stork, Ron'; 'Stratton, Susan'; 'Taylor, Mary Jane'; 'Terpstra, Thomas'; 'TeVelde, George'; 'Thompson, Larry'; 'Vasquez, Sandy'; 'Verkuil, Colette'; 'Vierra, Chris'; 'Wantuck, Richard'; 'Welch, Steve'; 'Wesselman, Eric'; 'Wheeler, Dan'; 'Wheeler, Dave'; 'Wheeler, Douglas'; 'Wilcox, Scott'; 'Williamson, Harry'; 'Willy, Allison'; 'Wilson, Bryan'; 'Winchell, Frank'; 'Wooster, John'; 'Workman, Michelle'; 'Yoshiyama, Ron'; 'Zipser, Wayne'
Subject: AGENDA and ADVANCE MATERIALS for Don Pedro River-Reservoir Temperature Models Workshop Oct 26 2012
Attachments: DonPedroReservoirBathymetricStudyRept_20121018.pdf; Reservoir-RiverTempModelsWorkshop_Oct 26 2012_AGENDA_20121018.pdf; ReservoirTempModel_DataSetsForModelVerification_20121018.pdf

River & Reservoir Temperature Models Workshop
Don Pedro Relicensing Studies W&AR-3 & 16
October 26, 2012 – 9:00 a.m. to 4:00 p.m. - MID Offices
Call-in #866-994-6437, Conference Code 5424697994
Link to LIVE MEETING will be sent via separate email closer to meeting date

AGENDA

Don Pedro Reservoir Temperature Model

9:00 a.m. to 9:15 a.m. **Study Plan Overview**

9:15 a.m. to 9:30 a.m.	Overview of Reservoir Bathymetry Study
9:30 a.m. to 10:00 a.m.	Model Design, Computations, and User Interface
10:00 a.m. to 10:20 a.m.	Data Sources and Data Collection: Meteorology, Inflow Temperatures, Reservoir Profiles
10:20 a.m. to 10:40 a.m.	Model Calibration
10:40 a.m. to 11:10 a.m.	Model Validation
11:10 a.m. to 11:30 a.m.	Next Steps

Lunch

1:30 a.m. to 1:00 p.m.	Lunch (on your own)

Lower Tuolumne River Temperature Model

1:00 p.m. to 1:15 p.m.	Study Plan Overview
1:15 p.m. to 1:45 p.m.	Model Description, Computations, and User Interface
1:45 p.m. to 2:15 p.m.	Data Sources and Collection: Meteorology, River Temperatures, Other Data
2:15 p.m. to 3:00 p.m.	Model Calibration
3:00 p.m. to 3:30 p.m.	Model Validation
3:30 p.m. to 4:00 p.m.	Next Steps

Attachments: (These materials are also being uploaded to the relicensing website at www.donpedro-relicensing.com under the INTRODUCTION tab / ANNOUNCEMENT)

1. **Don Pedro Reservoir Bathymetric Study Report , October 2012. NOTE: Attachments A & B referenced In this report are extremely large files containing plots of bathymetry data. Available upon request (rose.staples@hdrinc.com)**
2. **W&AR-16 Lower Tuolumne River Temperature Model Status Report, September 2012 This is currently a 8 MB file, so we are uploading to the relicensing website only rather than attaching to this email**
3. **W&AR-03 Reservoir Temperature Model: Upstream Water Temperature and Meteorological Data Sets for Model Verification, September 2012**

If you have any difficulties accessing or downloading any of these documents, please let me know.

A CD with the River/Reservoir Temperature and Meteorological Data will be available at this meeting. This CD will also be available after the meeting, upon request (rose.staples@hdrinc.com).

ROSE STAPLES
CAP-OM

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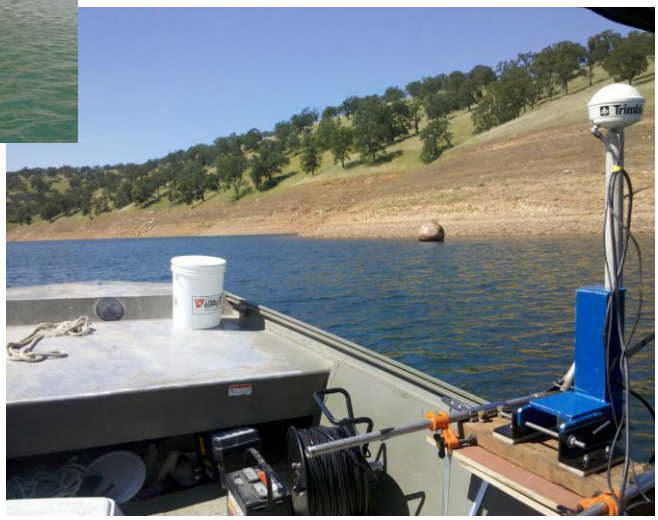
DON PEDRO RESERVOIR BATHYMETRIC STUDY REPORT



Prepared for:

TURLOCK IRRIGATION DISTRICT

MODESTO IRRIGATION DISTRICT AND

Turlock and Modesto, California

Prepared by:

HDR ENGINEERING, INC.

Sacramento, California

October 2012

Don Pedro Project
FERC No. 2299

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BATHYMETRIC STUDY REPORT

1.0 Objectives

The objective of this study was to develop an accurate reservoir geometry for the Turlock Irrigation District and Modesto Irrigation District (collectively, the "Districts") Don Pedro Reservoir (FERC No. 2299). The resulting reservoir geometry is also used to update the reservoir's elevation-storage curve and provide data on existing conditions for inclusion in the three-dimensional ("3-D") reservoir temperature model under development in support of the FERC relicensing of the Don Pedro Project ("Project").

2.0 Study Area

The study area consists of Don Pedro Reservoir located in Tuolumne County, California, on the Tuolumne River (Figure 2.0-1). Based on Engineer's estimates developed prior to the construction of the Project, at the normal maximum pool elevation of 830 feet (ft) (NGVD 29), Don Pedro Reservoir has a surface area of 12,960 acres and stores 2,030,000 acre-feet of water (ACOE 1972).

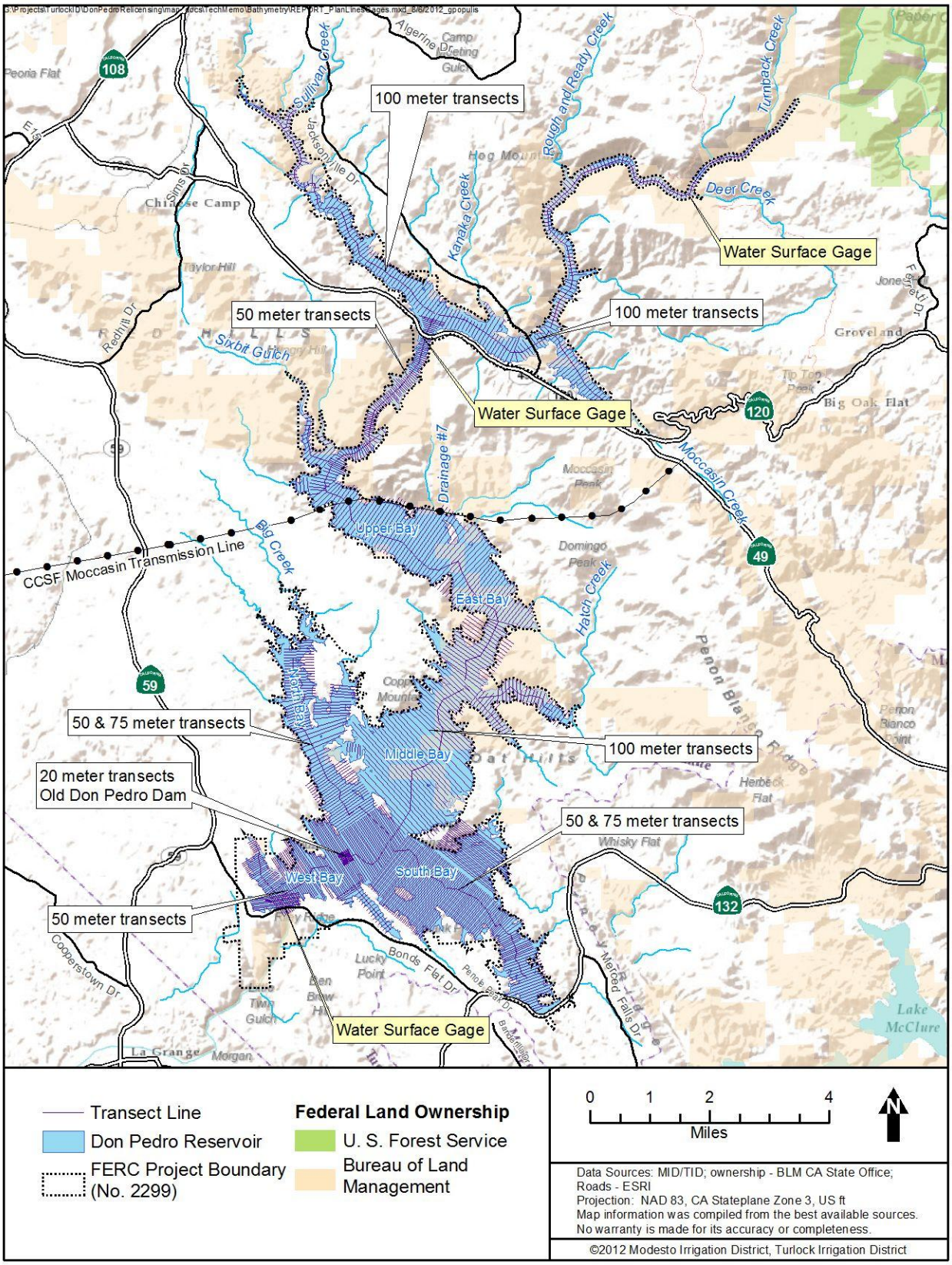

Figure 2.0-1. Don Pedro bathymetry survey plan transects and water surface gages.

3.0 Methods

Bathymetry below the full pool elevation of 830 ft was determined by two techniques: underwater surfaces were surveyed using field measurements (Section 3.1) and topographic information for surfaces above the water were obtained using radar technology (Section 3.2). Data obtained by the two techniques were synthesized into one surface using geographic information system (GIS) software (Section 3.3). Quality assurance and quality control practices are described in Section 3.4.

3.1 Field Survey

The field survey was performed over 16 days between May 1 and June 5, 2011, from a flat-bottom aluminum Johnboat with an outboard motor. This time period was selected due to the relatively high water levels, relatively calm weather, and low amount of recreational boater activity.

During the bathymetric data collection, Don Pedro Reservoir's water surface elevation ranged from approximately 792 ft to 805 ft. Depth data for Don Pedro Reservoir was collected using an Airmar B258 1-kW dual frequency transducer and a Foruno FCV-585 digital depth sounder (with real-time depth profile display) connected to a Trimble PRO-XR GPS and TSC1 Data Collector, capable of providing a real time differential Global Positioning System ("DGPS") data stream. The depth sounder's transducer was mounted onto the side of the boat and lowered 0.3 ft below the surface of the water. The GPS dome antenna was mounted on a platform above the level of the boat. The accuracy of the B258 transducer was ± 0.1 foot of depth (for depths roughly 4 ft or greater) and the accuracy of the PRO-XR GPS receiver was less than one meter of linear distance (with optimal satellite coverage).

Soundings were taken at approximately 1-second intervals and the boat speed was set to ensure that bottom features were appropriately sampled. The boat was navigated along the transect lines using the DGPS, and the position of each sounding was determined using the DGPS system. All depth and horizontal positioning data were recorded digitally in the field as a series of points with x-y-z coordinates, using a rugged field notebook personal computer, running Hypack Hydrographic Survey software.

A total of 1152 transects, spaced at 50, 75, 100 meter intervals and oriented approximately perpendicular to the longitudinal axis of the reservoir, were pre-located and created using Hypack. Areas of topographical concern, such as the Old Don Pedro Dam, were surveyed with greater density for added resolution. In addition to the standard transects, perpendicular "tie lines", oriented approximately parallel to the longitudinal axis of the reservoir and its tributary arms, were established to ensure inter-transect data consistency. A Furuno real-time depth profile display was deployed to identify and navigate areas of topographical concern including confined coves and bars that were found while performing routine grid transects. Transects covered the entire reservoir at the water surface elevation during the time of the field data collection (Figure 2.0-1).

Once all the data were collected, the sounder depth records were edited in Microsoft Excel to remove all but the necessary data to be matched up with a DGPS location and depths were corrected for submergence of the transducer, i.e. the "draft" or the depth from the water surface to the face of the transducer.

Reservoir water level elevations were measured throughout the study from three gages. Water surface elevations near the dam of the reservoir are routinely measured and recorded hourly by TID.[1] For this study, water surface elevation gages were also installed at two other locations, where existing benchmarks provided vertical control for combining all elevation data to a common datum: (1) the Highway 120/49 Bridge across Railroad Canyon (NGS E1389),[2] and (2) the Wards Ferry Bridge (NGS HS4439).[3] All vertical control measurements were then converted to match the vertical datum of the gage at Don Pedro Dam. These reservoir elevations were incorporated into the bathymetric model to adjust each reservoir depth measurement across the reservoir for changes in water surface elevation between the beginning and end of each survey period to the reservoir datum.

The potential existed for an energy slope to form on the surface of Don Pedro Reservoir, as relatively large rates of inflow were observed at the time of the survey.[4] (When an energy slope is present, a reservoir's water surface elevation increases from downstream to upstream.) Hence, on May 5, 2011, a water surface elevation logger (WSEL) was surveyed near the upper end of the reservoir using the monuments at the Highway 120/49 Bridge and at Wards Ferry Bridge. Water surface elevations as detected by the new logger were then compared to the water level as detected by the gage at Don Pedro Dam. After analyzing the collected water level information, it was determined that there was not a measurable energy gradient during the period of survey. Hence, for the purpose of this data collection effort, the water surface of Don Pedro Reservoir was assumed to be flat.

3.2 IFSAR

Topographic information above 792 ft was obtained by interferometric synthetic aperture radar (IFSAR), which was collected by the vendor Intermap during August 2004. The water surface of the reservoir at the time the IFSAR data were collected was 760 ft and the resulting Digital Terrain Model (DTM) extends upwards to well above the reservoir's full pool elevation of 830 ft.

3.3 Surface Model Generation

A contour line at the normal maximum water surface elevation of 830 ft was generated using a GIS contouring tool with the IFSAR DTM. It was visually checked and modified as needed using a horizontally more accurate hi-resolution aerial image.

1 http://www.tid.org/water/hydrological-data
2 http://www.ngs.noaa.gov/cgi-bin/ds_mark.prl?PidBox=HS1389
3 http://www.ngs.noaa.gov/cgi-bin/ds_mark.prl?PidBox=HS4439
4 Inflows to Don Pedro Reservoir ranged from 5,192 cfs to 12,652 cfs during this study (http://cdec.water.ca.gov/).

The bathymetric survey point data were imported into ESRI ArcGIS Desktop software where the point data was integrated with the IFSAR DTM data to make a continuous network of points below the normal maximum water surface contour. That network of points was used develop a network of bottom lines or thalwegs. The points, the bottom lines and the normal maximum water surface contour were then used as input for the ESRI surface interpolation tool "Topo to Raster". The Old Don Pedro Dam was located during the survey and construction drawings of that dam[5] were useful to integrate that feature into the interpolated surface. Contours at 10 ft intervals were then inferred using ESRI contouring tools. The result of this analysis was a continuous surface model that will be used as input to the 3-D reservoir temperature model.

3.4 Quality Assurance and Quality Control

Data quality was assured by following manufacturer's instructions and periodically verifying data values through an alternative measurement (in the field) and third-party review (in the office). Throughout the field survey, the depths measured by the sounder were periodically compared to the actual depth. The actual depth was measured by either lowering a "bar" beneath the sounder or by direct measurement of the bottom with a lead line or pole. Measurement of the "draft" or the depth from the water surface to the face of the transducer was also periodically recorded.

Quality Assurance of the bathymetric surface was performed by an independent reviewer following three steps. The first step consisted of a review of the field methods and materials. The second step consisted of checking the edited raw data. Finally, the third step consisted of verifying the methods used in the production of the final deliverable.

Review of field methods included a review of the "bar checks" performed in the field and described above. In addition, specifications of the sounder and DGPS used in the survey were reviewed to confirm the accuracy of the data as reported. The water surface elevation data at the three gages were also checked for consistency.

Next the processing of the raw data was checked. Any data with DGPS errors or sounding errors that had been flagged by the modeler were checked to confirm that the deletion was appropriate prior to interpolation. Soundings were spot checked for consistency. The crossing of transects and tie-lines was reviewed to ensure that the sounder recorded similar depths at the intersection of survey lines. If any sharp differences in depth at adjacent points were present, they were identified as either an error or a real feature.

The last step was check of the final bathymetric surface (Attachment A). Once the field methods and raw data were reviewed, the production of contours from a bathymetric surface was checked. Calculation of the bottom elevation from sounding depths was reviewed to ensure corrections for the draft and varying water surface elevation were properly accounted for. The method of interpolation and settings used in the interpolation was reviewed to ensure that reasonable contours were generated. Contours created using interpolation were checked against actual soundings to verify that the interpolated surface is reasonable. Finally, contours were checked

[5] TID and MID 1920

against the original elevation-storage curve, as well as historical United States Geological Survey (USGS) maps.

4.0 Results and Analysis

Don Pedro Reservoir contours at 10-ft intervals are displayed along with a shaded relief of the surface in a series of maps at the end of this report (Figures 1 through 15 in Attachment B).

Using the survey data, reservoir volume was calculated in one-foot contour intervals from the bottom of the reservoir to the normal full pool elevation. The calculated storage using the new bathymetry data is compared to the original storage capacity information in Table 4.0-1 and Figure 4.0-1. The original elevation-storage curve indicated that Don Pedro Reservoir at the time of its construction had a total storage capacity of 2,030,000 acre-feet of water at elevation 830 ft (ACOE 1972), while the new bathymetric surface indicates the reservoir holds 2,014,306 acre-feet at that elevation—a difference of less than 1 percent.

Table 4.0-1. Don Pedro Reservoir volume comparison between original elevation storage curve and 2011 bathymetry survey data.

	Cumulative Volume (ac-ft)				Incremental	
Elevation (ft)	Original Storage Curve[1]	2011 Bathymetry Survey	Gain (Loss) in Total Storage[2]	Percent Gain/Loss of Total Storage	Gain (Loss) in Total Storage[2]	Percent
550	158731	158578	(153)	-0.01%	(153)	-0.10%
570	212870	211023	(1,847)	-0.09%	(1,694)	-0.80%
590	274760	272508	(2,252)	-0.11%	(405)	-0.15%
620	384060	382330	(1,730)	-0.09%	523	0.14%
650	517450	516849	(601)	-0.03%	1,129	0.22%
680	678950	677807	(1,143)	-0.06%	(542)	-0.08%
710	869700	867442	(2,258)	-0.11%	(1,116)	-0.13%
740	1094900	1090096	(4,804)	-0.24%	(2,545)	-0.23%
770	1359200	1350810	(8,390)	-0.41%	(3,586)	-0.26%
800	1669000	1657028	(11,972)	-0.59%	(3,582)	-0.21%
830	2030000	2014306	(15,694)	-0.77%	(3,722)	-0.18%

[1]ACOE 1972 Flood Control Manual
[2] Original Survey Volume at Elevation – 2011 Survey Volume at Same Elevation

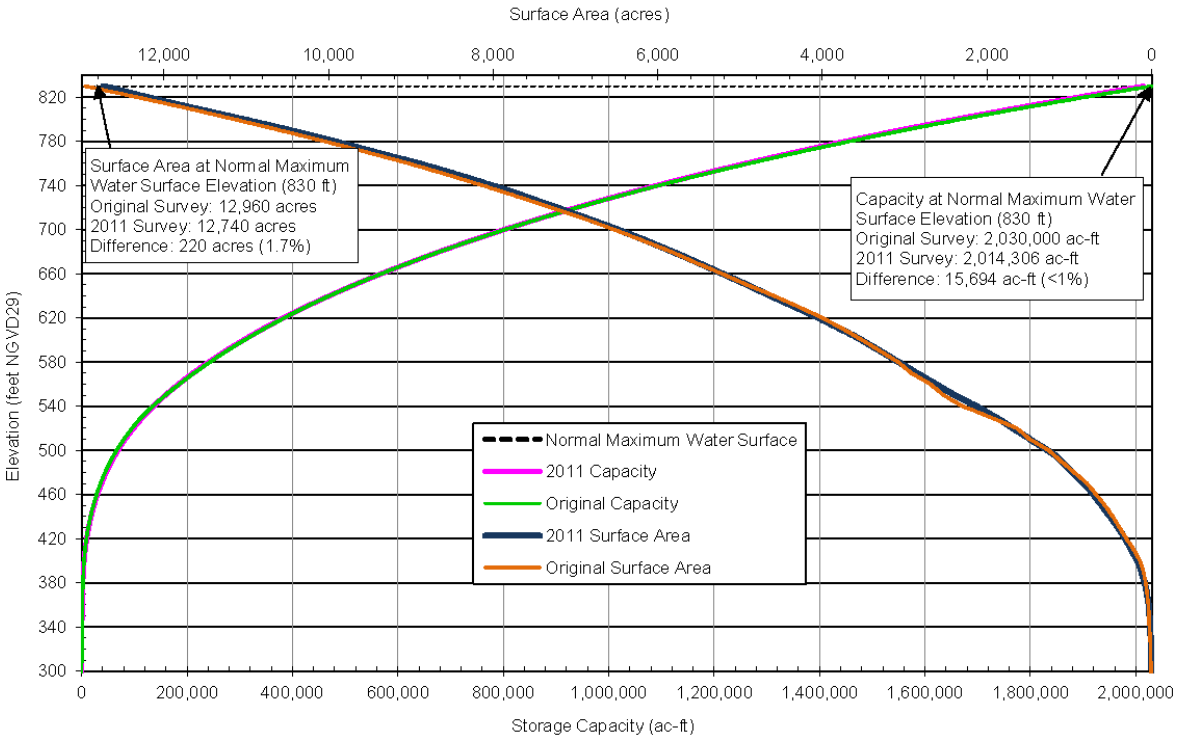

Figure 4.0-1. Don Pedro Reservoir area-capacity curves (reference data: ACOE 1972; 2011 bathymetry study).

5.0 Discussion

As demonstrated in Section 4.0, the storage volumes provided by the original elevation-storage curve and the new bathymetric surface differ by less than 1%. It is recognized that the two estimates were developed based on different survey methods and bathymetric surface calculation methodologies. Other than the elevation-storage curve itself, the input data used to generate the ACOE 1972 curve were not available. However, both methods relied on engineering standards for computations in use at the time of survey, indicating an appropriate level of computational rigor was applied to both estimates. Therefore, it is reasonable to conclude that, for all intents and purposes, the 2011 survey substantially confirms the 1972 elevation-storage information and that any loss of storage in the Don Pedro Reservoir since Project construction can be considered to be minimal.

6.0 References

ACOE. 1972. Report on Reservoir Regulation for Flood Control. Appendix A Flood Control Regulations. Don Pedro Dam and Lake, Tuolumne River, California. Department of the Army. Sacramento District, Corps of Engineers. Sacramento, California. August.

Barnes, D.H. 1987. The Greening of Paradise Valley. The first 100 years (1887-1987) of the Modesto Irrigation District. Commissioned by the Modesto Irrigation District in recognition of its centennial year. 233 pp. Available on line at: http://www.mid.org/about/history/default.html

Environmental Science Research Institute ArcGIS 10. Available online at: <http://help.arcgis.com/en/ arcgisdesktop/10.0/help/index.html>.

Intermap. Available online at: <http://www.intermap.com/>.

TID and MID, 1920. Don Pedro Dam. General Plan of Dam and Spillway. 1 inch = 20 and 40 feet. R.V. Miekle, Chief Engineer. Sheet Number 15 of 42. September. TID file 1-149.

River & Reservoir Temperature Models Workshop
Don Pedro Relicensing Studies W&AR-3 & 16
October 26, 2012 – 9:00 a.m. to 4:00 p.m. - MID Offices

Call-in #866-994-6437, Conference Code 5424697994
Link to LIVE MEETING will be sent via separate email closer to meeting date

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10:40 a.m. to 11:10 a.m.	Model Validation
11:10 a.m. to 11:30 a.m.	Next Steps

Lunch

11:30 a.m. to 1:00 p.m.	Lunch (on your own)

Lower Tuolumne River Temperature Model

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1:15 p.m. to 1:45 p.m.	Model Description, Computations, and User Interface
1:45 p.m. to 2:15 p.m.	Data Sources and Collection: Meteorology, River Temperatures, Other Data
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   Attachments A & B referenced in this report are extremely large files containing plots of Bathymetry data. Available upon request (rose.staples@hdrinc.com)
2. **W&AR-16 Lower Tuolumne River Temperature Model Status Report, September 2012**
   As this status report is 8 MB in size, it is being uploaded to relicensing website only, rather than emailed with this agenda.
3. **W&AR-03 Reservoir Temperature Model: Upstream Water Temperature and Meteorological Data Sets for Model Verification, September 2012**

A CD with the River/Reservoir Temperature and Meteorological Data will be available at this meeting. This CD will also be available after the meeting, upon request (rose.staples@hdrinc.com).

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Memo

To:	Don Pedro Relicensing Participants		
From:	Turlock Irrigation District / Modesto Irrigation District	Project:	Don Pedro Hydroelectric Project
Date:	September, 2012		

Re: Study W&AR-03 Reservoir Temperature Model: upstream water temperature and meteorological data sets for model verification

Introduction

The MIKE3-FM model is being calibrated with data collected in 2011 and 2012 at Turlock Irrigation District's ("TID") and Modesto Irrigation District's ("TID") (collectively, the "Districts") water temperature station on the Tuolumne River at Indian Creek Trail (TRINDCRK), which represents the upstream boundary condition. Also, the Districts installed a meteorology station adjacent to Don Pedro Reservoir in 2010 to collect local atmospheric conditions. The W&AR-3 Study Plan initially identified 2008 as the calibration year and 2011 as the verification year. With a complete 2011 data set now available, we have elected to use it as the calibration year and 2012 as the validation year. These two years are also suitable choices since water surface elevations during the verification year are lower than in the calibration year. This will serve to demonstrate that the model simulates varying storage conditions. Temperature profiles have been collected monthly at six California Department of Fish and Game (CDFG) stations since 2008. The same six stations are being profiled this year by both CDFG and the Districts. Since 2010, the Districts have been collecting profiles at stations upstream and downstream of the Old Don Pedro Dam.

To develop a long-term record for reservoir inflow, upstream water temperature stations are identified and data collected concurrently at these stations and the Indian Creek Trail station are compared to assess the similarity in temperature of the different upstream river locations. Likewise, data from an established meteorology station in the vicinity of the reservoir is compared to data collected near the dam.

Upstream Water Temperature

Thermistor stations upstream of the reservoir are operated by CDFG, the University of California at Davis (UC Davis), the San Francisco Public Utilities Commission (SFPUC), and the Districts. The station name, operator, code and location are provided in Table 1 for the five stations:

Table 1: Thermistor stations located upstream of Don Pedro Reservoir.

Station	Operator	Station Code	River Mile	Latitude	Longitude
Tuolumne River, downstream of South Branch	CDFG	TBSFRK	96	37.8360	-120.0537
Tuolumne River above Don Pedro at Indian Creek	UC-Davis	TuolblwIC	88	37.8853	-120.1547

Station	Operator	Station Code	River Mile	Latitude	Longitude
Tuolumne River at Indian Creek Trail	TID/MID	TRINDCRK	83	37.8838	-120.1536
Tuolumne River, upstream of Ward's Ferry	SFPUC	TR8	79.5	37.8830	-120.2809
Tuolumne River upstream of Wards Ferry Bridge	CDFG	TRWARDS	76.5	37.8807	-120.2918

CDFG and SFPUC's stations upstream of Wards Ferry may be slightly affected by the backwater of Don Pedro Reservoir when the reservoir is nearly full, although this seldom occurs except during late spring or early summer. The three other stations are upstream of the North Fork Tuolumne River confluence and downstream of the South Fork Tuolumne River confluence with the Tuolumne, well outside of the reservoir's influence.

Hourly water temperature data for these five stations are contained in Excel spreadsheets. Time periods when data were recorded are shown in the chart below (Figure 1). The stations are ordered downstream to upstream. As TRWARDS and TuolblwIC are missing data during all of 2008, these stations would not be able to be used in the model verification if the 2008 year was selected for model verification. Because temperature was not measured at TR8 during the first six months and six days of 2008 (January 1 – July 6), this station would also not have sufficient data for model verification. However, data at TR8 are available for the recent period when TRINDCRK was recording data, and these data are compared later in this memo to assess potential reservoir backwater effects. The next upstream station, TBSFRK, has data starting January 3, 2008 through the end of that year and extending through August 16, 2011 (last data download).

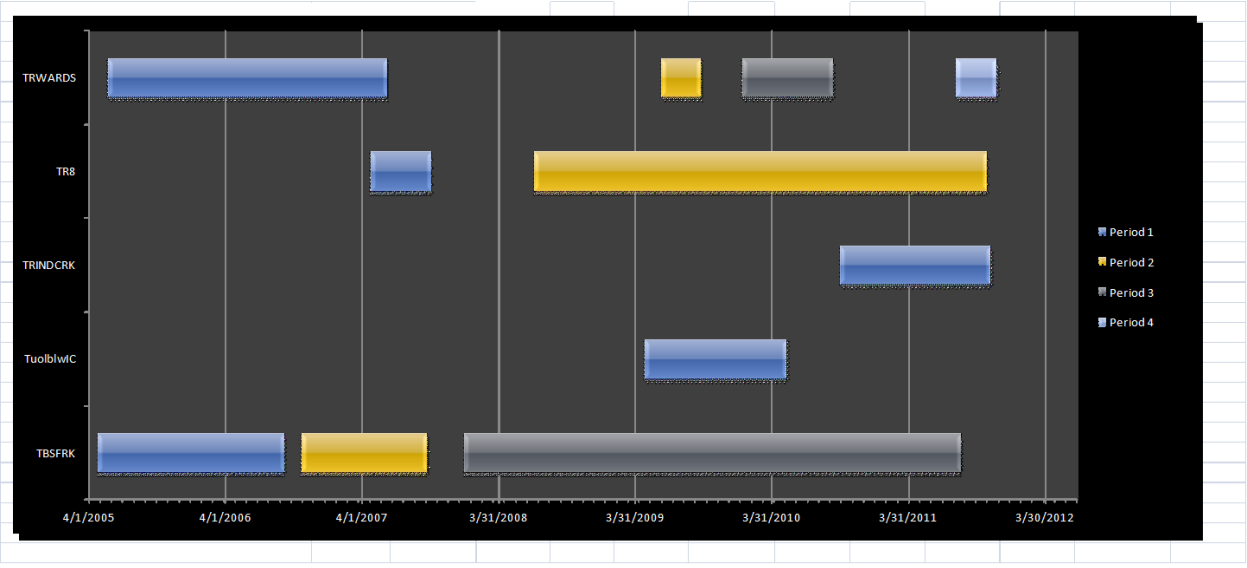


Figure 1: Intervals of data availability by thermistor station upstream of Don Pedro Reservoir.

Daily average, minimum and maximum temperatures were compiled from available data from October 1, 2010 through September 30, 2011 for the three stations. This time interval was selected because the Districts' station, TRINDCRK, began collecting data on October 1, 2010

and 12 months of data are currently available for comparison with TR8 and TBSFRK. These three metrics are presented as graphical comparisons in the following plots. The daily average air temperature at the District's met station near the dam is also plotted.

Average, minimum, and maximum temperatures for the three stations are plotted in Figure 2, Figure 3, and Figure 4, respectively.

- The daily <u>average</u> temperatures recorded at TBSFRK compares well with the average temperature at TRINDCRK during most of the overlapping period (Figure 2), except during October 2010 and July/August 2011 when the upstream station's (TBSFRK) temperature is slightly lower than the downstream station's (TRINDCRK). The daily average temperature at TR8 is also similar to TRINDCRK from November 2010 through mid-July 2011. Beyond that date, TR8 appears to be unresponsive to the changes in air temperature, unlike the other two stations. This apparent malfunction in the thermistor at TR8 is further considered in the minimum and maximum temperature comparisons.
- The daily <u>minimum</u> temperatures at TBSFRK and TRINDCRK show similar trends as the daily average temperature (Figure 3). Daily minimum temperature at TR8 is approximately equal to the Districts' station through mid-July. Beyond that date, TR8 displays little diurnal variation indicating an equipment malfunction.
- The daily <u>maximum</u> temperatures at the three stations show patterns observed in the previous comparisons (Figure 4).

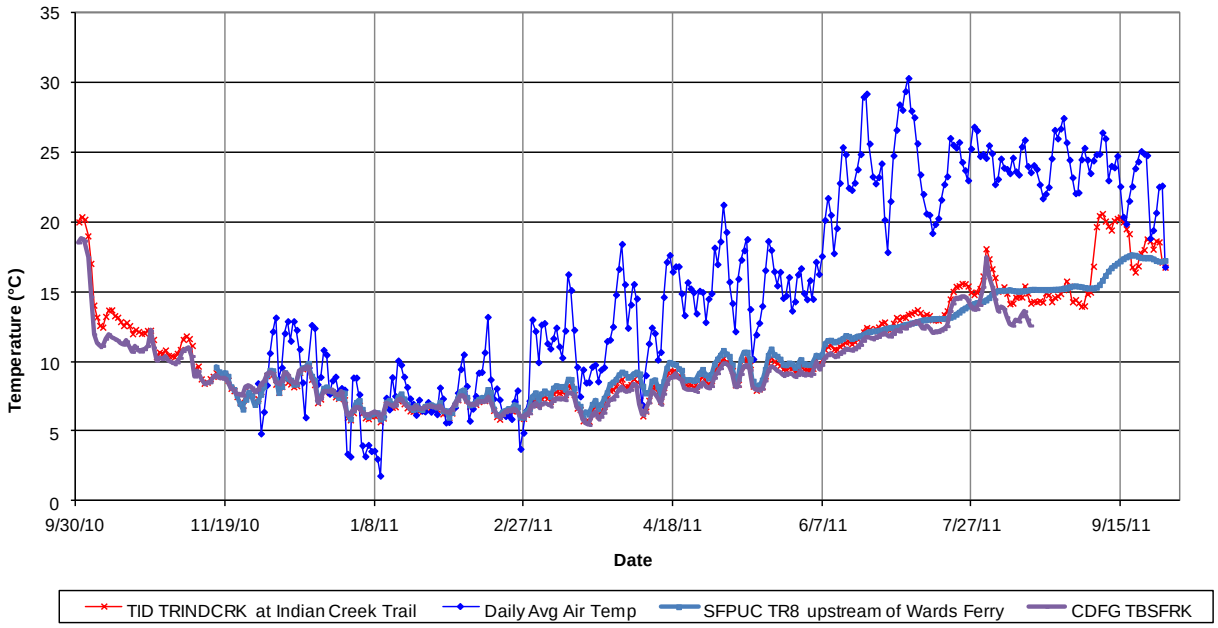


Figure 2: Average daily temperatures at TRINDCRK, TR8, and TBSFRK, upstream of Don Pedro Reservoir, and daily average air temperature at Don Pedro Reservoir dam October 2010 to September 2011

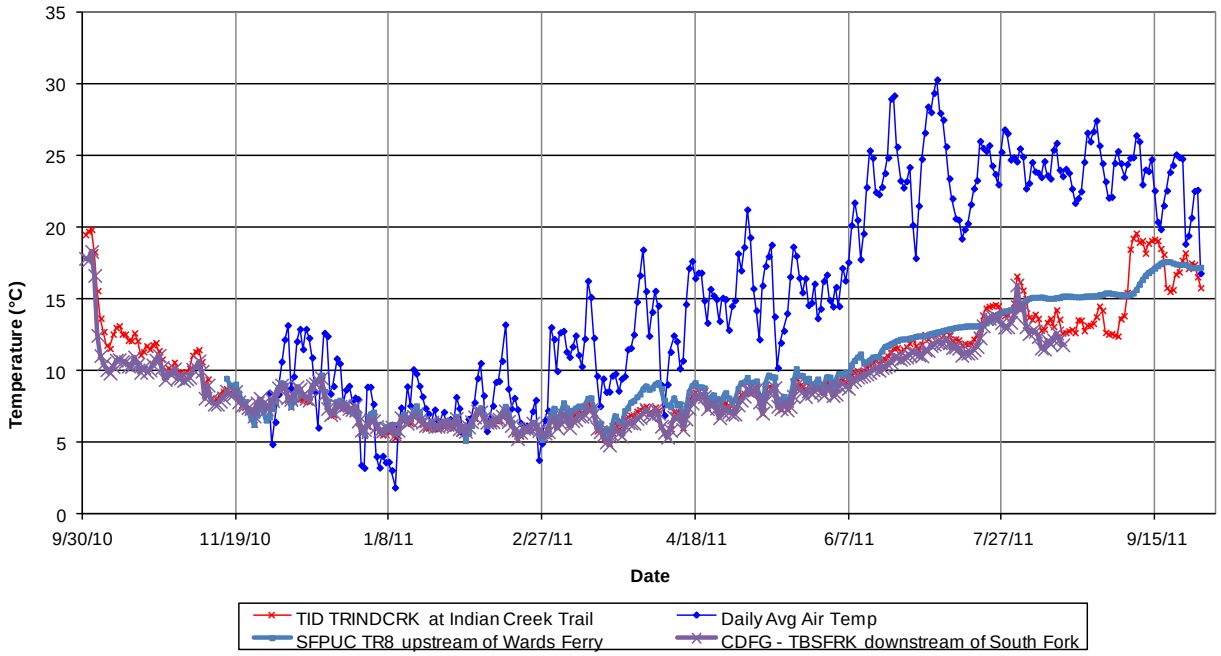


Figure 3: Minimum daily temperatures at TRINDCRK, TR8, and TBSFRK, upstream of Don Pedro Reservoir, and daily average air temperature at Don Pedro Reservoir dam October 2010 to September 2011.

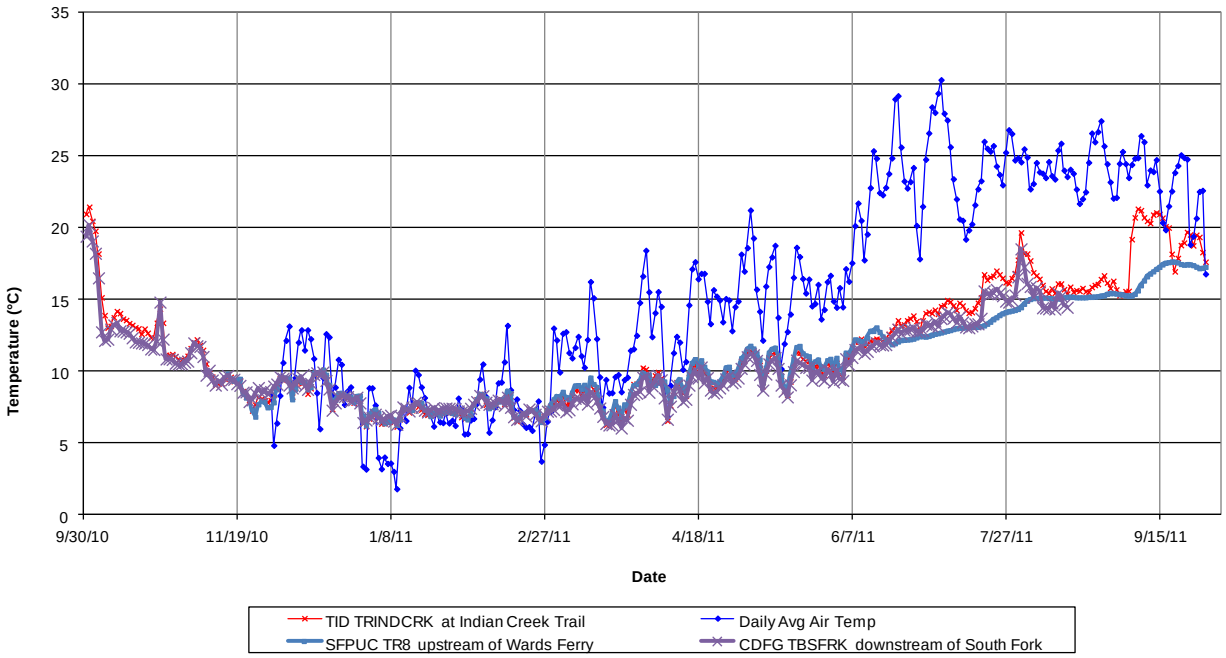


Figure 4: Maximum daily temperatures at TRINDCRK, TR8, and TBSFRK upstream of Don Pedro Reservoir, and daily average air temperature at Don Pedro Reservoir dam October 2010 to September 2011.

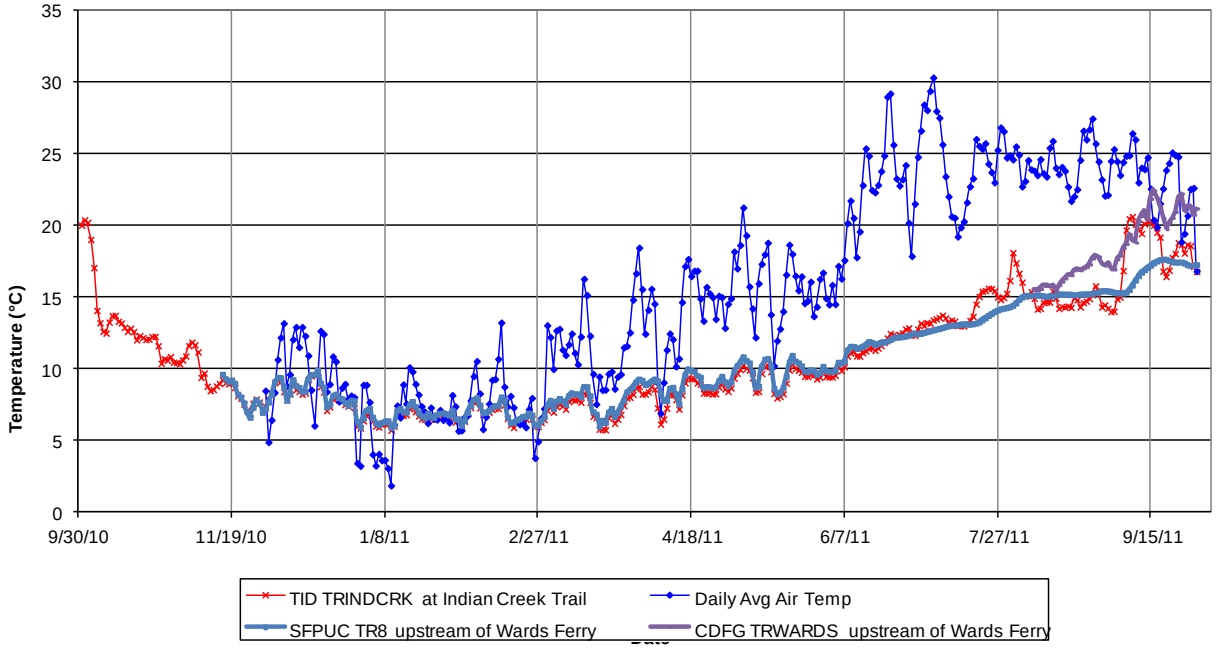


Figure 5: Average temperatures at TRWARDS, TR8, and TRINDCRK, and daily average air temperature at Don Pedro Reservoir dam October 2010 to September 2011.

Hence, comparison of temperature data collected during a period of almost 12 months indicates that the temperature at TBSFRK is closely related to the temperature at TRINDCRK. Assuming that subsequent data collections continue to show similar comparisons, temperature data at the "surrogate" station TBSFRK during 2008 may be able to be used for model verification with minor adjustment. This may allow 2008 to also be used as an additional verification year.

The comparisons also indicate that there is only minor variations in temperature between River Mile (RM) 96 (TBSFRK) and RM 83 (TRINDCRK). The difference in temperature between this reach and "upstream of Wards Ferry" (TR8 - RM 79.5) also appears to be minimal during October 2010 through June 2011 when the water surface in the reservoir was below 820 feet and not high enough to cause a backwater effect at TR8.

Meteorological Conditions

The atmospheric conditions at the reservoir/atmosphere boundary are defined in the model by:

- Air Temperature
- Relative Humidity
- Solar Radiation
- Wind Speed and Direction

Hourly data for these meteorological parameters are input to the MIKE3-FM model, except solar radiation, which is calculated within the model based on location (Lat/Long), elevation, and

clearness coefficient, which is inversely related to cloud cover. Calculated rates are then compared to observed data and adjusted as needed. Meteorology stations in the vicinity of Don Pedro Reservoir were investigated to identify potential sources of data for the above parameters (Table 2). The Buck Meadows station which is operated by the National Interagency Fire Center (NIFC) has hourly data for these parameters. The station is located at latitude 37.8233 and longitude -120.0975, which is approximately 15 miles northeast of the reservoir, just within the watershed boundary at an elevation of 3,200 ft. Data records at Buck Meadows extend from July 1999 to the present. Hourly data were obtained from the Western Regional Climate Center in Reno, NV. A CIMIS station is located at Denair, south of the Tuolumne watershed, but approximately the same distance from Don Pedro Reservoir as the Buck Meadows Station. In April 2009, the original Denair station (Denair I) was moved about one mile southeast to its present location (Denair II). In 2010, the Districts installed a meteorology station at Don Pedro Reservoir, near the dam.

Table 2: Meteorological stations in the vicinity of Don Pedro Reservoir.

Station	Operator	Station Code	Elevation	Latitude	Longitude
Buck Meadows	NIFC	BMEC1	3200 ft	37.8233	-120.0975
Don Pedro Reservoir	TID/MID	DP	800 ft [1]	37.7319[2]	-120.3846[2]
Denair I	CIMIS	168	140 ft	37.5529	-120.7793
Denair II	CIMIS	206	150 ft	37.5459	-120.7545

ft = feet
[1] Estimated value.
[2] Middle Bay

Daily average, minimum and maximum values of air temperatures, relative humidity, and solar radiation during 2010-2011 were compiled for the Buck Meadows station and the Districts' station (Figures 6 through 8). These three metrics are appropriate for graphical comparisons as presented in the following plots.

- Air temperature at Buck Meadows and Denair II show similar temporal variation to Don Pedro Reservoir (Figure 6). The daily minimum and average air temperature at the dam is slightly higher than at Buck Meadows and Denair.
- Maximum daily relative humidity at Buck Meadows tends to be greater than at Don Pedro (Figure 7). The difference in the daily averages is slightly less than the difference in daily maxima.
- Daily average solar radiation at Don Pedro Reservoir was lower than at Buck Meadows and Denair II, particularly between mid-April and mid-August 2011 (Figure 8). Daily maximum solar radiation during the summer is substantially lower at the reservoir dam than at Buck Meadows and Denair. This may indicate equipment malfunction and is being checked.

The TID/MID meteorological station near Roberts Ferry (referred to as "Tuolumne") provided solar radiation data which can be compared to the Don Pedro data (Figure 9). There is no decrease in solar radiation near Roberts Ferry between early June and late July 2011. As the solar radiation near Roberts Ferry is similar to Don Pedro during August through December 2011, the early-June through late July data near Roberts Ferry can be used in place of the anomalous Don Pedro data for this interval. The daily maximum solar radiation at Don Pedro increased at the end of July to narrow the gap between the Buck Meadows and Don Pedro stations for the remainder of the year.

Although wind speed and direction data were not compared, differences between the Don Pedro and Buck Meadows and Denair stations are expected because the spatial variability in wind is generally substantial. Model sensitivity analysis to wind speed and direction can be used to assess the effects of values lower and higher than Buck Meadows and Denair data.

Conclusion

Data collected in 2011 show a correlation between upstream thermistor temperature measurements and meteorological station measurements near the dam and approximately15 miles away. Hence, water temperature data collected in 2008 from stations TBSFRK and TR8 are considered, with minor adjustment, to represent inflow water temperatures for verification of the model. The 2008 meteorological data at Denair I can also be used for model verification, as well. Uncertainty associated with these assumptions will be explored in the model's sensitivity analysis. While it is recognized that the 2008 data may not be as well suited as 2012 data for reservoir model verification because of the direct measurement of inflow temperatures in 2012, the year 2008 may still provide an additional year of model verification. If 2008 water levels are substantially lower than 2012, then 2008 may be used as further verification of the model.

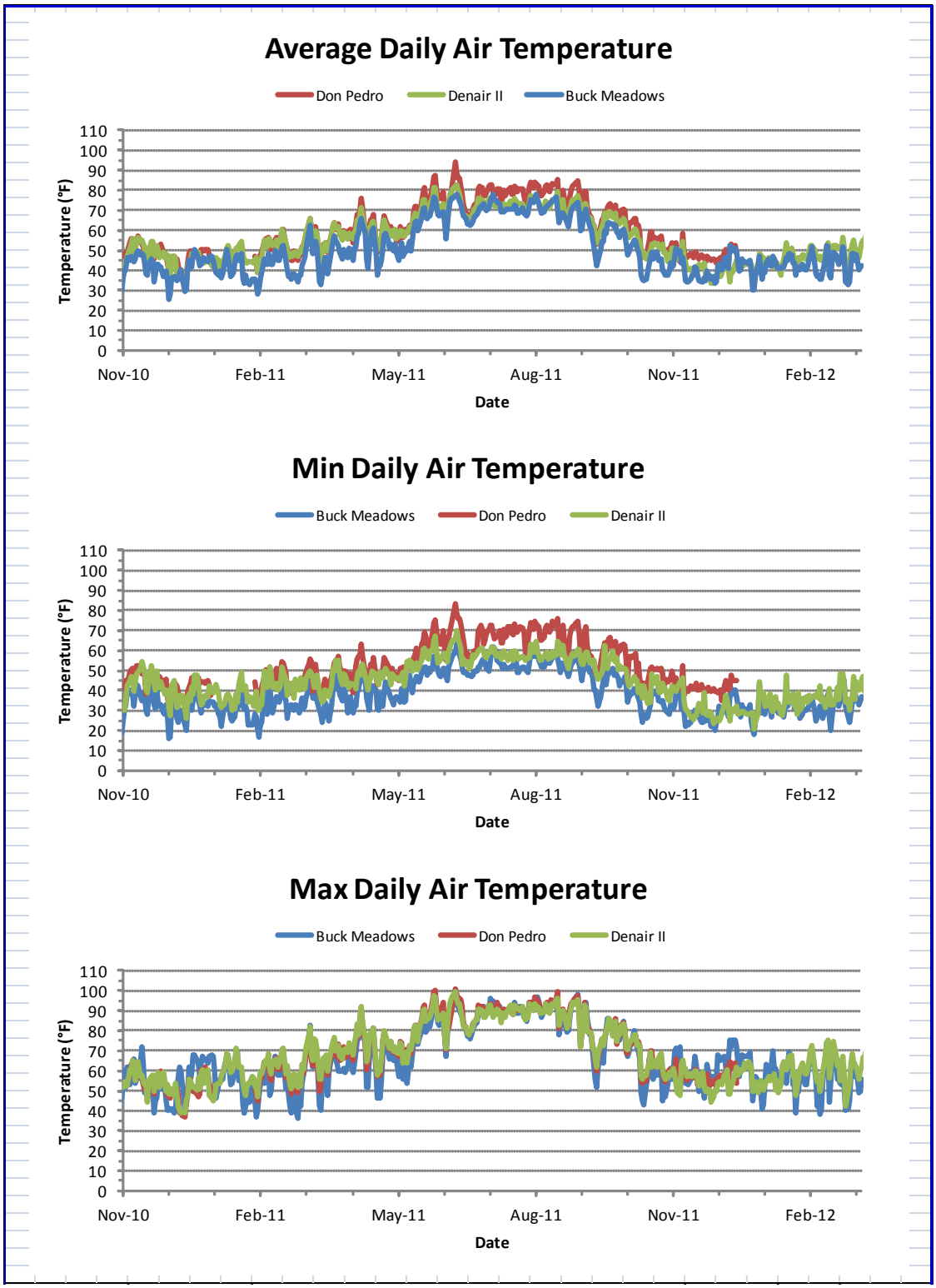


Figure 6: Air temperature comparisons, Buck Meadows, Don Pedro, and Denair II Stations November 2010 through February 2012.

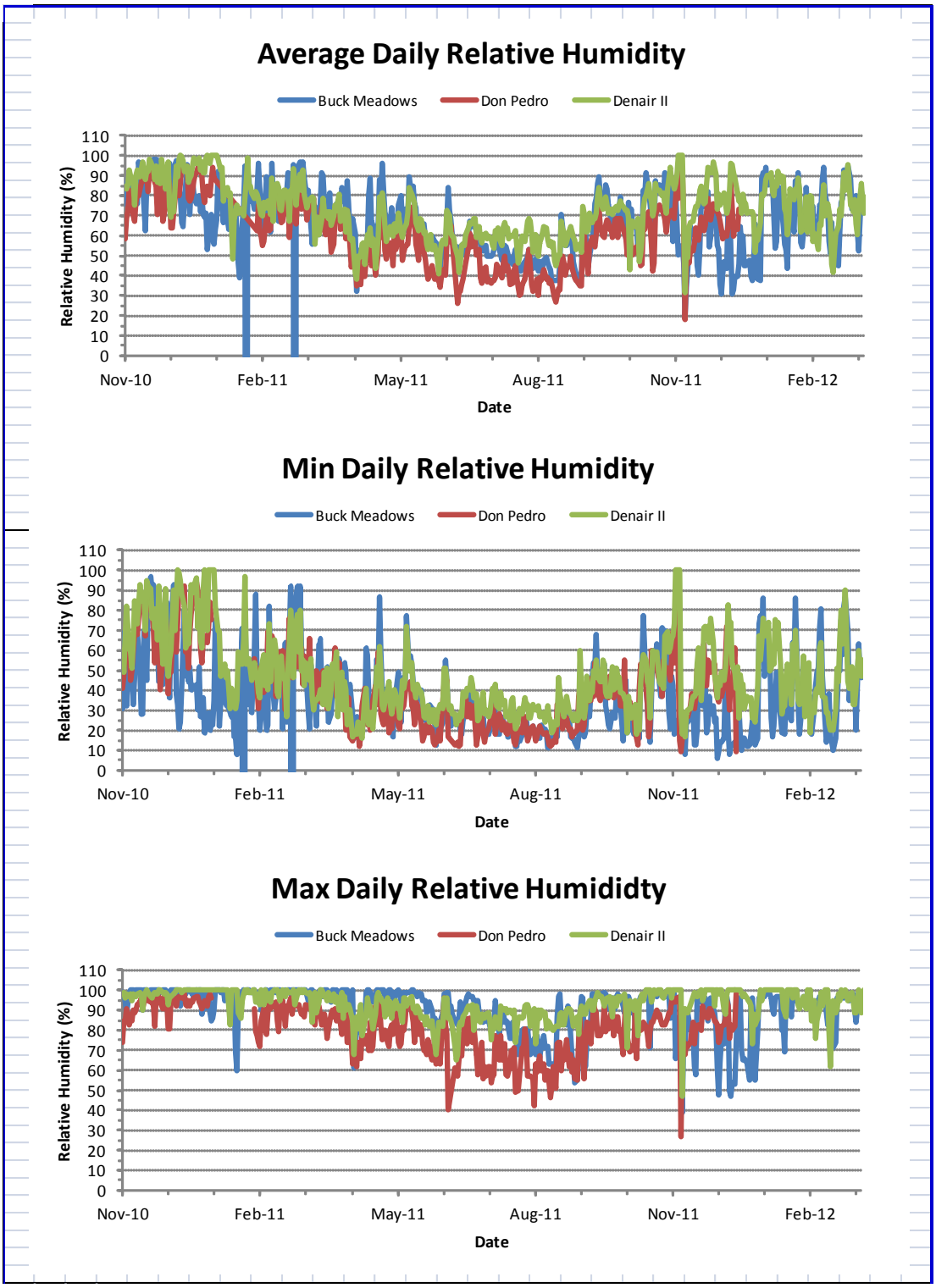


Figure 7: Relative daily humidity comparisons, Buck Meadows, Don Pedro, and Denair II stations November 2010 through February 2012.

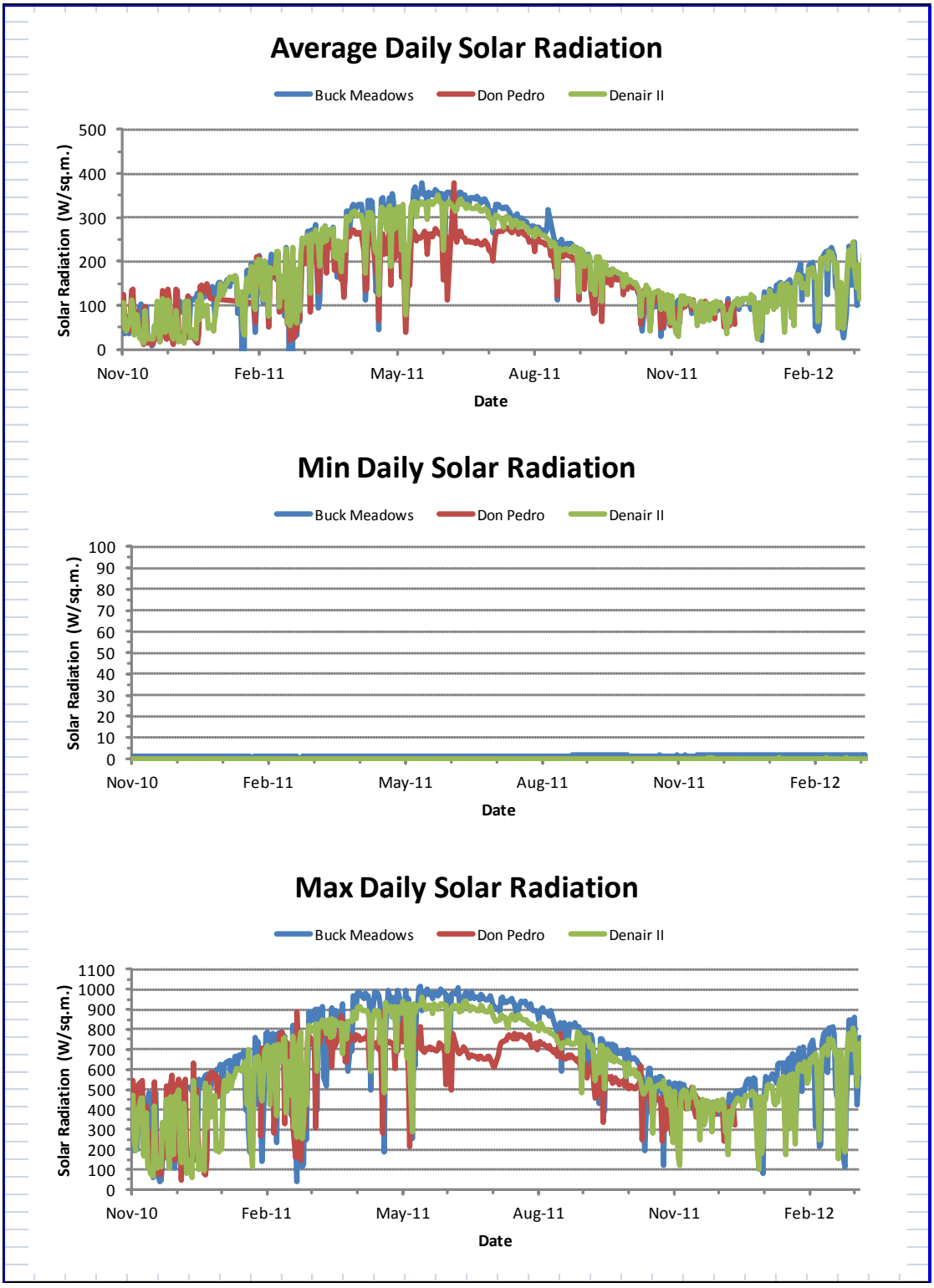


Figure 8: Daily solar radiation, Buck Meadows, Don Pedro and Denair II stations, November 2010 through February 2012

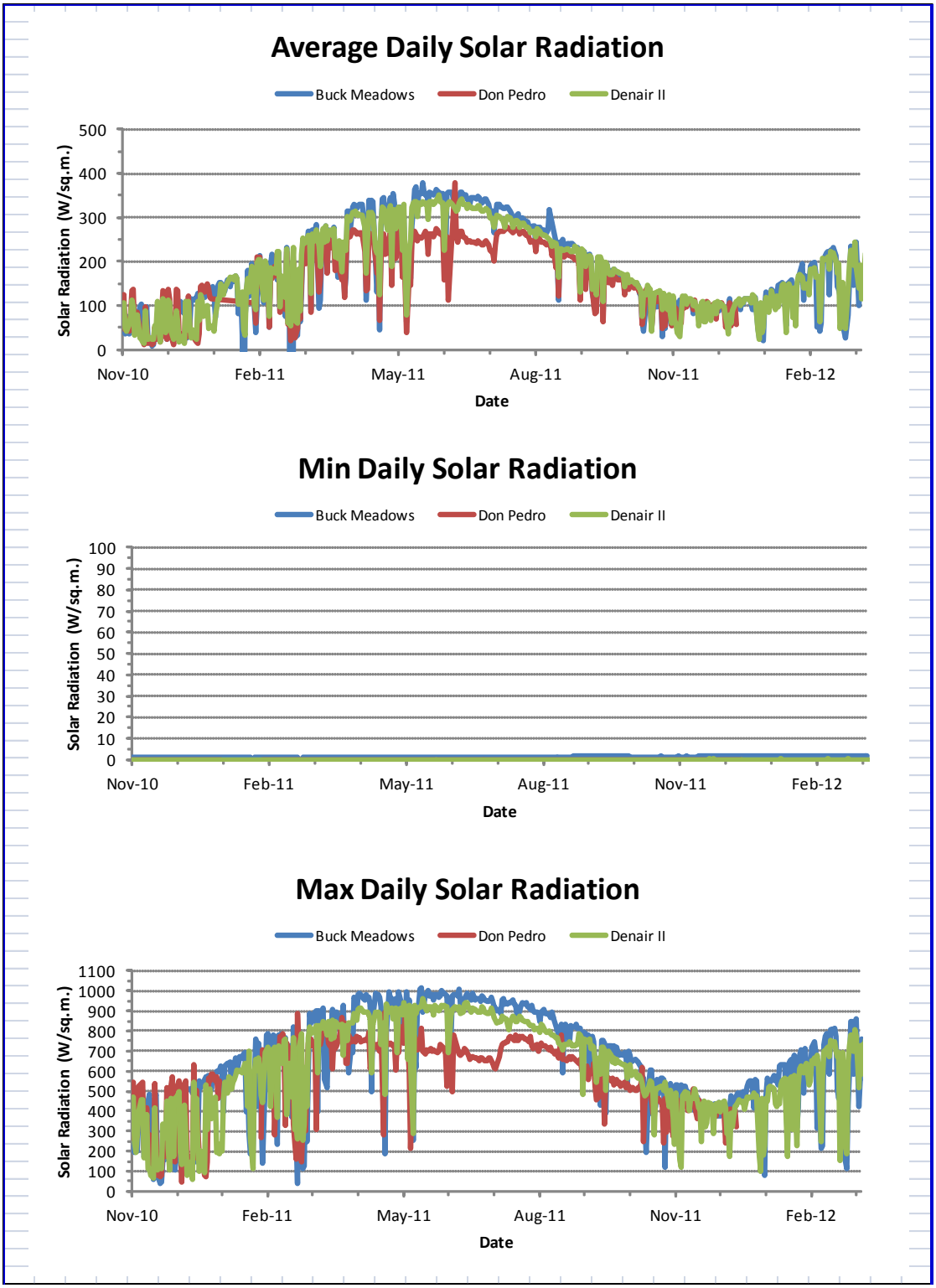


Figure 9: Daily solar radiation Buck Meadows, Don Pedro, and Denair II stations, November 2010 through February 2012.

From: Staples, Rose
Sent: Tuesday, October 23, 2012 3:26 PM
To: 'Alves, Jim'; 'Anderson, Craig'; 'Asay, Lynette'; 'Barnes, James'; 'Barnes, Peter'; 'Beniamine Beronia'; 'Blake, Martin'; 'Bond, Jack'; Borovansky, Jenna; 'Boucher, Allison'; 'Bowes, Stephen'; 'Bowman, Art'; 'Brenneman, Beth'; 'Brewer, Doug'; 'Buckley, John'; 'Buckley, Mark'; 'Burt, Charles'; 'Byrd, Tim'; 'Cadagan, Jerry'; 'Carlin, Michael'; 'Charles, Cindy'; 'Colvin, Tim'; 'Costa, Jan'; 'Cowan, Jeffrey'; 'Cox, Stanley Rob'; 'Cranston, Peggy'; 'Cremeen, Rebecca'; 'Damin Nicole'; 'Day, Kevin'; 'Day, P'; 'Denean'; 'Derwin, Maryann Moise'; Devine, John; 'Donaldson, Milford Wayne'; 'Dowd, Maggie'; 'Drekmeier, Peter'; 'Edmondson, Steve'; 'Eicher, James'; 'Fargo, James'; 'Ferranti, Annee'; 'Ferrari, Chandra'; 'Fety, Lauren'; 'Findley, Timothy'; 'Fuller, Reba'; 'Furman, Donn W'; 'Ganteinbein, Julie'; 'Giglio, Deborah'; 'Gorman, Elaine'; 'Grader, Zeke'; 'Gutierrez, Monica'; 'Hackamack, Robert'; 'Hastreiter, James'; 'Hatch, Jenny'; 'Hayat, Zahra'; 'Hayden, Ann'; 'Hellam, Anita'; 'Heyne, Tim'; 'Holley, Thomas'; 'Holm, Lisa'; 'Horn, Jeff'; 'Horn, Timi'; 'Hudelson, Bill'; 'Hughes, Noah'; 'Hughes, Robert'; 'Hume, Noah'; 'Jackman, Jerry'; 'Jackson, Zac'; 'Jauregui, Julia'; 'Jennings, William'; 'Jensen, Art'; 'Jensen, Laura'; 'Johannis, Mary'; 'Johnson, Brian'; 'Justin'; 'Keating, Janice'; 'Kempton, Kathryn'; 'Kinney, Teresa'; 'Koepele, Patrick'; 'Kordella, Lesley'; 'Lein, Joseph'; 'Levin, Ellen'; 'Lewis, Reggie'; 'Linkard, David'; Loy, Carin; 'Lwenya, Roselynn'; 'Lyons, Bill'; 'Madden, Dan'; 'Manji, Annie'; 'Marko, Paul'; 'Marshall, Mike'; 'Martin, Michael'; 'Martin, Ramon'; 'Mathiesen, Lloyd'; 'McDaniel, Dan'; 'McDevitt, Ray'; 'McDonnell, Marty'; 'McLain, Jeffrey'; 'Mein Janis'; 'Mills, John'; 'Minami Amber'; 'Monheit, Susan'; 'Morningstar Pope, Rhonda'; 'Motola, Mary'; 'Murphey, Gretchen'; 'O'Brien, Jennifer'; 'Orvis, Tom'; 'Ott, Bob'; 'Ott, Chris'; 'Paul, Duane'; 'Pavich, Steve'; 'Pinhey, Nick'; 'Pool, Richard'; 'Porter, Ruth'; 'Powell, Melissa'; 'Puccini, Stephen'; 'Raeder, Jessie'; 'Ramirez, Tim'; 'Rea, Maria'; 'Reed, Rhonda'; 'Richardson, Kevin'; 'Ridenour, Jim'; 'Robbins, Royal'; 'Romano, David O'; 'Roos-Collins, Richard'; 'Roseman, Jesse'; 'Rothert, Steve'; 'Sandkulla, Nicole'; 'Saunders, Jenan'; 'Schutte, Allison'; 'Sears, William'; 'Shakal, Sarah'; 'Shipley, Robert'; 'Shumway, Vern'; 'Shutes, Chris'; 'Sill, Todd'; 'Slay, Ron'; 'Smith, Jim'; Staples, Rose; 'Steindorf, Dave'; 'Steiner, Dan'; 'Stone, Vicki'; 'Stork, Ron'; 'Stratton, Susan'; 'Taylor, Mary Jane'; 'Terpstra, Thomas'; 'TeVelde, George'; 'Thompson, Larry'; 'Vasquez, Sandy'; 'Verkuil, Colette'; 'Vierra, Chris'; 'Wantuck, Richard'; 'Welch, Steve'; 'Wesselman, Eric'; 'Wheeler, Dan'; 'Wheeler, Dave'; 'Wheeler, Douglas'; 'Wilcox, Scott'; 'Williamson, Harry'; 'Willy, Allison'; 'Wilson, Bryan'; 'Winchell, Frank'; 'Wooster, John'; 'Workman, Michelle'; 'Yoshiyama, Ron'; 'Zipser, Wayne'
Subject: Don Pedro Workshops PPT Presentations

We have uploaded today to the www.donpedro-relicensing.com website (under the MEETINGS Tab / Meetings Calendar / September 21 and October 26 Calendar Dates)
the following:

September 21
The PowerPoint presentation used in the September 21 Hydrologic Investigations Workshop

October 26
The two PowerPoint presentations to be used at the October 26 Don Pedro Reservoir and Lower Tuolumne River Temperature Models Workshops

If you have any problems accessing/downloading these documents, please let me know.

ROSE STAPLES

Don Pedro Project Relicensing

W&AR-03: Don Pedro Reservoir Temperature Model Workshop #2

October 26, 2012

MODESTO IRRIGATION DISTRICT | TURLOCK IRRIGATION DISTRICT

FERC PROJECT No. 2299

Agenda

- Reservoir Model
  - Study Plan Overview
  - Reservoir Bathymetry Study
  - Model Design and Calculations
  - Data Sources and Collection: Meteorology; Inflow Temperatures; Reservoir Profiles
  - Calibration
  - Validation

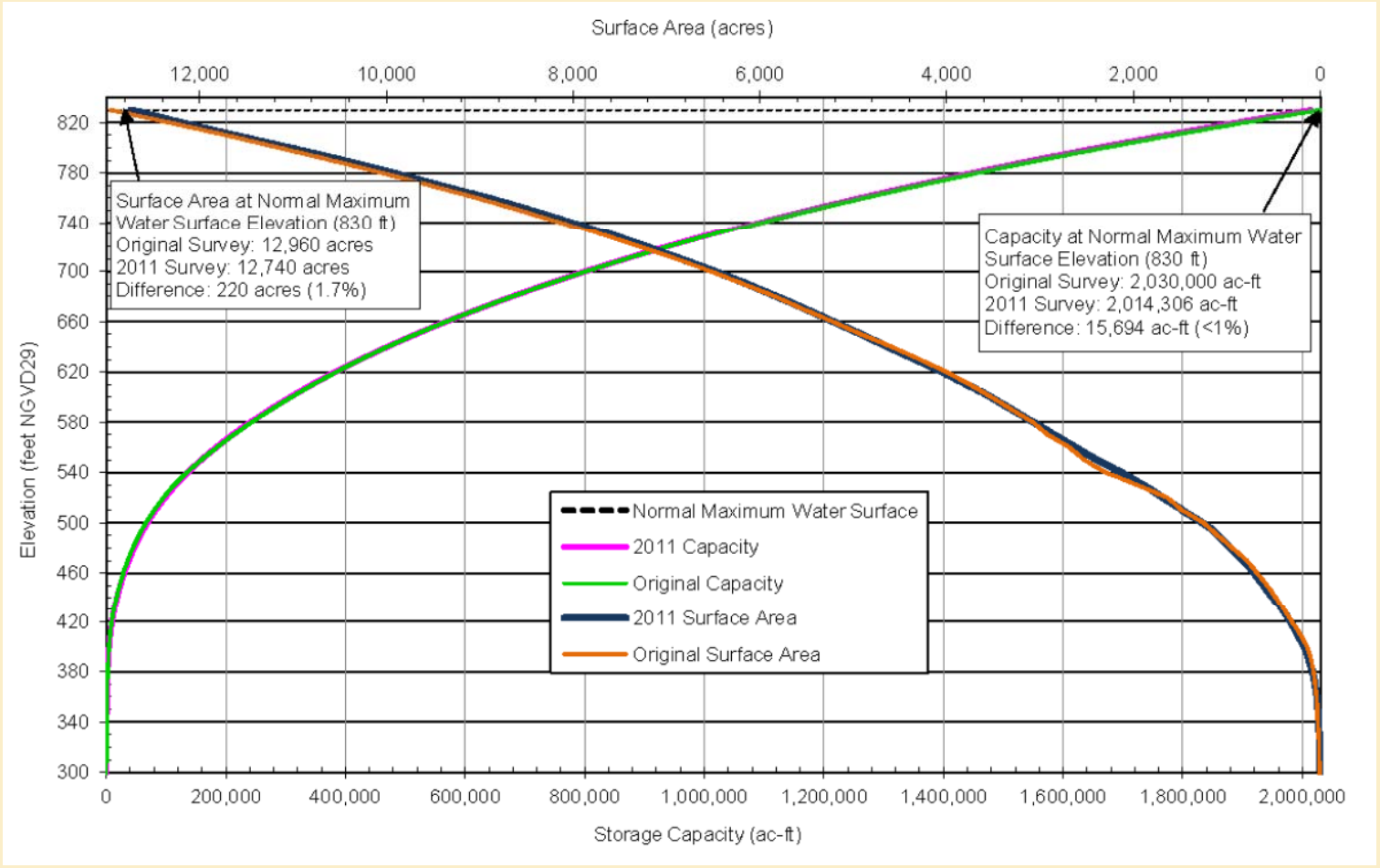
FERC-Approved Study Plan And Path Forward

- DHI's MIKEFM 3D Model
- Model Mesh
- Boundary Conditions
- Study Schedule:
  - April 10, 2012: Model Description and Features
  - October 26, 2012: Model Principles, Reservoir Mesh, Input Data, Initial Calibration Results
  - Model Review by RPs After Calibration/Validation
  - User Training
  - Model Report

Bathymetry Report

- Study Plan Issued with W&AR-3 Study
- Field Data Collection: May 1 to June 5, 2011
- IFSAR Data Above Elev 792 ft
- Surface Model Generation
- QA/QC
- Results

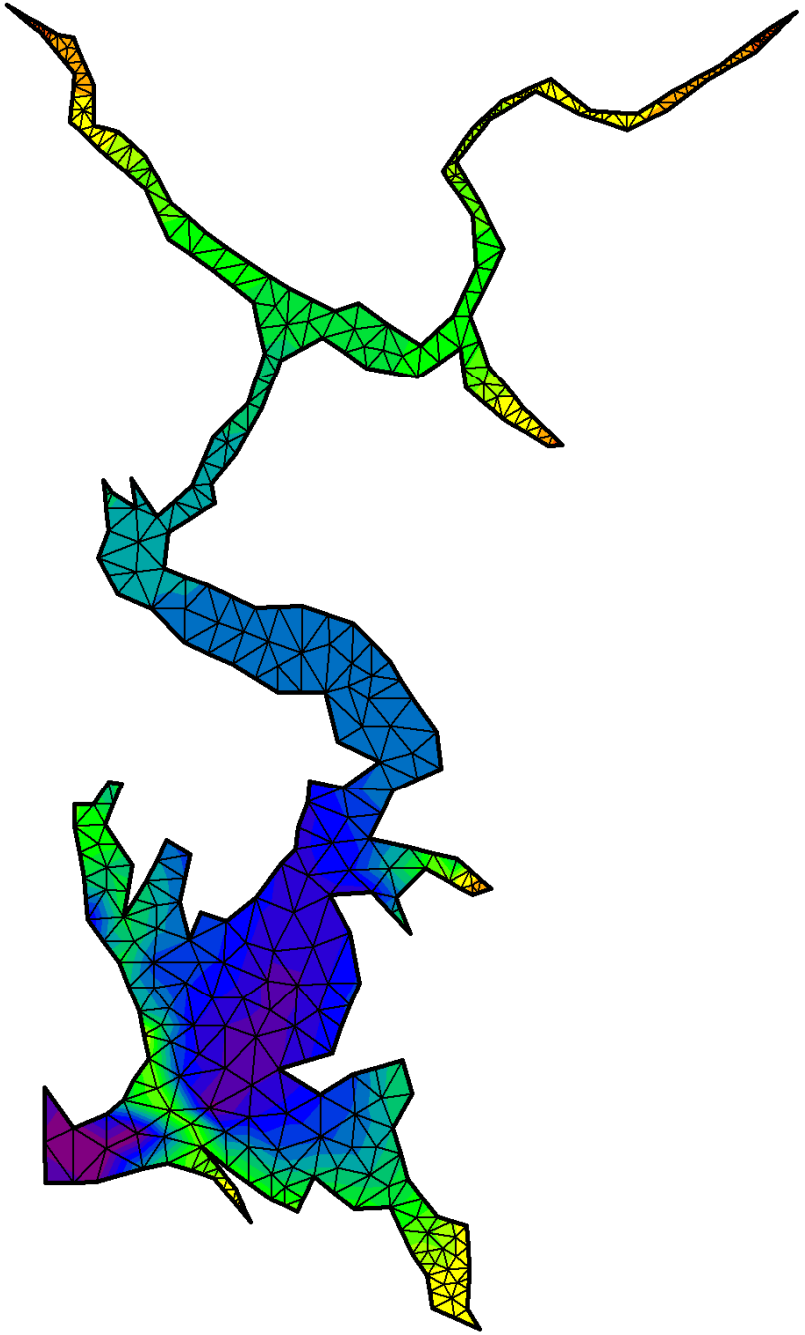
Reservoir Bathymetry



Reservoir Model Design and Principles

- The model used is MIKE3 developed by the Danish Hydraulic Institute
- MIKE3 is a three dimensional, time variable hydrodynamic model
- The model domain for Don Pedro was created using measured bathymetry
- The model uses an unstructured triangular element mesh in a layered, horizontal plane

MODEL MESH


Bathymetry [m]
Above 250
240 - 250
230 - 240
220 - 230
210 - 220
200 - 210
190 - 200
180 - 190
170 - 180
160 - 170
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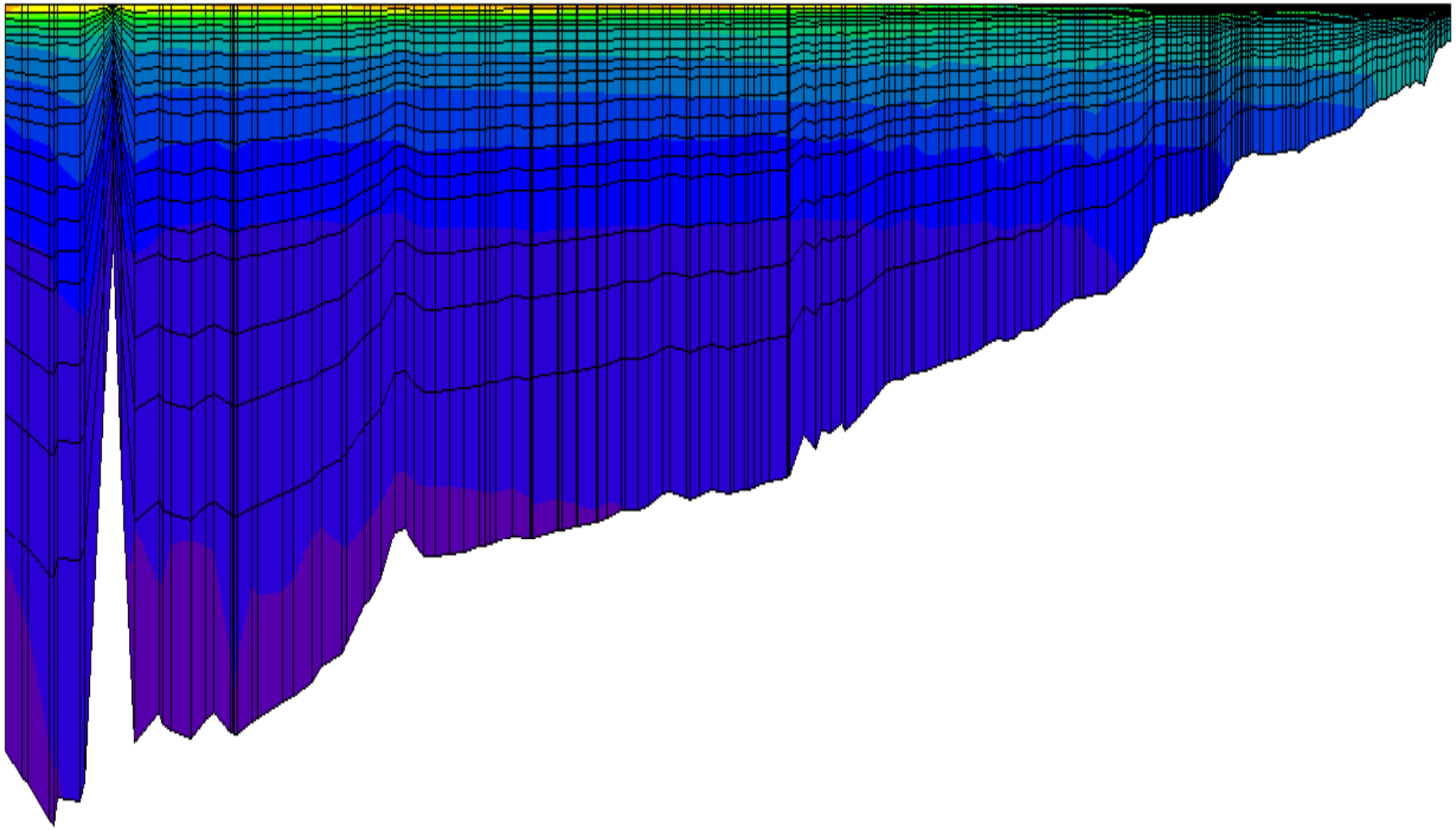
140 - 150
130 - 140
120 - 130
110 - 120
Below 110
Undefined Value

Model Vertical Structure



Model Calculations

- Hydrodynamic and thermodynamic computations
- The model will solve the governing fluid momentum and mass conservation equations to determine the velocity in 3 dimensions (x,y,z)
- The model has several options to compute turbulence
- Wind induced circulation also considered

Three Dimensional Hydrodynamic Equations

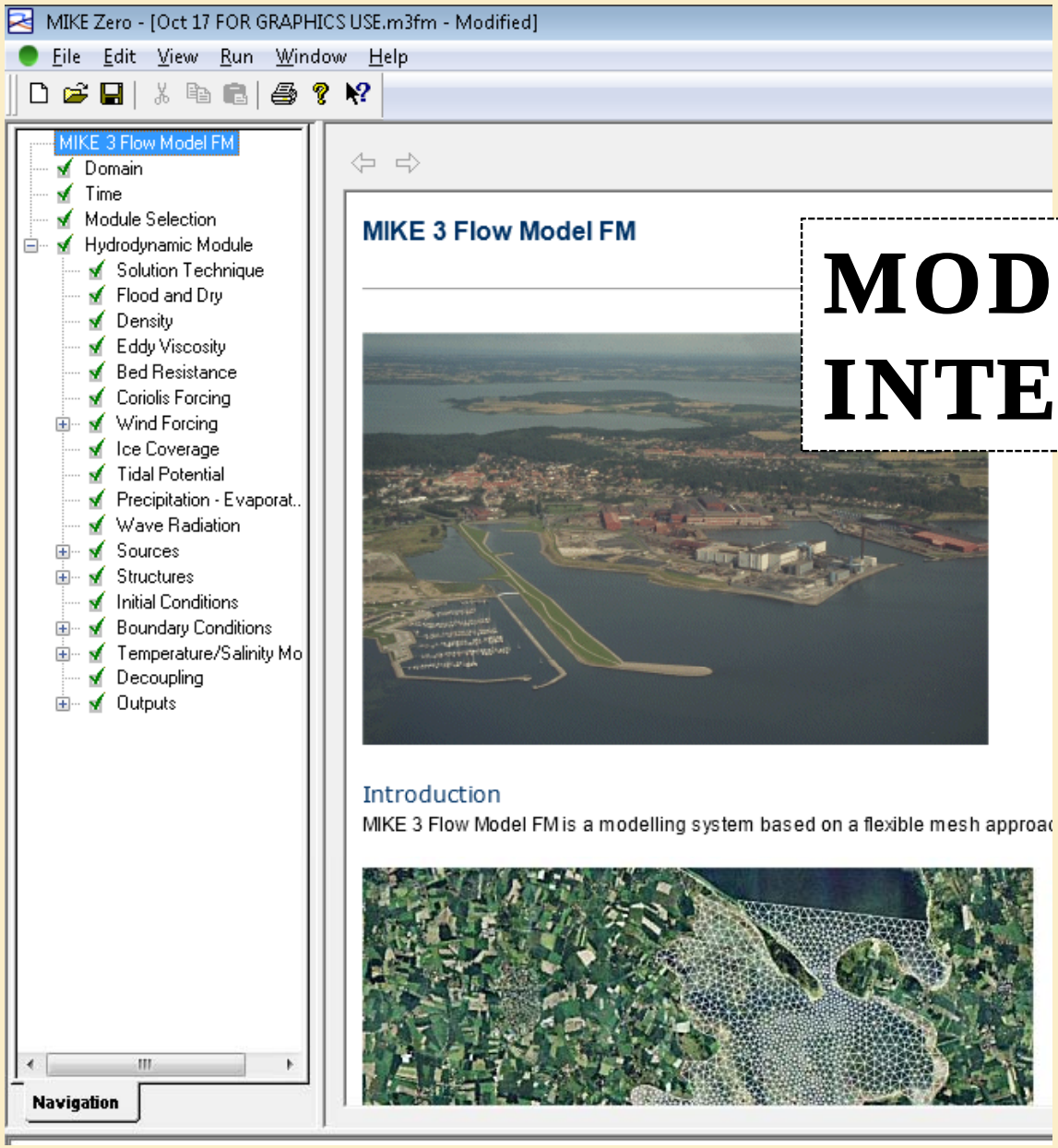
$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=S$$

$$\frac{\partial u}{\partial t}+\frac{\partial u^2}{\partial x}+\frac{\partial vu}{\partial y}+\frac{\partial wu}{\partial z}=fv-g\frac{\partial \eta}{\partial x}-\frac{1}{\rho_0}\frac{\partial p_a}{\partial x}-$$

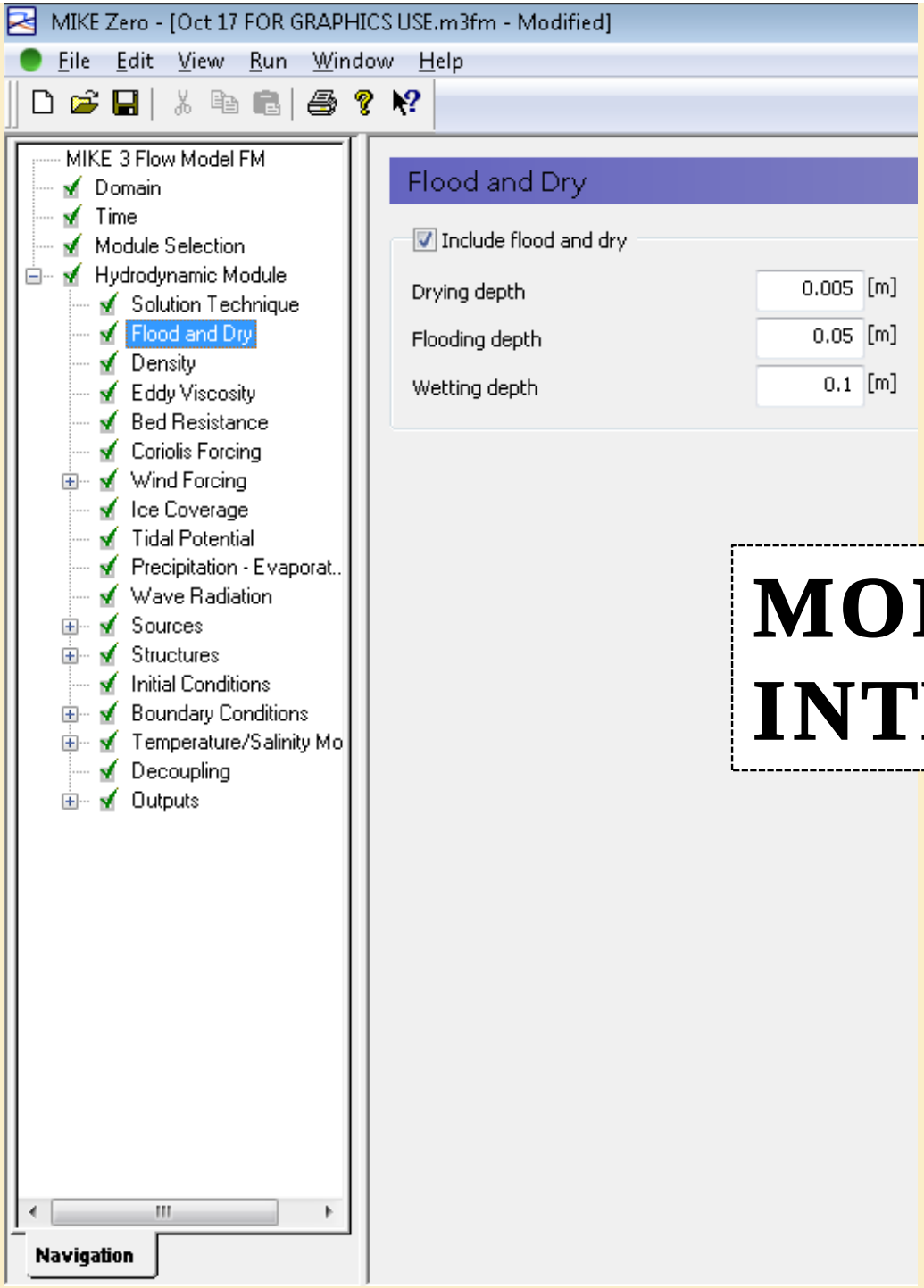
$$\frac{g}{\rho_0}\int_z^{\eta}\frac{\partial \rho}{\partial x}dz-\frac{1}{\rho_0 h}\left(\frac{\partial s_{xx}}{\partial x}+\frac{\partial s_{xy}}{\partial y}\right)+F_u+\frac{\partial}{\partial z}\left(\nu_t\frac{\partial u}{\partial z}\right)+u_s S$$

$$\frac{\partial v}{\partial t}+\frac{\partial v^2}{\partial y}+\frac{\partial uv}{\partial x}+\frac{\partial wv}{\partial z}=-fu-g\frac{\partial \eta}{\partial y}-\frac{1}{\rho_0}\frac{\partial p_a}{\partial y}-$$

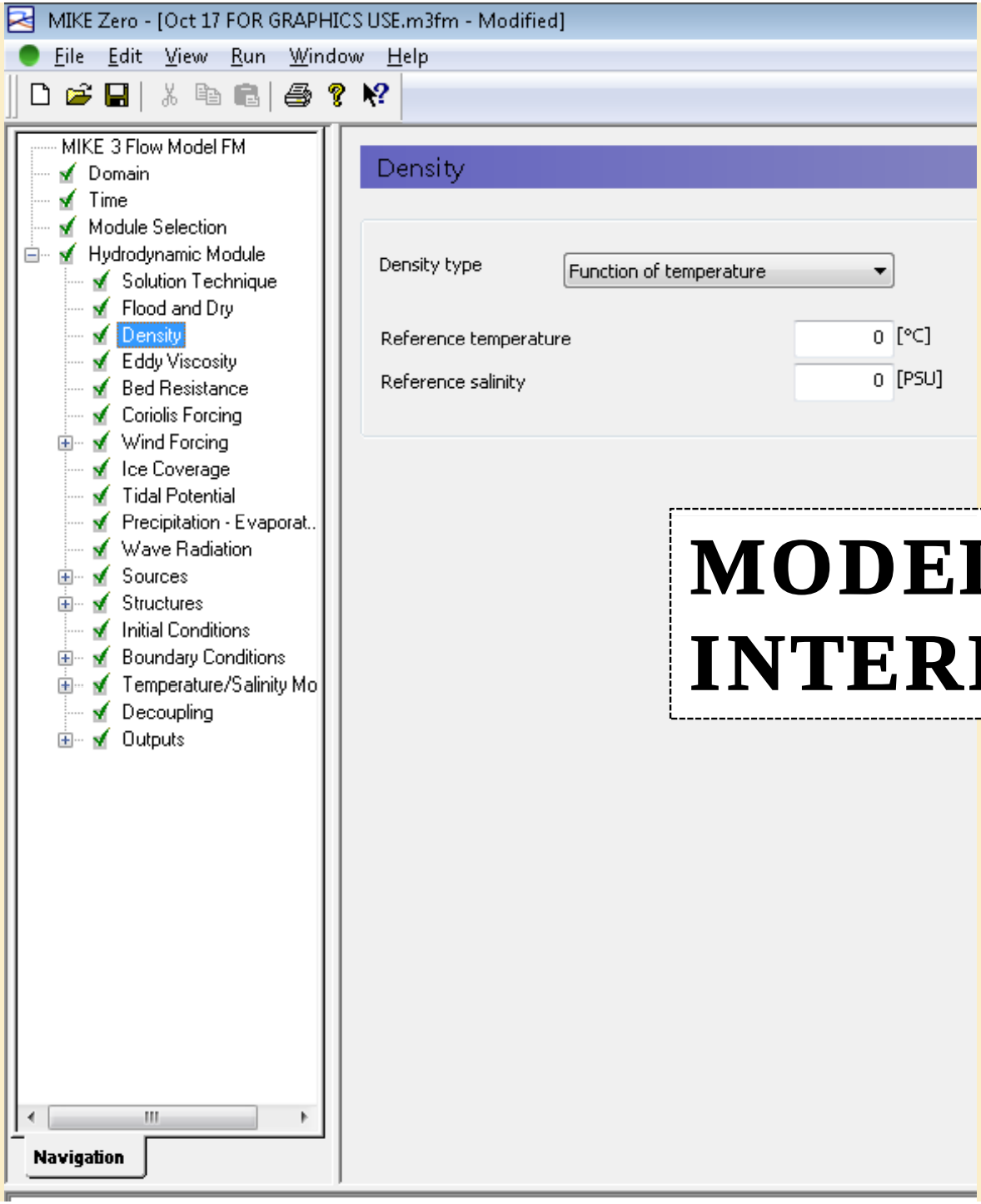
$$\frac{g}{\rho_0}\int_z^{\eta}\frac{\partial \rho}{\partial y}dz-\frac{1}{\rho_0 h}\left(\frac{\partial s_{yx}}{\partial x}+\frac{\partial s_{yy}}{\partial y}\right)+F_v+\frac{\partial}{\partial z}\left(\nu_t\frac{\partial v}{\partial z}\right)+v_s S$$



MODEL INTERFACE



MODEL INTERFACE



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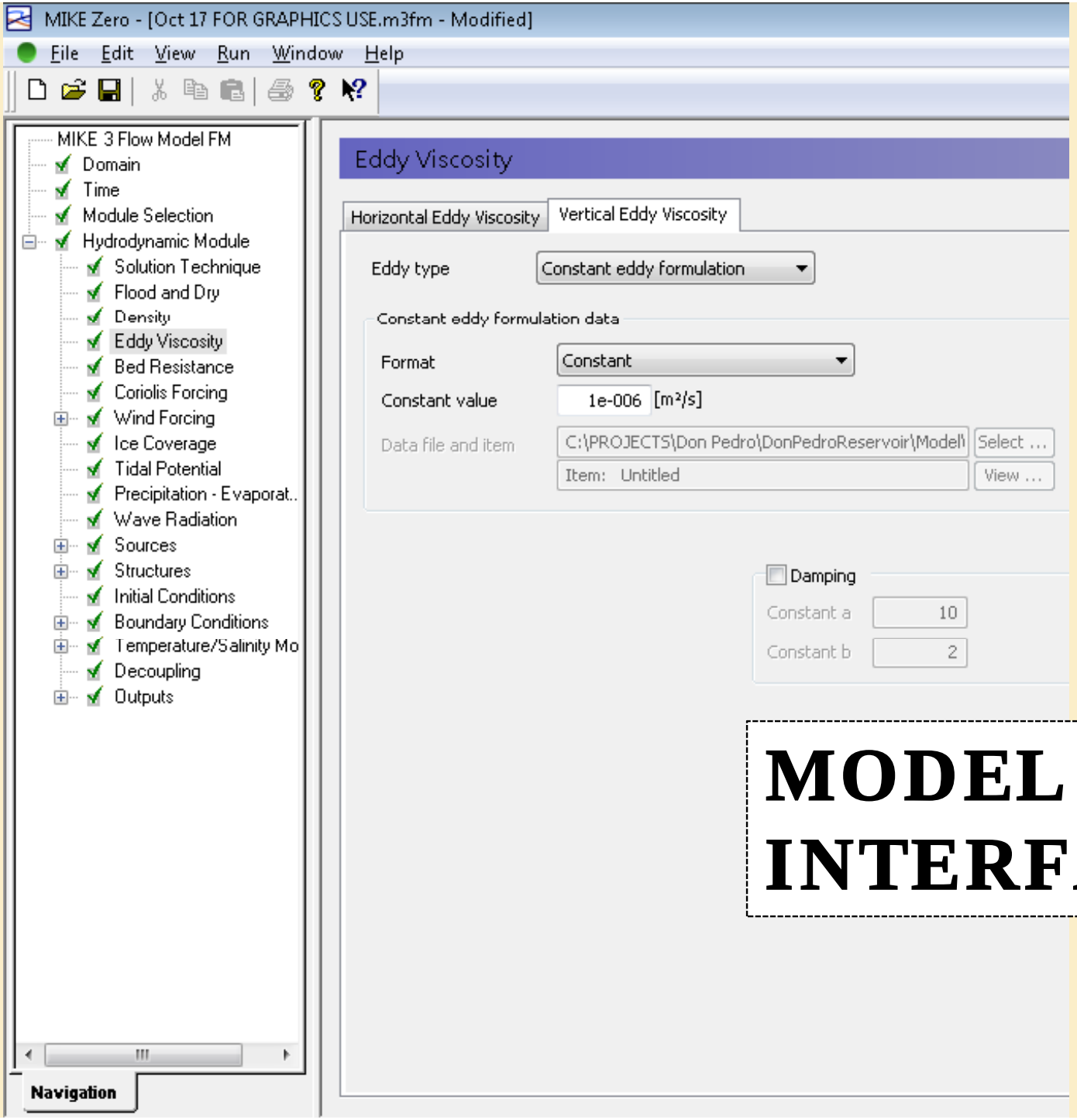

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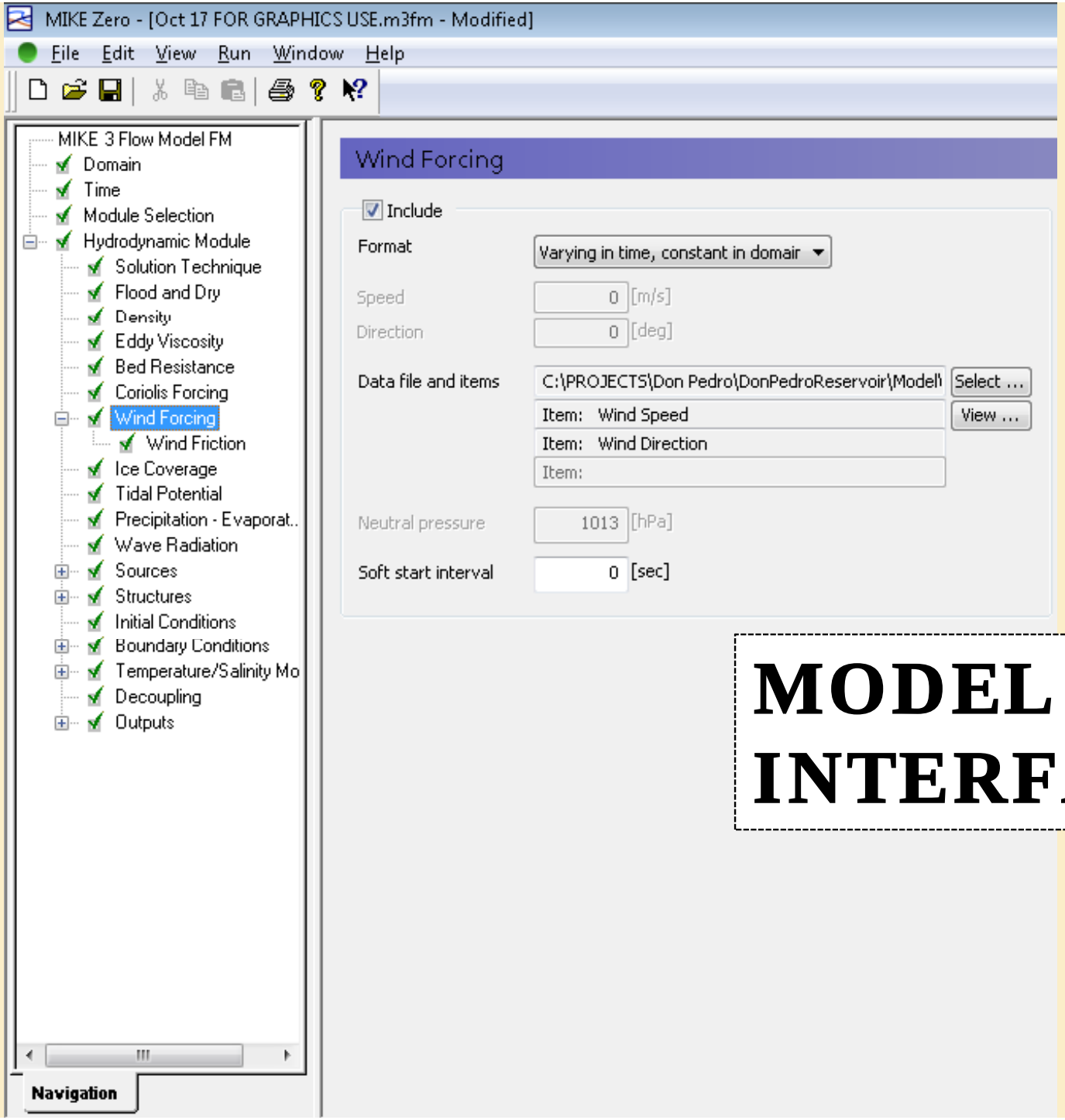
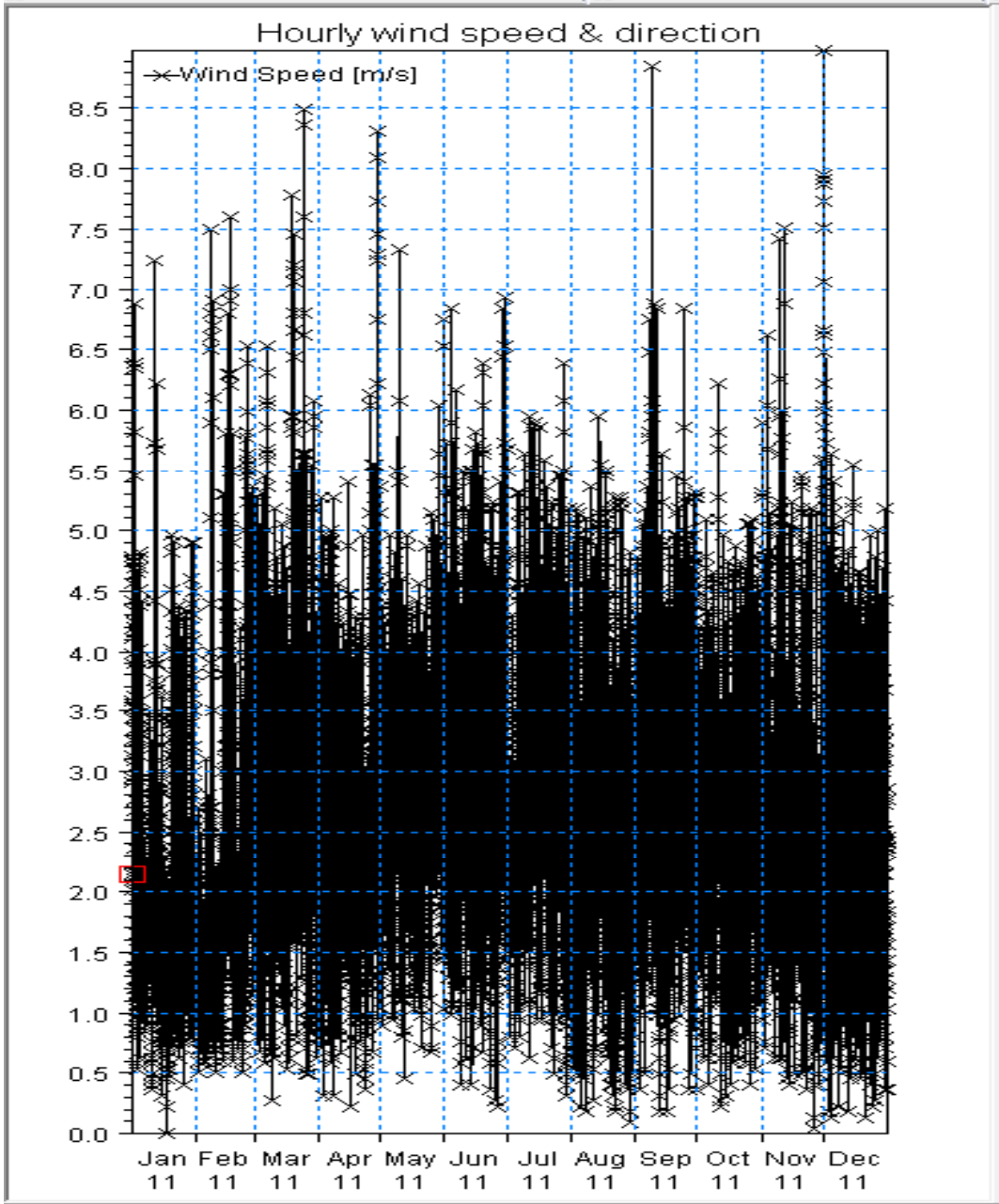


MODEL INTERFACE

MIKE Zero - [Wind_speed_dir_2011.dfs0]

File Edit View Settings Tools Window Help



	Time	1:Wind Speed	2:Wind Directi
0	1/1/2011 1:00:0	2.1456	165
1	1/1/2011 2:00:0	2.0115	163
2	1/1/2011 3:00:0	3.5313	169
3	1/1/2011 4:00:0	4.4253	165
4	1/1/2011 5:00:0	3.576	164
5	1/1/2011 6:00:0	4.5594	171
6	1/1/2011 7:00:0	4.7829	171
7	1/1/2011 8:00:0	4.7382	176
8	1/1/2011 9:00:0	4.1124	164
9	1/1/2011 10:00:	2.9502	117
10	1/1/2011 11:00:	2.9055	151
11	1/1/2011 12:00:	3.129	175
12	1/1/2011 1:00:0	3.4419	146
13	1/1/2011 2:00:0	3.2631	137
14	1/1/2011 3:00:0	3.9783	152
15	1/1/2011 4:00:0	3.8889	142
16	1/1/2011 5:00:0	4.7382	162
17	1/1/2011 6:00:0	4.1571	160
18	1/1/2011 7:00:0	3.0843	136
19	1/1/2011 8:00:0	3.3525	154
20	1/1/2011 9:00:0	3.0396	172
21	1/1/2011 10:00:	2.682	155
22	1/1/2011 11:00:	2.3691	133
23	1/2/2011 00:00:	3.0843	262
24	1/2/2011 1:00:0	1.3857	96
25	1/2/2011 2:00:0	2.1009	161
26	1/2/2011 3:00:0	4.2018	176
27	1/2/2011 4:00:0	5.811	12
28	1/2/2011 5:00:0	6.3474	17
29	1/2/2011 6:00:0	6.3921	18
30	1/2/2011 7:00:0	6.8838	22
31	1/2/2011 8:00:0	5.4534	7
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34	1/2/2011 11:00:	4.2465	170
35	1/2/2011 12:00:	3.0396	171
36	1/2/2011 1:00:0	3.5313	6
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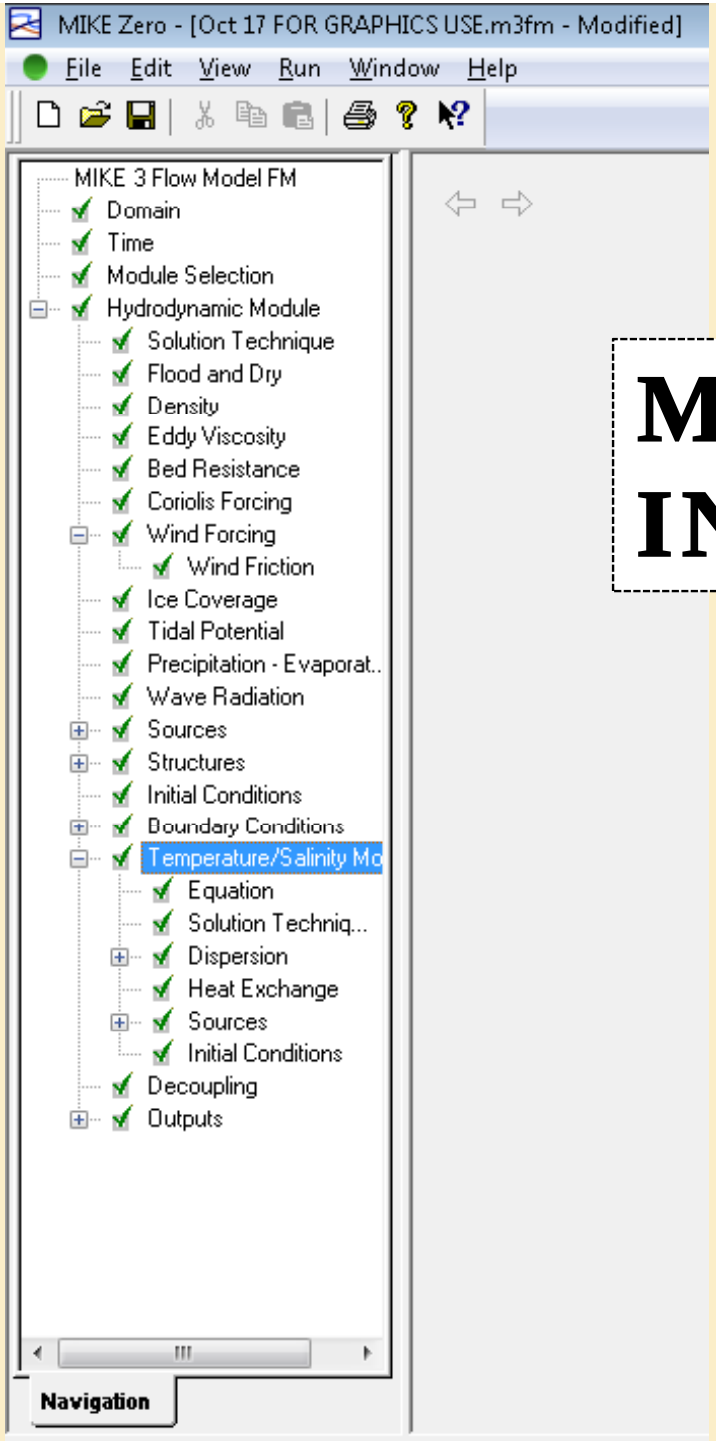
40	1/2/2011 5:00:0	4.6935	39

Ready



MODEL INTERFACE

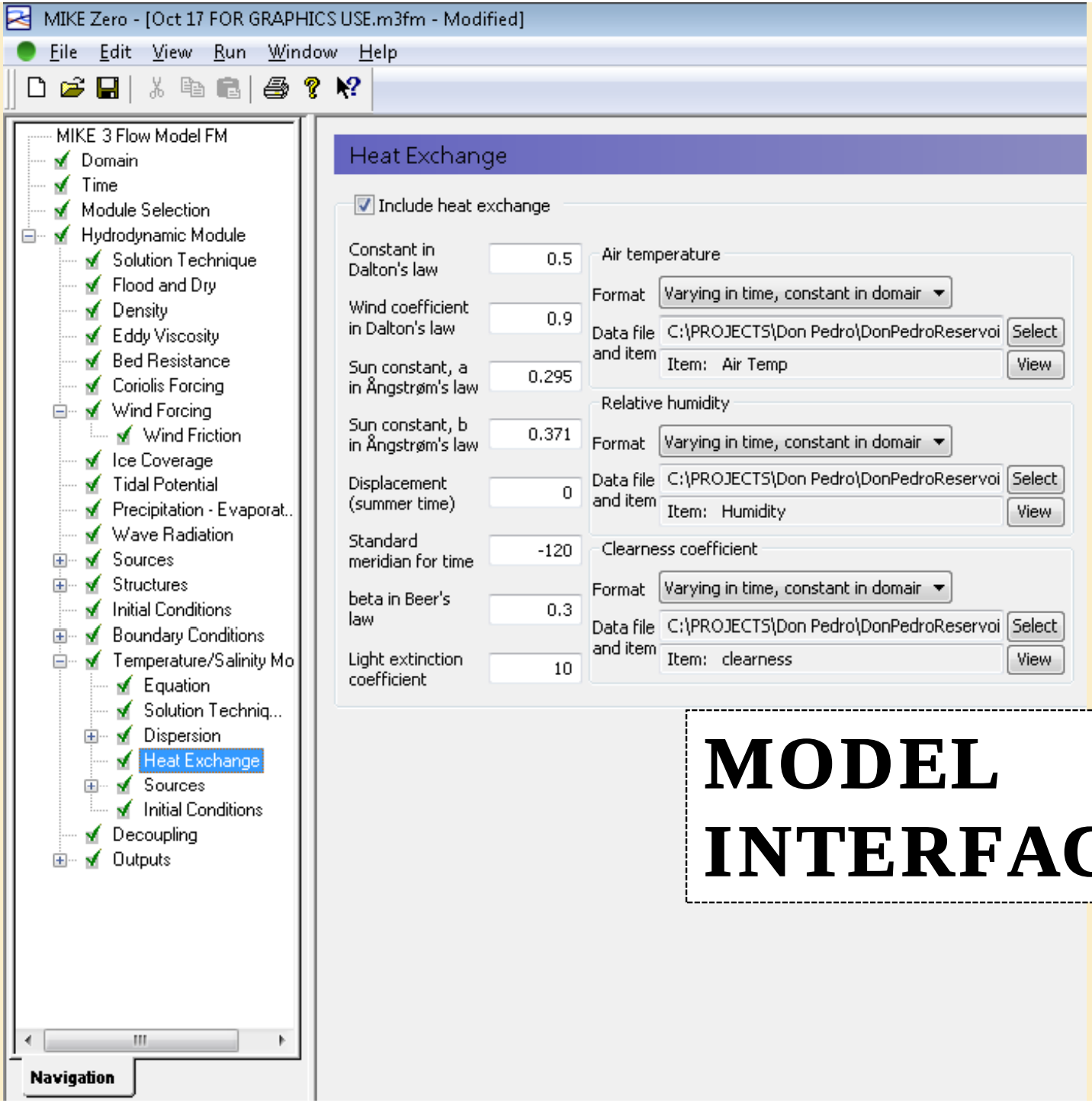
Heat Balance

- The heat balance in the water is based on 4 physical processes
  - Latent heat flux (vaporization)
  - Sensible heat flux (convection)
  - Short wave radiation
  - Long wave radiation

Heat Balance

- Vaporization is based on Dalton's Law

$$q_v = LC_e(a_1 + b_1 W_{2m})(Q_{water} - Q_{air})$$



MODEL INTERFACE

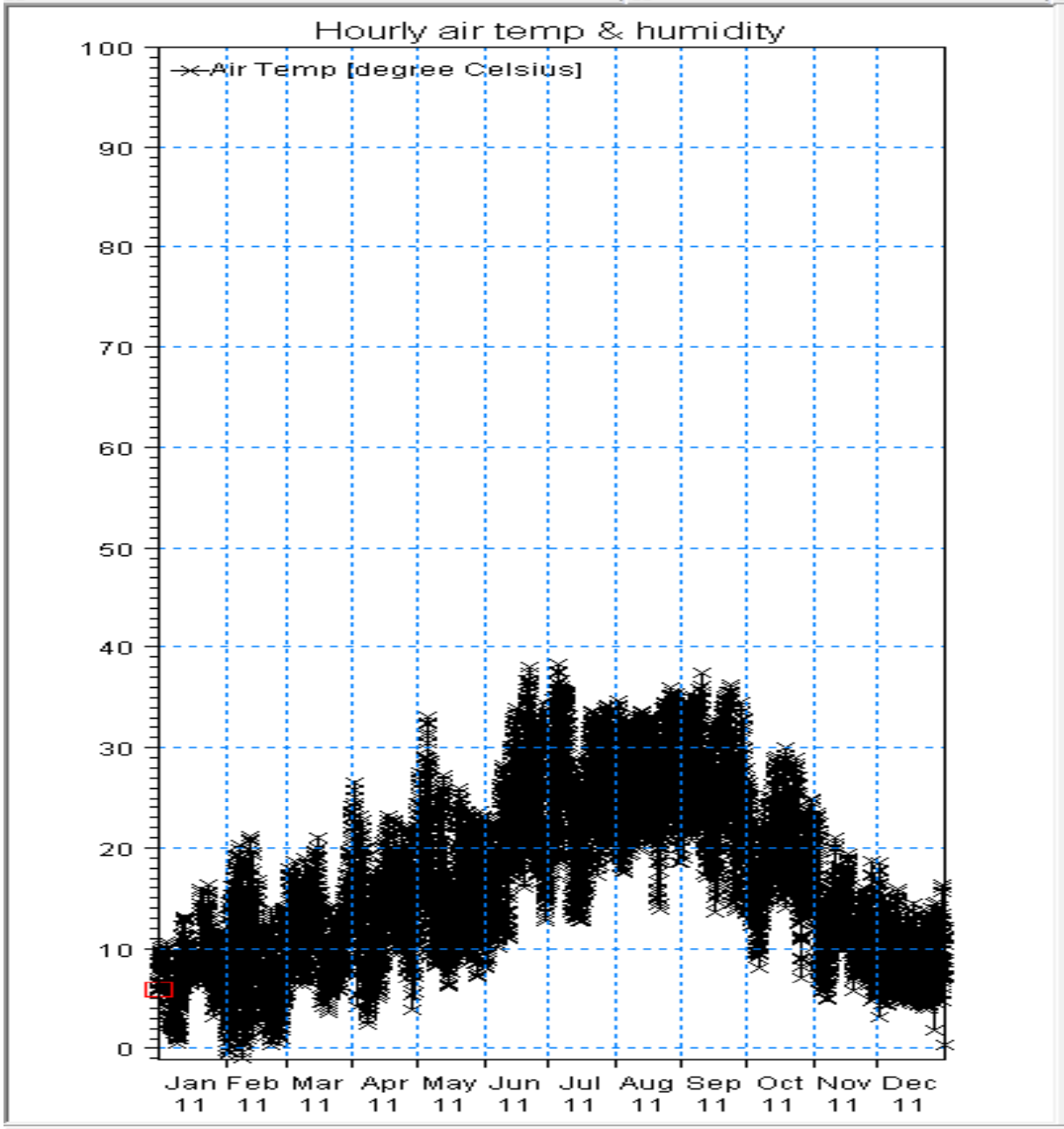
Heat Balance

- Convection is based on the air – water temperature difference

$$q_c = \begin{cases} \rho_{air} c_{air} c_{heating} W_{10} (T_{air} - T_{water}) & T_{air} \geq T \\ \rho_{air} c_{air} c_{cooling} W_{10} (T_{air} - T_{water}) & T_{air} < T \end{cases}$$

MIKE Zero - [Air_Temp_Humidity_2011.dfs0]

File Edit View Settings Tools Window Help



	Time	1:Air Temp [de
0	1/1/2011 1:00:0	5.89
1	1/1/2011 2:00:0	6.56
2	1/1/2011 3:00:0	7.06
3	1/1/2011 4:00:0	7.17
4	1/1/2011 5:00:0	6.06
5	1/1/2011 6:00:0	5.67
6	1/1/2011 7:00:0	5.78
7	1/1/2011 8:00:0	6.5
8	1/1/2011 9:00:0	6.06
9	1/1/2011 10:00:	7
10	1/1/2011 11:00:	7.56
11	1/1/2011 12:00:	7.89
12	1/1/2011 1:00:0	7.78
13	1/1/2011 2:00:0	8.67
14	1/1/2011 3:00:0	8.89
15	1/1/2011 4:00:0	9.78
16	1/1/2011 5:00:0	9.78
17	1/1/2011 6:00:0	9.06
18	1/1/2011 7:00:0	9
19	1/1/2011 8:00:0	10.06
20	1/1/2011 9:00:0	9.67
21	1/1/2011 10:00:	8.78
22	1/1/2011 11:00:	8.17
23	1/2/2011 00:00:	8.06
24	1/2/2011 1:00:0	8.56
25	1/2/2011 2:00:0	8.89
26	1/2/2011 3:00:0	8.28
27	1/2/2011 4:00:0	8.06
28	1/2/2011 5:00:0	8.06
29	1/2/2011 6:00:0	8.56
30	1/2/2011 7:00:0	9.39
31	1/2/2011 8:00:0	8.67
32	1/2/2011 9:00:0	8.89
33	1/2/2011 10:00:	9.39
34	1/2/2011 11:00:	8.67
35	1/2/2011 12:00:	8.67
36	1/2/2011 1:00:0	8.39
37	1/2/2011 2:00:0	7.28
38	1/2/2011 3:00:0	7.39
39	1/2/2011 4:00:0	8.56
40	1/2/2011 5:00:0	8.5

Ready

Heat Balance

- Short wave radiation reaching the surface of the water is based on many functions including Angstroms Law which depends on many parameters, including the location of the site; how clear the sky is; and the attenuation constants

- The amount of radiation reaching the surface is given by:

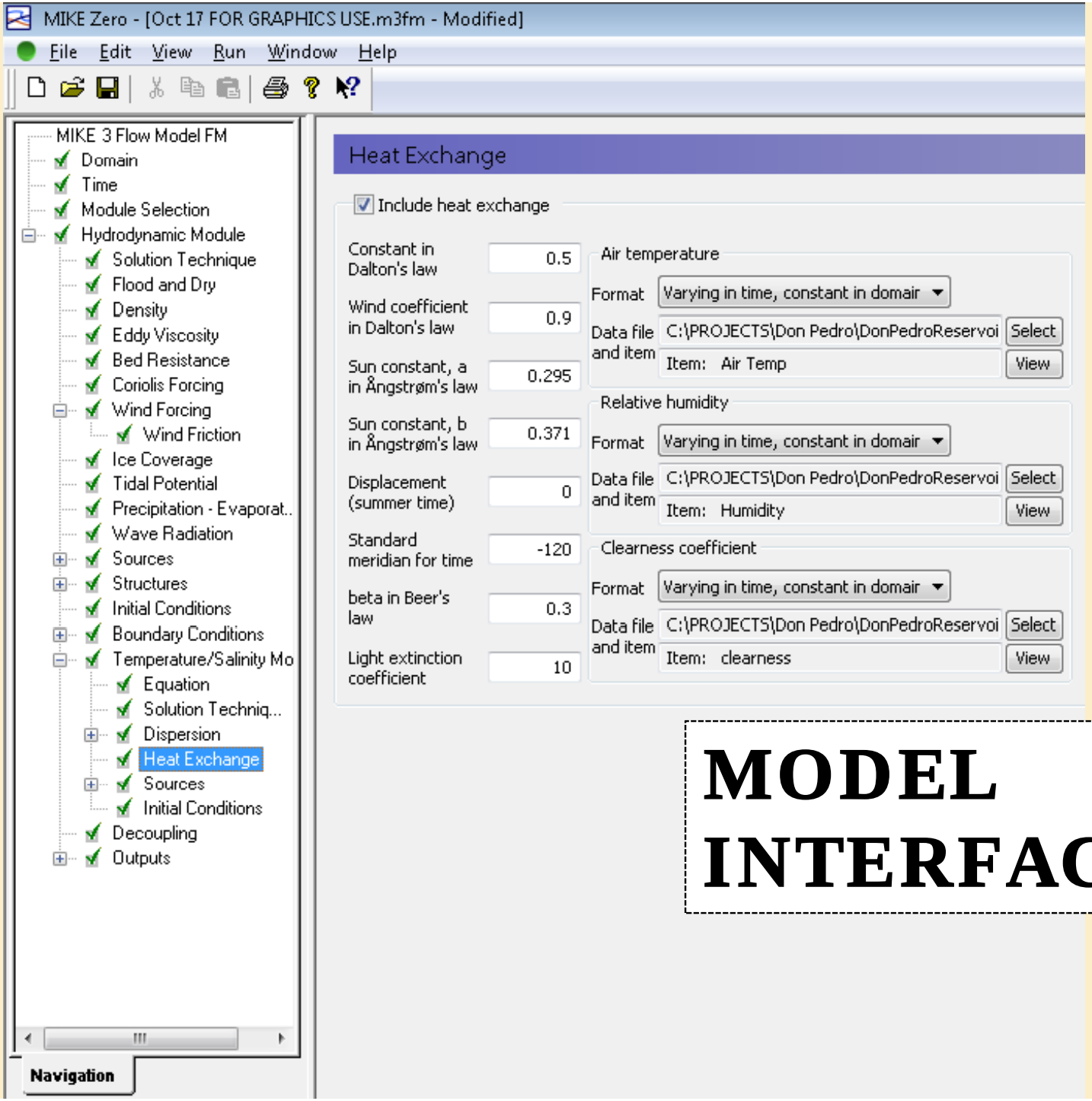
$$H/Ho = a + b\,X$$

H = radiation reaching surface W/m^2

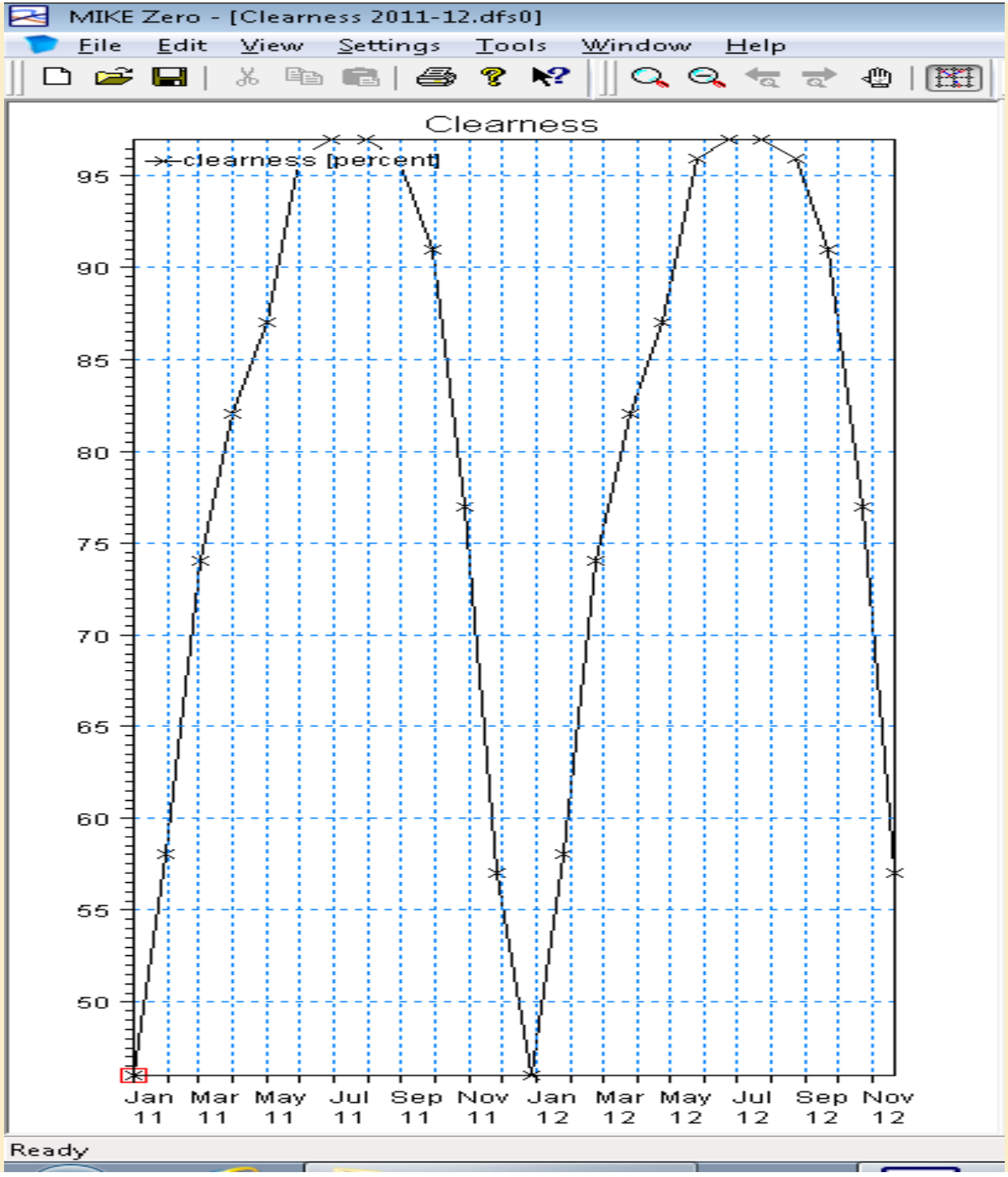
Ho = incoming solar radiation W/m^2

X = clearness of sky

a, b = constants



MODEL INTERFACE


MIKE Zero - [Clearness 2011-12.dfs0]
File Edit View Settings Tools Window Help
Clearness
clearness [percent]
95
90
85
80
75
70
65
60
55
50
Jan 11
Mar 11
May 11
Jul 11
Sep 11
Nov 11
Jan 12
Mar 12
May 12
Jul 12
Sep 12
Nov 12
Ready

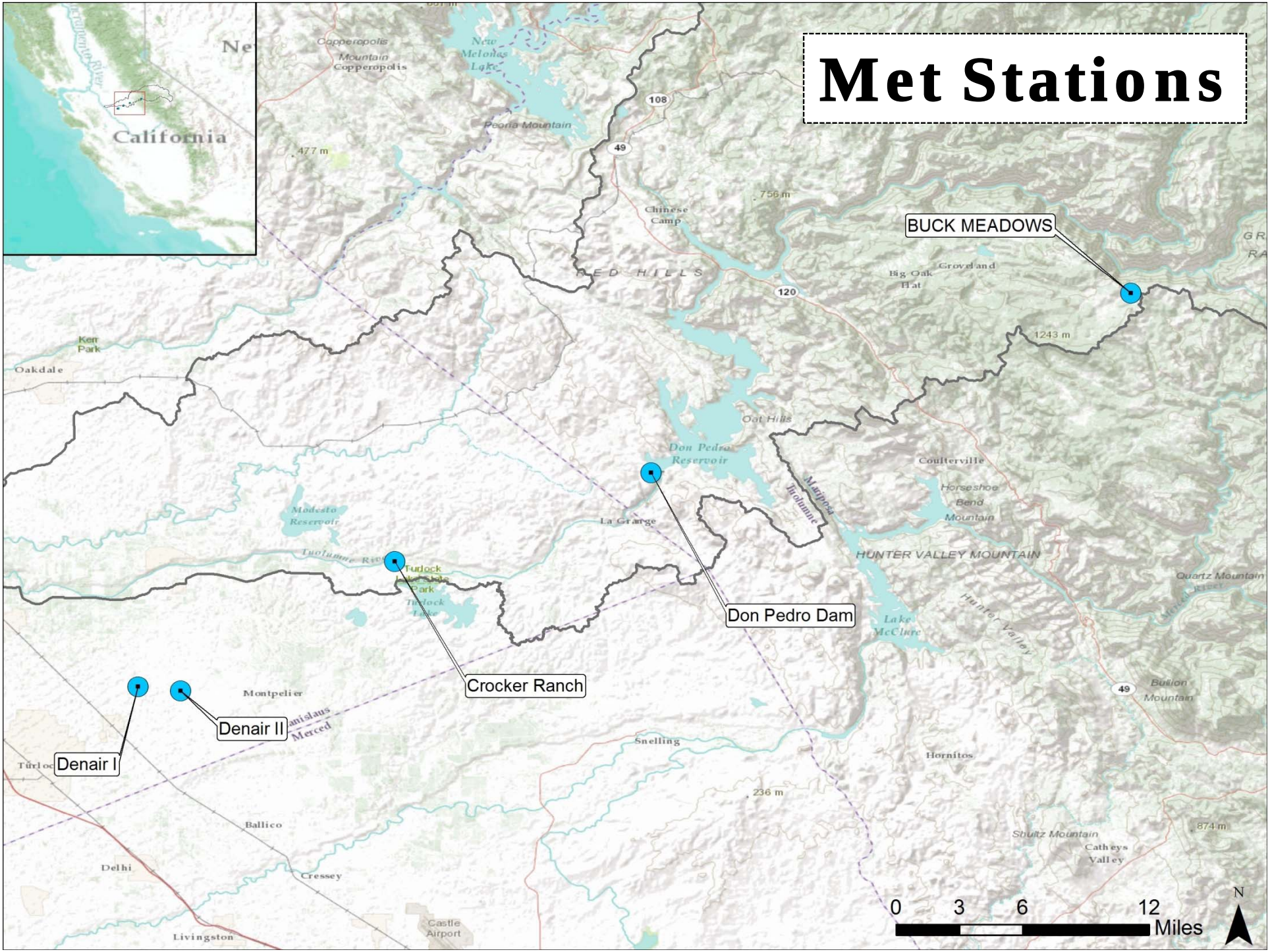
Heat Balance

- Long wave radiation is based on Brunt's equation that in turn includes parameters that depend on air temperature, humidity and cloud cover

$$q_{lr,net} = -\sigma_{sb}(T_{air} + T_K)^4\left(a - b\sqrt{e_d}\right)\left(c + d\frac{n}{n_d}\right)$$

Data Sources and Collection

- Inflow and outflow – based on Project Operations Model
- Inflow temperature – recorded at Indian Creek Trail and other upstream locations
- Met data recorded at Don Pedro
  - Air temperature
  - Humidity
  - Wind speed and direction
- Cloud cover – from Modesto data


Met Stations
California
BUCK MEADOWS
Don Pedro Dam
Crocker Ranch
Denair II
Denair I
Copperopolis
New Melones Lake
Peoria Mountain
Chinese Camp
RED HILLS
Groveland
Big Oak Flat
Oakdale
Ken Park
Oak Hills
Don Pedro Reservoir
Coulterville
Horseshoe Bend Mountain
Modesto Reservoir
La Grange
Turlock
HUNTER VALLEY MOUNTAIN
Lake McClure
Quartz Mountain
Bullion Mountain
Montpelier
Snelling
Hornitos
Ballico
Delhi
Cressey
Castle Airport
Livingston
Stultz Mountain
Catheys Valley
756 m
1243 m
477 m
236 m
874 m
0 3 6 12
Miles
N

Reservoir Temperature Profiles and Locations

Woods Creek Arm

Wards Ferry

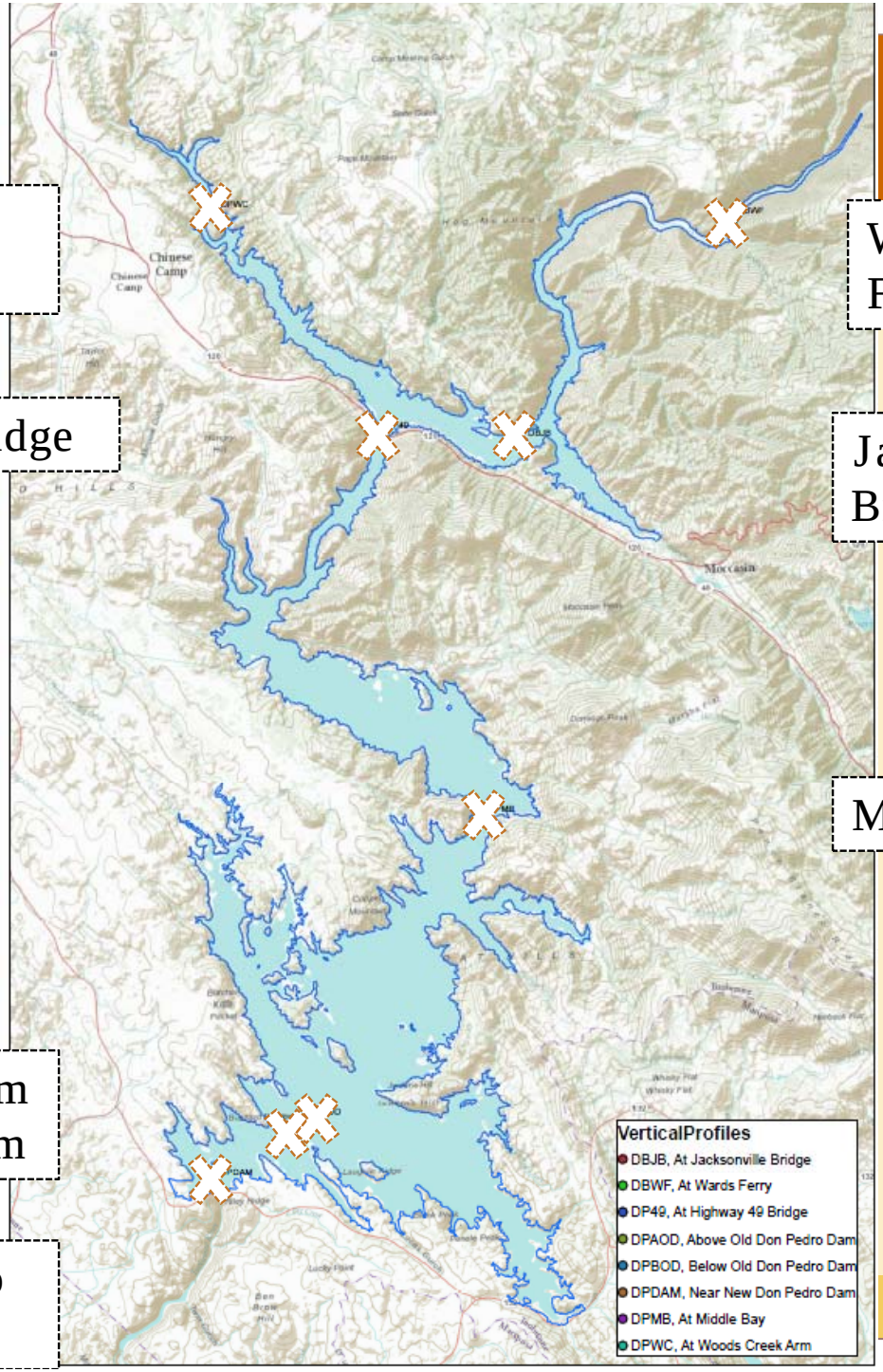
HWY 49 Bridge

Jacksonville Bridge

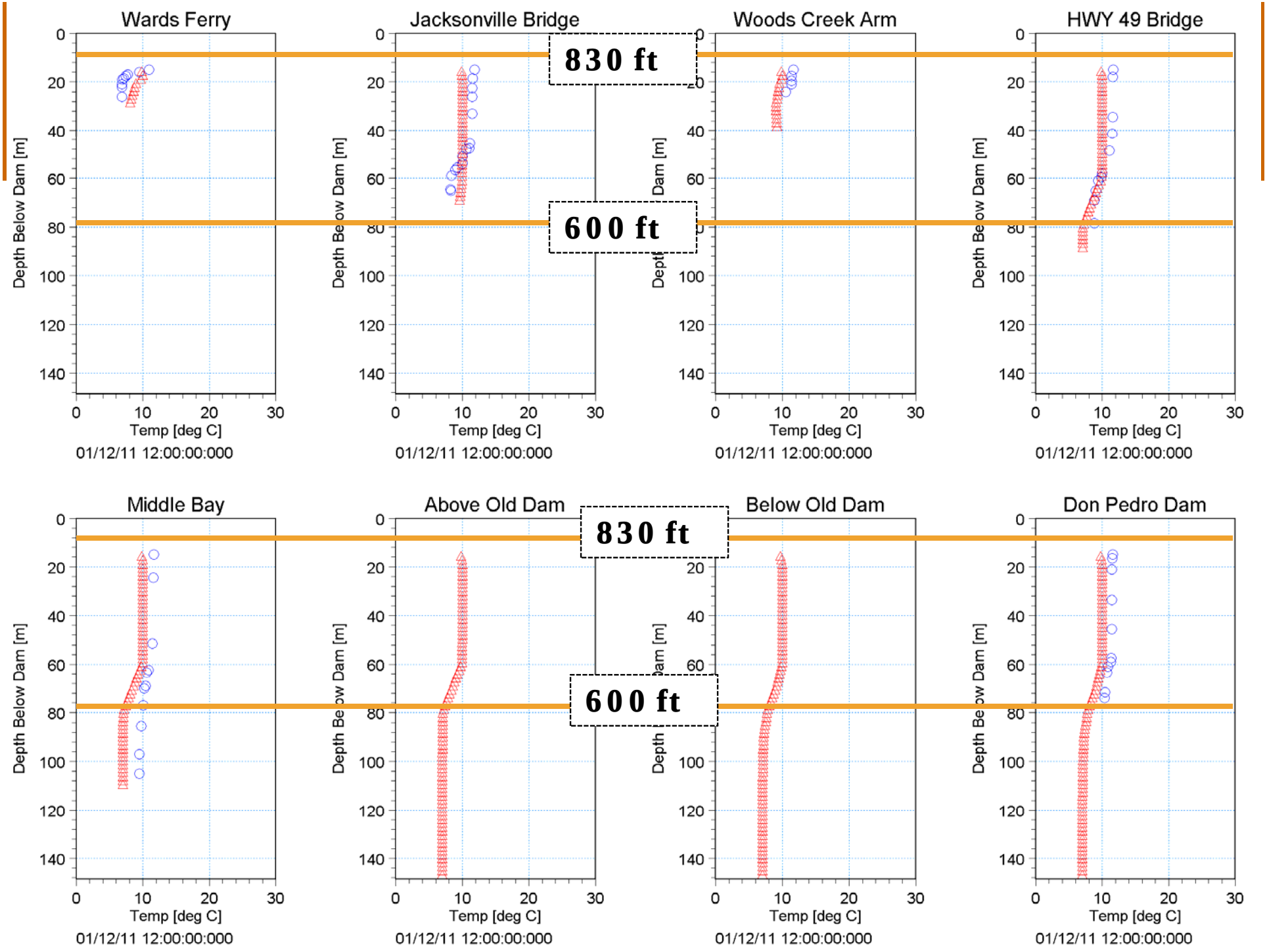
Middle Bay

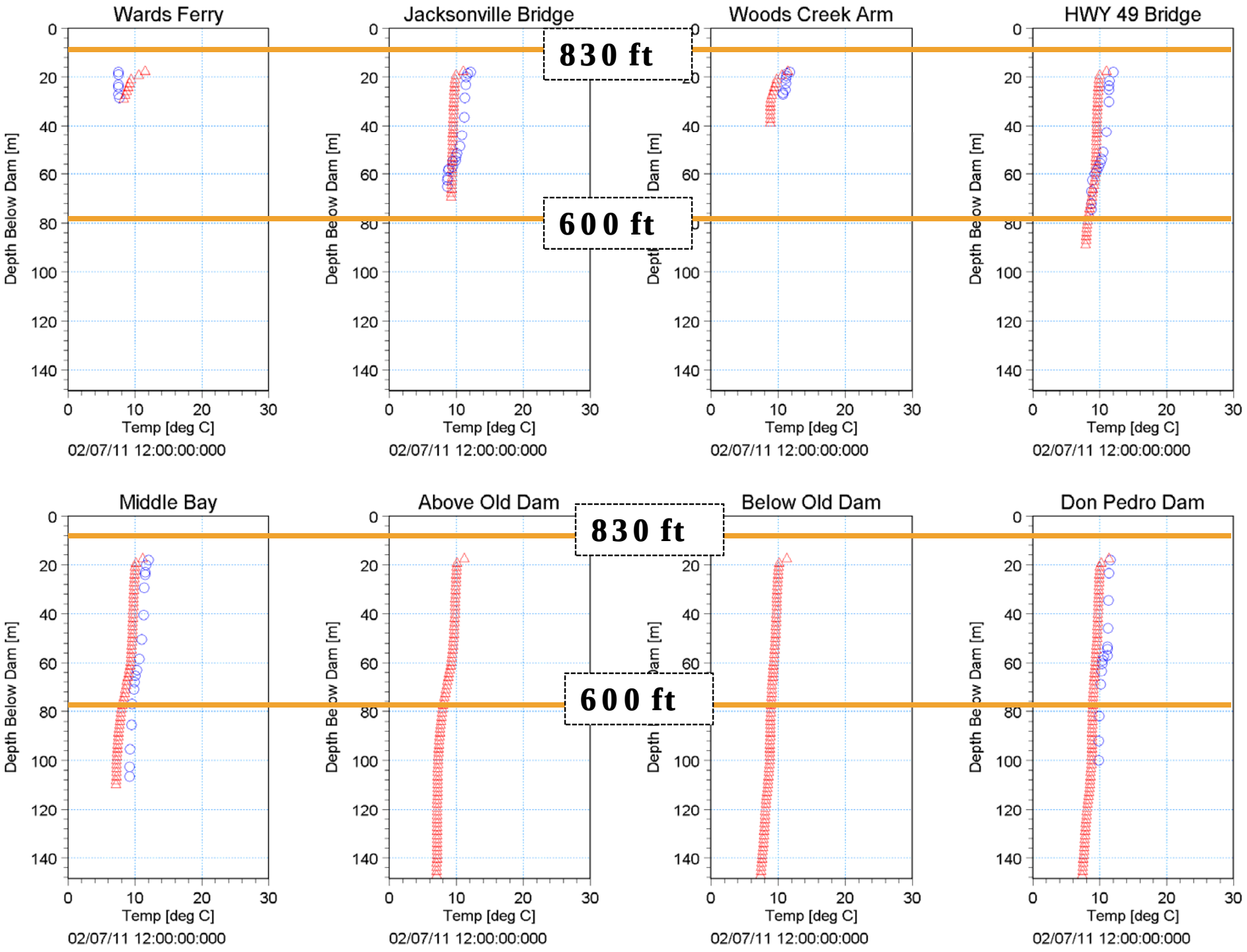
Above Old Dam
Below Old Dam

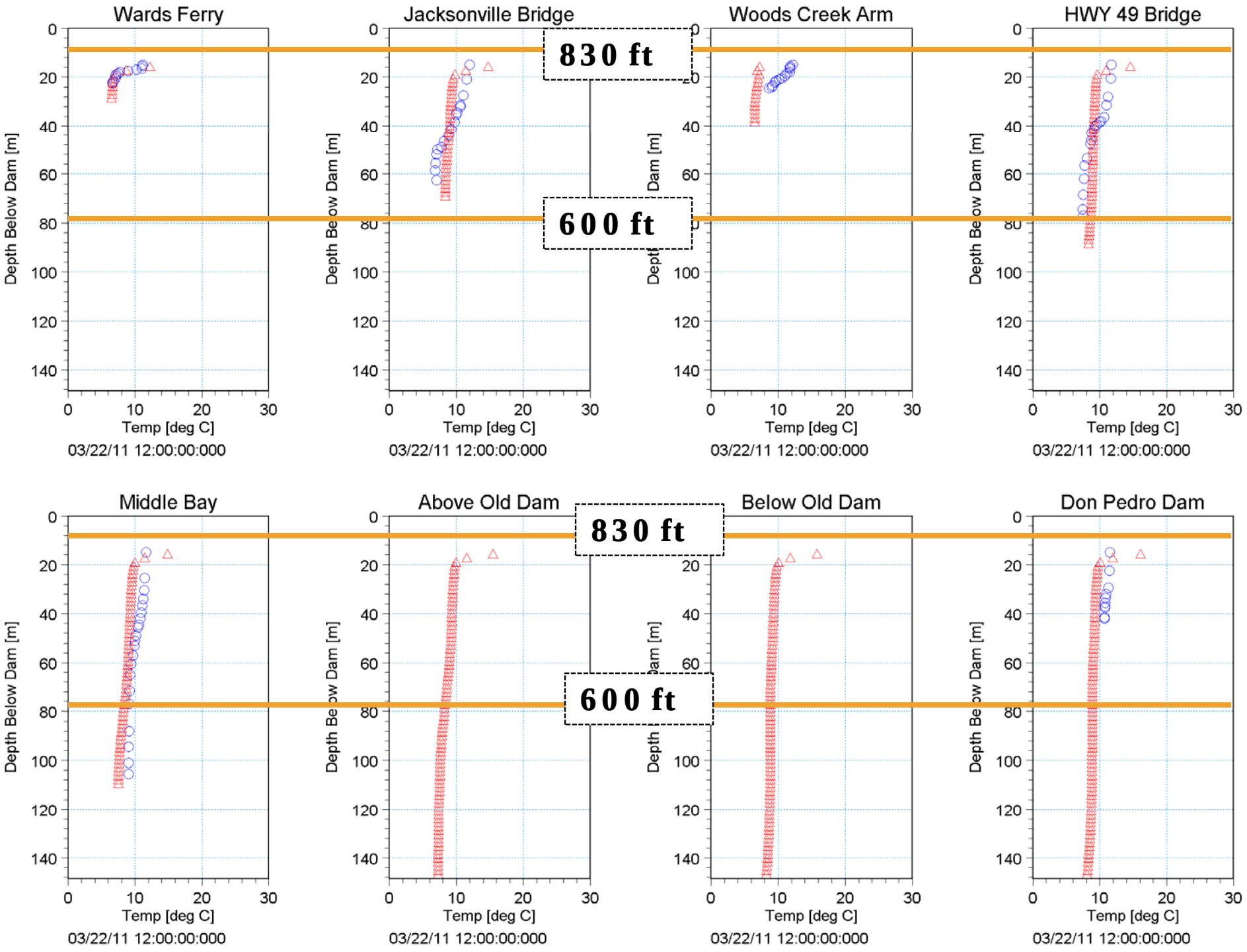
Don Pedro Dam

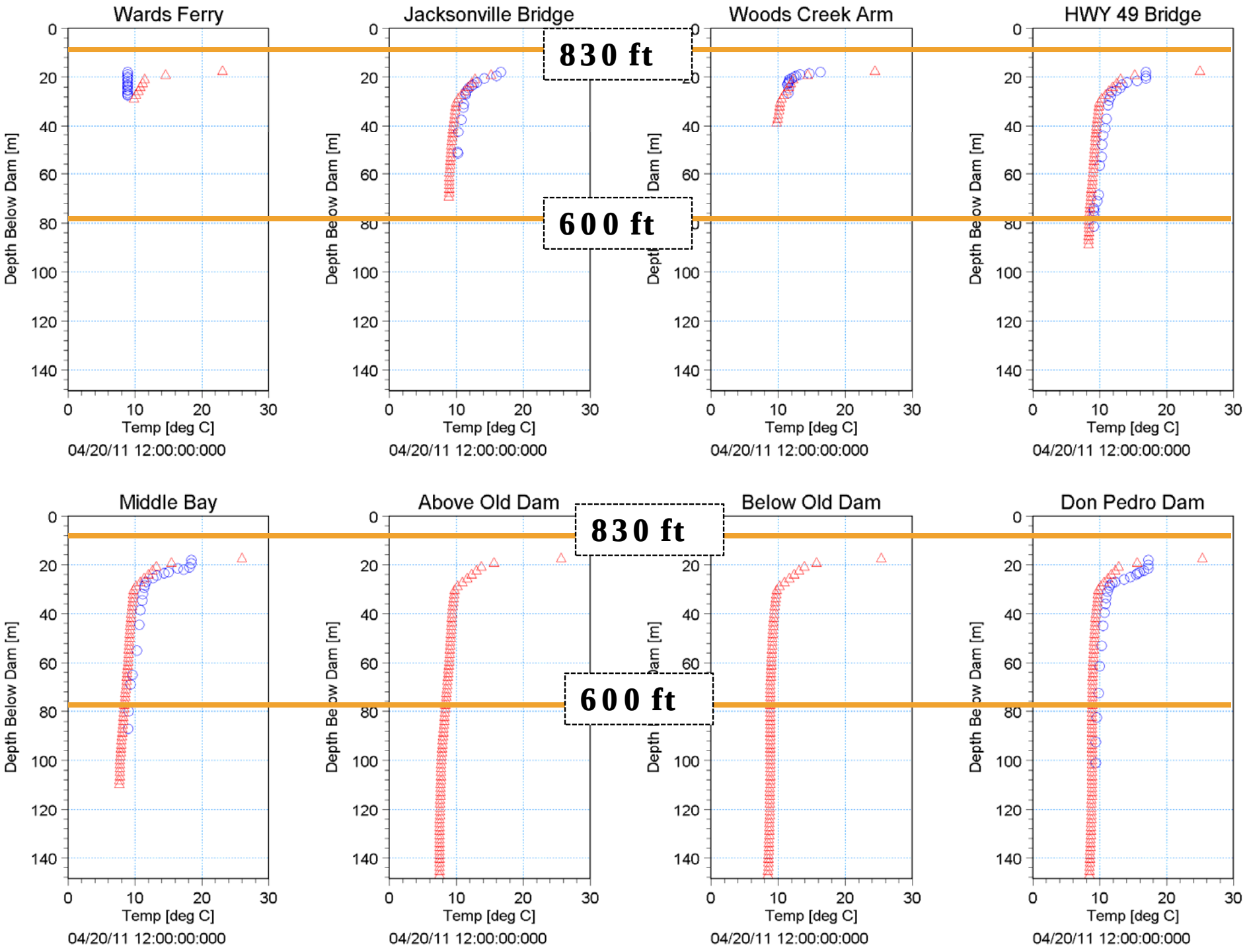


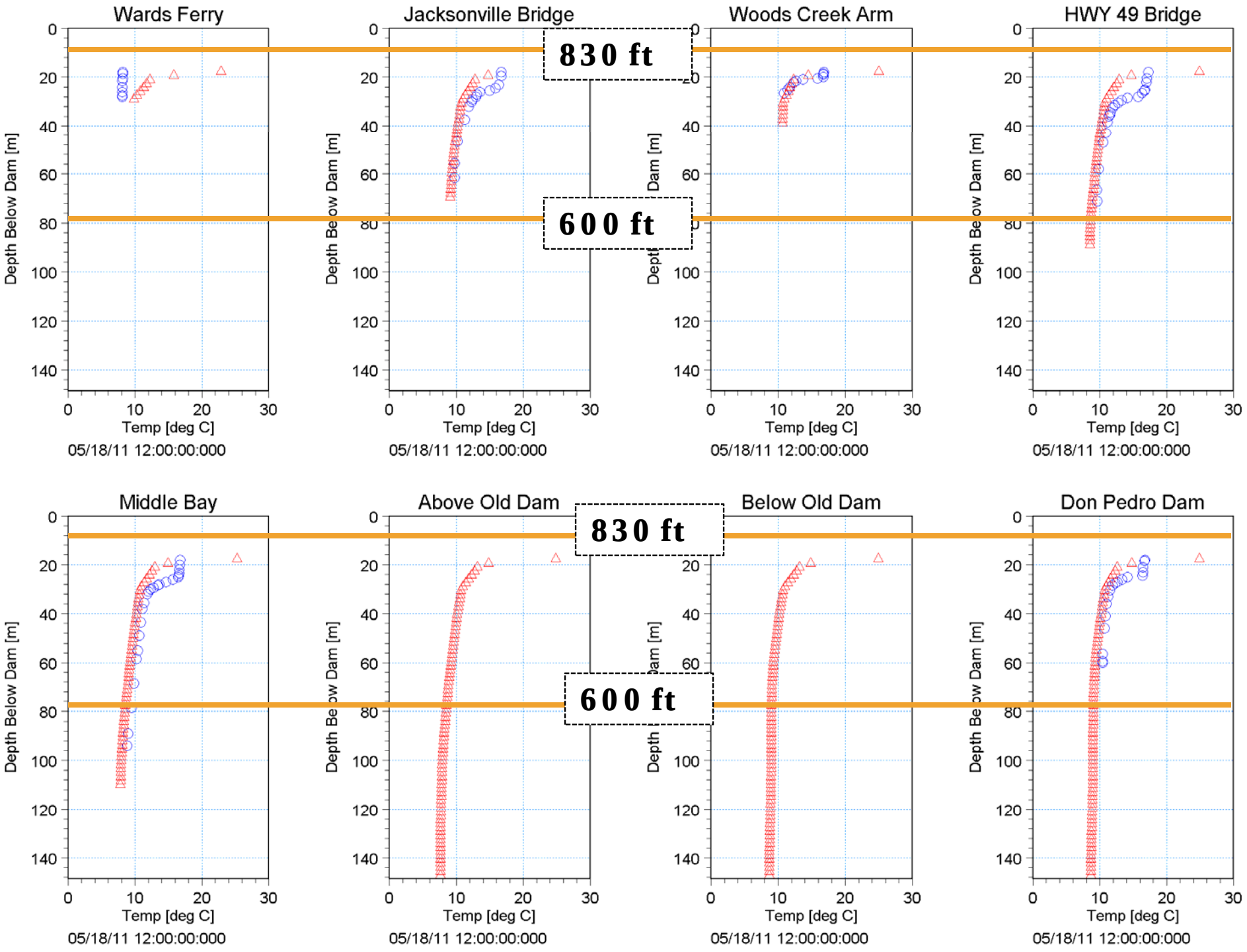
Model Calibration Using 2011 Data

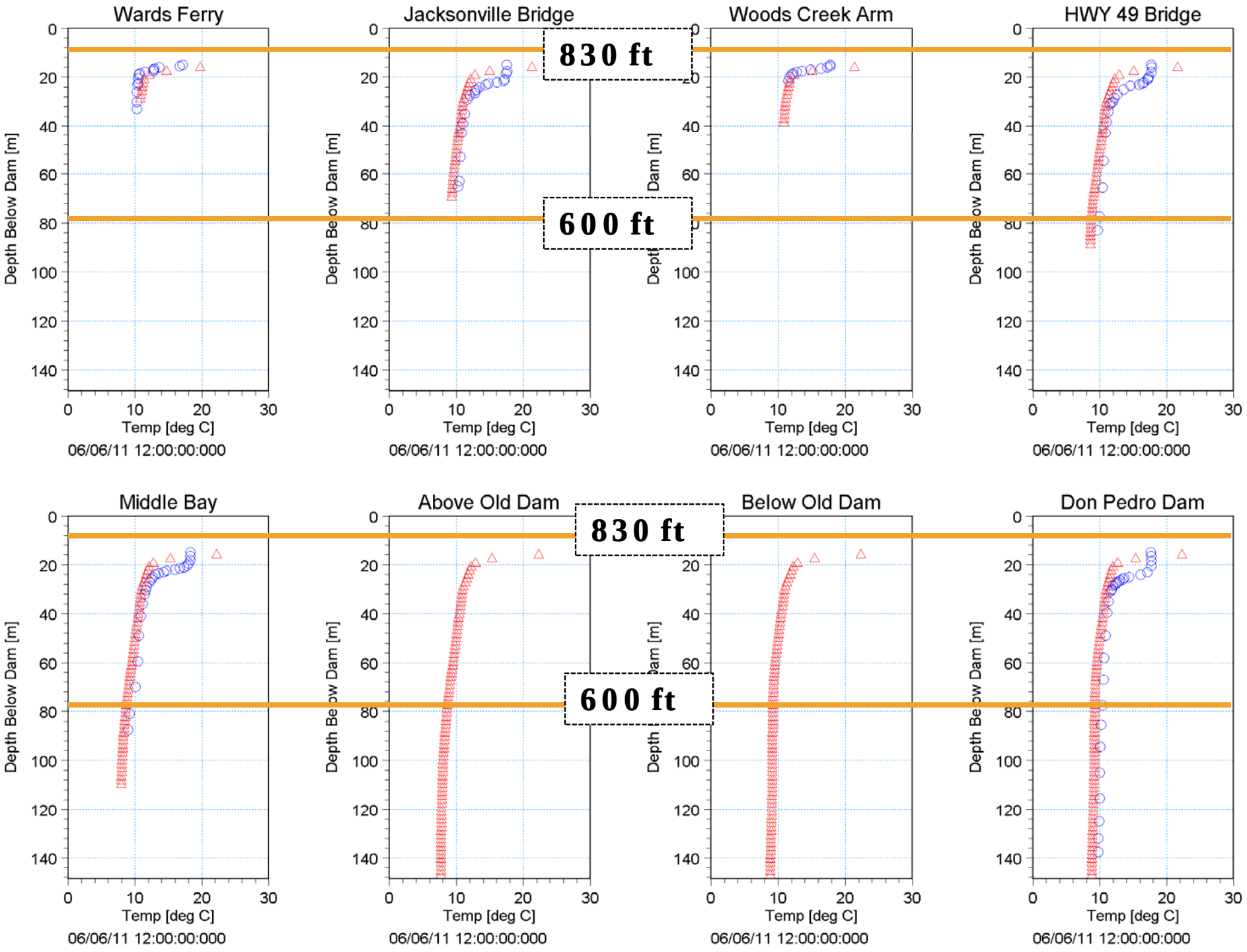

Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
01/12/11 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
01/12/11 12:00:00:000

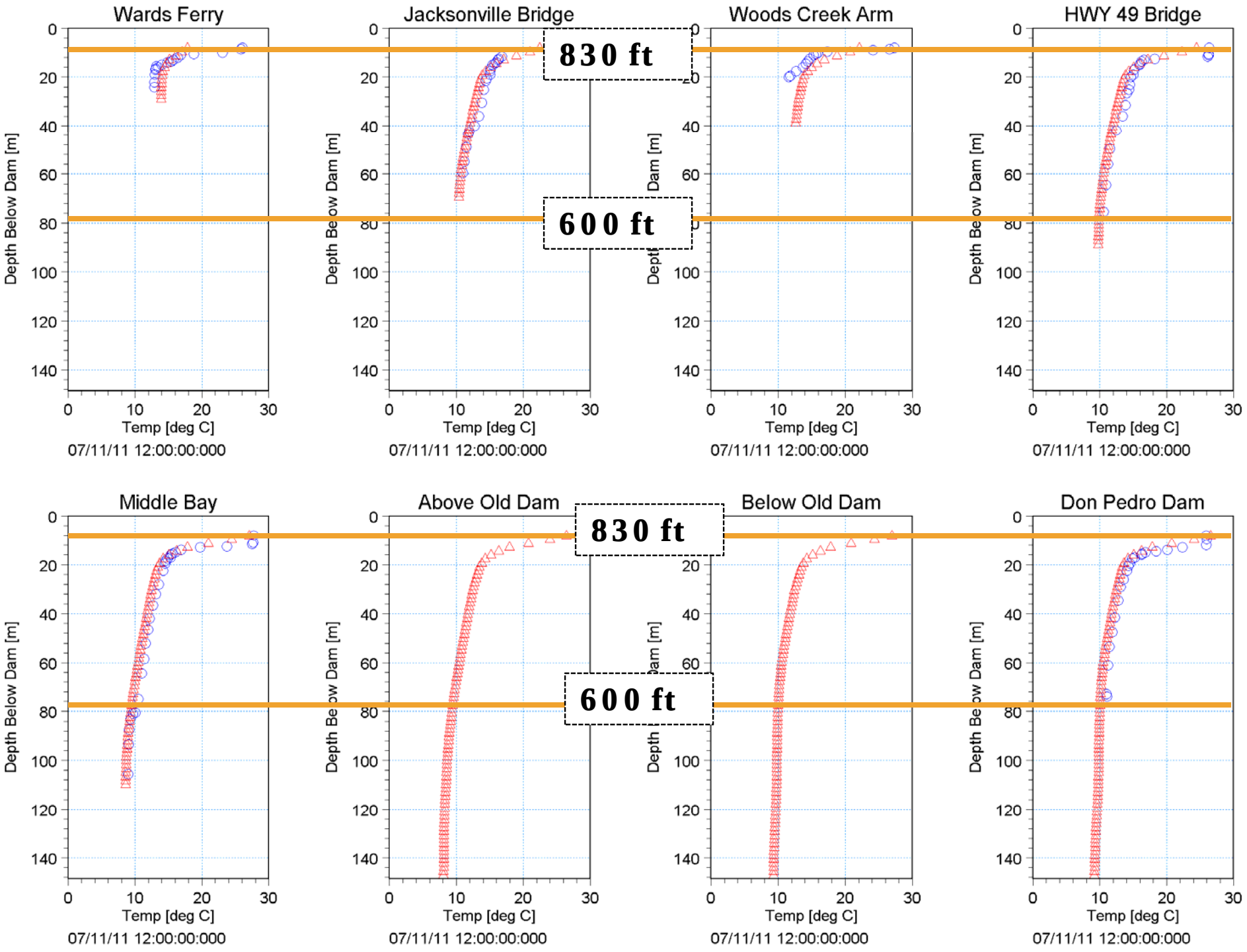

Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
02/07/11 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
02/07/11 12:00:00:000

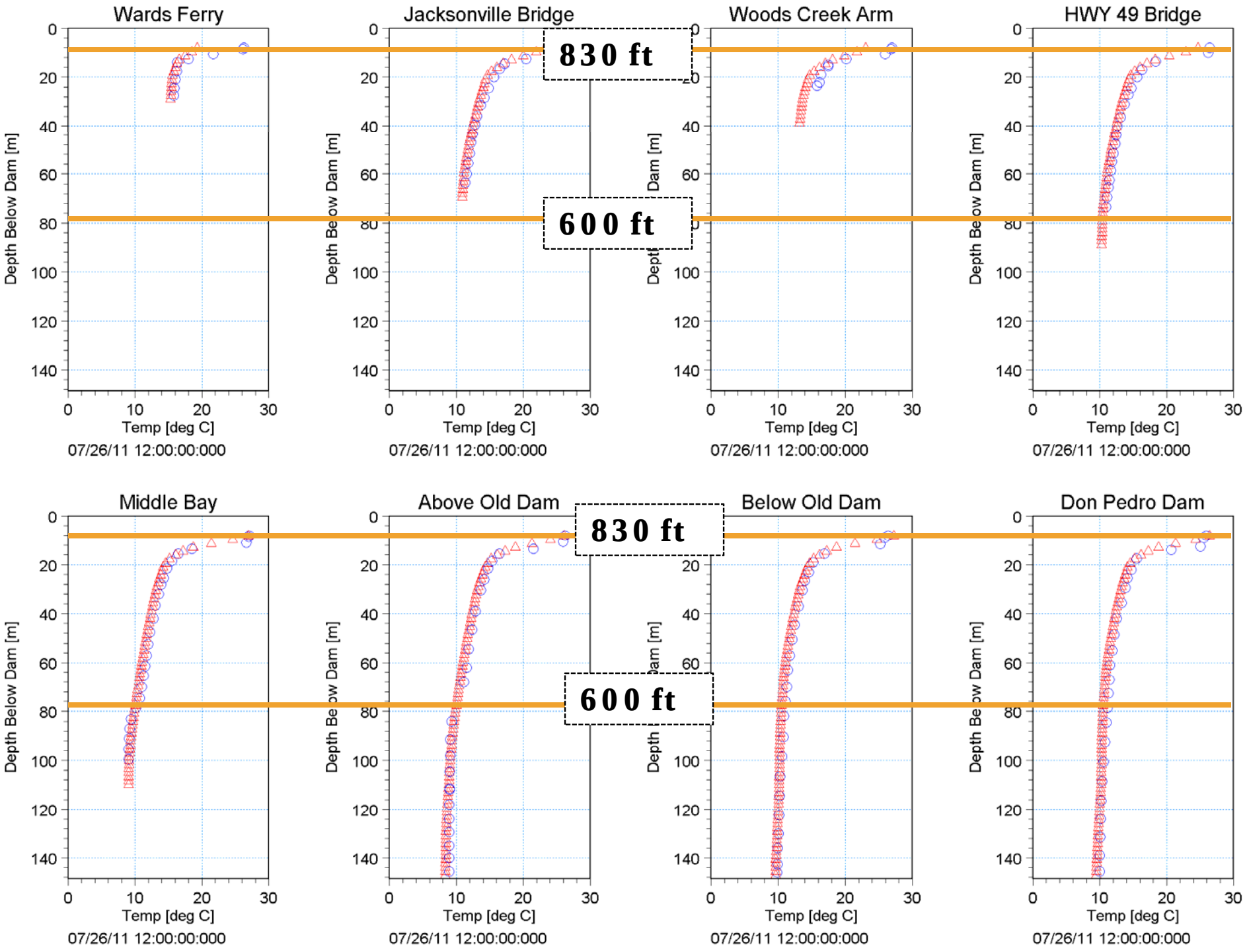

Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
03/22/11 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
03/22/11 12:00:00:000

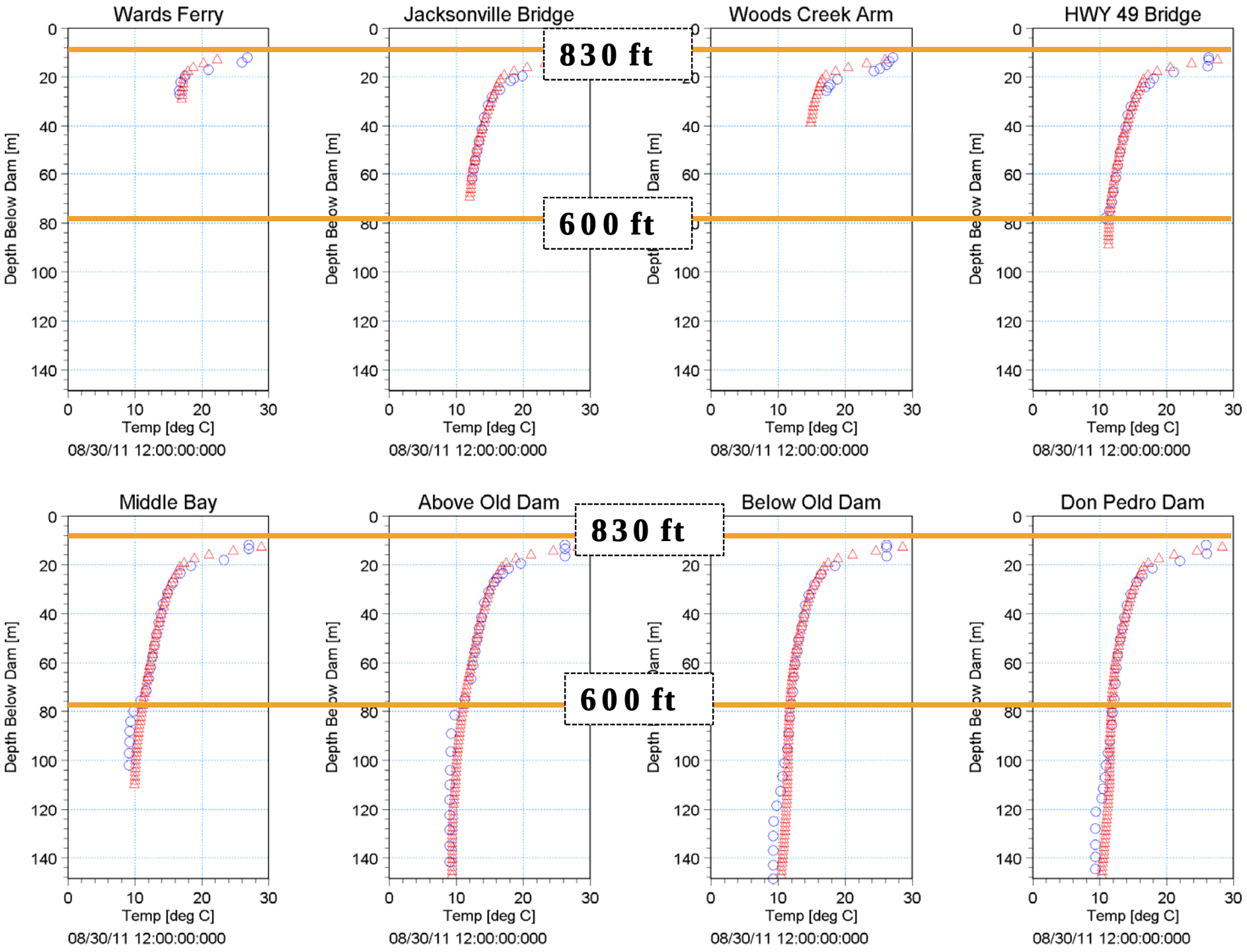

Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
04/20/11 12:00:00:000

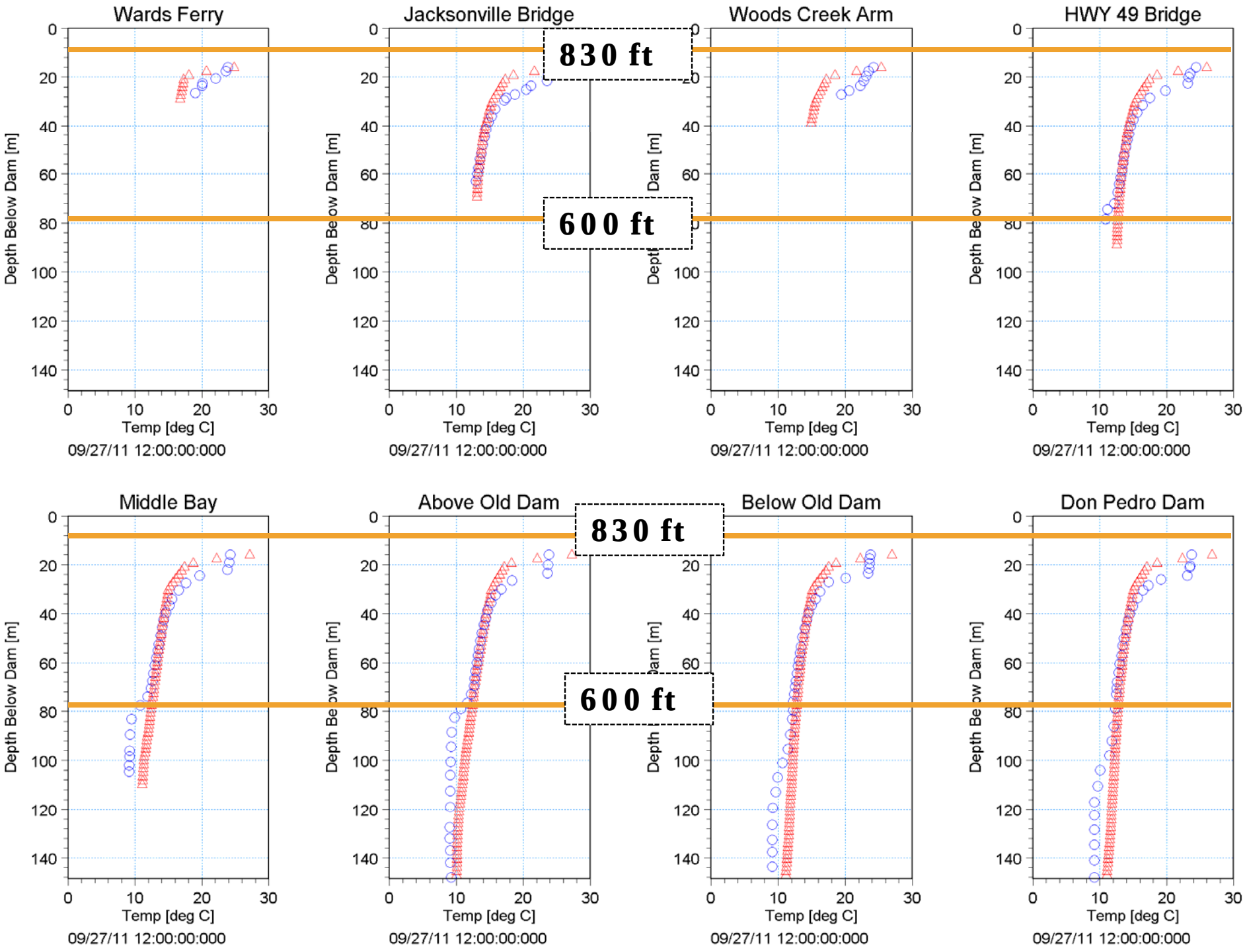

Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
05/18/11 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
05/18/11 12:00:00:000

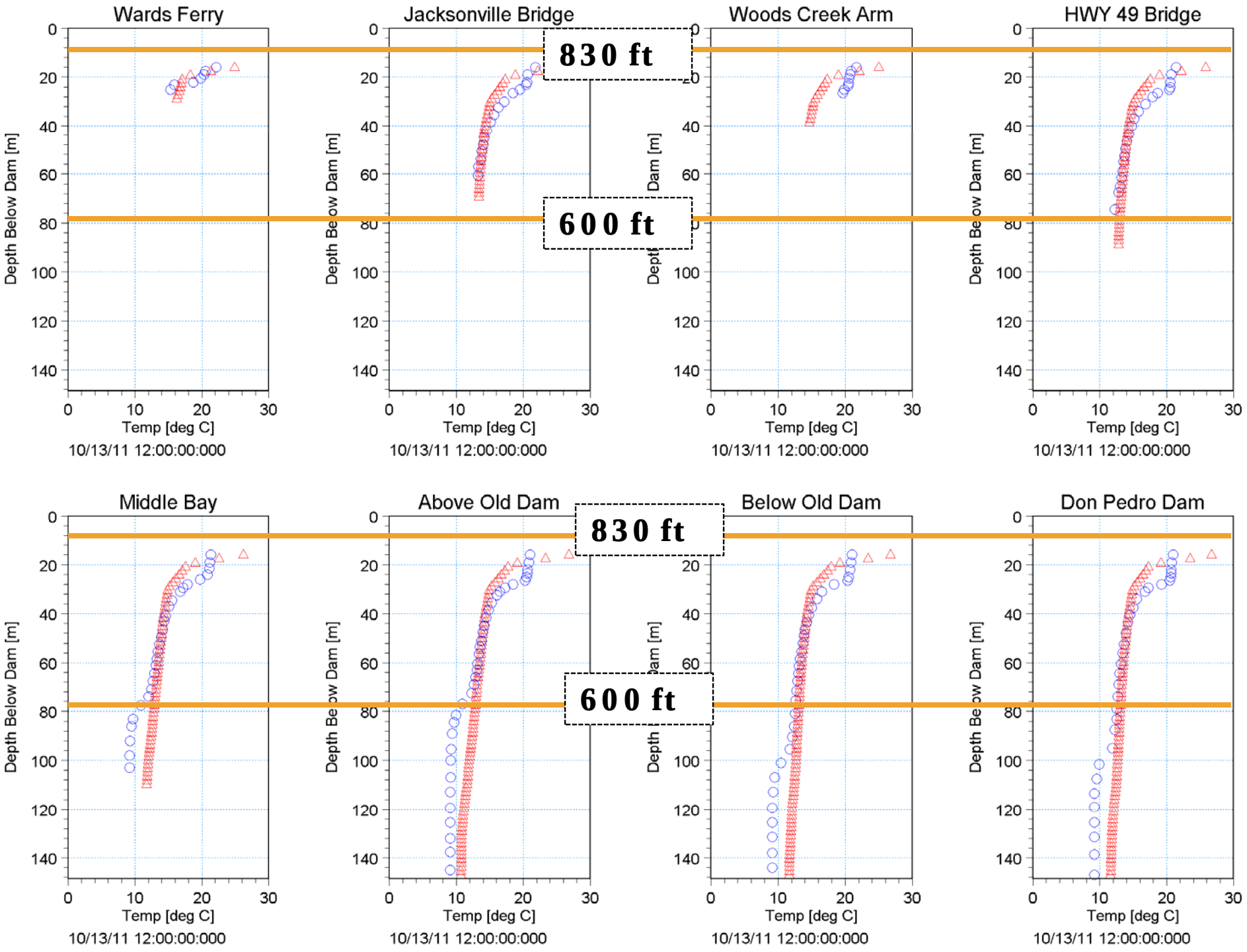

Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
06/06/11 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
06/06/11 12:00:00:000


Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
07/11/11 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
07/11/11 12:00:00:000


Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
07/26/11 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
07/26/11 12:00:00:000


Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
08/30/11 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
08/30/11 12:00:00:000


Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
09/27/11 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
09/27/11 12:00:00:000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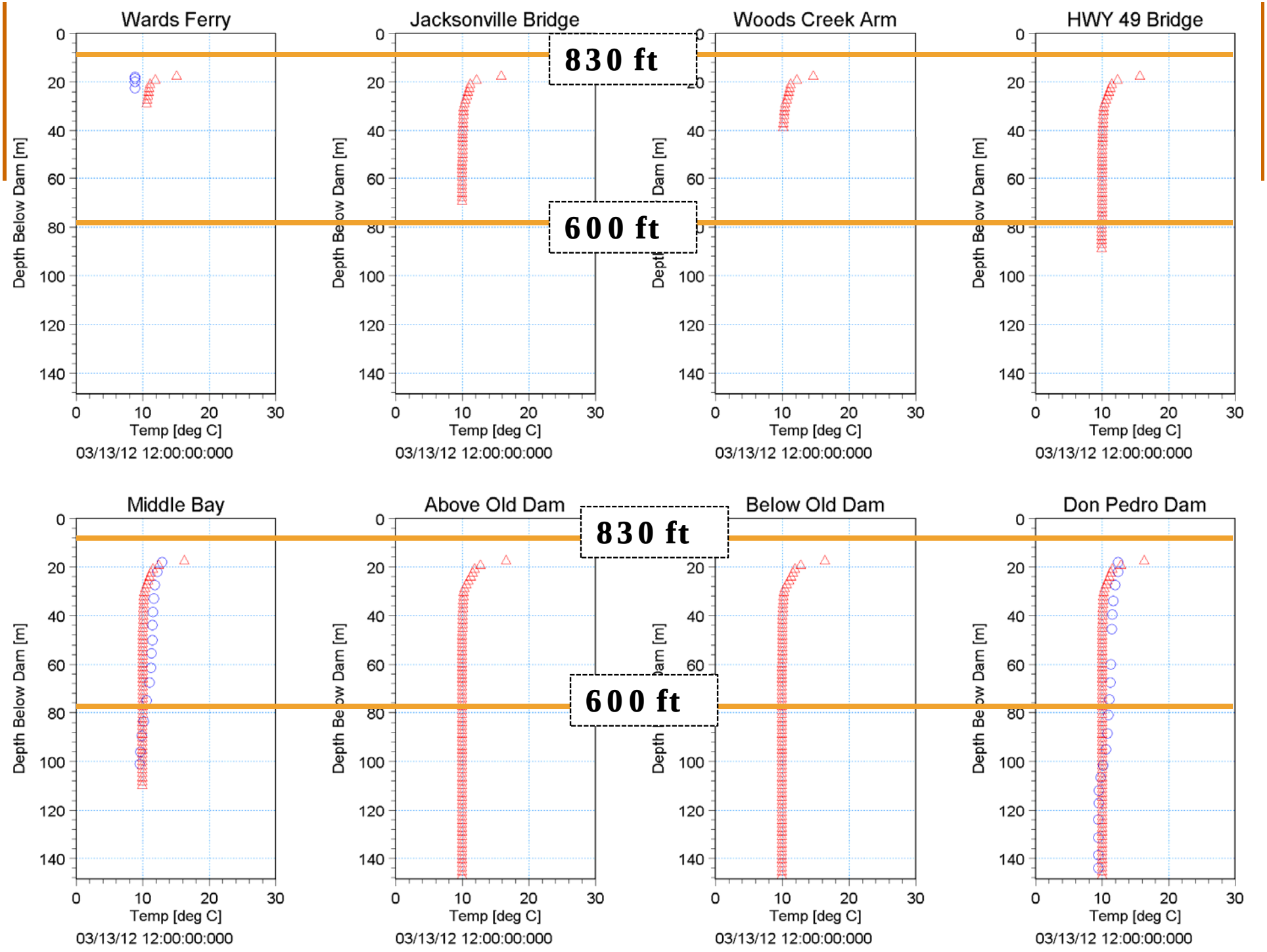
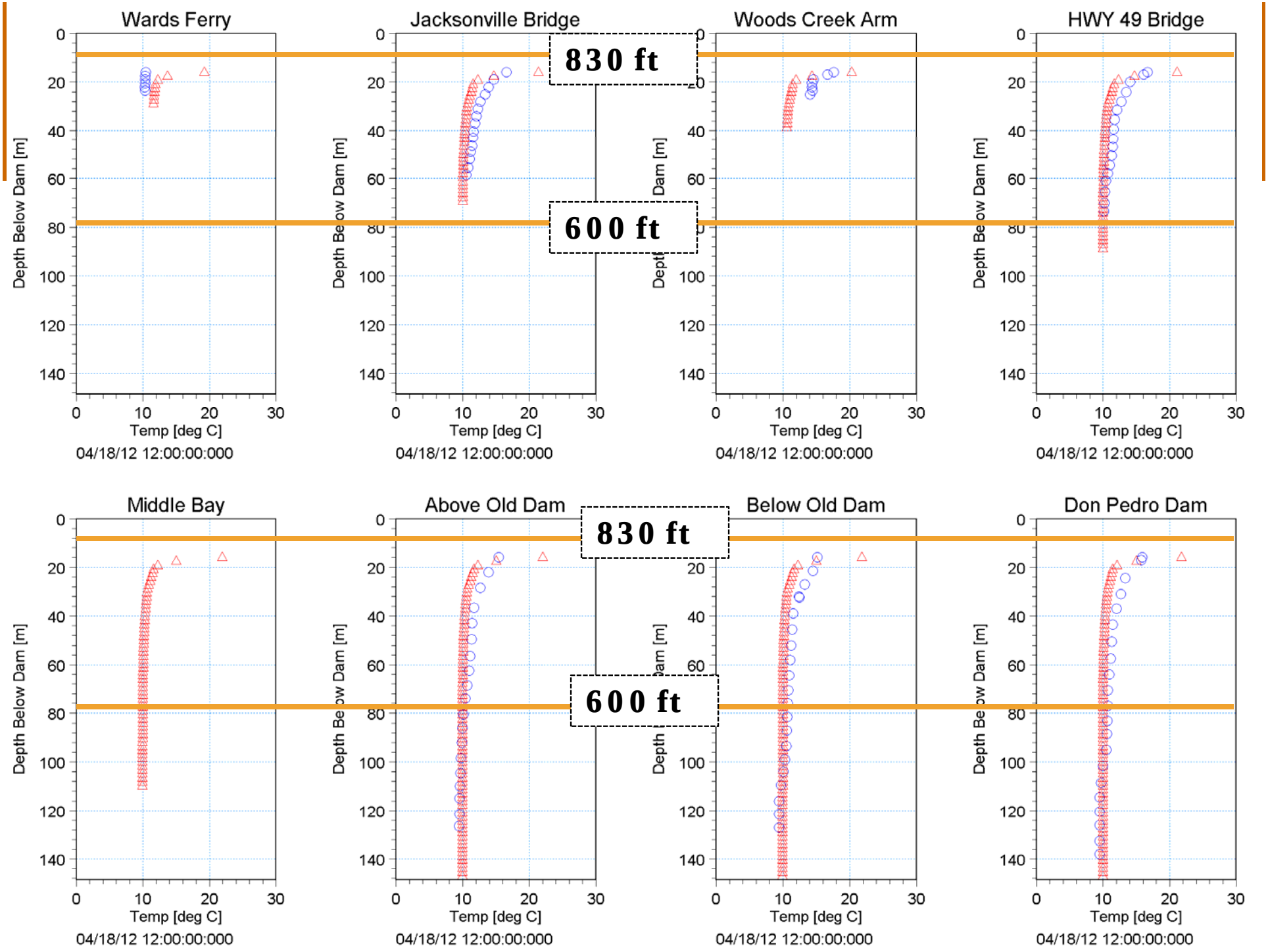
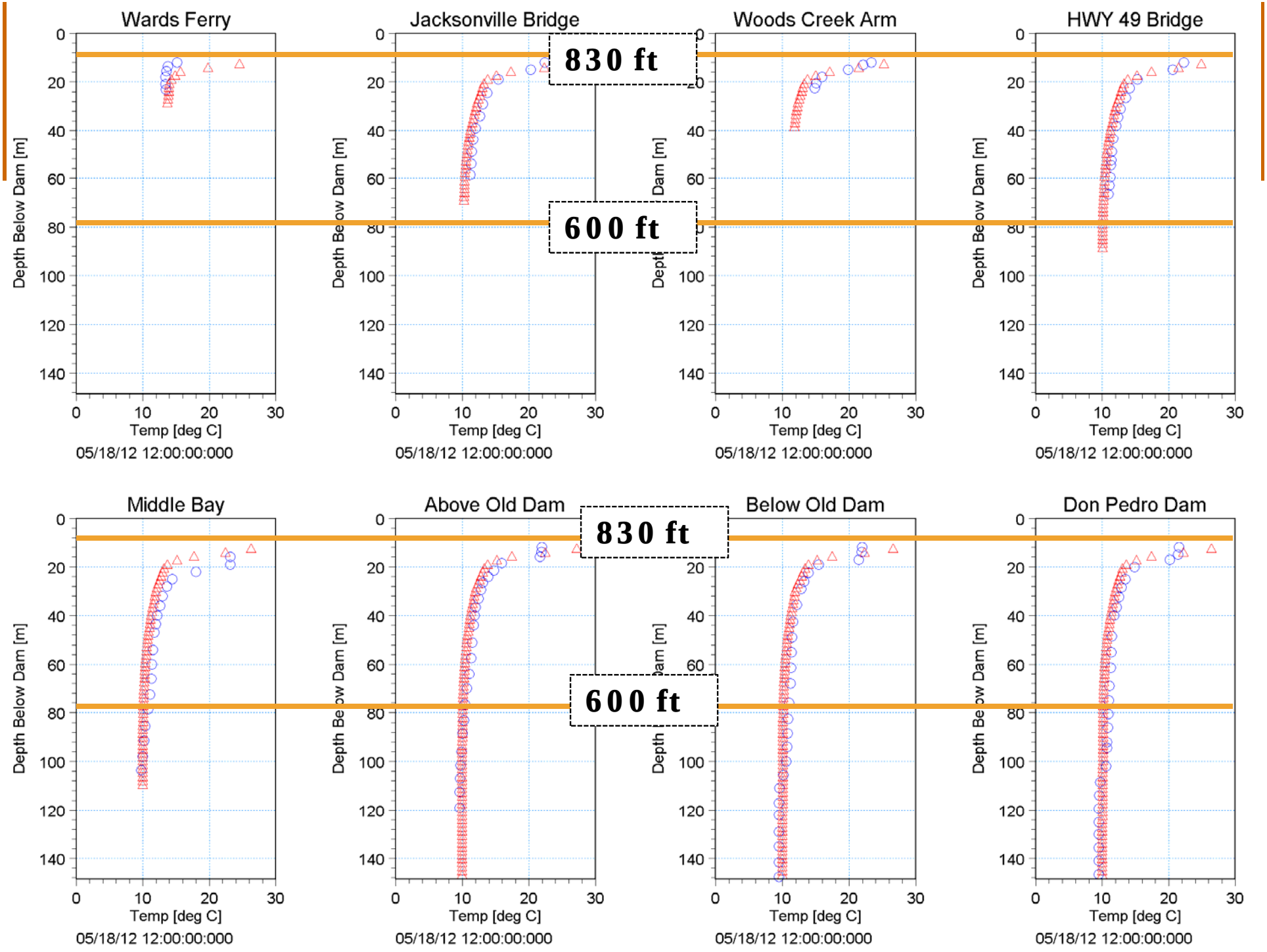
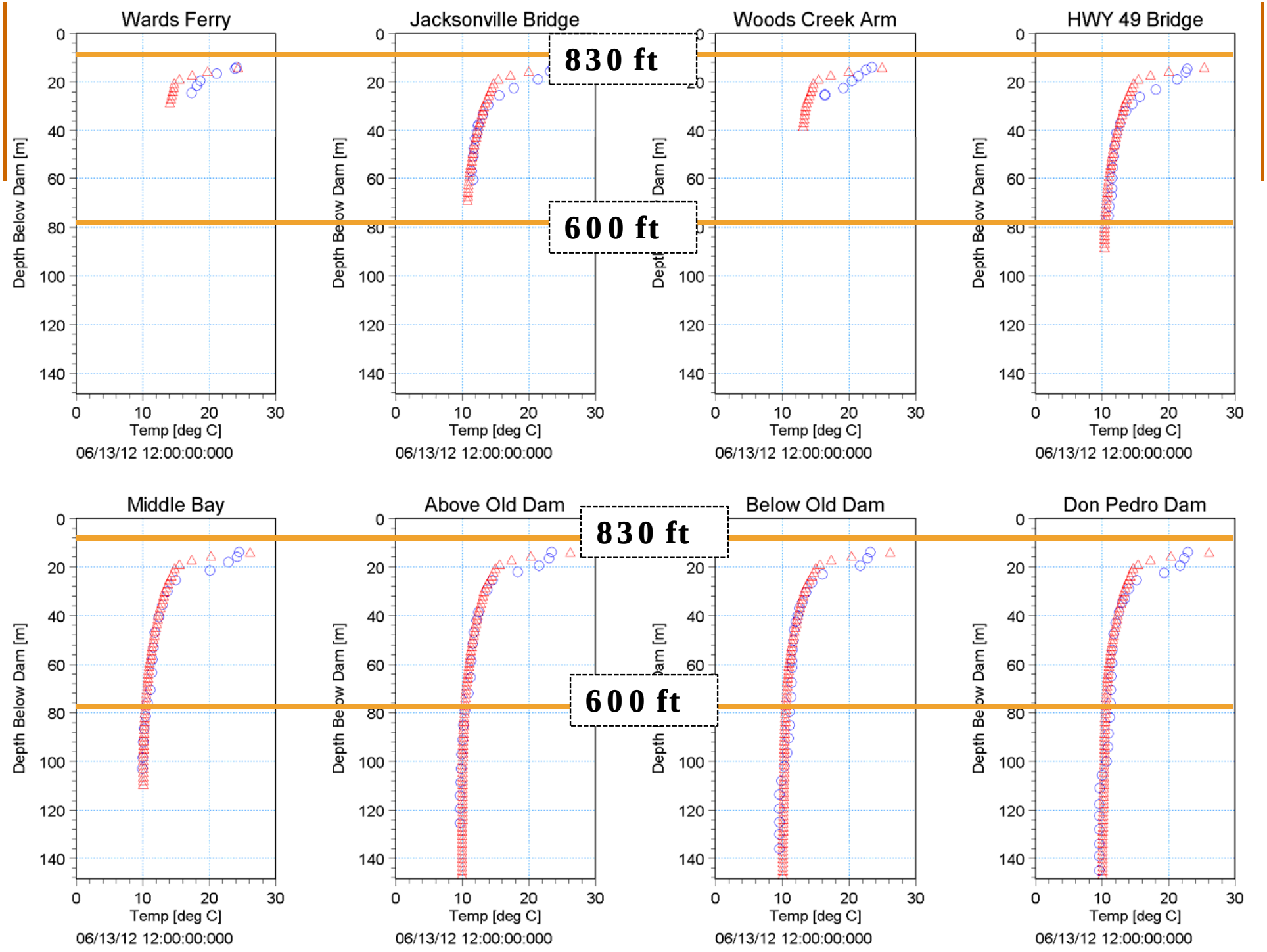
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
10/13/11 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
10/13/11 12:00:00:000

Model Validation Using 2012 Data


Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
03/13/12 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
03/13/12 12:00:00:000


Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
04/18/12 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
04/18/12 12:00:00:000

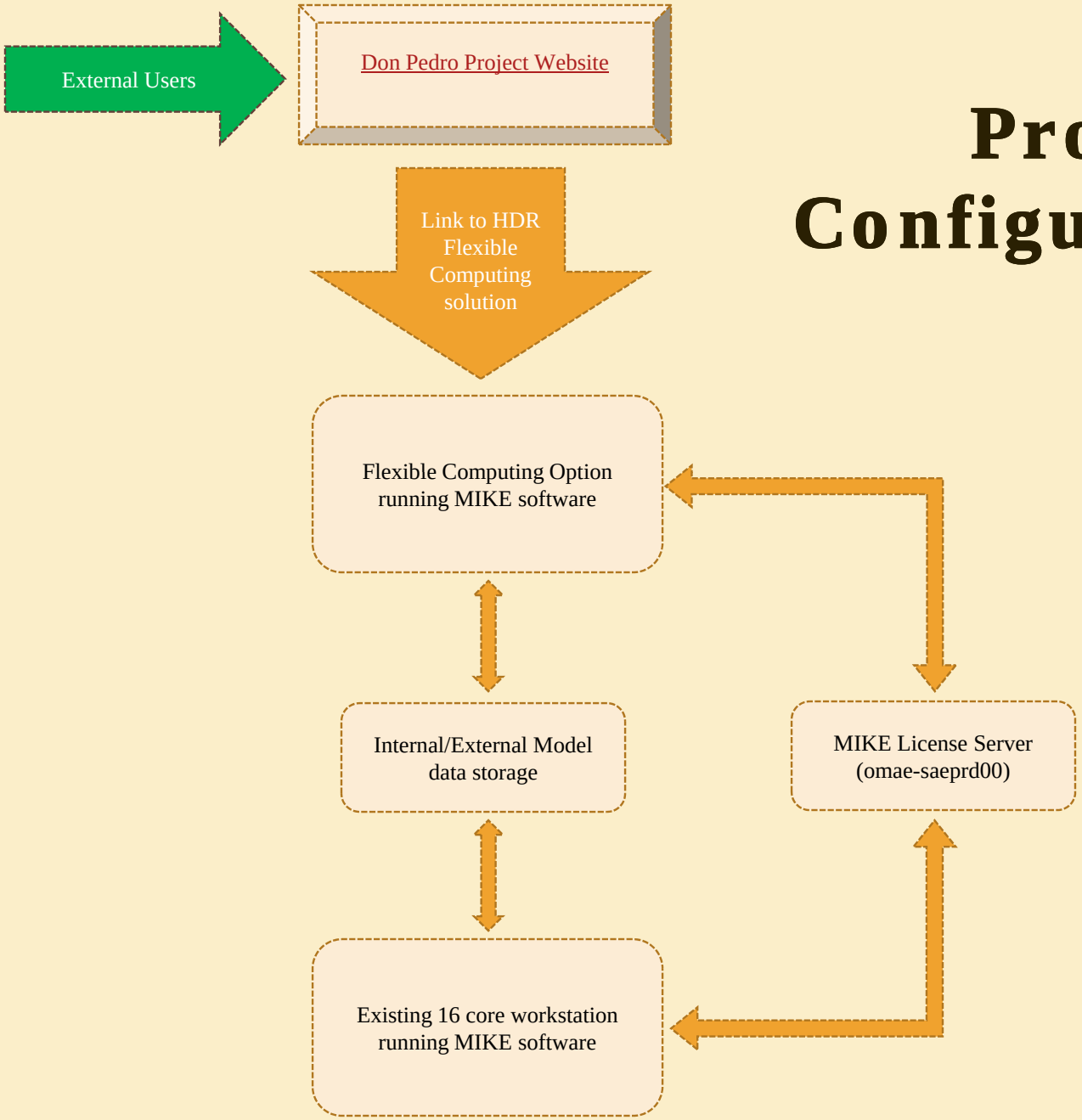

Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
05/18/12 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
05/18/12 12:00:00:000


Wards Ferry
Jacksonville Bridge
Woods Creek Arm
HWY 49 Bridge
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
06/13/12 12:00:00:000
Middle Bay
Above Old Dam
Below Old Dam
Don Pedro Dam
830 ft
600 ft
Depth Below Dam [m]
Temp [deg C]
06/13/12 12:00:00:000

Next Steps

- Resolve temperature profile data issues
- Finalize 2011 calibration
- Complete 2012 validation as data becomes available
- Model access and use by RPs
- Training

Proposed Configuration



MIKE 3D Model Use Plan

- Provide link to modeling workstation on Project Website
- Create modeling workstation on Citrix Server
  - Add user accounts for external users
  - Install MIKE modeling software on workstation
  - Provide connection to internal MIKE license server
  - Users will have ability to print locally
- Create shared folders on workstation for models
  - Provide location for Models posted by HDR
  - Assign permissions for above accounts to read Model data
  - Provide location for external users to save their data

Abstract

HDR will create a virtual workstation that will allow external users to connect to the MIKE modeling software and run "what-if" scenarios.

Access to the workstation will be provided via the existing Project website http://www.donpedro-relicensing.com/default.htm.

Users will be able to use the models provided by HDR as a base to perform other simulations and then have the ability to save and/or print the results.

Mitigate Issues

- Meet with Project team/ITG to create the testing plan
- Provide Project team/external users with training & use documentation to define use of workstation & software
- Include on-going project “check-in” schedule to verify that system is working as expected

Don Pedro Project Relicensing

W&AR-16: Lower Tuolumne River Water Temperature Model Workshop

October 26, 2012

MODESTO IRRIGATION DISTRICT | TURLOCK IRRIGATION DISTRICT

FERC PROJECT No. 2299

Agenda

- River Model
  - Study Plan Overview
  - Model Description
  - Data Sources and Data Collection: Meteorology; River Temperature
  - Modeling; Other Data Sources
  - Model Calibration
  - Model Validation

FERC-Approved Study Plan

- Background:
  - Basin-Wide Water Temperature Model (SJR5Q 2009)
  - July 2009 FERC Order: Stillwater Sciences March 2011
  - Don Pedro Revised Study Plan, November 2011
  - FERC Determination

FERC Determination

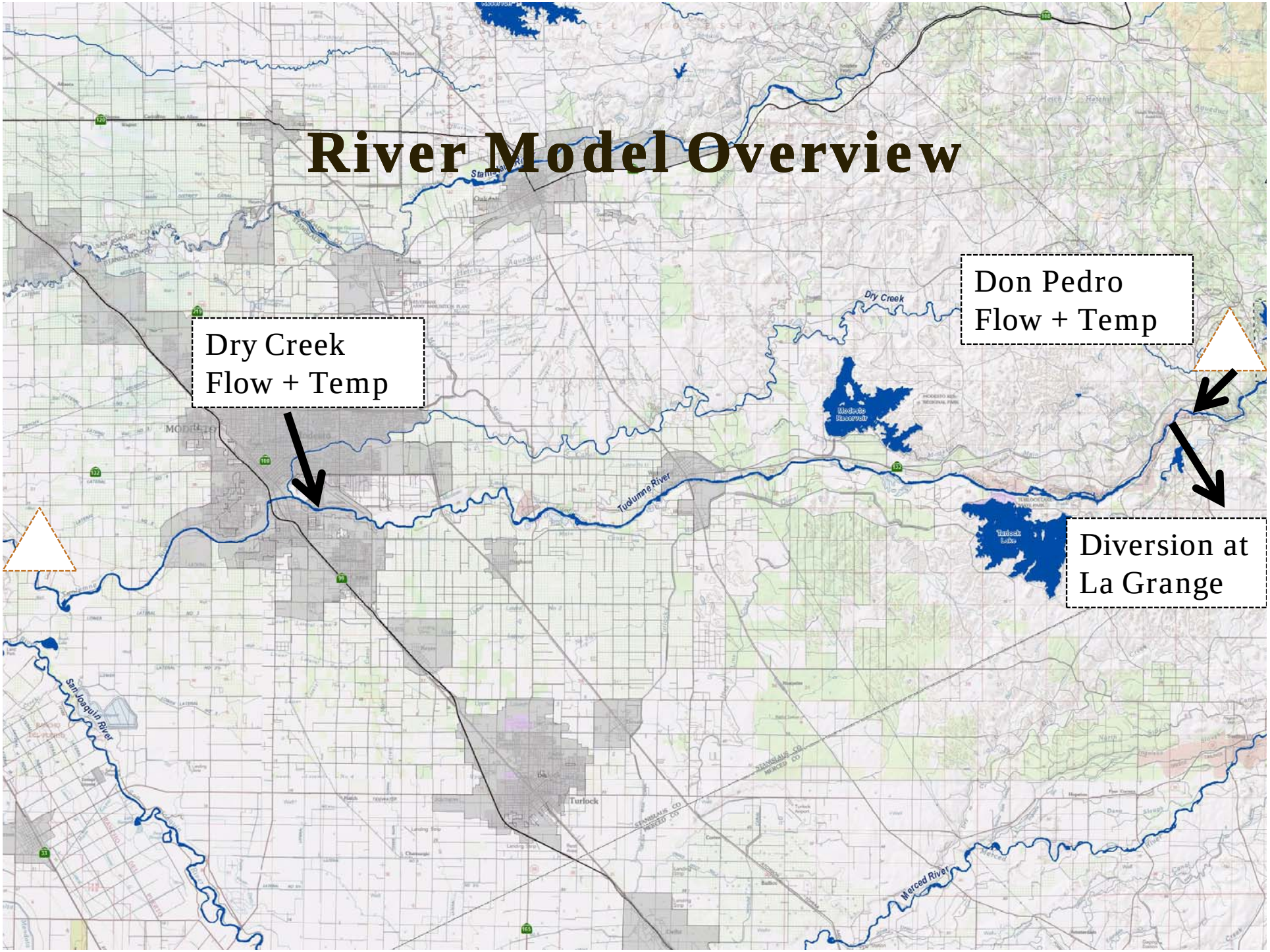
- Coordinate results with Cal-Fed San Joaquin Model
- Not necessary to extend model into San Joaquin River
- Model to produce 7DADMax results per EPA 2003
- Compare to Stillwater 2011 results
- Make available to RPs data and input files used in calibration/validation

Lower Tuolumne River Model

- The river model was based on an existing HEC-5Q model that included the lower Tuolumne River
- The existing model began above Don Pedro
- The current model begins below Don Pedro and uses Don Pedro releases and measured temperature as inputs
- The model uses 6-hr time step

Lower Tuolumne River Model

- The only inflow currently considered is Dry Creek
- Dry Creek flow and temp based on USGS and CDEC data
- There are no other inflows at this time; accretion flow measurements are underway
- Only significant outflow is diversion flow at La Grange diversion dam to TID and MID


River Model Overview
Dry Creek
Flow + Temp
Don Pedro
Flow + Temp
Diversion at
La Grange
Dry Creek
Tuolumne River
Modesto Reservoir
Turlock Lake
San Joaquin River
Merced River
Turlock

Model Computations

Hydraulics

- The model hydraulics are based on Manning's Equation:

$$Q = AV = A\ 1.49/n\ \ R_h^{\ 2/3}\ S^{1/2}$$

Model Computations

Temperature

- Heat transfer is given by
  $H = K_{ex} (T_e - T_w)$
- H is in $kcal/m^2/s$
- K_{ex} is the heat exchange coefficient
- T_e is the equilibrium temp
- T_w is the water temp

Model Computations

- K_{ex} is time variable, usually lower at night, max during day
- There are many formulations for equilibrium temp. The simplest is:

  $T_e = T_d + R/K$

- T_d is dew point temp
- R is solar radiation
- K is surface heat exchange coefficient

Model Set Up

- The model is set up using 6 files
- 5 are formatted text files
- 1 is binary

Formatted Text File

Tuolumne_5.dat - Notepad

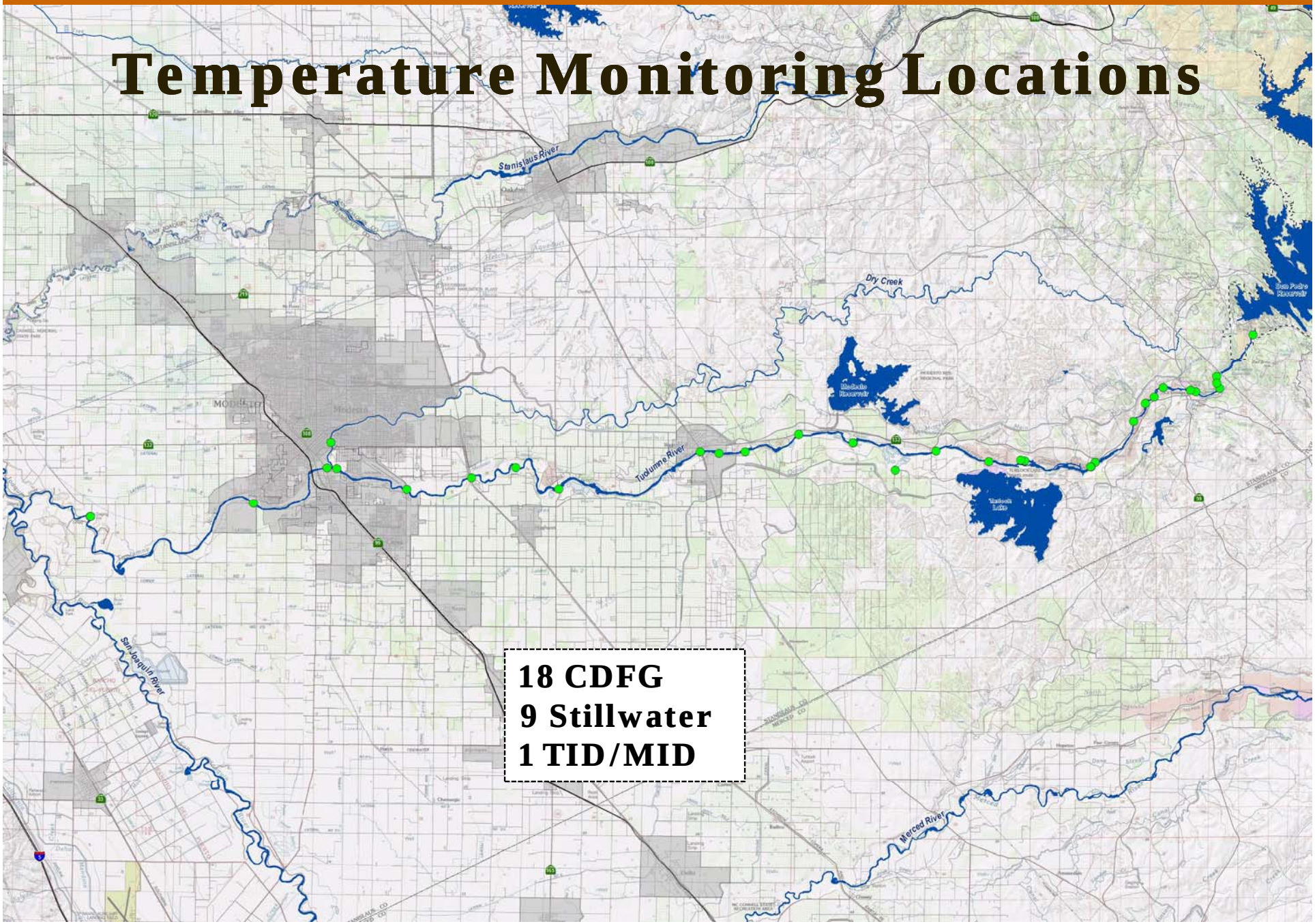
File Edit Format View Help

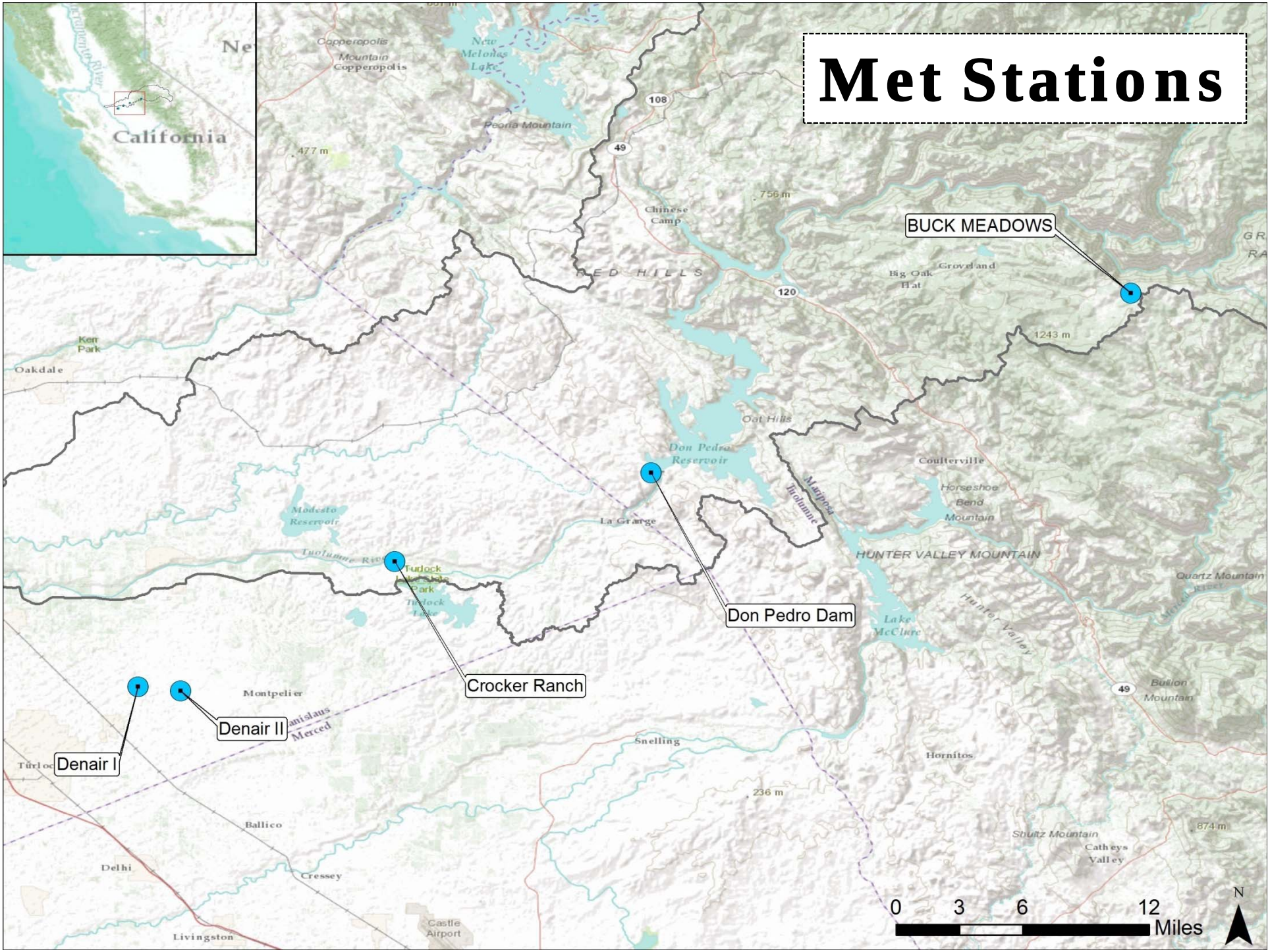
```
CR      2      .67      .33
C ********************************************************************************

CP    452   999999        0        0
IDTR-at LaGrange
RT    452      450

C ***************** LaGrange Diversion Dam ***************** River mile 137
RL   -450    130.       52       77      130      131      255
RO

c.RS     12     12.0     56.3    103.4    153.2    205.8    261.1    319.2    380.0    443.6
c.RS 509.9    579.0    650.9
RS       12      6.0     27.3     51.4     77.2    103.8    131.1    160.2    190.0    222.6
RS 255.9    290.0    325.9

RQ      12       -1       -1       -1       -1       -1       -1       -1       -1       -1
RQ      -1       -1       -1

RA      12     21.5     22.8     24.2     25.6     27.0     28.4     29.7     31.1     32.5
RA   33.9     35.2     36.6

c.RE     12      285      287      289      291      293      295      297      299      301
c.RE    303      305      307
RE       12      290      291      292      293      294      295      296      297      298
RE      299      300      301

CP    450   999999        0        0
IDLaGrange Reservoir
RT    450      448
DR    450                                              -5

CP    448   999999        0        0
IDDon Pedro Control
C  Tuolumne, La Grange Dam to Turloch State Park
RT    448      440      1.9
CR      2      .67      .33

CP    440   999999        0        0
IDTurloch State Park
C  Tuolumne, Turloch State Park to J9 Bridge @ Waterford
RT    440      430      1.9
```

Data Sources and Locations

- River Temperature Monitoring
- Meteorology
- Other Data Sources

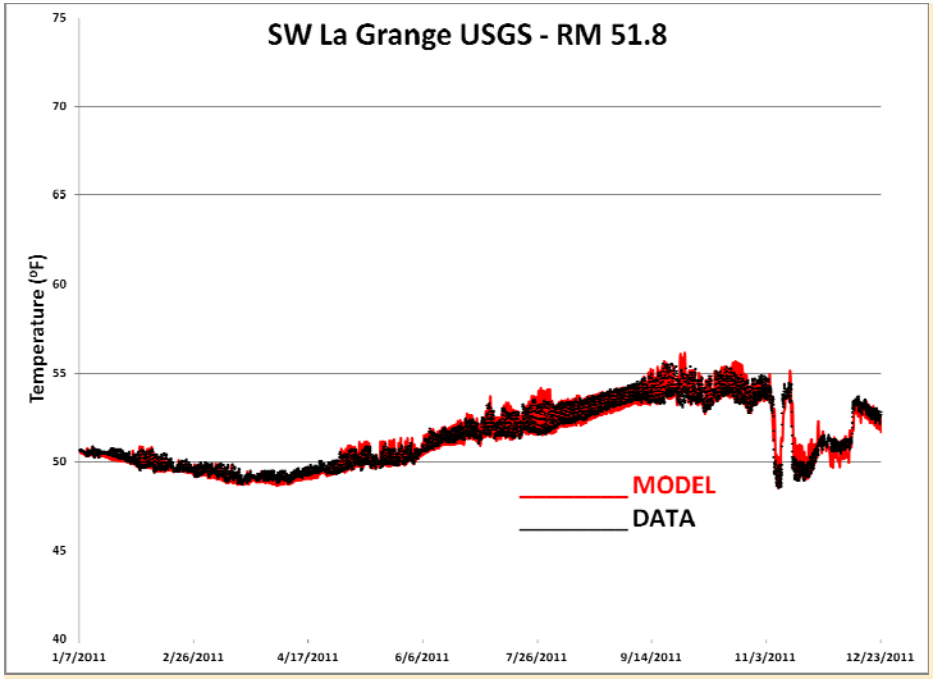
Temperature Monitoring Locations

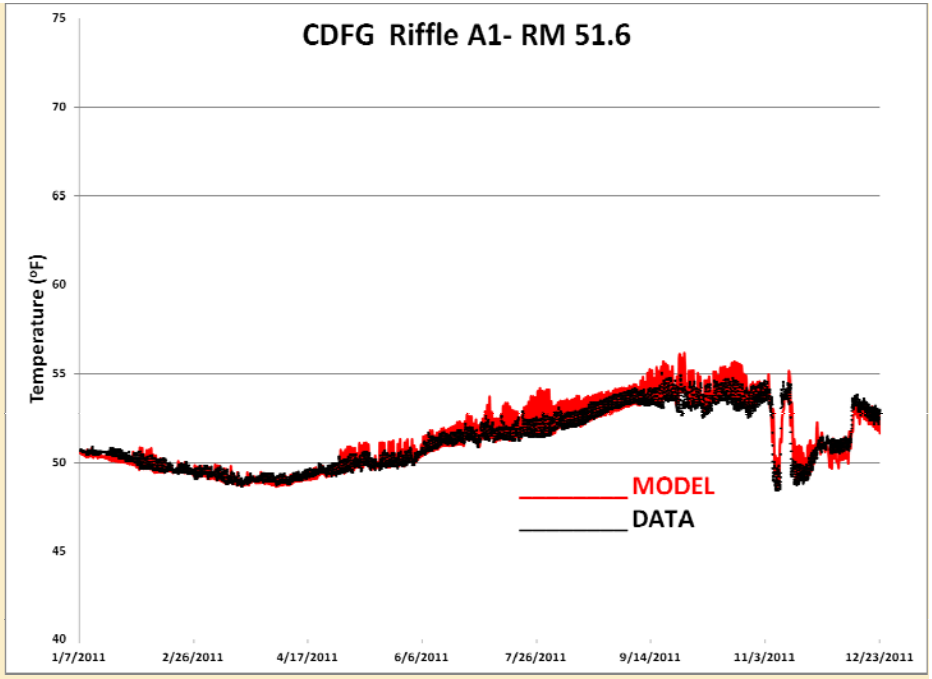


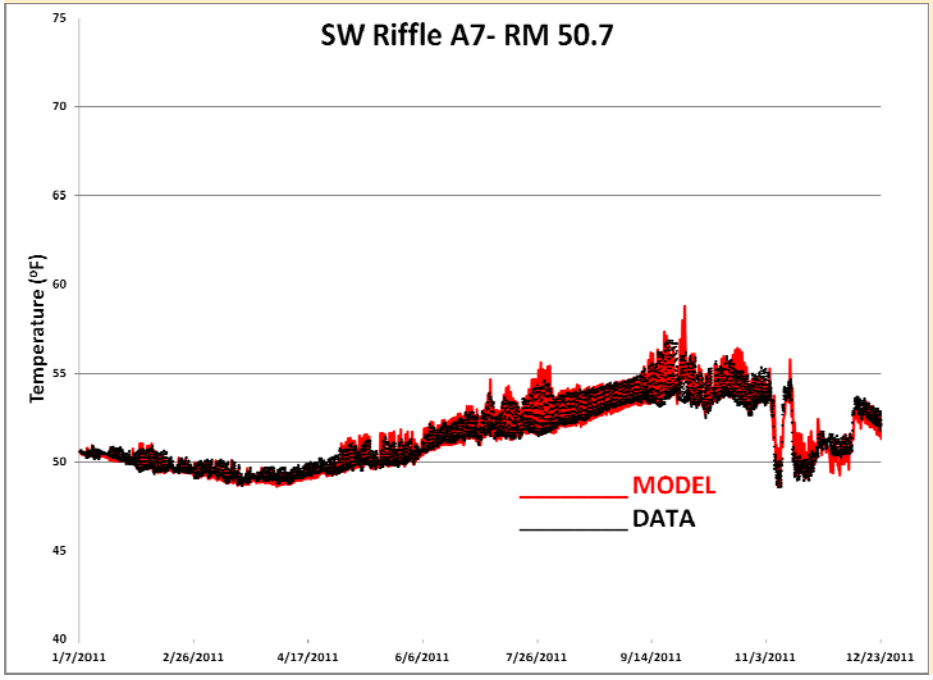

Met Stations
BUCK MEADOWS
Don Pedro Dam
Crocker Ranch
Denair II
Denair I
California
Copperopolis
Mountain
Copperopolis
New
Melones
Lake
Peoria Mountain
477 m
108
49
Chinese
Camp
756 m
RED HILLS
120
Groveland
Big Oak
Flat
1243 m
Ken
Park
Oakdale
Oat Hills
Don Pedro
Reservoir
Coulterville
Horseshoe
Bend
Mountain
Modesto
Reservoir
La Grange
Tuolumne Riv
Turlock
Lake
State
Park
Turlock
Lake
Merced
Mariposa
Tuolumne
HUNTER VALLEY MOUNTAIN
Quartz Mountain
Hunter Valley
Lake
McClure
Bullion
Mountain
Montpelier
anislaus
Merced
Snelling
Hornitos
Turlock
236 m
Ballico
Delhi
Cressey
Castle
Airport
Livingston
Stultz Mountain
874 m
Catheys
Valley
0 3 6 12
Miles
N

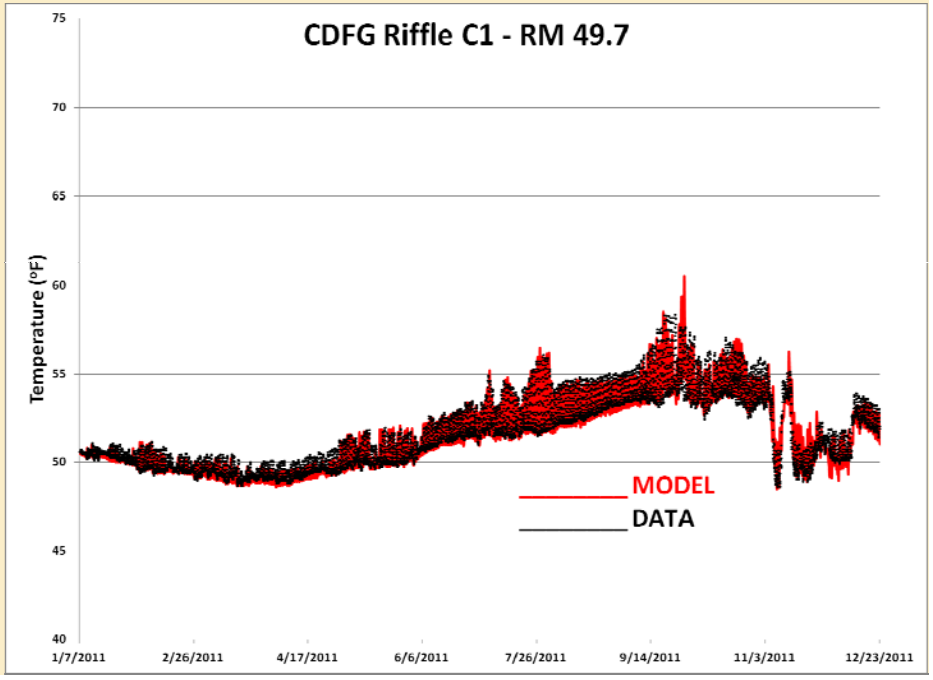
Model Calibration

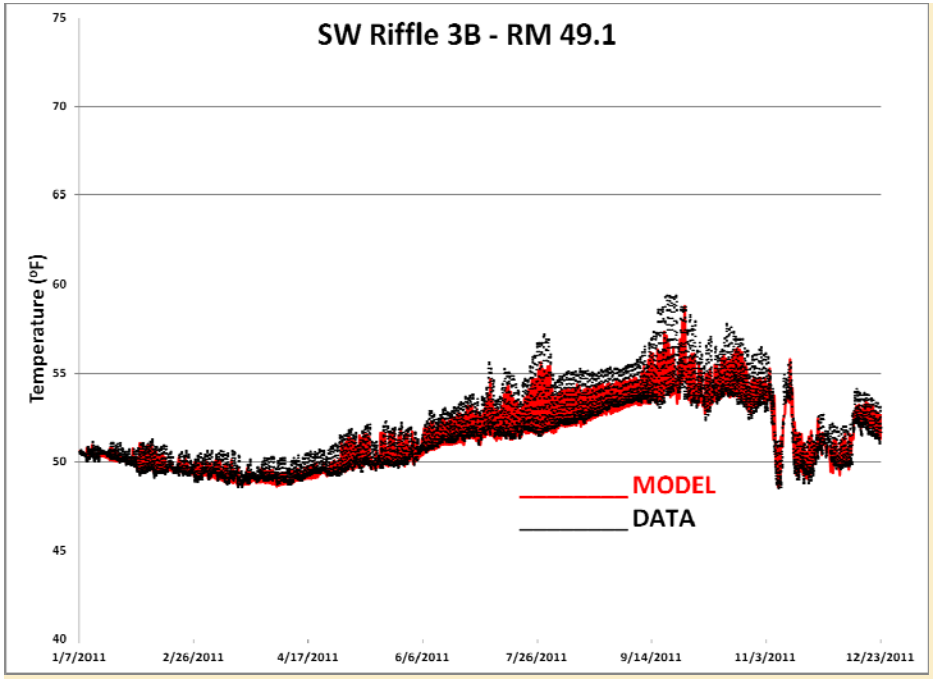
- Description of Calibration
- Model vs Real Time Data
- 6-hr time step vs hourly data
- Next Steps

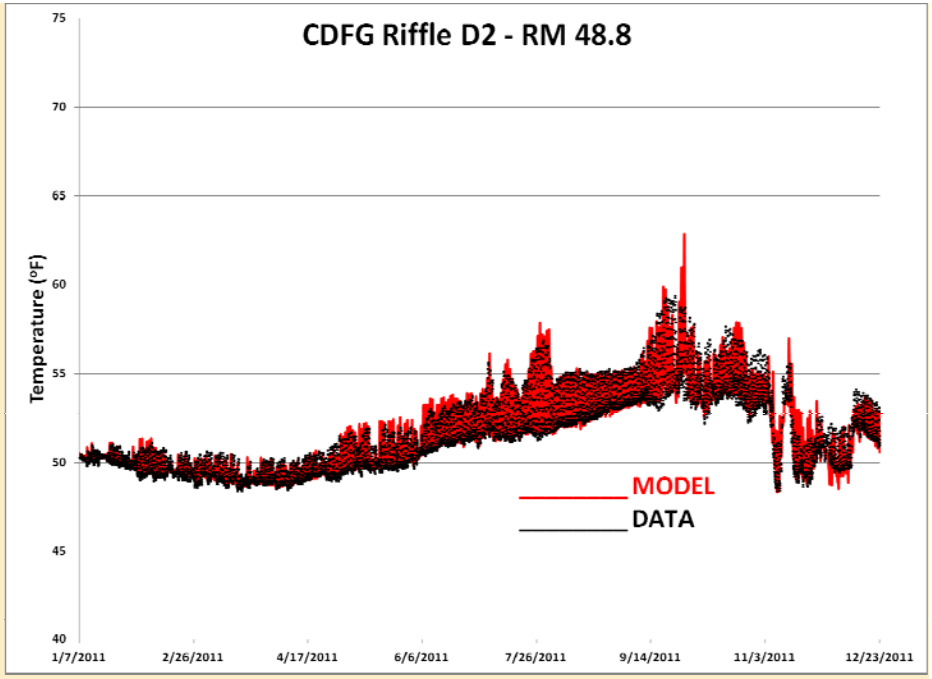

SW La Grange USGS - RM 51.8
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

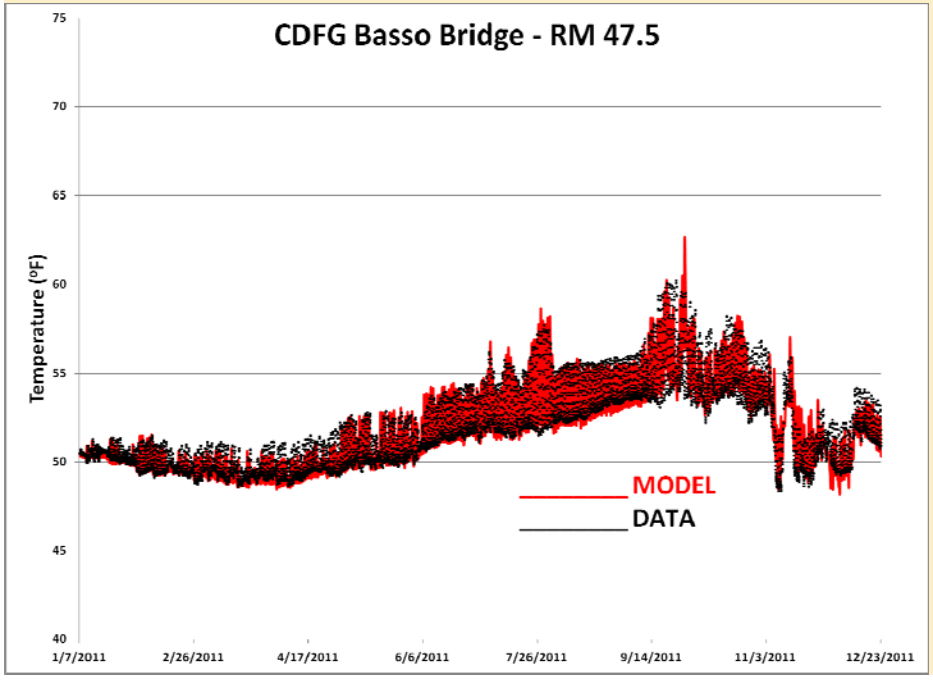

CDFG Riffle A1- RM 51.6
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

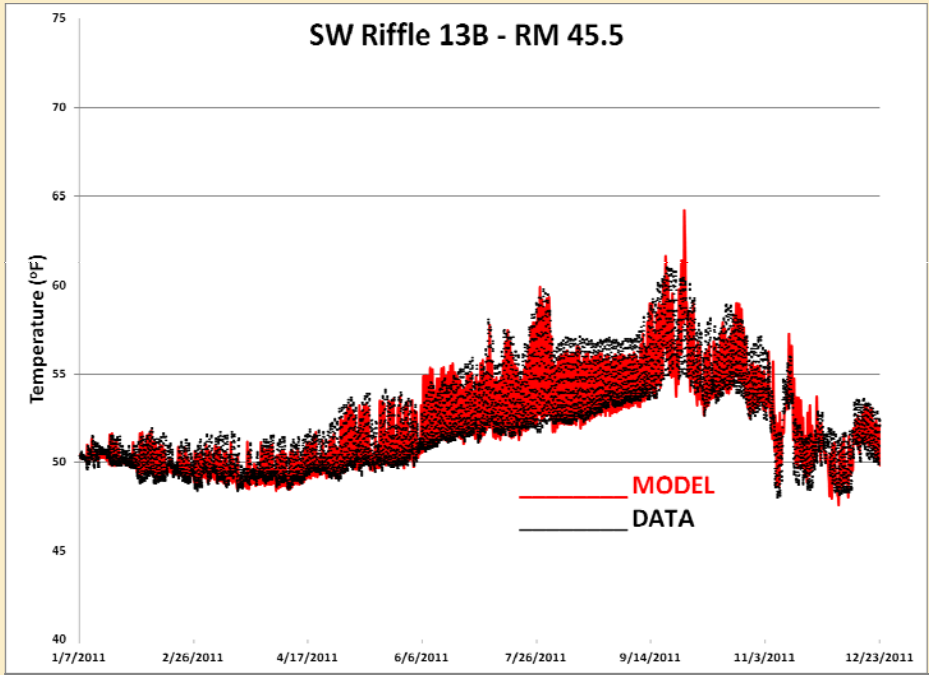

SW Riffle A7- RM 50.7
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

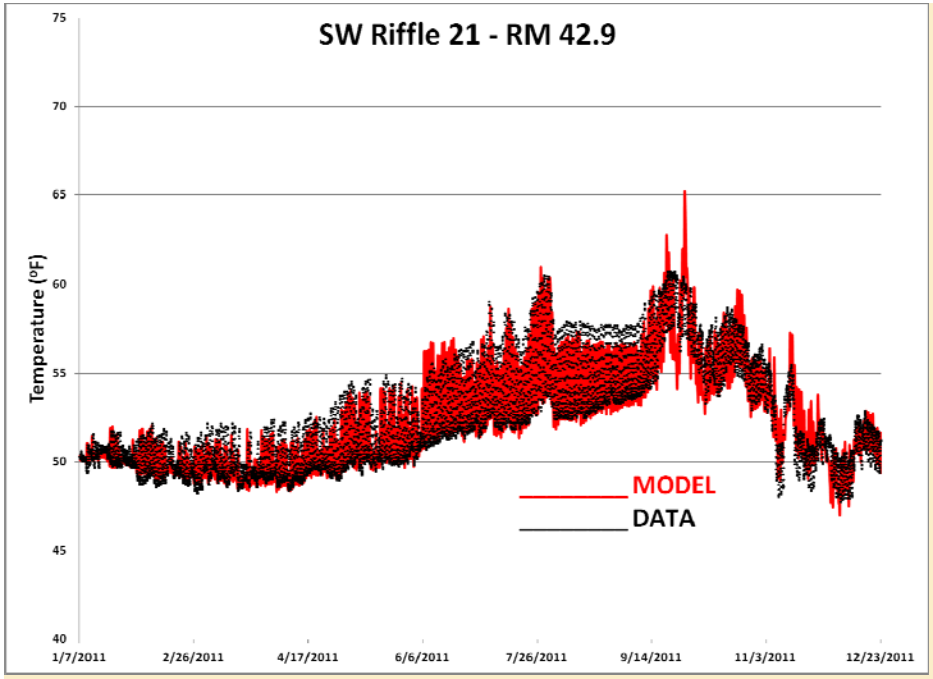

CDFG Riffle C1 - RM 49.7
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

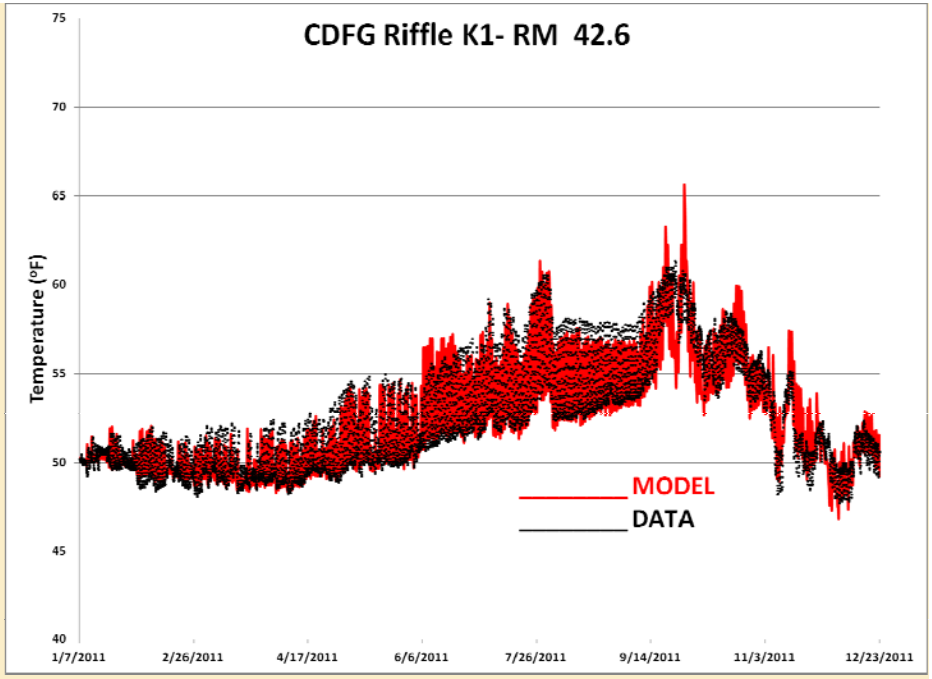

SW Riffle 3B - RM 49.1
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

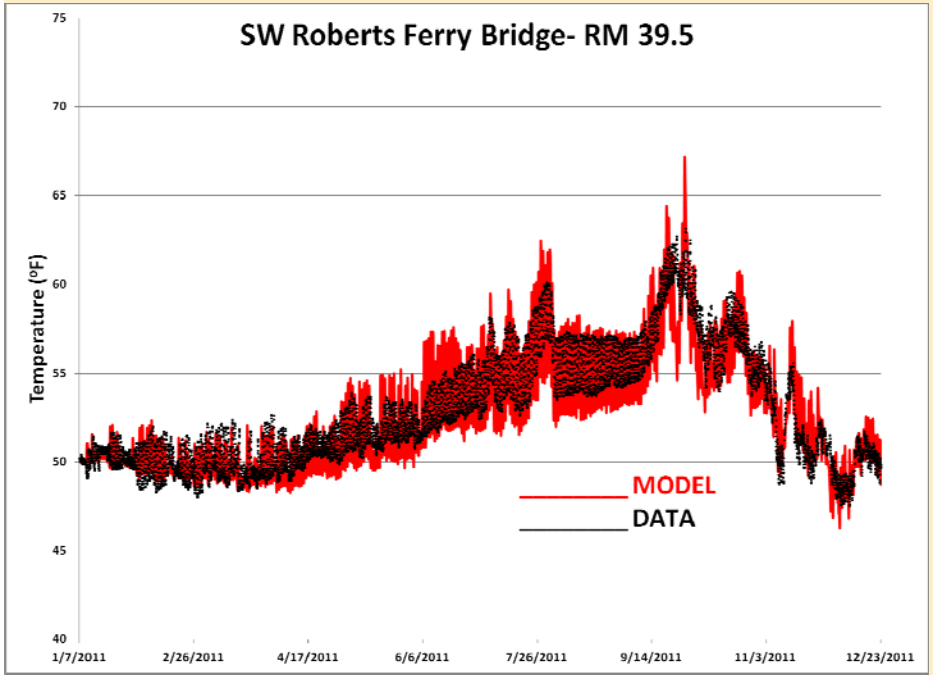

CDFG Riffle D2 - RM 48.8
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

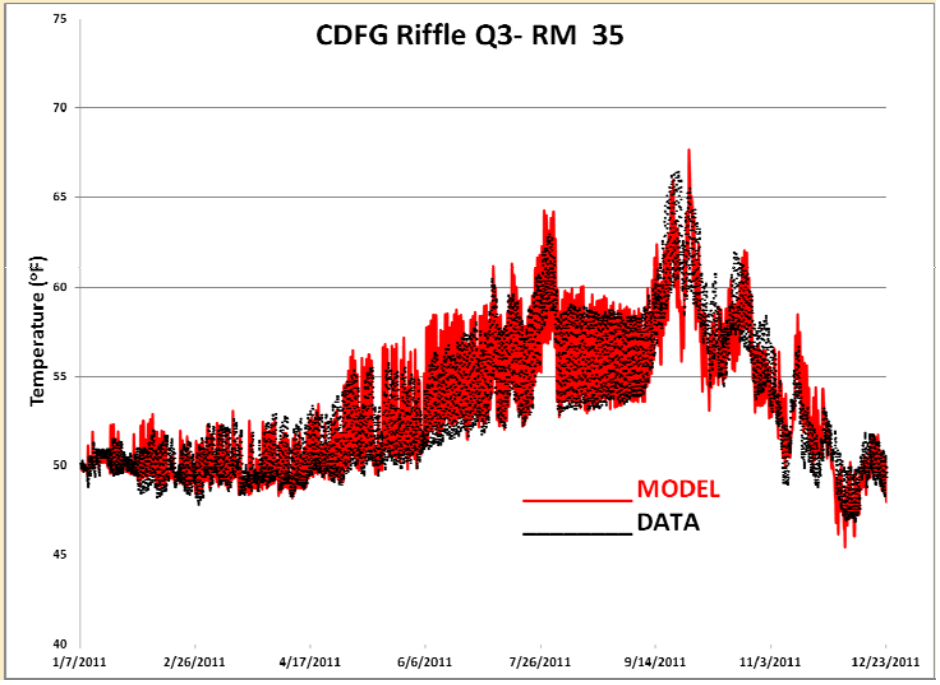

CDFG Basso Bridge - RM 47.5
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

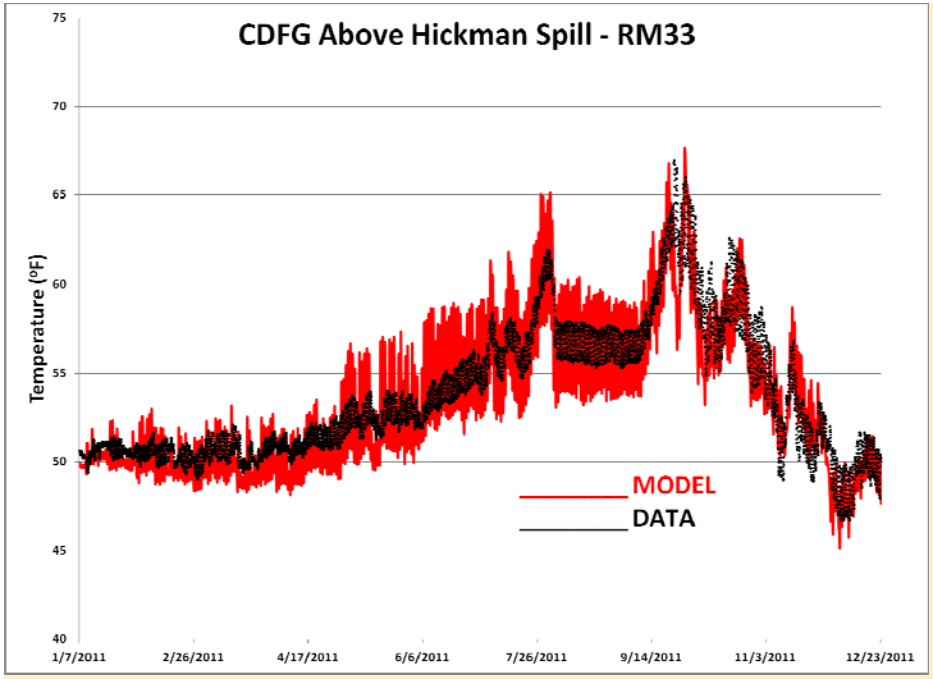

SW Riffle 13B - RM 45.5
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

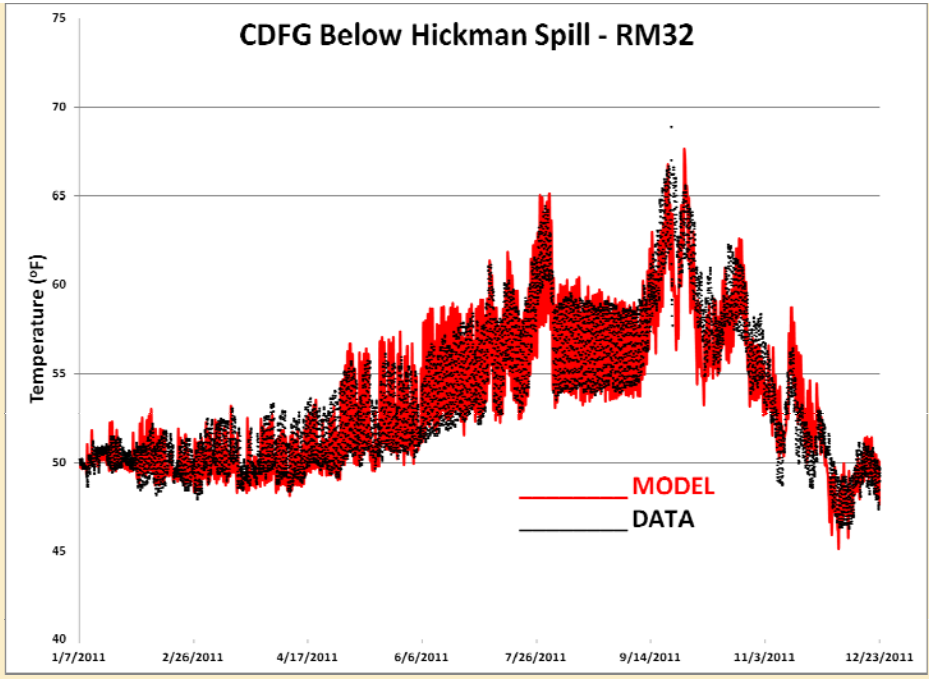

SW Riffle 21 - RM 42.9
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

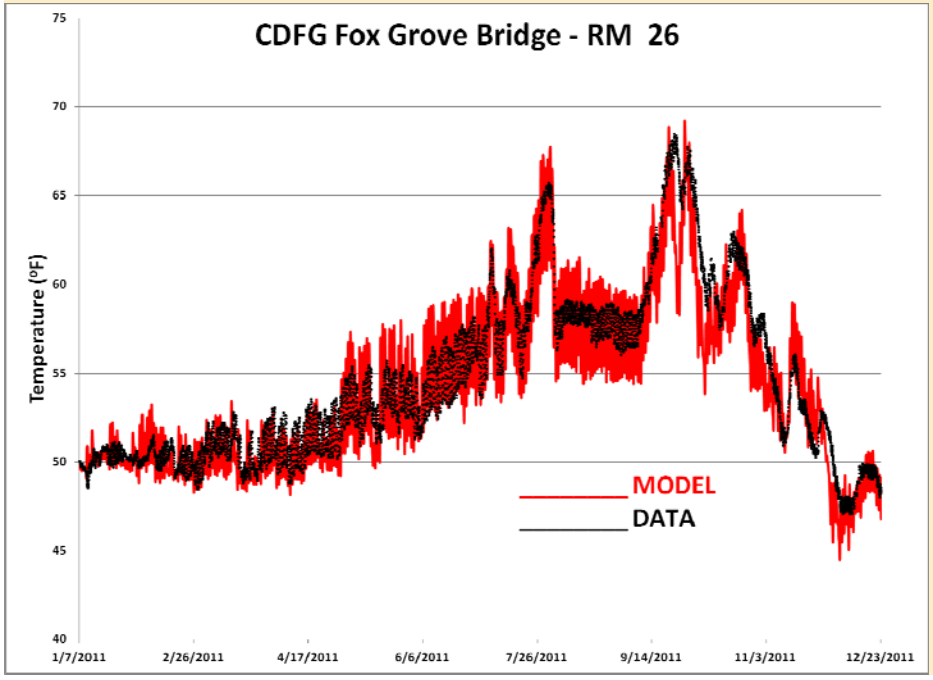

CDFG Riffle K1- RM 42.6
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

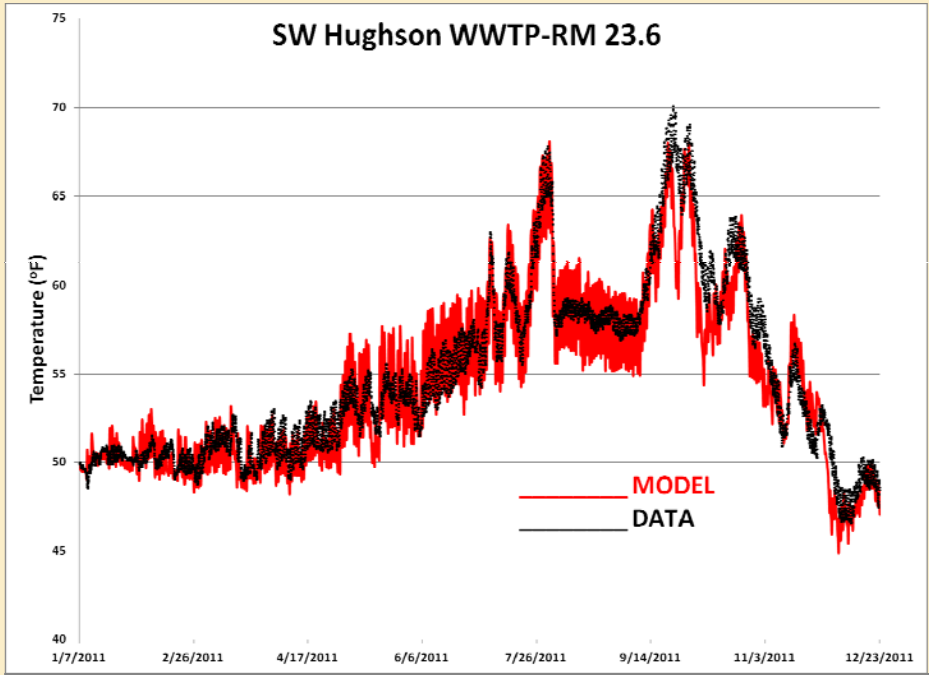

SW Roberts Ferry Bridge- RM 39.5
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

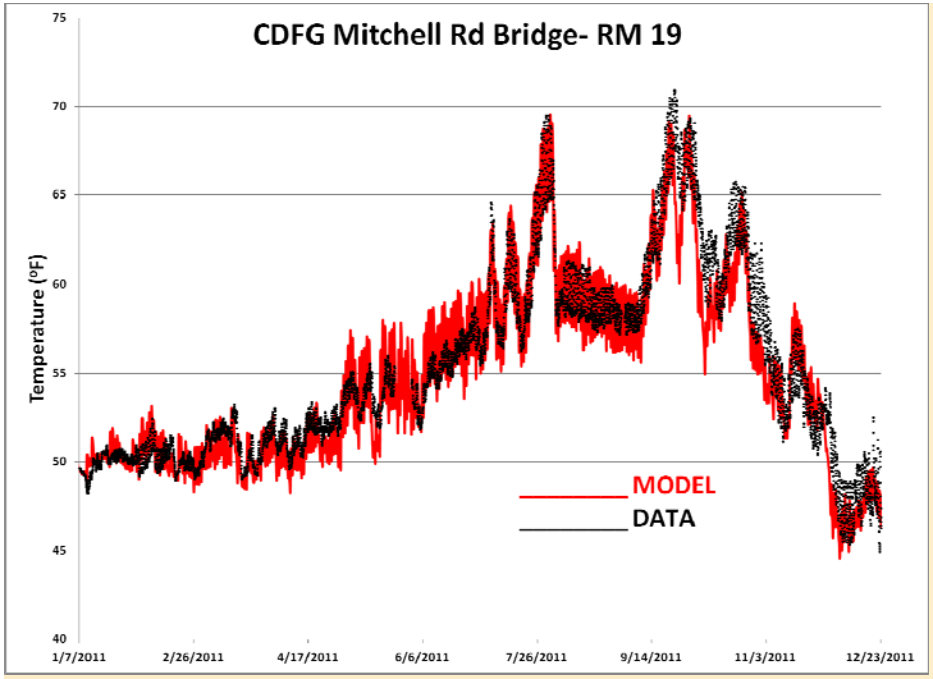

CDFG Riffle Q3- RM 35
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

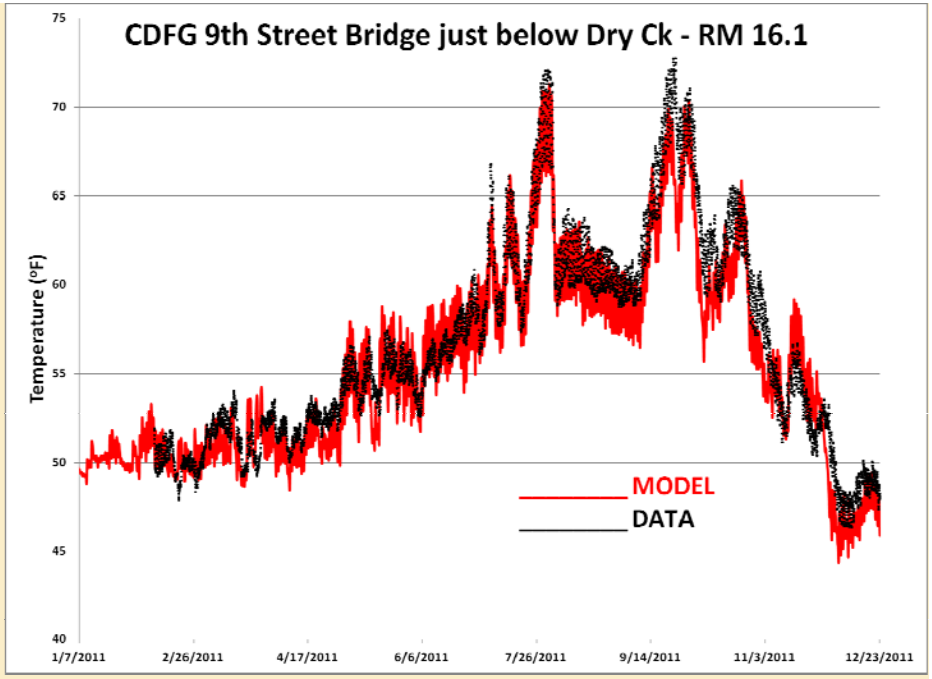

CDFG Above Hickman Spill - RM33
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

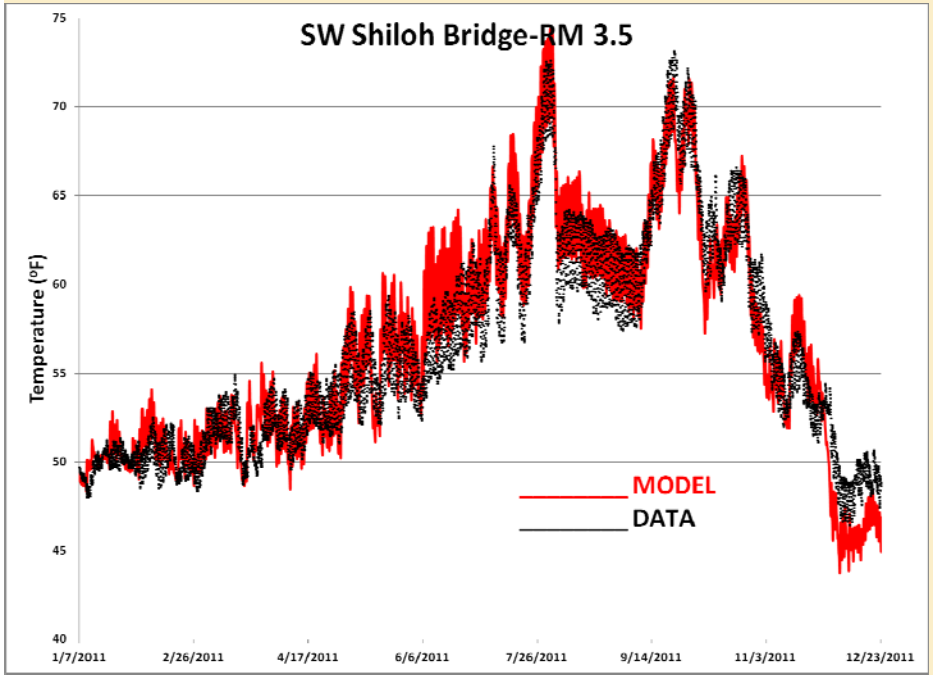

CDFG Below Hickman Spill - RM32
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

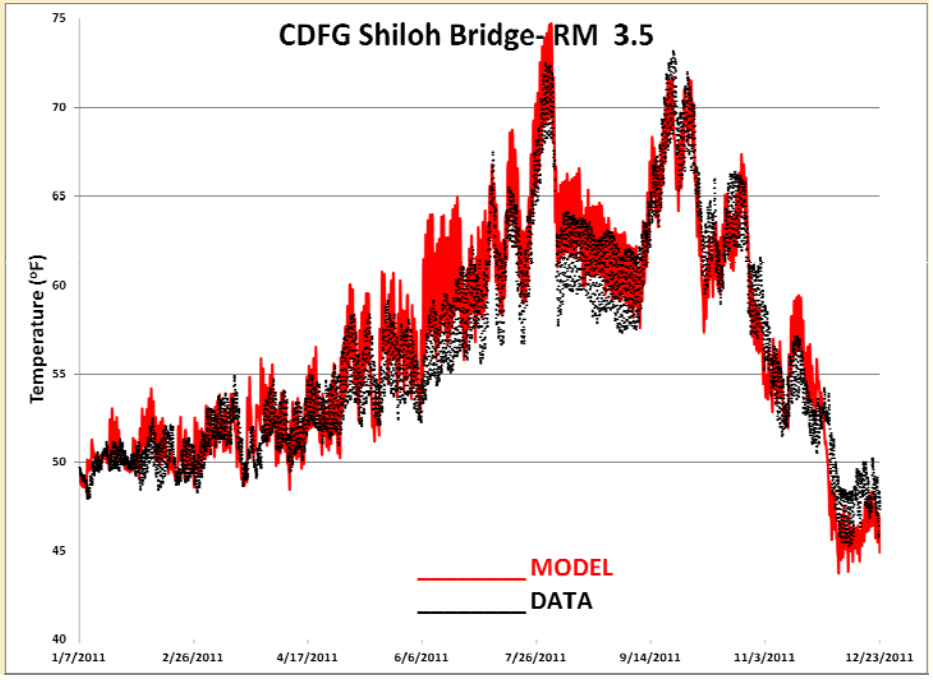

CDFG Fox Grove Bridge - RM 26
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA


SW Hughson WWTP-RM 23.6
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA


CDFG Mitchell Rd Bridge- RM 19
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA


CDFG 9th Street Bridge just below Dry Ck - RM 16.1
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA


SW Shiloh Bridge-RM 3.5
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

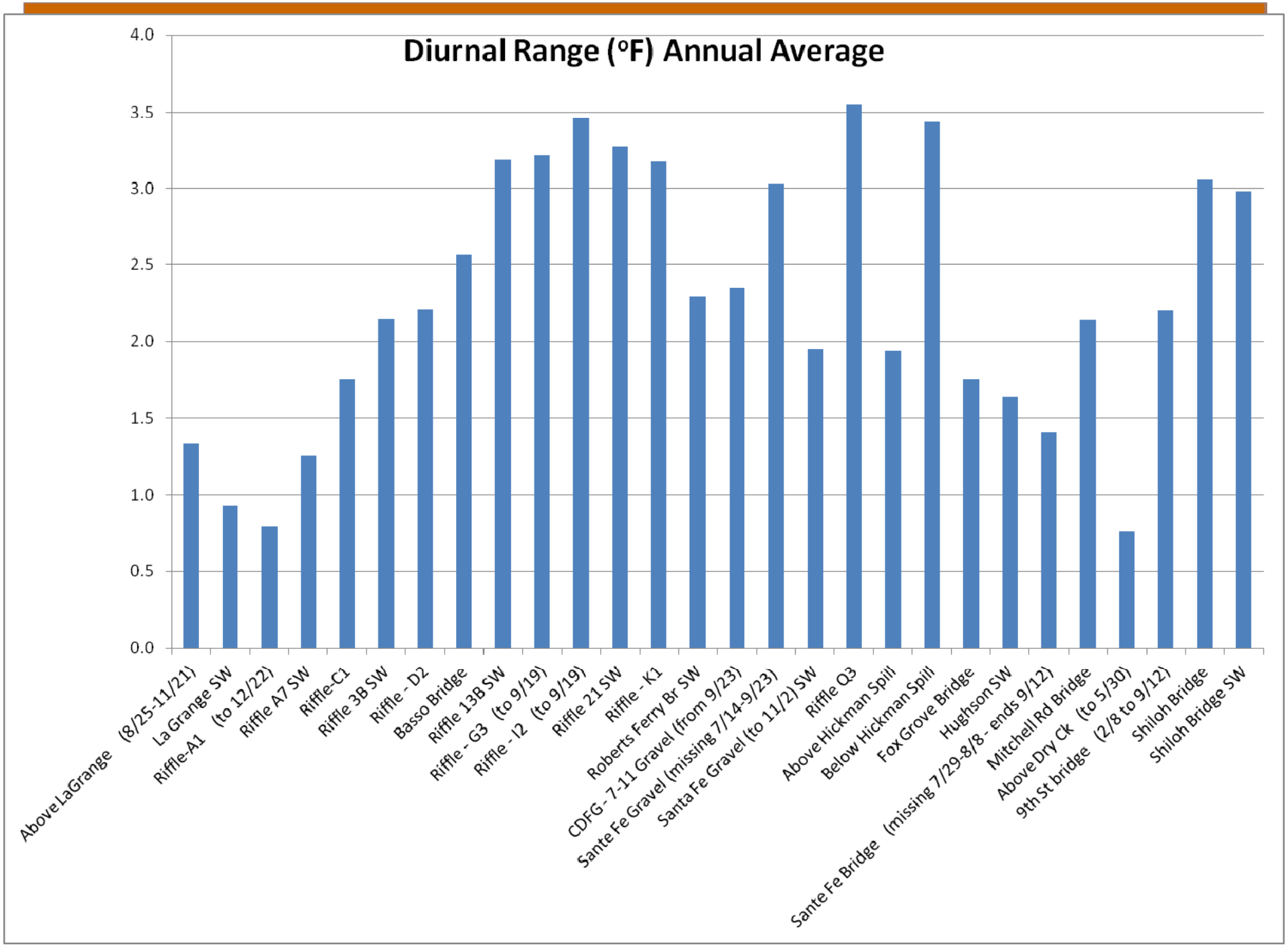

CDFG Shiloh Bridge- RM 3.5
Temperature (°F)
75
70
65
60
55
50
45
40
1/7/2011
2/26/2011
4/17/2011
6/6/2011
7/26/2011
9/14/2011
11/3/2011
12/23/2011
MODEL
DATA

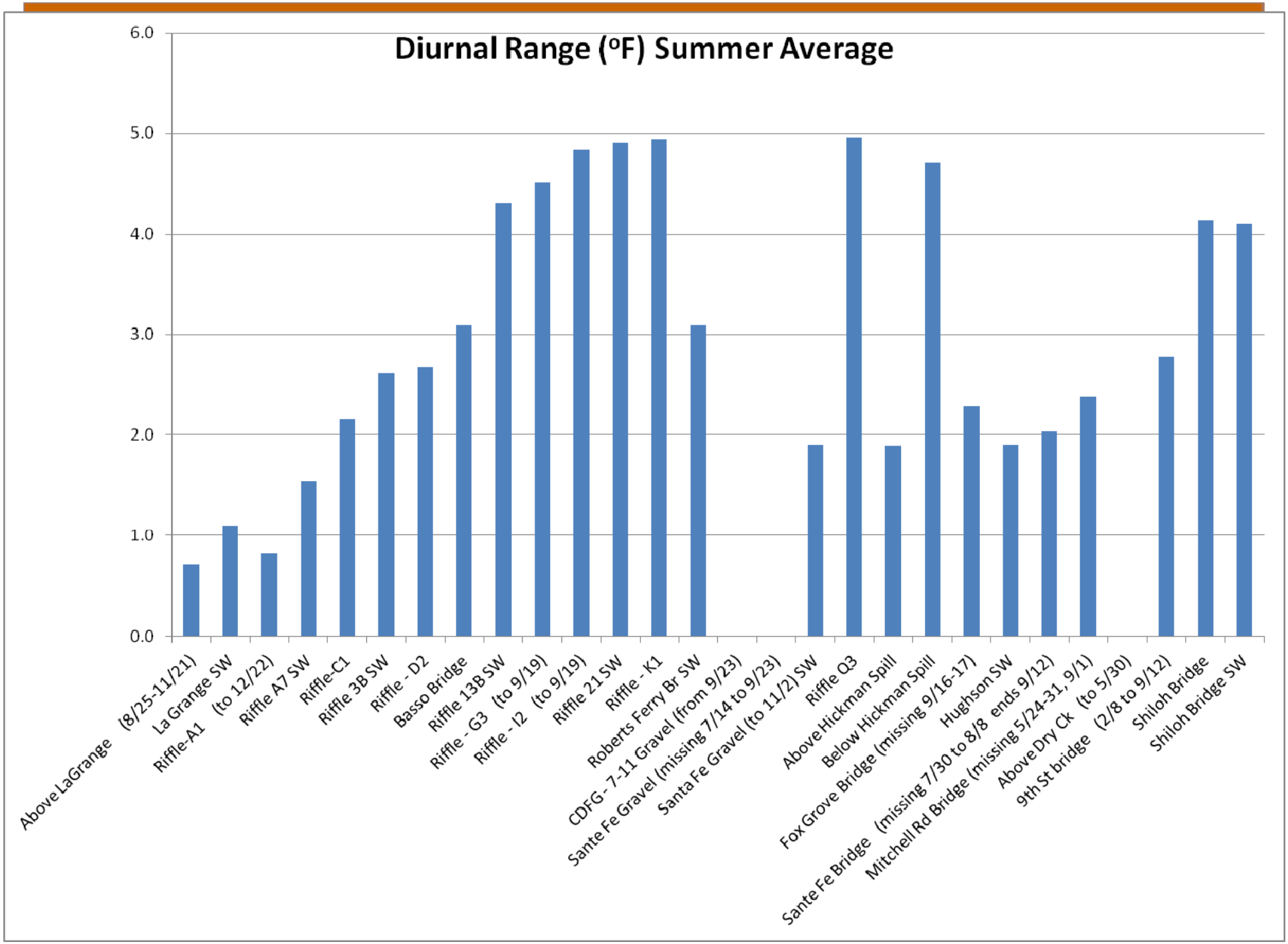
Statistics

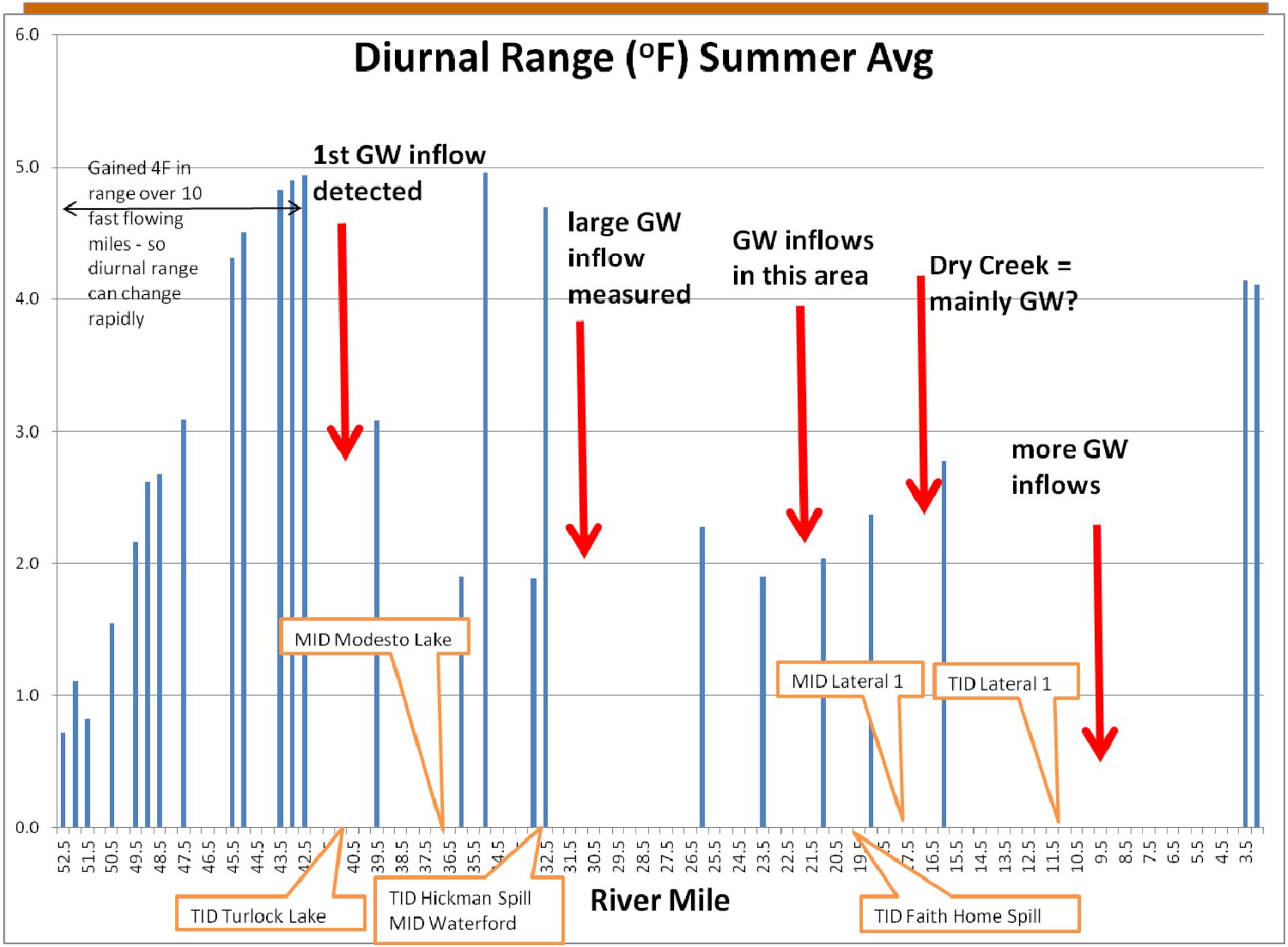
		Percent Coverage			percent above
Site	r^2	+/-0.9F	+/-1.8F	+/-2.7F	observed
CDFG Riffle-A1 (to 12/22)	0.89	81%	96%	99%	52%
CDFG Riffle-C1	0.95	88%	98%	100%	37%
CDFG Riffle - D2	0.95	85%	96%	99%	64%
CDFG Basso Bridge	0.94	82%	95%	99%	46%
CDFG Riffle - K1	0.88	51%	77%	92%	49%
CDFG Riffle Q3	0.92	54%	75%	88%	60%
CDFG Above Hickman Spill	0.87	25%	58%	84%	52%
CDFG Below Hickman Spill	0.90	44%	66%	83%	49%
CDFG Fox Grove Bridge	0.91	28%	58%	81%	52%
CDFG Mitchell Rd Bridge	0.95	40%	71%	89%	58%
CDFG 9th St bridge - just below Dry Ck (from 2/8)	0.96	46%	77%	94%	44%
CDFG Shiloh Bridge	0.96	41%	67%	87%	66%
SW La Grange	0.97	94%	99%	100%	28%
SW Riffle A7	0.95	91%	98%	100%	32%
SW Riffle 3B	0.96	85%	98%	99%	26%
SW Riffle 13B	0.89	61%	84%	96%	39%
SW Riffle 21	0.87	51%	76%	93%	35%
SW Roberts Ferry Br	0.85	37%	69%	88%	36%
SW Hughson	0.93	36%	65%	87%	41%
SW Shiloh Bridge	0.95	41%	66%	82%	52%
average	**0.92**	**0.58**	**0.80**	**0.93**	**0.47**

Diurnal Temperature Range Anomaly

- Raw data shows substantial differences from station to station, this even occurs between adjacent stations that are close to each other
- HDR visited each thermologger site to investigate reasons for this occurrence
- HDR is continuing to investigate; the model alone is not yet able to simulate this site-specific condition, station to station differences


Diurnal Range (°F) Annual Average
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Above LaGrange (8/25-11/21)
La Grange SW
Riffle-A1 (to 12/22)
Riffle A7 SW
Riffle-C1
Riffle 3B SW
Riffle - D2
Basso Bridge
Riffle 13B SW
Riffle - G3 (to 9/19)
Riffle - I2 (to 9/19)
Riffle 21 SW
Riffle - K1
Roberts Ferry Br SW
CDFG - 7-11 Gravel (from 9/23)
Sante Fe Gravel (missing 7/14-9/23)
Santa Fe Gravel (to 11/2) SW
Riffle Q3
Above Hickman Spill
Below Hickman Spill
Fox Grove Bridge
Hughson SW
Sante Fe Bridge (missing 7/29-8/8 - ends 9/12)
Mitchell Rd Bridge
Above Dry Ck (to 5/30)
9th St bridge (2/8 to 9/12)
Shiloh Bridge
Shiloh Bridge SW


Diurnal Range (°F) Summer Average
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Above LaGrange (8/25-11/21)
La Grange SW
Riffle-A1 (to 12/22)
Riffle A7 SW
Riffle-C1
Riffle 3B SW
Riffle - D2
Basso Bridge
Riffle 13B SW
Riffle - G3 (to 9/19)
Riffle - I2 (to 9/19)
Riffle 21 SW
Riffle - K1
Roberts Ferry Br SW
CDFG - 7-11 Gravel (from 9/23)
Sante Fe Gravel (missing 7/14 to 9/23)
Santa Fe Gravel (to 11/2) SW
Riffle Q3
Above Hickman Spill
Below Hickman Spill
Fox Grove Bridge (missing 9/16-17)
Hughson SW
Sante Fe Bridge (missing 7/30 to 8/8 ends 9/12)
Mitchell Rd Bridge (missing 5/24-31, 9/1)
Above Dry Ck (to 5/30)
9th St bridge (2/8 to 9/12)
Shiloh Bridge
Shiloh Bridge SW


Diurnal Range (°F) Summer Avg
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Gained 4F in range over 10 fast flowing miles - so diurnal range can change rapidly
1st GW inflow detected
large GW inflow measured
GW inflows in this area
Dry Creek = mainly GW?
more GW inflows
MID Modesto Lake
MID Lateral 1
TID Lateral 1
TID Turlock Lake
TID Hickman Spill
MID Waterford
TID Faith Home Spill
River Mile
52.5
51.5
50.5
49.5
48.5
47.5
46.5
45.5
44.5
43.5
42.5
40.5
39.5
38.5
37.5
36.5
35.5
32.5
31.5
30.5
29.5
28.5
27.5
26.5
25.5
24.5
23.5
22.5
21.5
20.5
16.5
15.5
14.5
13.5
12.5
11.5
10.5
9.5
8.5
7.5
6.5
5.5
4.5
3.5

Next Steps

- Refine model calibration; validate model using 2012 data; review latest accretion flow results
- Conduct additional Workshop after final calibration/validation (circa first week in December); conduct training session
- Issue draft report with ISR in January

From: Staples, Rose
Sent: Wednesday, October 24, 2012 5:30 PM
To: Alves, Jim; Anderson, Craig; Asay, Lynette; Barnes, James; Barnes, Peter; Beniamine Beronia; Blake, Martin; Bond, Jack; Borovansky, Jenna; Boucher, Allison; Bowes, Stephen; Bowman, Art; Brenneman, Beth; Brewer, Doug; Buckley, John; Buckley, Mark; Burt, Charles; Byrd, Tim; Cadagan, Jerry; Carlin, Michael; Charles, Cindy; Colvin, Tim; Costa, Jan; Cowan, Jeffrey; Cox, Stanley Rob; Cranston, Peggy; Cremeen, Rebecca; Damin Nicole; Day, Kevin; Day, P; Denean; Derwin, Maryann Moise; Devine, John; Donaldson, Milford Wayne; Dowd, Maggie; Drekmeier, Peter; Edmondson, Steve; Eicher, James; Fargo, James; Ferranti, Annee; Ferrari, Chandra; Fety, Lauren; Findley, Timothy; Fuller, Reba; Furman, Donn W; Ganteinbein, Julie; Giglio, Deborah; Gorman, Elaine; Grader, Zeke; Gutierrez, Monica; Hackamack, Robert; Hastreiter, James; Hatch, Jenny; Hayat, Zahra; Hayden, Ann; Hellam, Anita; Heyne, Tim; Holley, Thomas; Holm, Lisa; Horn, Jeff; Horn, Timi; Hudelson, Bill; Hughes, Noah; Hughes, Robert; Hume, Noah; Jackman, Jerry; Jackson, Zac; Jauregui, Julia; Jennings, William; Jensen, Art; Jensen, Laura; Johannis, Mary; Johnson, Brian; Justin; Keating, Janice; Kempton, Kathryn; Kinney, Teresa; Koepele, Patrick; Kordella, Lesley; Lein, Joseph; Levin, Ellen; Lewis, Reggie; Linkard, David; Loy, Carin; Lwenya, Roselynn; Lyons, Bill; Madden, Dan; Manji, Annie; Marko, Paul; Marshall, Mike; Martin, Michael; Martin, Ramon; Mathiesen, Lloyd; McDaniel, Dan; McDevitt, Ray; McDonnell, Marty; McLain, Jeffrey; Mein Janis; Mills, John; Minami Amber; Monheit, Susan; Morningstar Pope, Rhonda; Motola, Mary; Murphey, Gretchen; O'Brien, Jennifer; Orvis, Tom; Ott, Bob; Ott, Chris; Paul, Duane; Pavich, Steve; Pinhey, Nick; Pool, Richard; Porter, Ruth; Powell, Melissa; Puccini, Stephen; Raeder, Jessie; Ramirez, Tim; Rea, Maria; Reed, Rhonda; Richardson, Kevin; Ridenour, Jim; Robbins, Royal; Romano, David O; Roos-Collins, Richard; Roseman, Jesse; Rothert, Steve; Sandkulla, Nicole; Saunders, Jenan; Schutte, Allison; Sears, William; Shakal, Sarah; Shipley, Robert; Shumway, Vern; Shutes, Chris; Sill, Todd; Slay, Ron; Smith, Jim; Staples, Rose; Steindorf, Dave; Steiner, Dan; Stone, Vicki; Stork, Ron; Stratton, Susan; Taylor, Mary Jane; Terpstra, Thomas; TeVelde, George; Thompson, Larry; Vasquez, Sandy; Verkuil, Colette; Vierra, Chris; Wantuck, Richard; Welch, Steve; Wesselman, Eric; Wheeler, Dan; Wheeler, Dave; Wheeler, Douglas; Wilcox, Scott; Williamson, Harry; Willy, Allison; Wilson, Bryan; Winchell, Frank; Wooster, John; Workman, Michelle; Yoshiyama, Ron; Zipser, Wayne
Subject: Don Pedro October 26 Reservoir-River Temp Models Workshop LIVE MEETING Link and Audio Call-In Number

Immediately below is the LIVE MEETING link to the Don Pedro River & Reservoir Temperature Models Workshop being held on Friday, October 26th (9:00 a.m. to 4:00 p.m.) at the MID Offices in Modesto. The audio link to the workshop is also listed below.

Join online meeting
https://meet.hdrinc.com/jenna.borovansky/3D64F0F5

First online meeting?

Call-in #866-994-6437, Conference Code 5424697994

AGENDA

Don Pedro Reservoir Temperature Model

9:00 a.m. to 9:15 a.m. Study Plan Overview

9:15 a.m. to 9:30 a.m. Overview of Reservoir Bathymetry Study
9:30 a.m. to 10:00 a.m. Model Design, Computations, and User Interface
10:00 a.m. to 10:20 a.m. Data Sources and Data Collection: Meteorology, Inflow Temperatures, Reservoir Profiles
10:20 a.m. to 10:40 a.m. Model Calibration
10:40 a.m. to 11:10 a.m. Model Validation
11:10 a.m. to 11:30 a.m. Next Steps

Lunch

11:30 a.m. to 1:00 p.m. Lunch (on your own)

Lower Tuolumne River Temperature Model

1:00 p.m. to 1:15 p.m. Study Plan Overview
1:15 p.m. to 1:45 p.m. Model Description, Computations, and User Interface
1:45 p.m. to 2:15 p.m. Data Sources and Collection: Meteorology, River Temperatures, Other Data
2:15 p.m. to 3:00 p.m. Model Calibration
3:00 p.m. to 3:30 p.m. Model Validation
3:30 p.m. to 4:00 p.m. Next Steps

Attachments: (Also being uploaded to the relicensing website: www.donpedro-relicensing.com)

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Attachments A & B referenced in this report are extremely large files containing plots of Bathymetry data. Available upon request (rose.staples@hdrinc.com)

2. W&AR-16 Lower Tuolumne River Temperature Model Status Report, September 2012
As this status report is 8 MB in size, it is being uploaded to relicensing website only, rather than emailed with this agenda.

3. W&AR-03 Reservoir Temperature Model: Upstream Water Temperature and Meteorological Data Sets for Model Verification, September 2012

A CD with the River/Reservoir Temperature and Meteorological Data will be available at this meeting. This CD will also be available after the meeting, upon request to (rose.staples@hdrinc.com

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From: Borovansky, Jenna
Sent: Friday, October 26, 2012 1:40 PM
To: Staples, Rose; Alves, Jim; Anderson, Craig; Asay, Lynette; Barnes, James; Barnes, Peter; Beniamine Beronia; Blake, Martin; Bond, Jack; Boucher, Allison; Bowes, Stephen; Bowman, Art; Brenneman, Beth; Brewer, Doug; Buckley, John; Buckley, Mark; Burt, Charles; Byrd, Tim; Cadagan, Jerry; Carlin, Michael; Charles, Cindy; Colvin, Tim; Costa, Jan; Cowan, Jeffrey; Cox, Stanley Rob; Cranston, Peggy; Cremeen, Rebecca; Damin Nicole; Day, Kevin; Day, P; Denean; Derwin, Maryann Moise; Devine, John; Donaldson, Milford Wayne; Dowd, Maggie; Drekmeier, Peter; Edmondson, Steve; Eicher, James; Fargo, James; Ferranti, Annee; Ferrari, Chandra; Fety, Lauren; Findley, Timothy; Fuller, Reba; Furman, Donn W; Ganteinbein, Julie; Giglio, Deborah; Gorman, Elaine; Grader, Zeke; Gutierrez, Monica; Hackamack, Robert; Hastreiter, James; Hatch, Jenny; Hayat, Zahra; Hayden, Ann; Hellam, Anita; Heyne, Tim; Holley, Thomas; Holm, Lisa; Horn, Jeff; Horn, Timi; Hudelson, Bill; Hughes, Noah; Hughes, Robert; Hume, Noah; Jackman, Jerry; Jackson, Zac; Jauregui, Julia; Jennings, William; Jensen, Art; Jensen, Laura; Johannis, Mary; Johnson, Brian; Justin; Keating, Janice; Kempton, Kathryn; Kinney, Teresa; Koepele, Patrick; Kordella, Lesley; Lein, Joseph; Levin, Ellen; Lewis, Reggie; Linkard, David; Loy, Carin; Lwenya, Roselynn; Lyons, Bill; Madden, Dan; Manji, Annie; Marko, Paul; Marshall, Mike; Martin, Michael; Martin, Ramon; Mathiesen, Lloyd; McDaniel, Dan; McDevitt, Ray; McDonnell, Marty; McLain, Jeffrey; Mein Janis; Mills, John; Minami Amber; Monheit, Susan; Morningstar Pope, Rhonda; Motola, Mary; Murphey, Gretchen; O'Brien, Jennifer; Orvis, Tom; Ott, Bob; Ott, Chris; Paul, Duane; Pavich, Steve; Pinhey, Nick; Pool, Richard; Porter, Ruth; Powell, Melissa; Puccini, Stephen; Raeder, Jessie; Ramirez, Tim; Rea, Maria; Reed, Rhonda; Richardson, Kevin; Ridenour, Jim; Robbins, Royal; Romano, David O; Roos-Collins, Richard; Roseman, Jesse; Rothert, Steve; Sandkulla, Nicole; Saunders, Jenan; Schutte, Allison; Sears, William; Shakal, Sarah; Shipley, Robert; Shumway, Vern; Shutes, Chris; Sill, Todd; Slay, Ron; Smith, Jim; Steindorf, Dave; Steiner, Dan; Stone, Vicki; Stork, Ron; Stratton, Susan; Taylor, Mary Jane; Terpstra, Thomas; TeVelde, George; Thompson, Larry; Vasquez, Sandy; Verkuil, Colette; Vierra, Chris; Wantuck, Richard; Welch, Steve; Wesselman, Eric; Wheeler, Dan; Wheeler, Dave; Wheeler, Douglas; Wilcox, Scott; Williamson, Harry; Willy, Allison; Wilson, Bryan; Winchell, Frank; Wooster, John; Workman, Michelle; Yoshiyama, Ron; Zipser, Wayne
Subject: RE: Don Pedro October 26 Reservoir-River Temp Models Workshop LIVE MEETING Link and Audio Call-In Number

Don Pedro Relicensing Participants:
We are running ahead of schedule.

If you are interested in the River Temperature Model Presentation, we will be starting at 11 AM.

Please See Below for log in information.

JENNA BOROVANSKY
HDR Engineering, Inc.
Senior Regulatory Specialist, Hydropower Services

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From: Staples, Rose
Sent: Friday, December 14, 2012 3:50 PM
To: Alves, Jim; Amerine, Bill; Anderson, Craig; Asay, Lynette; Barnes, James; Barnes, Peter; Beniamine Beronia; Blake, Martin; Bond, Jack; Borovansky, Jenna; Boucher, Allison; Bowes, Stephen; Bowman, Art; Brenneman, Beth; Brewer, Doug; Buckley, John; Buckley, Mark; Burt, Charles; Byrd, Tim; Cadagan, Jerry; Carlin, Michael; Charles, Cindy; Colvin, Tim; Costa, Jan; Cowan, Jeffrey; Cox, Stanley Rob; Cranston, Peggy; Cremeen, Rebecca; Damin Nicole; Day, Kevin; Day, P; Denean; Derwin, Maryann Moise; Devine, John; Donaldson, Milford Wayne; Dowd, Maggie; Drekmeier, Peter; Edmondson, Steve; Eicher, James; Fargo, James; Ferranti, Annee; Ferrari, Chandra; Fety, Lauren; Findley, Timothy; Fleming, Mike; Fuller, Reba; Furman, Donn W; Ganteinbein, Julie; Giglio, Deborah; Gorman, Elaine; Grader, Zeke; Gutierrez, Monica; Hackamack, Robert; Hastreiter, James; Hatch, Jenny; Hayat, Zahra; Hayden, Ann; Hellam, Anita; Heyne, Tim; Holley, Thomas; Holm, Lisa; Horn, Jeff; Horn, Timi; Hudelson, Bill; Hughes, Noah; Hughes, Robert; Hume, Noah; Jackson, Zac; Jauregui, Julia; Jennings, William; Jensen, Art; Jensen, Laura; Johannis, Mary; Johnson, Brian; Justin; Keating, Janice; Kempton, Kathryn; Kinney, Teresa; Koepele, Patrick; Kordella, Lesley; Le, Bao; Lein, Joseph; Levin, Ellen; Lewis, Reggie; Linkard, David; Loy, Carin; Lwenya, Roselynn; Lyons, Bill; Madden, Dan; Manji, Annie; Marko, Paul; Marshall, Mike; Martin, Michael; Martin, Ramon; Mathiesen, Lloyd; McDaniel, Dan; McDevitt, Ray; McDonnell, Marty; Mein Janis; Mills, John; Minami Amber; Monheit, Susan; Morningstar Pope, Rhonda; Motola, Mary; Murphey, Gretchen; Murray, Shana; O'Brien, Jennifer; Orvis, Tom; Ott, Bob; Ott, Chris; Paul, Duane; Pavich, Steve; Pinhey, Nick; Pool, Richard; Porter, Ruth; Powell, Melissa; Puccini, Stephen; Raeder, Jessie; Ramirez, Tim; Rea, Maria; Reed, Rhonda; Richardson, Kevin; Ridenour, Jim; Riggs T; Robbins, Royal; Romano, David O; Roos-Collins, Richard; Roseman, Jesse; Rothert, Steve; Sandkulla, Nicole; Saunders, Jenan; Schutte, Allison; Sears, William; Shakal, Sarah; Shipley, Robert; Shumway, Vern; Shutes, Chris; Sill, Todd; Slay, Ron; Smith, Jim; Staples, Rose; Stapley, Garth; Steindorf, Dave; Steiner, Dan; Stender, John; Stone, Vicki; Stork, Ron; Stratton, Susan; Taylor, Mary Jane; Terpstra, Thomas; TeVelde, George; Thompson, Larry; Ulibarri, Nicola; Vasquez, Sandy; Verkuil, Colette; Vierra, Chris; Wantuck, Richard; Welch, Steve; Wesselman, Eric; Wheeler, Dan; Wheeler, Dave; Wheeler, Douglas; White, David K; Wilcox, Scott; Williamson, Harry; Willy, Allison; Wilson, Bryan; Winchell, Frank; Wooster, John; Workman, Michelle; Yoshiyama, Ron; Zipser, Wayne
Subject: Don Pedro River-Reservoir Temp Models Workshop No 2 Draft Meeting Notes for Review
Attachments: Don Pedro Rvr-ResTempModelsWkspNo2_drftnotes_121214.doc

Attached please find the DRAFT Meeting Notes from the Don Pedro Project Relicensing Water & Aquatic Resources ("W&AR") Study No. 3: *Don Pedro Reservoir Temperature Model* and W&AR-16: *Lower Tuolumne River Temperature Model* Studies Consultation Workshop No. 2 held on October 26, 2012.

Please provide any comments on these draft notes to me at rose.staples@hdrinc.com by no later than Monday, January 14, 2013. Thank you.

ROSE STAPLES
CAP-OM

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Don Pedro Project Relicensing
River & Reservoir Temperature Models Consultation Workshop #2
Don Pedro Relicensing Studies W&AR-3 & W&AR-16
Draft Meeting Notes

Friday, October 26, 2012
9:00 a.m. to 4:00 p.m. - MID Offices

Attendees

Art Godwin (TID)
Bill Johnston (MID)
Bill Paris (MID)
Bill Sears (CCSF)
Bob Hughes (CDFG)
Bob Nees (TID)
Carin Loy (HDR)
Greg Dias (MID)
Jenna Borovansky (HDR)
John Devine (HDR)
Mike Maher (SWRCB)
Scott Lowe (HDR)
Steve Boyd (TID)
Zac Jackson (USFWS)

Attended via phone:
Allison Boucher (FOTR)
Chris Shutes (CalSPA)
Ellen Levin (CCSF)
John Wooster (NMFS)
Tim Findley (BAWSCA)

Purpose of Meeting

The Temperature Model Workshop #2 was held on October 26, 2012 to discuss with the Don Pedro Relicensing Participants (RPs) the status of the temperature models being developed for the Don Pedro Reservoir (W&AR-3) and the Lower Tuolumne River (W&AR-16), including:

(1) Review initial calibration and validation results of both the Don Pedro Reservoir 3D temperature model and the Lower Tuolumne River temperature model

(2) Path forward and schedule for model completion

This Workshop follows the protocols of the consultation workshop process; draft meeting notes are provided for a 30-day review following issuance by the Districts.

The Districts reviewed the FERC ILP process schedule as well and alerted RPs to the fact that the ISR meeting will cover two days, January 30, 2013 and January 31, 2013. A detailed schedule will be forthcoming in early December.

Meeting Materials

Materials provided to Relicensing Participants to support the meeting discussion:

- Don Pedro Reservoir Bathymetric Study Report, October 2012. NOTE: Attachments A & B referenced in this report are extremely large files containing plots of bathymetry data. These plots are available upon request to rose.staples@hdrinc.com.
- W&AR-16: Lower Tuolumne River Temperature Model Status Report, September 2012. An 8 MB file, available on the relicensing website (www.donpedro-relicensing.com).
- W&AR-03: Reservoir Temperature Model: Upstream Water Temperature and Meteorological Data Sets for Model Verification, September 2012.
- Study Reports W&AR-3 and W&AR-16 Reservoir Temperature Model and Lower Tuolumne River Temperature Model Water Temperature Data Set October 2012 Update. NOTE: This report contains extremely large files with plots of Tuolumne River stream temperature and Don Pedro Reservoir temperature data and profiles, the raw data used for the plots, and the data collected from the Districts metrological stations, installed in 2010. Available on Compact Disc (CD), upon request rose.staples@hdrinc.com.

Meeting Summary

The Districts distributed the meeting agenda on October 18, 2012 via email and it was reviewed prior to starting the presentation and discussions. The only suggested change in the agenda was the addition of a discussion of the integration between the operations model and the temperature model.

Don Pedro Reservoir Temperature Model (W&AR-3)

The following topics were covered in the meeting:

- Study Plan Overview
- Reservoir Bathymetry Study
- Model Design and Calculations
- Data Sources and Collection: Meteorology; Inflow Temperatures; Reservoir Profiles
- Calibration
- Validation

Study Plan Overview
The study plan (W&AR-3) specifies the model platform and data acquisition requirements for the Reservoir Temperature Model. DHI's MIKEFM 3D Model is the platform. Data compiled and collected to support the model's development include reservoir bathymetry, reservoir temperature profiles, and local meteorological data.

Reservoir Bathymetry Study (Report distributed)
The bathymetry study plan was part of reservoir model study plan. The Districts collected the bathymetry data in 2011. The effort consisted of joining two surfaces: one measured when the reservoir elevation was 792 feet, the other purchased IFSAR data, acquired (flown) when the reservoir elevation was 760 feet. The overlap between the two surfaces contributes to the bathymetric surface's precision.

The 2011 bathymetric surface was compared to the New Don Pedro Reservoir area-capacity curve (pre-1972). Research by TID indicates that the new Don Pedro Reservoir elevation-

storage data incorporated the original elevation-storage data for the Old Don Pedro Reservoir. The two volumes were found to be within 1% of each other at elevation 830 ft and a very close match was found at all of the elevation intervals.

Model Design, Computations, and User Interface

MIKE3 is a three dimensional, time variable hydrodynamic model. The temperature structure of the reservoir was described and the items that can be varied in the model were discussed. Specific discussions included flooding and drying (how the model mesh can adapt to changes in reservoir elevation) and heat balance equations, including, air temperature, humidity, short and long wave radiation.

> Comment: Bob Hughes asked if the ground temperatures of reservoir land areas temporarily not inundated were included in the model.
>
> Response: Scott Lowe indicated they were not and that the temperature of the adjacent ground would not be expected to affect reservoir water temperatures.
>
> Comment: Chris Shutes asked about clearness information and time step used for this information. Mr. Shutes recommended that the actual solar data be provided in the report.
>
> Response: Mr. Lowe answered that monthly average cloud cover is used in the model based on local information. Daily information is not available. With respect to solar radiation, the Districts' meteorological station is collecting hourly solar radiation data. The data will be used to confirm/modify the model's internally calculated solar radiation, but solar radiation is not a direct input. However, it will be included in the report.

Data Sources and Data Collection: Meteorology, Inflow Temperatures, Reservoir Profiles

Sources of model input data consist of the following:

- Inflow and outflow – based on Project Operations Model (daily time step)
- Inflow temperature – recorded on the Tuolumne River at Indian Creek Trail and other upstream locations (hourly time step)
- Met data recorded at Don Pedro
    - Air temperature
    - Humidity
    - Wind speed and direction
- Cloud cover – from Modesto
- Reservoir bathymetry collected by CDFG and the Districts

Model Calibration

Data collected in 2011 are being used to calibrate the model. Initial calibration results were presented. Model results were shown with red triangles and observed results were blue circles. The calibration figures also included two dark horizontal lines: (1) 830 feet, shows the reservoir's normal maximum pool; and (2) 600 feet, indicating the minimum operating pool.

Other elevations of interest include: (1) the power tunnel inlet, 535 feet at central line; (2) the diversion tunnel/outlet works inlet at approximately 350 feet; (3) the Old Don Pedro top of dam at 611 feet; 4) the spillway crest at about 596 feet; 5) the old Don Pedro Dam gates on top to raise to 604 feet. The Old Don Pedro Dam also had lower level outlet works consisting of two sets of six gates, the upper ones at about centerline 512 ft and the lower ones at about centerline of 422 ft. The Districts believe all of these gates are open.

The modelers have encountered a few inconsistencies in the data that they are in the process of evaluating. Examples of these data inconsistencies were discussed. One of the problems is that data sheets from other sources need to be reviewed to confirm the accuracy of the recorded depth measurements. In addition, it appears that some CDFG data collection sites were moved during low water, so the precise latitude and longitude where the profile was collected needs to be confirmed. The modelers are using the bottom elevations from the interpolated bathymetric surface to help check the reliability of some of the input profile data where it appears that the data collection sites were moved.

Model Validation

A detailed write-up on this topic was distributed, entitled *W&AR-03 Reservoir Temperature Model: Upstream Water Temperature and Meteorological Data Sets for Model Verification, September 2012.*

Data collected in 2012 are being used to validate the model. At the time of the run presented at this meeting, data included was only through June 2012 because that was the latest data retrieved. The validation will be completed upon receipt of all data through November 2012. The study plan (W&AR-3) stated that 2008 data would be used for model validation. Use of the 2012 data for model validation will be a variance, but is preferred because of the availability of actual inflow temperature data. The synthesized 2008 data set, however, may still be used as an additional model check if the water levels in 2008 were significantly lower than in 2012.

The Districts' two meteorological stations installed in 2010 were discussed, along with the data available from local stations.

Model Training and Access

A virtual workstation will be created that will allow external users to connect to the MIKE modeling software and run "what-if" scenarios. Access to the workstation will be provided via the existing Project website. Users will be able to use the models provided as a base to perform other simulations and then have the ability to save and/or print the results.

Next Steps

- Modelers are working with CDFG staff to resolve temperature profile data issues
- Once these data issues are resolved, the calibration will be finalized
- Once all data through November 2012 is available, the validation runs will be completed
- Model access for use by RPs will be established by the time of the ISR Meeting in January 2013
- Training will be scheduled for early-2013 (currently scheduled for January 24, 2013 in HDR's Sacramento office)

Action Items:

- Schedule model training for Relicensing Participants. Proposed dates are:
  - January 24, 2013 – River and Reservoir Model Training
  - March 20, 2013 (preliminary) – Operations and Temperature Model integration training

- The study report and graphs will provide intake structure elevations as a reference on temperature plots.

Lower Tuolumne River Temperature Model (W&AR-16)

The following topics were covered in the meeting:

- Study Plan Overview
- Reservoir Bathymetry Study
- Description, Computations, and User Interface
- Data Sources and Collection: Meteorology; Inflow Temperatures; Reservoir Profiles
- Calibration and Validation

Study Plan Overview

The study plan (W&AR-16) specifies the model platform and data acquisition requirements for the Lower Tuolumne River Temperature Model. The river model platform consists of an existing San Joaquin River basin-wide HEC-5Q model that included the lower Tuolumne River. This basin-wide model was initially developed in part under Bay-Delta funding, and was referred to as the SJR5Q model. Under direction of the 2009 FERC Order on Rehearing, this model was recalibrated using the then most-recent river temperature data and used to evaluate river temperature regimes in the lower Tuolumne River. The report was filed with FERC, after opportunity for comment, in March 2011. This report noted the need for further recalibration of the model using new data to be collected at the La Grange Dam location. The Districts prepared a study plan for accomplishing this recalibration (W&AR-16), and FERC approved the study plan with modification in the December 22, 2011 Study Plan Determination. FERC's modifications were (1) make sure the results of the temperature model would be available to the ongoing CALFED modeling efforts; (2) extend the model to the confluence of the Tuolumne River and the San Joaquin River; and (3) ensure data collected and modeling results are sufficient to calculate the 7-day average daily maximum temperature (7DADM) values.

Description, Computations, and User Interface

The original SJR5Q model of the Tuolumne River began above Don Pedro Reservoir and extended to the mouth. This Districts' river temperature model for relicensing purposes starts at the Don Pedro powerhouse. Like the original SJR5Q model, it has a 6-hour time step. The only significant outflows in the lower Tuolumne River are the Districts' diversions at La Grange Dam. The only significant inflow is Dry Creek. Accretions are not included in the model; however, the Districts are undertaking accretion flow measurements under study W&AR-2 and may input these flows into the model once they are completed (circa February 2013).

Data Sources and Collection: Meteorology, River Temperatures, Other Data

CDFG and the Districts have been monitoring river temperatures in the lower Tuolumne River for as long as two decades at some sites. A list of monitoring sites was provided. The Districts are maintaining two meteorological stations, one near the Don Pedro Reservoir and one near RM 30. Relevant meteorological data is collected at various nearby locations as described in the attachments provided prior to the Workshop.

Model Calibration and Validation

Like the reservoir temperature model, the Districts plan to use 2011 as a calibration year and 2012 as a validation year.

An initial calibration run has been performed using the HEC-5Q model. Modeled vs. measured data are shown from 2011. Modeled data are shown in red and measured data are shown in black. The model calibration was strong with the exception that the diurnal range in temperatures varies considerably from station to station with upstream stations above RM circa 37 showing expected and predicted diurnal ranges, but farther downstream stations displaying unexpected (and not predicted) smaller diurnal ranges. In addition, the downstream stations are not consistent in displaying these more narrow ranges with measuring stations quite close to one another displaying significantly different diurnal ranges.

To better understand why the model predicted greater temperature ranges during theses months and locations, each data collection site has been visited to examine for variations in shade, substrate, flow, District vs CDFG collection, spikes associated with operational spill, and no correlation was found to explain this inconsistent and unpredicted range in diurnal variation. The Districts discussed the data with RPs and asked for any ideas in regard to explaining such data variances. A good discussion ensued but without resolution. The Districts have concluded that the data are all good and reliable and that the phenomena being observed are real and not a data anomaly. The Districts and RPs agreed that the Districts should evaluate (1) whether similar data ranges occur in other years, (2) do the accretion flow measurements indicate potential groundwater sources that may be reducing the diurnal range.

RPs also indicated that the outflow data temperature showed a relatively sudden reduction of about 2 degrees C in late 2011. The Districts indicated they believed this occurred during a full powerhouse outage that occurred in late October or early November and the low level outlet works had to be opened. The Districts agreed to confirm this and provide the dates of the event.

Districts Shifting to the HECRAS Model

The Districts proposed migrating the Lower Tuolumne River Temperature Model to the HECRAS model platform. The Districts provided their rationale for the change, including the HECRAS model is a publicly available model, it is much more user friendly, and it is completely transparent. Importantly, it performs at an hourly and even sub-hourly time step which is consistent with the RPs requests for the model and FERC's Determination. Migration to the HECRAS model is underway in order to meet the relicensing schedule.

Comment: Mr. Shutes asked about how the HECRAS model would match up with San Joaquin model.

Response: Mr. Devine answered that they are compatible and that the flows and temperature at the SJR/TR confluence can be fed directly into the SJR5Q model, or the models can be run independently. However, like with any two models, slightly different results are to be expected.

Next Steps

- Refine calibration of both models; validate models using 2012 data; review latest accretion flow results and evaluate year-to-year consistency of observed ranges in river diurnal temperatures.
- Conduct additional Workshop after final calibration/validation; conduct training session, likely in January (now set for January 24, 2013).
- Issue draft report with ISR in January 2013.

Action Items

- The Districts will provide the RPs with details of the powerhouse outage, including the dates and times.
- Bob Hughes observed that California Agencies have not used HECRAS in a FERC water rights forum yet. He will check with other CDFG staff, including Dale Stanton, and ask for suggestions and observations. (Action item complete.)
- Mike Maher will likewise check in with SWRCB staff.
- The Districts will set up a meeting/conference call with agencies to discuss the HECRAS model, if necessary. (Follow-up communication with agencies via email deemed this action item unnecessary.)

April 9, 2013
Via Electronic Filing

Project No. 2299-075-California
Don Pedro Project

Kimberly D Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington DC 20426

RE: Don Pedro Project P-2299-075
Districts' Response to Relicensing Participants Comments
on the Initial Study Report

Dear Secretary Bose:

Pursuant to 18 C.F.R. § 5.15(c)(5) of the Federal Energy Regulatory Commission ("FERC") regulations, this letter contains Turlock Irrigation District and Modesto Irrigation District (collectively, the "Districts") response to Relicensing Participants ("RPs") comments on the Don Pedro Project Initial Study Report. The response has considered the study criteria set forth in Sections 5.9(b), 5.15(d), and 5.15(e) of FERC's regulations, applicable law, FERC policy and practice, and FERC staff's December 22, 2011 Study Plan Determination ("SPD").

FERC's SPD for the Don Pedro Project approved, or approved with modifications, 34 studies proposed in the Districts' Revised Study Plan ("RSP"), filed on November 22, 2011. These studies addressed cultural and historic resources, recreational resources, terrestrial resources, and water and aquatic resources. FERC staff recommended that one of the Districts' proposed studies, the Water and Aquatic Resources ("W&AR") Study No. 09, not be undertaken.

As required by the SPD, the Districts filed three revised study plans with more detailed methodologies on February 28, 2012 (W&AR-18: *Sturgeon Study*, W&AR-19: *Lower Tuolumne River Riparian Information and Synthesis Study*, and W&AR-20: *Oncorhynchus mykiss Scale and Age Determination Study*) and one modified study plan on April 6, 2012 (W&AR-12 *Oncorhynchus mykiss Habitat Survey*) after further consultation with RPs. FERC approved or approved with modifications these studies on July 25, 2012.

The Districts filed an Initial Study Report ("ISR") for the Don Pedro Project on January 17, 2013; held an ISR Meeting on January 30 and 31, 2013; and filed a summary of the meeting on February 8, 2013. Comments on the meeting summary and requests for new studies and study modifications were filed by the U.S. Bureau of Land Management ("BLM"), U.S. Forest Service ("USFS"), National Marine Fisheries Service ("NMFS"), National Park Service ("NPS"), U.S. Fish & Wildlife

Service ("USFWS"), California Department Fish & Wildlife ("CDFW"), State Water Resources Control Board ("SWRCB"), All-Outdoor, American River Tour Association ("ARTA"), Conservation Groups ("CGs"), Robert Hackamack, O.A.R.S., Restore Hetch Hetchy ("RHH"), Tuolumne River Trust ("TRT"), and Sierra Mac.

The Districts' response to comments contained herein does not address all comments; it only addresses RPs' comments on study variances, requests for study modifications, or requests for new studies. Pursuant to Section 5.15(d) of FERC's regulations, any proposal to modify an ongoing study must be accompanied by a showing of good cause why the proposal should be approved and must include a demonstration that: (1) the approved studies were not conducted as provided for in the approved study plan; or (2) the study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way. As specified in Section 5.15(e), new study requests must also show good cause and a statement explaining: (1) any material changes in the law or regulations applicable to the information request, (2) why the goals and objectives of any approved study could not be met with the approved study methodology; (3) why the request was not made earlier; (4) significant changes in the project proposal or that significant new information material to the study objectives has become available; and (5) why the new study request satisfies the study criteria in Section 5.9(b).

I. Districts' Response to Requests for New Studies

The RPs submitted a number of requests for new studies. However, most of these requests for new studies were identical, or nearly so, to study requests made in 2011 during the initial study plan development process. Section 5.15(e) of FERC's regulations governing the Integrated Licensing Process ("ILP") requires that any request for new information gathering subsequent to the ISR must not only meet the basic requirements for study requests set forth in Section 5.9(b), but also must be accompanied by a showing of "good cause" why the new study should be approved. To meet the requirement of "good cause," a request for a new study must identify a material change in relevant law or regulation, provide an explanation of why the request was not made earlier, or explain what significant new information material to the study objectives has become available. The Districts have reviewed each of the requests for new studies submitted by RPs and provide their response below.

[1] NMFS

In Enclosure B of its March 11, 2013 comments on the Districts' ISR, NMFS identified four new study requests. Each of these requests is virtually identical to study requests previously submitted during the initial study development process leading to the Districts' November 22, 2011 RSP and FERC's December 22, 2011 SPD. NMFS' new study requests are repeated below:

- Original Request #1: *Study of the Effects of the (Don Pedro) Project and Related La Grange "Complex" on Anadromous Fishes*
- Original Request #3: *Effects of the Project on Fish Passage*
- Original Request #7: *Evaluation of Upper Tuolumne River Habitats for Anadromous Fish*

- Original Request #9: *Effects of the Project on Ecosystem/Marine Derived Nutrients for Anadromous Fish*

Regarding NMFS Study Request #1: *Study of the Effects of the (Don Pedro) Project and Related La Grange "Complex" on Anadromous Fishes*, (Elements #3 and #6), NMFS presents this as a new study request, but it is a request for existing information and is, therefore, not relevant to either study modifications or new study requests. In any event, the Districts have a different interpretation of the direction provided by FERC to the Districts in the May 24, 2012 Formal Study Dispute Determination. NMFS seems to be indicating that the Districts were directed by FERC's Dispute Determination to identify existing information in its possession broadly related to NMFS-1 Elements 3 and 6 and to actually include all of the raw data as part of the Initial Study Report; and further, that the Districts failed to do this. To the contrary, the Districts provided in the ISR, consistent with FERC's determination related to NMFS-1 (Elements 3 and 6) as described on page 10 of FERC's Dispute Determination, additional information and an assessment of the combined effects of the Don Pedro and La Grange projects "on the hydrology of the Tuolumne River" as depicted in Figures 1.4-1, 1.4-2, and 1.4-3.

FERC's Dispute Determination also instructed the Districts to "identify the specific sources of the information that would address NMFS-1, Elements 3 and 6, and file it with the Commission in the Initial Study Report." The Districts identified the information it had that might be "associated with the cumulative environmental effects of the operations of La Grange dam on the Tuolumne River between La Grange dam and the La Grange stream gage." The Districts filed this information list with FERC in Table 1.4-2 of the ISR. If FERC's intent was for the Districts to simply file all the raw data with the ISR, this seemed inappropriate to do before it was determined to be relevant and "associated with cumulative environmental effects." The Districts are certainly willing to provide the actual raw data if that was the direction intended by FERC.

However, we would like to point out that much of the information in NMFS-1 Elements 3 and 6 has either already been provided to NMFS as part of the Don Pedro relicensing (e.g., in the Don Pedro PAD, at meetings, or in meeting notes), is known to already be in NMFS possession, or is public information. For example, as NMFS is well aware, the Districts have recently filed substantial information about the La Grange facilities and operations with FERC as part of FERC's jurisdictional investigation of La Grange dam. This includes information responsive to Element 3(a), (b), (d), (e), (f) and virtually all of (h). It seems unreasonable that the Districts now have to separately provide this information once again to NMFS.

Regarding NMFS Request #3, #7, and #9, NMFS indicates in its March 11, 2013, letter that it is re-submitting these study requests, without modification, for reconsideration by FERC. Each of these requests proposes studies which deal with anadromous fish passage at the Don Pedro Project and/or the potential for habitats upstream of the Don Pedro Project to support anadromous fish life stages. NMFS attempts to show "good cause" as required by FERC's regulations at 18 C.F.R. § 5.15(e) by asserting that "[s]ignificant new information material to the study objectives has become available" in the form of FERC's December 19, 2012 Order finding that the Districts' La Grange diversion dam is subject to FERC jurisdiction and therefore the Districts must obtain a license from FERC if TID is to

continue the operation of the small hydro plant in the TID forebay. NMFS concludes that given this new information coupled with NMFS Section 18 fish passage prescription authority, it is now "reasonably foreseeable" that anadromous fish could be present below Don Pedro Dam and would need to migrate through Don Pedro Reservoir.

The Districts disagree with NMFS' claims that FERC's December 19, 2012 Order related to the La Grange diversion dam is sufficient to meet the "good cause" test and represents "significant new information." The Districts disagree that the December 19, 2012 Order on La Grange now makes it "reasonably foreseeable" that anadromous fish will be present below Don Pedro Dam.

FERC's December 22, 2011 SPD did not adopt the original NMFS Requests #3, #7, or #9 because FERC found that "the Don Pedro Project does not block the upstream migration of anadromous fish because the upstream extent of anadromous fish in the Tuolumne River is currently limited to areas below La Grange Dam." FERC provides its underlying rationale for this decision when it states on page 74 that "the facts are clear" that "La Grange Dam is not a **Commission-licensed** facility under the FPA" and that the "**unlicensed** La Grange dam is the downstream barrier to upstream migration of anadromous fish" [emphasis added]. These facts have not changed. It continues to be a fact that the La Grange dam is not a FERC-licensed facility. FERC's December 19, 2012 Order does not alter that fact. It remains highly uncertain whether the Districts will file an application for license, whether FERC will issue a license upon reasonable terms, or whether the Districts would accept a license issued by FERC for La Grange dam. Indeed, the Districts have contested FERC's Order finding the La Grange Project is subject to its jurisdiction. For these reasons, the Districts disagree with NMFS' assertion that fish passage at La Grange dam is now "reasonably foreseeable."

FERC also cited other reasons in the December 22, 2011 SPD for not requiring the Districts to undertake several of NMFS' study requests. While the Districts consider these other reasons unnecessary to support the decision not to adopt NMFS' resubmitted study requests, they are worth reiterating here. FERC noted that the Draft Central Valley (Spring-Run) Recovery Plan remains a draft and no specific fish passage plans have been developed, approved, or funded, and therefore, it is unknown when fish passage might occur or which part of the San Joaquin or Sacramento river basins would be targeted. FERC's statement is true; the NMFS Central Valley Recovery Plan remains a draft. Appropriately, FERC also stated on page 84 of the SPD that "the suitability of upstream habitat for anadromous salmonids, as it relates to recovery planning under NMFS guidelines, pertains to management decisions and actions which most appropriately fall under NMFS jurisdiction." The Districts agree with these rationales. NMFS' purpose in requesting these studies is to use the FERC licensing process as a means to gather data and studies that NMFS itself should be undertaking for its own programs. In years past, the FERC licensing process had become a means for resource agencies to obtain data for their own programs, unrelated to the needs of FERC decision-making required under the Federal Power Act ("FPA"). Preventing this acknowledged abuse of the FERC licensing process, as NMFS attempts here, was a large part of the rationale for the development of the seven study request criteria under the ILP regulations. FERC should not undermine this important component of the ILP by assenting to NMFS in this case.

Finally, NMFS, on page 6 of Enclosure B, clearly and concisely spells out that NMFS believes that the information to be obtained through the resubmitted study request is needed by NMFS to exercise NMFS' various statutory authorities. The Districts would point out that FERC, supported by the courts (*see, e.g. U.S. Department of the Interior v. FERC* (952 F.2d 538 (D.C. Cir. 1992)), has long held that there is nothing in the FPA that requires FERC to conduct the studies that the fish and wildlife agencies deem necessary for the exercise of their Section 10(j) or Section 18 authorities. Nothing in the FPA suggests that FERC must order studies that resource agencies desire but which FERC deems unnecessary to evaluate the public interest.

[2] USFWS

In its comments on the ISR dated March 11, 2013, USFWS requests five new studies, three of which are repeats of studies previously requested during the initial study plan development process (USFWS-A, B, and D), one of which is very similar to a previously requested study (USFWS-C), and one of which is a request for further consultation (USFWS-E). The Districts respond to each of these below. These study requests are:

- USFWS-A: *Instream Flow and Juvenile Chinook Salmon Floodplain Rearing Study*
- USFWS-B: *Juvenile Chinook Salmon Outmigration Study*
- USFWS-C: *IFIM Study on Pacific Lamprey, Sacramento Splittail, and Non-Native Predatory Fish of the Lower Tuolumne River*
- USFWS-D: *Bioenergetics Study*
- USFWS-E: *California Red-Legged Frog Surveys*

USFWS-A is similar to study request FWS-1 contained in USFWS' June 9, 2011 letter providing comments on the Districts' PAD and containing USFWS' original study requests. Although the Districts are uncertain exactly what new studies USFWS is actually requesting in USFWS-A, it appears that this request actually contains several comments on the Districts' IFIM study submitted for resource agency review and comment on February 28, 2013 and one new study request.

Regarding the recently issued IFIM study, USFWS makes several comments that were raised in prior consultation meetings related to salmonid rearing habitat, including the need for cover and adjacent velocity information, preference for using 2-D rather than 1-D PHABSIM, use of logistic regression, and development of river-specific habitat suitability data. In general, the Districts point out that the in-channel 1-D PHABSIM and the 2-D "Pulse Flow" studies were conducted consistent with FERC-approved study plans. The PHABSIM model includes elements of depth, velocity, and cover, as applicable per the direction of the technical working group that USFWS was part of which discussed all of these issues. The IFIM study included data collection and evaluation of adjacent velocity to examine whether fish are occupying lower velocity locations than those used for habitat suitability criteria determination. No other rearing habitat parameters were requested or proposed. Results from individual sampling sites for the 1-D PHABSIM study were extrapolated to the rest of the study reach using standard methods. Time series analyses were performed to evaluate total habitat under different flow conditions on a seasonal basis. The modeling studies (W&AR-06: *Tuolumne River*

Chinook Salmon Population Model and W&AR-10: *Oncorhynchus mykiss Population Study*) will further develop this information for use in evaluating the juvenile salmonid rearing life stage in the context of overall population dynamics. The PHABSIM model provides sufficient information to inform these models on habitat availability for the salmonid juvenile rearing life stage as well as to address beneficial uses in the CVRWQCB Basin Plan related to anadromous fish spawning and migration. Further, the Districts contend that the USFWS comments are premature and are more relevant to the recently issued IFIM study conducted by the Districts under the July 2009 Order.[1]

USFWS appears to have focused the new study request part of USFWS-A on two elements. The first element contained in USFWS' request is to have the Districts perform a hydraulic analysis of the amount of floodplain inundated between RM 52.2 and RM 21.5 at river flows that would supplement those used by USFWS in its own 2008 assessment of floodplain inundation. USFWS conducted an analysis of inundated floodplain (USFWS 2008) at historically observed flows of approximately 1,100 cfs; 3,100 cfs; 5,300 cfs; and 8,400 cfs. USFWS indicates that "without the intermediate data, the Service must assume a linear relationship that does not take gradient and topography into consideration." USFWS requests that the Districts perform the necessary analyses to provide this "intermediate data." Although the Districts previously provided an analysis of the applicability of the USFWS (2008) report as part of the 2-D Pulse Flow Study (Stillwater Sciences 2012), the Districts agree to perform the USFWS' requested analyses, subject to further discussions with USFWS intended to define the requirements of this task to a greater level of detail. This will require close coordination with USFWS in the planning of the analysis (e.g., the data sources to be used, agreement on hydraulic parameters) to make certain the analysis meets the intended purpose. The second new study element requested by USFWS is to evaluate inundation frequency and inundation period at a range of flows. The Districts believe that this analysis should be performed in coordination with the Operations Modeling of alternative future operating scenarios, and comparing these scenarios to the current baseline conditions. The Districts are amenable to performing these assessments once potential alternative future operating scenarios have been defined. USFWS also requests that Project-related effects be evaluated by comparing "pre- and post-project flows." The Districts disagree that this analysis is appropriate as it would not inform the development of license conditions (18 C.F.R. § 5.9(b)(5)). FERC had previously addressed this issue in its December 22, 2011 SPD. Related to evaluating either a partial unimpaired flow scenario (Don Pedro removed and Hetch Hetchy in place) or a full unimpaired flow scenario, FERC staff stated that neither of these scenarios "is necessary for our evaluation of project effects and [we] are not recommending it (study criterion 5)" (see page 23 of the SPD).

In some respects **USFWS-B** is very similar to study request FWS-4 originally submitted by USFWS in its June 9, 2011 submittal. The original study request was entitled *Juvenile Chinook Salmon Survival Study* and it consisted of measuring smolt survival during outmigration at various pulse flows over a two- year period. In its March 11, 2013 letter providing comments on the ISR, USFWS states that the Districts have not explained in the ISR "why such a study [of salmon smolt survival] is not needed as was originally ordered by FERC in the Study Plan Determination." In reality, FERC's

[1] On April 2, 2013, USFWS requested additional time to comment on the IFIM study; the Districts agreed to a new date of April 8, 2013 for the USFWS to submit comments.

December 22, 2011 SPD did not adopt the original FWS-4 request, but did adopt the Districts' W&AR-07: *Predation Study* and stated that the Districts' study, when combined with the river temperature model, would provide the information necessary to inform decisions about the high rate of smolt mortality experienced on the Tuolumne River.

Many of the comments in USFWS-B are basically comments on the Districts' W&AR-07: *Predation Study* and are addressed in Section II of this response to comments.

In USFWS-B, USFWS does recommend a second year predation study. The Districts concur and will be issuing a proposed 2013 study plan by April 12, 2013. However, the 2013 study is likely to be able to investigate only predator abundance because the necessary permits have not yet been received to allow a repeat of the predation rate effort. The Districts assert the investigation of predator abundance will still be valuable. The Districts will also be proposing to perform, subject to FERC approval, a repeat of the full 2012 Predation Study in 2014, possibly combined with a series of pulse flows, as suggested by USFWS, to examine outmigration survival under different pulse flow regimes. As 2013 is another dry year, there is insufficient water to do an extensive study of this nature in 2013. The Districts do note, however, that the flow schedule for 2013 being proposed by the resource agencies already envisions some pulse flow events that should yield valuable survival data at the Rotary Screw Traps ("RSTs"). The Districts' proposed studies for 2013 and 2014 will be limited to the Tuolumne River and are not planned to include acoustic tagging and tracking. The Districts' proposed second-year Predation Study will largely be consistent with its original FERC-approved study plan. The Districts are not proposing to extend the study into and through the San Joaquin River ("SJR") because this will not inform the development of license conditions for the Don Pedro Project because the direct effects of the Project on smolt survival in the SJR and Delta cannot be parsed out from the numerous confounding impacts on smolts that occur in these areas. The Districts propose to work with resource agencies to develop a revised predation study plan for 2014 and submit it to FERC for approval by September 2013.

USFWS-C is a request for a new study intended to evaluate the cumulative effects to habitat on the Tuolumne River for Pacific lamprey, splittail, and various non-native predator species. As a new study request, the entity proposing the study must address not only the criteria for second-year studies, but also the study request criteria of 18 C.F.R. § 5.9(e). USFWS makes no attempt to address these criteria and, therefore, does not explain why the study is needed, why existing information is not adequate, what potential Project effect on the resource is being evaluated, or how the study would inform the development of license conditions. In fact, FERC did not adopt a somewhat similar request made in the original study development process for just these reasons (see page 90-91 of the SPD). This is the second attempt by USFWS to get FERC to approve this study without ever formally submitting a study request that meets FERC criteria under Section 5.9(b). Further, USFWS does not address the required criteria under Section 5.15(e) for new study requests. The information it provides is essentially a repetition of its USFWS-B rationale and has nothing at all to do with Pacific lamprey, splittail, or non-native predators. The Districts contend that existing information is adequate to assess the cumulative effects to these species on the lower Tuolumne River.

In **USFWS-D,** USFWS is requesting a new study intended to provide information on growth rates for salmonids in the lower Tuolumne River. USFWS indicated that this is not a new study request, but one made originally in its June 9, 2011 submittal. This is not the case; USFWS made no request for a Bioenergetics Study in its June 9, 2011 submittal to FERC. However, USFWS did submit study request FWS-2 entitled *Age and Growth Study of O.mykiss in the Tuolumne River* which was a study proposed to evaluate growth differences between *O.mykiss* captured above and below La Grange Dam. The Districts developed study plan W&AR-20: *Oncorhynchus mykiss Scale Collection and Age Determination* in response to this request, FERC approved the study plan, and the Districts performed the study. Therefore, the study request USFWS-D is a completely new study request being submitted by the USFWS and as such must explain how it meets the study criteria under 18 C.F.R. § 5.9(b). Since USFWS makes no attempt to do this, its request must be denied. In any event, CDFW also has made a request for a new Bioenergetics study, which is a repeat of a prior CDFW request. The Districts respond to this below; and this response also addresses concerns raised by USFWS in its USFWS-D request.

In **USFWS-E**, it does not appear to the Districts that there is any new study requested. This request deals with the need for continued consultation between the Districts and USFWS regarding California Red-Legged Frog and potential Project effects on the species. The Districts will continue to consult with the USFWS in this regard and look forward to USFWS guidance on development of the draft Biological Assessment.

[3] CDFW

CDFW requests that the Districts undertake three new studies, listed below:

- *Reservoir Water Temperature Management Feasibility Study*
- *Instream Flow Study* (adapted from Districts' ongoing study)
- *Bioenergetics Study*

The first of CDFW's requests for a new study is a repeat of a study request, CDFG-3, originally made in CDFW's letter dated June 10, 2011. CDFW asks that the Districts undertake a study to evaluate the feasibility of engineering alternatives for reservoir water temperature management and selective withdrawal of cold water from Don Pedro Reservoir. FERC did not adopt this study when originally proposed because FERC determined that the study was an evaluation of a potential protection, mitigation and enhancement ("PM&E") measure, the need for which had not been shown at that point. This continues to be the case, and therefore, CDFW has not met the study criteria under Section 5.9(b). Further, CDFW makes no attempt to address the requirements under Section 5.15(e) for new study requests. The Districts explain their proposed approach to reservoir water temperature management below.

The first requirement of any engineering feasibility study is the development of a clear and detailed definition of what the study is intended to achieve, otherwise no amount of effort will result in a satisfactory outcome. In engineering terms, this is accomplished by providing at the outset the design

basis and the design criteria, including the basis for judging whether a particular engineering solution can deliver the expected results. The study objectives provided by CDFW in its study request are insufficient to begin or undertake an engineering feasibility study of selective withdrawal structures or a reservoir water management plan. Developing a reservoir cold water management plan or configuring a selective withdrawal structure is not an end unto itself. The proof of feasibility is whether such a plan or structure can be effective in meeting the defined goals, in this case, specific temperatures in the lower Tuolumne River at specific locations at specific times of the year. Absent this clear definition, there can be no way to know whether a particular plan or structure can deliver the expected results. The Districts can already conclude that the cold water in Don Pedro Reservoir can be readily accessed by the existing reservoir outlets. In addition, the Districts' 3-D Reservoir Temperature Model can model the extraction of water from any location in Don Pedro Reservoir. The Districts selected a 3-D reservoir temperature model for the express purpose of being able to evaluate a range of options for water withdrawal. The 3-D Reservoir Temperature Model can be run to determine if the existing facilities can meet the numeric goals. If existing facilities are not able to meet the specific goals, then and only then, would such a study requested by CDFW be justified. Therefore, FERC's decision in the December 22, 2011 SPD is still valid – development of a specific management plan or consideration of the need for, and cost of, a selective withdrawal study remains a PM&E measure not yet shown to be needed.

By CDFW's definition, "feasible means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors." CDFW also indicates the goal is to assess "biological" feasibility." All of these terms are too generic for attempting to undertake a detailed engineering feasibility study. All of these terms must be defined from the outset; otherwise the engineer is left in the dark while trying to imagine alternatives which might meet such goals as "biologically feasible" or "environmentally feasible." The Districts are willing to work with CDFW in a collaborative fashion to define the necessary design basis and criteria; but until this is accomplished and it is shown that the existing facilities cannot meet the specified numeric goals, FERC should not adopt this study request for the identical reason it rejected the original study request.

The second new study requested by CDFW is related to the IFIM study performed by the Districts in response to FERC's July 2009 Order, not as a study approved under the relicensing process. A draft IFIM study report was issued for review and comment to interested parties on February 28, 2013. CDFW's request for a new study appears to be a placeholder indicating the desire to have the draft IFIM study be considered a study under relicensing, to which the Districts do not object. Based on CDFW's expectations as listed in its proposed study plan in Section 6.0 – Product, information already presented in the IFIM study meets all these goals except for providing floodplain frequency and inundation of juvenile salmon rearing habitat. The Districts have addressed this request for new information under USFWS-A above.

The third new study request is for a Bioenergetics Study, which is very similar to a study request originally made in June 2011 as CDFG-5. The purpose of the study, according to CDFW, is to provide information to RPs concerning the effects of Don Pedro Project on the key variables of water

temperature and food and how this impacts salmonid growth, abundance, survival, and habitat. According to CDFW, the objectives of the study are to:

- Determine factors limiting salmonid growth (food and/or water temperature) under existing conditions.
- Predict the effects of changes in instream flow/water temperature and food availability on salmonid growth, abundance, survival, and habitat.

CDFW's proposed new study would use a combination of existing data and collecting additional data to model and analyze the bioenergetic relationships of these variables. The stated goal is to use the bioenergetics relationships to analyze alternative instream flow/temperature regime effects on juvenile salmonid growth and relate the information to abundance and survival in order to identify the instream flow/water temperature regimes that provide for optimal growth of juvenile salmonids in the lower Tuolumne River and guide development of PM&E measures. CDFW indicates that understanding the site specific bioenergetic relationships would allow resource managers to evaluate when and where potential alternatives to the EPA water temperature benchmarks might be justified. The additional data collection proposed by CDFW includes one year of macroinvertebrate data collection beginning in the spring of the year and extending to the late fall.

The population models under development by the Districts are designed to serve the purposes outlined by CDFW, and further, to consider other variables as well, including density-dependence, habitat selection, growth, predation, and temperature-related mortality affecting juvenile production. The Districts, under FERC-approved study plans, have developed reservoir and river temperature models, IFIM models, and population models through Workshops held with the RPs. The bioenergetics study proposed by CDFW will not provide any further information than is already being planned and nearing completion. The W&AR-05: *Salmonid Populations Information Integration & Synthesis* report illustrates that the Districts have extensive historical information on the macroinvertebrate species and abundance along the lower Tuolumne River (1983-2009) which shows the lower Tuolumne has plentiful food resources for rearing juvenile salmonids. Growth of Chinook juveniles are modeled as part of the population models (W&AR-06: *Tuolumne River Chinook Salmon Population* and W&AR-10: *Oncorhynchus mykiss Population*) using existing food ration estimates (e.g. TID/MID 1997, Report 96-9) fitted to size at age information using a bioenergetics model as a function of water temperature and ration (Stauffer 1973).

FERC did not adopt the CDFW's original request for a Bioenergetics study due to the fact that the Districts' proposed models would provide a more comprehensive consideration of relevant factors. Nothing has changed since FERC's original decision. Nor does CDFW attempt to address FERC's regulations under Section 5.15(e) explaining what new information has become available that would now justify this study. CDFW provides no specific explanation of why the Districts studies are not sufficient to perform the same assessment of instream flows, temperatures, and survival. There is also no explanation as to why new macroinvertebrate data is now needed, when existing data indicate that benthic food sources are plentiful in the Tuolumne River. Therefore, this new study request should not be adopted.

[4] SWRCB

In its March 11, 2013 letter, SWRCB requests two new studies identified below:

- *Reservoir Water Temperature Management Feasibility Study*
- *Juvenile Chinook Salmon Outmigration Flow Study*

The first of these studies is identical to the CDFW's study request of the same name. The Districts have responded to this new study request above. SWRCB comments on two aspects of water temperature management that are not covered by CDFW. SWRCB suggests that the requested Reservoir Water Temperature Management Study also include an "assessment of engineering feasibility at the lower District-operated dam, La Grange." The Districts point out that the La Grange pool is very small and does not stratify. Temperature data collected at La Grange indicates very little change in water temperature from Don Pedro outlet to the lower end of La Grange pool. The reach from Don Pedro outlet to the La Grange dam is included in the HEC-RAS model developed under W&AR-16: *Lower Tuolumne River Temperature*. SWRCB also states that the Districts have not proposed to perform any assessments of the feasibility of reservoir water temperature management in the relicensing process. The Districts disagree with this statement. The Districts have developed at considerable expense a complete three-dimensional temperature model of the Don Pedro Reservoir for the very purpose of examining reservoir water temperature management. The 3-D model will be able to reliably predict reservoir thermal regime under a broad range of conditions, and with the elevation of all reservoir outlets geometrically input to the model, different water release strategies can be fully evaluated. In the Districts' response above to CDFW's similar new study request, the Districts simply point out that before undertaking the considerable cost of engineering feasibility studies of selective withdrawal facilities, specific temperature goals of the resource agencies should be defined and the model used to determine if existing facilities, or any facilities, can reliably meet the resource agencies spatially and temporally specific goals. The Districts also point out that, similar to the CDFW study, the SWRCB study request does not address the ILP requirements contained in Section 5.15 (e) applicable to new study requests.

The second new study request is intended to provide data to update information from prior studies in order to evaluate the ability of the Project to (1) enhance fry emigration survival by providing variable flows in February, March, and April and (2) induce emigration of larger juveniles including smolts by providing variable flows during the April and May time period. SWRCB recommends that the both mark-recapture techniques and acoustic tagging be employed and the study extended to the San Joaquin River at Vernalis. As SWRCB states, the Districts proposed a similar fry emigration component of this study in 2011. However, the Districts were not able to reach consensus with RPs on the usefulness of studying whether there were any benefits to early emigration. SWRCB suggests that the Districts should design, in consultation with RPs, a flow schedule for the juvenile Chinook salmon fry and smolt outmigration study period from February to May that may stimulate fry and smolt emigration. SWRCB recommends that the Districts and RPs should collaboratively develop the flow schedule at a workshop in December 2013 and adaptively manage flows so that the juvenile Chinook salmon outmigration flow study objectives and the conditions under Article 37 of the existing license are met.

FERC did not approve the original District study plan W&AR-09: *Chinook Salmon Fry Movement Study*, indicating that such a measure amounted to a PM&E measure that could be examined if early emigration were shown to be beneficial. It should be noted that the SWRCB's comments incorrectly ascribe preliminary regression analyses of flow vs. various production and recruitment estimates (e.g. RST passage, subsequent escapement) as "otolith analyses" contained in Mesick et all (2008) and Mesick (2009, 2010). Subject to cooperative analysis of historical otolith samples collected by CDFW, information directly assessing the benefits of early fry emigration or later smolt emigration of Chinook salmon is currently being developed as part of the Otolith study (W&AR-11).

In this study request, the SWRCB does not address the requirements of the ILP regulations for new studies at Section 5.15(e). Absent any explanation of why SWRCB believes this new study is now justified, the Districts are unable to understand or comment on SWRCB's rationale as to how this new study request meets the ILP requirements. The Districts do not believe this request meets these requirements.

However, the Districts are willing to participate in the Workshop suggested by the SWRCB to determine whether a cost-effective study similar to the one requested by SWRCB could be undertaken. The Districts would propose that those discussions begin in June 2013 with the goal to submit a study plan to FERC for approval by September 2013, if a study plan can be agreed upon. This would allow sufficient time to acquire the necessary permits and conduct the study starting in February 2014.

[5] Conservation Groups

The Conservation Groups ("CGs") propose that the Districts undertake three new studies identified below:

- *Upper Tuolumne River Habitats for Anadromous Fishes*
- *Bioenergetics Study*
- *Juvenile Chinook Salmon Outmigration Study – Chinook*

The second and third of these studies are identical to new studies proposed by CDFW (*Bioenergetics*) and USFWS (*Juvenile Chinook Salmon Outmigration Study*). The Districts have responded to these new study requests above. However, comments provided by the CGs in their request for a study of upper river habitats include several erroneous statements that should be corrected on the record. On page 2 of the CGs' March 11, 2013 submittal, they state that the FERC "Study Plan Determination rejected several studies on the basis that La Grange was not jurisdictional." CGs reference page 74 of FERC's Determination. However, this is not what FERC actually states on page 74 of the Determination. Page 74 clearly and correctly states that "La Grange dam is not a **Commission-licensed** facility under the FPA", and further that "the **unlicensed** La Grange dam is the downstream barrier to upstream migration" [emphasis added]. As CGs well know, there is a considerable difference between a jurisdictional project and a licensed project. The CGs go on to exacerbate their

error when they next state that FERC's Order finding licensing of La Grange is required is a "final agency action." This is patently false, as rehearing requests of that order are currently pending before FERC and FERC action on them will be subject to judicial review, and the CG must know this. Therefore, as the Districts have pointed out previously in this response to ISR comments, the facts have not changed related to La Grange; it remains an unlicensed facility and it is highly uncertain at this point in time that its status will change.

With regard to the CGs' new study request to evaluate upstream habitats for anadromous fish, the Districts point out that a similar study was requested in June 2011 which FERC did not adopt because the Don Pedro Project is not a barrier to anadromous fish and it is not reasonably foreseeable that this will change in the near future (see also response to NMFS requests above). Even if FERC were to decide that fish passage studies at Don Pedro were warranted, which the Districts strongly disagree with, requiring the Districts to examine habitats and hydrology upstream of the Don Pedro Project does not meet FERC study criteria of 18 C.F.R. § 5.9(b)(5) in that there is no Project effect on these habitats or flows and such a study would not inform the development of license conditions. It is abundantly clear that the Don Pedro Project does not affect the physical habitats in the upper Tuolumne River. It is also clear that flows and river temperatures, two primary components of habitat suitability, for most of the upstream areas identified by the CGs are materially influenced by the operation of CCSF's Hetch Hetchy water system. FERC has no authority to modify the operation of that water system. Investigating the upstream habitats, temperatures, and hydrology under current CCSF operations does not provide information that would inform FERC's decision-making because these conditions can change in the near or long term and FERC has no authority to maintain current, or require certain future, habitat conditions upstream of the Don Pedro Project.

Nevertheless, the CGs contend that these studies are needed by FERC to inform decision-making on the need for fish passage facilities at Don Pedro and, further, that the Districts are somehow obligated to provide the information. The Districts strongly disagree. These studies would be very costly, exceeding $500,000 to acquire these data. The Districts should not be obligated to acquire these data just because relicensing is underway. One of the express purposes of the ILP study criteria is to eliminate studies thrust upon the licensee simply because relicensing was underway. This study does not meet the bare requirements of the Section 5.9 (b) study criteria because, *inter alia*, it is tied to fish passage at Don Pedro, an area the Director has already determined is not an appropriate topic for study. Further, NMFS has strongly indicated to FERC that it is a NMFS program goal to restore migratory fish to this geographical area. Thus, this request for data is related to the exercise of a NMFS statutory authority. However, as explained previously, FERC and its applicants are not obligated to conduct studies to assist NMFS to exercise its statutory authorities. See the discussion of *U.S. Department of the Interior vs. FERC, supra.*

II. Response to Study Modifications and Study Variances

Fifteen entities filed comments on the Districts' ISR and/or ISR Meeting Summary. The comments can be considered to be subdivided into three categories described below:

Category 1: Comments on a study variance identified by the Districts in the resource report, or a variance identified by the commenting entity.
Category 2: Request for a study modification proposed by a commenting entity.
Category 3: Technical comment on a study that is neither a variance nor a request for study modification.

Due to the number of comments filed by the RPs, the Districts developed a spreadsheet format for providing their responses. The Districts have attempted to capture and respond to all Category 1 and Category 2 comments in the spreadsheet attached to this submittal (Attachment 1). General technical comments will be addressed in the final reports, or in the draft and final license applications, as appropriate and are not included in this submittal.

The spreadsheet format is described below:

Column 1: Sequential numbering, within each resource table, for reference purposes. The first half of the number indicates the resource table (i.e. Table 2, Table 3, etc.); the second half, the sequential number.

Column 2: The study number (e.g. W&AR-01, RR-02, CR-01, etc.) as assigned by the Districts and included in the RSP.

Column 3: Describes the type of comment, generally either a comment about a study variance or a request for study modification.

Column 4: Identifies the entity providing the comment; similar comments are combined and each of the entities providing similar comments is identified. In general, the Districts identified the most comprehensive comment on a particular subject and responded to that comment, thereby responding to all similar comments.

Column 5: The comment number is the Districts' internal tracking number used to differentiate among individual comments and is only used in the table for cross-referencing.

Column 6: Designation of the page number(s) of the letter where the entity's comment can be found.

Column 7: Provides the quote or paraphrased comment by a RP.

Column 8: Provides the Districts' response.

The Districts have made a good faith effort to respond to all Category 1 and Category 2 comments herein within the set of tables enumerated below:

Table 1: Identifies Category 1 and Category 2 comments provided by an RP and further identifies the relevant resource area and study plan.

Table 2: Provides responses to all comments on water and aquatic resources studies.

Table 3: Provides responses to all comments on terrestrial resources studies.

Table 4: Provides response to all comments on recreation resources studies.

Table 5: Provides responses to all comments on cultural resources studies.

III. Update on Hydrology for the Lower Tuolumne River Operations Model

On September 10, 2012, CDFW provided comments to SWRCB related to the unimpaired hydrology for the operations/water balance model being developed for the Don Pedro Project relicensing under study plan W&AR-02: *Project Operations/Water Balance Model*. In summary, CDFW raised a concern "that the Districts' proposed method of estimating unimpaired hydrology is not appropriate for the purpose of the state of California's environmental review process required for a new license." CDFW suggested an alternative approach for consideration by the Districts. The Districts subsequently undertook an investigation of CDFW's suggested approach and submitted its report to SWRCB, CDFW, and FERC on December 21, 2012. This report was also provided as Attachment A, Appendix A, of the W&AR-02 Initial Study Report issued January 17, 2013. On February 14, 2013, representatives from CDFW, SWRCB, and CCSF met with the Districts to discuss the Districts' report and the comparison of the two approaches. The Districts maintained that there are insufficient stream flow gage data in the Tuolumne River basin to support the gage proration approach for the period of record of the Operations Model. CDFW and SWRCB expressed interest in using all available gage proration hydrology even if the period of record was not as complete as might be desired and encouraged the Districts to search outside the immediate Tuolumne River watershed for flow records. CDFW and SWRCB suggested that alternatives be developed collaboratively in a workshop environment. CDFW and SWRCB also agreed that the monthly mass balances provided by the existing gage summation hydrology used by the Districts was sound and need not be adjusted. The Districts agreed to continue to discuss and consider alternative approaches, and agreed to provide a "strawman" to advance and promote dialogue at a meeting to be held on March 27, 2013.

The Districts issued a notice of meeting on March 16, 2013 to RPs for a Workshop to be held on March 27, 2013. On March 25, 2013, the Districts forwarded a "strawman" approach to developing a hybrid gauge summation/gage proration hydrologic record for Tuolumne River unimpaired flow. At the Workshop on March 27, 2013, the parties worked through the "strawman" and came to a consensus on an acceptable record of unimpaired flow for the Tuolumne River. The Workshop notes

and the report presenting the consensus approach and the hydrologic record are provided in Attachment 2.

IV. Lower Tuolumne River Instream Flow Study

The instream flow study undertaken by the Districts as directed by FERC in its July 2009 Order on Rehearing was submitted to agencies and interested parties for review and comment on February 28, 2013. Parties were to submit comments by April 1, 2013 and the Districts are scheduled to submit the final report to FERC by April 30, 2013. No parties provided comments during the 30-day review period. One party (USFWS) requested additional time to comment, with comments to be provided by April 8, 2013. The Districts will be incorporating these comments into the IFIM study report and providing responses to comments not incorporated. It was suggested at the ISR meeting on January 30, 2013 that the Districts should consider holding a workshop to discuss the comments following report submittal. The Districts are open to this approach, depending on the nature of, and if, any comments are received. The workshop would be held in May 2013 with a recommended date published within the next two weeks.

V. Response to General Comments Provided by California Department of Fish and Wildlife

In addition to the detailed comments provided on the ISR, CDFW also included some more general comments which the Districts believe are in need of addressing. The two areas of CDFW's general comments are (1) salmon population modeling and (2) 2012 spring pulse flows and 2012 predation study (W&AR-07). Each is discussed below.

A. Salmon Population Modeling

In its comment letter, CDFW devoted considerable attention to the principles it believes should be followed in developing, and the requirements of the data to support, the Districts' salmonid population models. Regarding process principles, CDFW notes that "information based on flawed assumptions can result in erroneous conclusions," that "responsible communication of study results includes a clear statement of study limitations," and that scientific research should be supported by a rigorous quality assurance program. From the Districts perspective, rigorous quality assurance requires an open and transparent data sharing and model development process. On the subject of the types of data needed to support model development, CDFW emphasizes the "need to have empirical data to populate the model." After laying this foundation of principles, CDFW then goes on to criticize what it believes is the Districts' lack of information on juvenile growth and health factors for in-river rearing life stages of salmon, citing especially "a lack of quantitative information on bioenergetics relationships within the Tuolumne River." Therefore, CDFW "reiterate(s) our recommendation for a bioenergetics study" as critical to the salmon model's ability to "assess Project effects on juvenile salmonid fish populations in Project-affected stream reaches." CDFW provides the Districts a study plan to undertake the necessary work. The study plan provided by CDFW states

that "[t]here is a need to utilize the existing data and **collect additional data** [emphasis added] to model and analyze the bioenergetics relationships of these variables" (i.e., food consumption, instream flow/water temperature, and growth). CDFW states that such information is needed to "guide the development of PM&E measures."

After providing this guidance on the principles of model development and data/information needs, CDFW then provides a summary of the SalSim model (Version 2.0), which it is "currently updating" to provide "scientific support for flow recommendations filed with the SWRCB" for the San Joaquin basin, including the Tuolumne River. According to CDFW, SalSim has been under development since 2005, and "uses empirical data from the San Joaquin watershed to predict how changes in a variety of environmental factors (both flow and non-flow) impact Chinook salmon populations." CDFW declares that due to SalSim's "specificity" and "use of empirical data," it will have "great utility" for the Don Pedro relicensing. The SalSim model, according to CDFW, has evolved into a complex model capable of evaluating the effects on salmon populations due to changes in flow, temperature, water quality, predation, and redd superimposition, among other variables. CDFW states that the model is currently being completed and the "exact release date is not set at this time." Finally, CDFW declares that SalSim will be the best available tool for assessing the impacts of different Don Pedro operations on salmon given (1) its "reliance on both empirical data for multiple parameters and life stages" and (2) the review process it has undergone (which as yet does not include any public participation).

The Districts are pleased to have this opportunity to respond to these comments on population modeling provided by CDFW. To date, the Districts have conducted an open and transparent process of model development, and will continue to do so. Through information requests and a series of Consultation Workshops (W&AR-05: *Salmonid Information Integration and Synthesis*), the Districts have requested all relevant reports and supporting data from all RPs, and have openly identified and shared information and data with RPs. CDFW, on the other hand, has yet to conduct any similar public meetings on SalSim, Version 2.0, preferring instead to develop the model without inviting external participation by interested parties.

CDFW strongly endorses the use of site-specific empirical data and claims its model will have "great utility" because of its reliance on such empirical data. At the same time, CDFW states that the Districts' model is in dire need of additional empirical data on bioenergetics relationships and has proposed that the Districts undertake an extensive study to acquire such data. This strikes the Districts as odd. Either CDFW already has obtained such data from the Tuolumne River and is withholding it from the Districts, or CDFW's SalSim model is itself lacking the tributary-specific empirical data it claims the Districts' model needs. If CDFW is in possession of such data, the Districts, once again, request that this empirical data be shared with the Districts and all RPs, as would be consistent with "responsible communication of study results" and "sound scientific research," both guiding principles of CDFW. If CDFW truly believes that the Districts' population model needs this additional bioenergetics data, then, obviously, so would the SalSim model. Furthermore, it seems premature for CDFW to be providing recommendations to the SWRCB on flow-based alternatives for the Tuolumne River based on an incomplete model lacking certain critically important data. CDFW states that SalSim is still under development and not ready for

public release and review, with no "exact date for release" identified. Yet, CDFW states that it has provided "scientific support for flow recommendations filed with the SWRCB" based on SalSim, Version 2.0. The Districts do not believe, and neither does CDFW judging by its own statements, that it is proper scientific practice to provide highly important "scientific support" to a regulatory body based on a model which the model developer itself acknowledges is not yet complete and may be lacking critical empirical data which the model developer is seeking to obtain from another party. Simply put, CDFW is leveling criticism at the Districts' model for its alleged lack of critical data, data that its own model developers evidently do not possess.

B. The 2012 Spring Pulse Flow and the 2012 Predation Study

On pages 13 and 14 of its comment letter, CDFW states that "in accordance with W&AR-07: *Predation Study*, the Don Pedro Project intentionally manipulated instream flows for study purposes during a time when State and Federal agencies already faced difficult water allocation decisions." CDFW goes on to imply that CDFW requested that the "W&AR-07 study be altered to prevent significant impact to resources." Both the accusation and implication are surprising since, as explained below, the Districts engaged in a lengthy process with CDFW concerning the flow schedule, which culminated in CDFW agreeing with the schedule proposed and implemented by the Districts.

As CDFW understands, the seasonal flow schedule must be established before the beginning of the new fish flow season which commences on April 15th of each year. Unfortunately, when the flow schedule is proposed and established the Districts do not have the ability to know what weather and air temperatures will be occurring in late April or May. On March 30, 2012 the Districts forwarded to resources agencies, including CDFW, a proposed flow schedule to commence on April 15. This flow schedule attempted to meet the FERC-approved W&AR-07: *Predation* study plan developed in late 2011 and approved by FERC in December 2011, well before there could be any knowledge of reduced levels of snowpack occurring in the winter of 2011/2012. CDFW provided comments on the Districts' March 30, 2012 flow schedule on April 6, 2012, the fundamental difference between the two being that CDFW based its schedule on assuming that the available pulse flow volume should be 35,361 acre-feet while the Districts had estimated, in accordance with its long-standing practice, an available pulse flow volume of 20,091 acre-feet based on the 90% exceedance probability of April-July runoff forecasts.

This set up a debate over the method of calculating the spring pulse flow with CDFW wanting to apply a different method for the fish flow year than had been used in the past. The Districts were unwilling to do this. On April 9, 2012, the Districts filed the proposed schedule with FERC using its standard method of calculating the total volume of the spring pulse flow. In any event, the Tuolumne River flow forecast provided by the State of California, which provides the basis for the schedule, was modified on April 17, 2012, and on April 20, 2012, the Districts submitted to the agencies and FERC a revised flow schedule with higher releases more closely resembling the previous schedule proposed by CDFW. Discussions between CDFW and the Districts continued through the next several days. On April 25, 2012 Robert Nees of TID spoke directly with Dean Marston of CDFW; on April 26, 2012 CDFW provided a revised recommended flow schedule; on April 27, 2012 CDFW

and the Districts came to an agreement on a flow schedule. Figure 1 below shows CDFW's flow proposal provided on April 26, 2012 and the final agreed-upon flow schedule, which corresponds to the actual flows recorded at the La Grange gage.

As the above recitation shows, the Districts did not intentionally manipulate the flow schedule for study purposes. Using the best available information throughout the spring of 2012, the Districts worked openly and collaboratively with FERC, CDFW, and other interested resource agencies to develop an appropriate flow schedule. This effort resulted in CDFW agreeing with the flow schedule proposed by the Districts, and agreeing to make the fish available to conduct the W&AR 07: *Predation Study* in 2012. In light of the above, the Districts do not understand and cannot explain the comments submitted by CDFW.

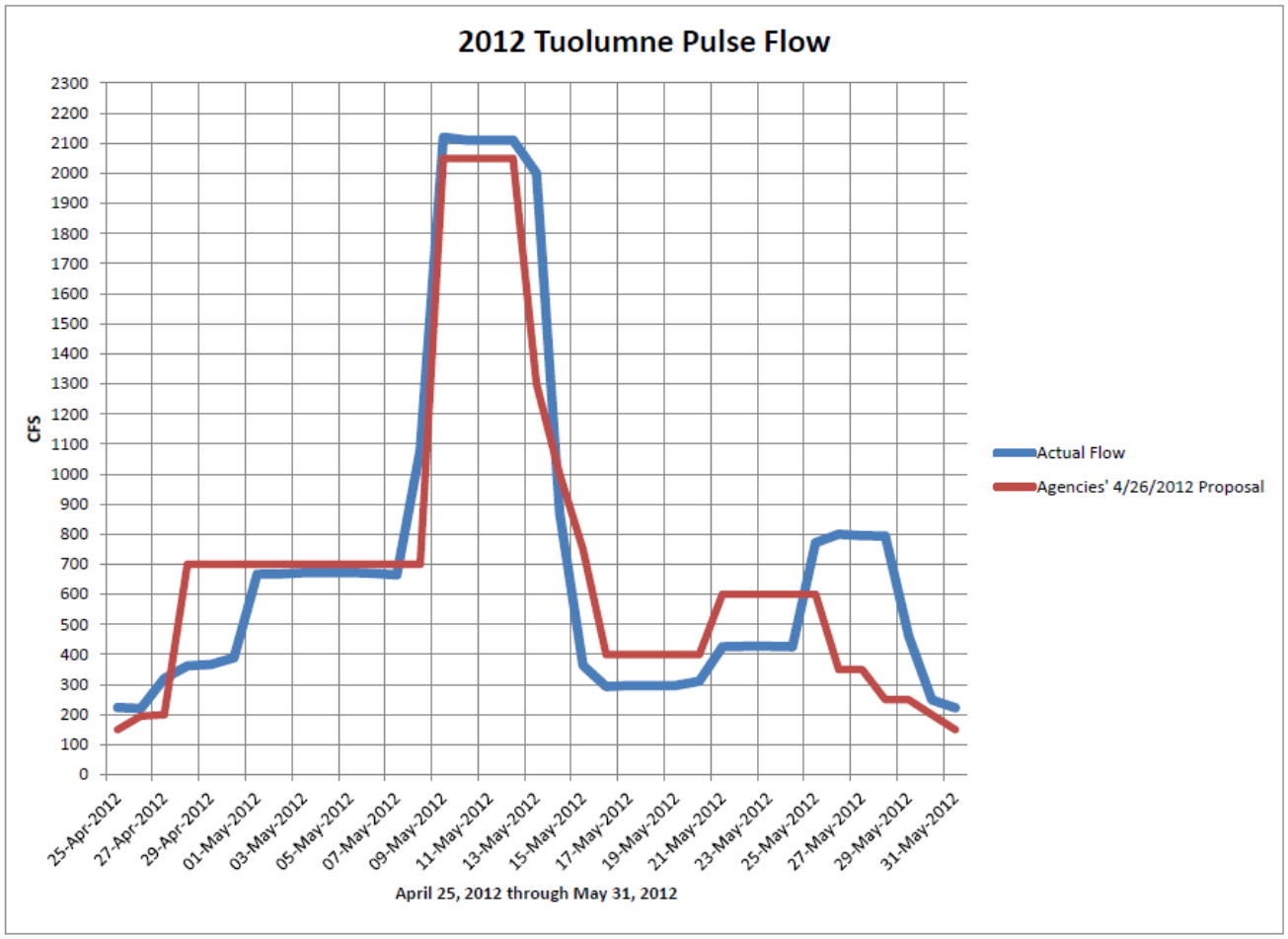

Figure 1. Comparison of CDFW's April 26, 2012 Flow Schedule and the Actual 2012 Tuolumne River Flows Corresponding to CDFW's/Districts' April 27, 2012 Agreed-On Flows.

VI. References

Mesick, C., McLain, J., Marston, D., and Heyne, T. 2008. Draft Limiting Factors Analysis & Recommended Studies for Fall-Run Chinook Salmon and Rainbow Trout in the Tuolumne River. Anadromous Fish Restoration Program, U.S. Fish and Wildlife Service, Sacramento Office of the National Marine Fisheries Service, Fresno Office of the California Department of Fish and Game.

Mesick, C. 2009. The High Risk of Extinction for the Natural Fall-Run Chinook Salmon Population in the Lower Tuolumne River Due to Insufficient Instream Flow Releases. California Sportfishing Protection Alliance, U.S. Fish and Wildlife Service, Energy and Instream Flow Branch, Sacramento.

Mesick, C. 2010. Comments on the Draft Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives.

Stauffer, G.D. 1973. A growth model for salmonids reared in hatchery environments. Dissertation. Department of Zoology, University of Washington, Seattle.

Stillwater Sciences. 2012. Lower Tuolumne River Instream Flow Studies: Pulse Flow Study Report. Final. Prepared by Stillwater Sciences, Berkeley, California for Turlock Irrigation District and Modesto Irrigation District, California. June.

TID/MID. 1997. Aquatic Invertebrate Report, Supplement to 1992 FERC Report Appendix 16. Report 96-9 *In* Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 39 of the License for the Don Pedro Project, No. 2299. Vol. VI. Prepared by EA Engineering, Science, and Technology, Lafayette, California.

USFWS. 2008. Flow-overbank inundation relationship for potential fall-run Chinook salmon and steelhead/rainbow trout juvenile outmigration habitat in the Tuolumne River. 15 p.

VII. Conclusion

The Districts appreciate this opportunity to respond to the comments provided by RPs, and look forward to continuing discussions during the relicensing process.

Sincerely,

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Attachments:

1. Tables 1 through 5: Districts' Response to RPs Comments on Study Variances and Requests for Study Modifications
2. Draft Notes for March 27, 2013 Hydrology Workshop No. 4
3. Final Meeting Notes for October 26, 2012 W&AR-03 and W&AR-16 Consultation Workshop

ATTACHMENTS

1. **Tables 1-5: Districts' Response to RPs' Comments on Study Variances and Requests for Study Modifications**

2. **Draft Notes for March 27, 2013 Hydrology Workshop #4**

3. **Final Meeting Notes for October 26, 2012 W&AR-03 and W&AR-16 Consultation Workshop**

ATTACHMENT 1

Tables 1-5: Districts' Response to RPs' Comments on Study Variances and Requests for Study Modifications

ATTACHMENT 1

Table 1. Summary of relicensing participants' commenting on study variances or requests for study modifications.

Study Number	Study Name	BLM	National Park Service	NMFS	USFWS	USFS Stanislaus	CDFW	SWRCB	All-Outdoors California	ARTA	Bob Hackamack	Conservation Groups	O.A.R.S.	Restore Hetch Hetchy	Sierra Mac River Trips	Tuolumne River Trust
		Government Agencies							Non-Governmental Organizations							
		Federal					State									
W&AR-01	Water Quality Assessment				X			X								
W&AR-02	Project Operations/Water Balance Model			X			X	X						X		
W&AR-04	Spawning Gravel in the Lower Tuolumne River Study			X	X			X								
W&AR-05	Salmonid Population Information Integration and Synthesis Study				X		X	X				X				
W&AR-06	Tuolumne River Chinook Salmon Population Model				X											
W&AR-07	Predation Study			X	X		X	X				X				
W&AR-10	*Oncorhynchus mykiss* Population Study				X											
W&AR-12	*Oncorhynchus mykiss* Habitat Assessment			X	X							X				
W&AR-14	Temperature Criteria Assessment (Chinook Salmon and *Oncorhynchus mykiss*)			X												
W&AR-15	Socioeconomics Study															X
W&AR-16	Lower Tuolumne River Temperature Model			X	X		X	X								

Study Number	Study Name	BLM	National Park Service	NMFS	USFWS	USFS Stanislaus	CDFW	SWRCB	All-Outdoors California	ARTA	Bob Hackamack	Conservation Groups	O.A.R.S.	Restore Hetch Hetchy	Sierra Mac River Trips	Tuolumne River Trust
		Government Agencies							Non-Governmental Organizations							
		Federal					State									
W&AR-18	Sturgeon Study				X			X				X				
W&AR-19	Lower Tuolumne River Riparian Information and Synthesis Study				X											
W&AR-20	*Oncorhynchus mykiss* Scale Collection and Age Determination Study				X											
CR-01	Historic Properties Study	X														
RR-02	Whitewater Boating Take Out Improvement Feasibility Study	X	X			X			X	X	X	X	X		X	
RR-03	Lower Tuolumne River Lowest Boatable Flow Study	X	X								X	X				
TR-01	Special-Status Plants Study	X														
TR-02	ESA- and CESA-Listed Plant Study	X														
TR-07	ESA-Listed Amphibians - California Red-Legged Frog Study	X			X											
TR-10	Bald Eagle Study				X											

Table 2. Comments on Water & Aquatic Resource Studies.

Response No.	Study No.	Type of Comment	Organization	Comment No.	Page No.	RP Comment (quote or paraphrase)	Districts' Response
2-1	W&AR-01	Study Comment	USFWS	1	p. 2	EPA's temperature water quality standards were not used in this assessment. A description of the water quality standards that are not meeting the State standards needs to be included in this study.	Water quality study results that were potentially inconsistent with the CVRWRCB's Basin Plan narrative and numeric water quality objectives are discussed in Section 6.0 of the W&AR-01: *Water Quality Assessment Study Report*. Temperature was explicitly excluded from the report, as it is addressed by W&AR-16: *Lower Tuolumne River Temperature Model*. Attachment 2-3 of the Water Quality Assessment Report presents water quality data in tables, highlighting results that are greater than the standards, criteria, and benchmarks listed in Table 4.3-1. The standards, criteria, and benchmarks provided in Table 4.3-1 were initially presented in the FERC-approved study plan (Table 5-3.2 of that document), which was initially presented in the Pre-Application Document ("PAD"). As detailed in the FERC-approved study plan, screening numbers were selected when a numeric objective was not provided in the Basin Plan. It was necessary to include other lines of evidence, other than screening numbers, in the Section 6.0 discussion because some results were not applicable "as is." For example, MCLs were used in the comparisons, but they apply to treated drinking water, not untreated surface water. EPA (2003) provides guidance for water temperatures, not standards.
2-2	W&AR-01	Study Comment	SWRCB	SWRCB-1	p.4	The Water Quality Assessment Study Report disagrees with the benchmark values for temperatures presented by the Districts as both references cited for development deal primarily with brown trout and are based upon studies conducted in Europe. SWRCB staff believe that these are inappropriate for this study and anticipate relying upon temperature water quality standards put forth for salmonids in the 2003 USEPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards.	The Districts note that the W&AR-01: *Water Quality Assessment* Study Plan was initially presented in the PAD, was not modified through the relicensing participant meeting process, and was later adopted without modification by FERC. The Districts agree that the temperature benchmark values presented in the FERC-approved Water Quality Assessment study plan are no longer appropriate and will be changed in the final report. As stated elsewhere in the study plan, as well as in the Water Quality Study Report, lower Tuolumne River temperature is being evaluated within Study W&AR-16: *Lower Tuolumne Temperature Model*.
2-3	W&AR-02	Variance	NMFS,CDFW,SWRCB	N/A	N/A	The biggest driver in producing a valid tool to meet all the relicensing applications of this model is the development of an unimpaired hydrology data set. Uncertainties and associated errors within the model result in the production of negative inflow values to Don Pedro Reservoir, often during low flow periods that can extend for multiple weeks. Additional errors within the unimpaired hydrology due to these uncertainties are also possible, particularly when deriving peak-flow magnitudes on a daily step.	The Districts and Relicensing Participants ("RPs") have been discussing this issue since September 2012. On March 25, 2013 the Districts issued a "strawman" outlining a possible analytical approach to developing a hybrid gage summation and gage proration approach to developing unimpaired hydrology. The Districts and RPs held Hydrology Workshop No. 4 on March 27, 2013 in Sacramento. At this meeting, a consensus was reached on the unimpaired hydrology. Participants also agreed that the Meeting Notes from this meeting should be included with the Districts' April 9th response to ISR comments to document resolution of this issue. (See Attachment 2 to this submittal.)

Response No.	Study No.	Type of Comment	Organization	Comment No.	Page No.	RP Comment (quote or paraphrase)	Districts' Response
2-4	W&AR-02	Study Modification	Restore Hetch Hetchy	6	N/A	Good cause exists to modify the water balance model to include CCSF's upstream hydropower production. Inclusion of upstream hydropower production was contemplated in the final Revised Water Balance Study Plan. Modification would require minimal additional effort.	RHH is incorrect when it states that the Districts intended to include CCSF's hydropower generation in the Operations Model. The Revised Study Plan ("RSP") W&AR-02: *Project Operations/Water Balance Model* never once even mentions CCSF's upstream hydropower facilities; Table 5.3-1 specifically identifies model nodes and outputs; CCSF hydropower generation is not included. On the other hand, Don Pedro generation is specifically identified. The word "Project" with a capital "P" is specifically referenced to, and only to, the Don Pedro Project on page 1 of every study plan, and specifically on W&AR-02. Again, contrary to RHH's assertion, the Don Pedro Project contains four generators in the powerhouse, not one, and these have multiple capacities. The Operations Model study plan never contemplated, nor did FERC's Determination require, that CCSF hydropower generation be a component of the model. Therefore, this request is a study modification, not a variance from the study plan. As such, the study modification must show that the study was not conducted as approved or that the study was conducted under anomalous environmental conditions. RHH does not show either of these. Nor does RHH ever attempt to show that a study of CCSF hydropower generation meets the criteria under Section 5.9(b) of the ILP regulations.
2-5	W&AR-02	Study Comment	Restore Hetch Hetchy	9	p. 16-17	The ISR mischaracterizes the size of the water bank. The water bank can hold up to 740,000 acre-feet--not 570,000 acre-feet as the ISR incorrectly states. For example, in its reporting to the Districts of historic water bank volumes, San Francisco reported that the end of month storage in the water bank was 733,555 in July 1983, 728,086 in July 1995, 729,692 in June 2005 and 726,481 in June 2006. To be consistent, it makes sense to describe the reservoir as having a capacity of 2,030,000 acre-feet and the water bank a capacity of 740,000 acre-feet, even though those maximum levels cannot be realized year-round.	The water bank is allowed to credit up to 740 TAF, however this is on a single year basis and must be used by October 2 of the year in which it exceeds 570 TAF; therefore, for water supply planning purposes, it is prudent to consider the water bank as having a capacity of 570 TAF.
2-6	W&AR-04	Variance	NMFS	6	p. A-7	There are important differences between the FERC-approved study elements and the alternative approaches developed in W&AR-04; the alternative approaches do not quantify how much coarse sediment is currently stored in an active, semi-active, or inactive state, and that provides current and potential future, geomorphic, and habitat function.	In its SPD, FERC staff recommended, based on NMFS Request Element #3, that the Districts quantify coarse sediment storage in the lower Tuolumne River and develop a sediment budget for the purpose of determining the annual ongoing cumulative effects of the Project in the lower Tuolumne River. The gravel-bedded reach of the lower Tuolumne River contains large, deep stores of coarse sediment that cannot be quantified without costly geophysical and stratigraphic investigation of the subsurface. This cost of such an effort to accurately determine total gravel in the gravel-bedded reach would be approximately $120,000. More importantly, this information is not needed to address the concerns raised. These deep sediment stores are not mobilized and/or affected by the Project and are not relevant to the intent of NMFS Request Element #3. The intent of NMFS Request

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							Element #3 was to assess the potential cumulative effects of the Project on changes in coarse bed material storage and spawning gravel. This objective was achieved by (1) simulating reach average changes in bed material storage through sediment transport modeling, and (2) estimating spatially explicit changes in bed material storage by differencing 2005 and 2012 digital terrain models in the Dominant Salmon Spawning Reach. This approach complied with the intent of NMFS Request Element #3 and is consistent with the direction given by FERC in the December 22, 2011 Study Plan Determination ("SPD"). The coarse sediment budget for the Dominant Salmon Spawning Reach (RM 52.1 to RM 45.5) indicates that approximately 3,500–6,035 yd^3 (4,550–7,846 tons) of coarse bed material was lost from storage between 2005 and 2012. If the estimated total storage change is distributed over the total channel area, it equates to 12 mm of bed lowering from 2005 to 2012. The estimated lowering in the reach during the 2005–2012 period is less than the average median grain size of the coarse channel bed (approximately 51 mm), and the total estimated volume lost from storage in the reach is comparable in magnitude to the quantity of coarse sediment added during any one of the augmentation projects that occurred since 2002. Assuming 12 mm of bed lowering from 2005 to 2012 and an average thickness of gravel deposits in the lower Tuolumne River channel of approximately 3 to 5 feet, it is highly unlikely that coarse sediment storage and associated spawning gravel availability in the Tuolumne River would limit anadromous fish population size over the next 50 years.
2-7	W&AR-04	Study Comment	NMFS	7	p. A-7	The alternative approaches, which are interpreted as intended to fulfill the FERC-ordered sediment budget, only provide analysis over a 12-year interval, as opposed to analysis of longer-term trends that could be reasonably foreseen over the remaining term of the current license and the term of a potential new license.	Neither the FERC SPD nor the approved W&AR-4: *Spawning Gravel in the Lower Tuolumne River* study plan specify a time period over which sediment budget analyses should occur; therefore, the study is not contrary to the study plan (Section 5.15 (d)(1)). The study plan was implemented using the best available information to determine changes in coarse sediment storage. River channel bathymetry developed in 2005 from approximately RM 51.8 to approximately RM 38 provided the best available information for determining changes in coarse bed material storage relative to current river channel bathymetry. The need for the analysis to cover a longer period is not explained by NMFS, especially in light of the response to NMFS (6) immediately above. (Section 5.9(b)(4))
2-8	W&AR-04	Study Modification	NMFS, SWRCB	NMFS 8 & 9, SWRCB-4	N/A	NMFS and SWRCB requested that the Districts conduct model runs utilizing the entire Project-related hydrology set, as well as with- and without-Project, in order to gain greater understanding in sediment transport capacity and changes in coarse sediment storage. NMFS also requested that data for model	This request is a study modification that does not meet Section 5.15 (d)(1) nor Section 5.9(b)(4) or (5). Neither NMFS nor SWRCB explains adequately what this analysis would be used for or how it would inform the development of license conditions. Running the model under "without project hydrology" would not inform the development of license

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						runs for the interval of WY 1970 to 2010 should be presented with and without WY 1997 so that the effects of WY 1997 can be isolated.	conditions and is contrary to FERC policy. The Districts acknowledge that performing the requested analysis for "with project" 1970-2009 hydrology is low cost and will provide this information to NMFS and SWRCB.
2-9	W&AR-04	Study Modification	NMFS	10	p. A-8	NMFS recommends presenting the results at a scale of order of every 1 to 2 miles, or providing the results to Relicensing Participants separately. From aerial photograph analysis of the 6 miles from RM 52 to 45.5, NMFS recognized at least 3 notable geomorphic breaks based on channel configuration and emergence of mid-channel bar/island features.	The Districts will provide this information.
2-10	W&AR-04	Study Modification	NMFS, USFWS SWRCB	NMFS-10, USFWS-2, SWRCB-5	N/A	The NMFS, USFWS, and SWRCB requested that the DREAM-2 model be made available for use by relicensing participants and that the Districts conduct a limited number of model runs to evaluate potential gravel augmentation scenarios.	The DREAM-2 sediment transport model was used to assess bedload flux and storage changes. The model will be made available to the RPs. Due to the complexity of the model, support from the model developer, Yantao Cui, will likely be required for RPs to effectively use the model. The Districts will perform a limited number of model runs if these are defined by RPs.
2-11	W&AR-04	Study Modification	NMFS	12	p. A-9	A sensitivity analysis should be conducted to determine what vertical resolution the DEM differencing analysis can accurately detect in actual change in topography, as opposed to measuring errors in both DEM generation and attempting to horizontally and vertically align DEM's created from different time periods.	The FERC SPD did not require, nor did the study plan propose, a sensitivity analysis and therefore this study modification does not meet the requirements of Section 5.15(d)(1). NMFS does not explain how this request meets Section 5.15(e)(2), (3), (4), or (5). Therefore, this request should not be approved. The W&AR-04 study as completed addresses uncertainties related to construction of the 2012 geometric surface. Uncertainties related to the 2005 surface and analyses conducted using it cannot be quantified. Changes in coarse sediment storage estimated from modeling and surface differencing agree within about 50 percent, therefore, sensitivity analysis is not justified, especially when the loss of material is placed in context (see response to NMFS(6) above).
2-12	W&AR-04	Study Modification	NMFS	13	p. A-9 & A-10	NMFS requests that the DEM difference polygons be intersected in GIS with certain geomorphic features (i.e., spawning gravel, riffles, fine bed material deposits) in order to gain a more spatially explicit and quantitative understanding of how these geomorphic and habitat features are changing, and may be influenced by the Project's operations. NMFS indicates that this additional modification represents minimal additional effort, since it involves a desktop exercise of intersecting already developed GIS layers and then relatively minor data presentation time.	Spatial data for bed elevation changes derived from surface differencing, geomorphology (e.g., spawning gravel and fine sediment mapping), and habitat (e.g., spawning habitat and riffle meso-habitat mapping) can be provided in a format compatible with Arc-GIS. Geomorphic mapping was conducted in accordance with the FERC SPD and approved as proposed in the Districts RSP; therefore, this study modification does not meet 5.15(d)(1) or (2). As a new study request, the study does not meet any of the criteria of 5.15(e). Habitat mapping was conducted consistent with the approved Lower Tuolumne River Instream Flow Study (Stillwater Sciences 2013). These geomorphic and habitat mapping data were collected at different spatial scales using methods appropriate to inform individual elements of the respective studies. The utility of these data to appropriately and accurately inform objectives different from these individual elements of the respective studies may be

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							limited, and inherent differences in scale and resolution among the different data sets should be carefully considered when conducting additional spatial analyses. The need for this information or how it would inform the development of license conditions is not addressed by NMFS. FERC should reject this request.
2-13	W&AR-04	Variance	USFWS	3,5	p. 3	Study Objective 2 and Study Objective 4 are not being met. [See USFWS Comments 4 and 5]. Inclusion of a reach-specific sediment budget for the entire study area is extremely important to this study's objectives.	The Districts disagree. Appropriate methods and analyses were applied where relevant and feasible to meet Study Objectives 2 and 4. Sediment transport modeling and surface differencing approaches were used to develop a reach-specific coarse sediment budget that includes estimates of changes in coarse sediment storage in the Dominant Salmon Spawning Reach (RM 52.1 to RM 39.7). This reach is where over half of the salmon spawning activity occurs, potential for storage change is greatest, and channel morphology is suited to these methods. These results can be found in Section 5.1 of the W&AR-4 Study Report. In the Dominant Salmon Spawning Reach and other reaches included in the study where developing a coarse sediment budget was infeasible due to natural and anthropogenically influenced channel conditions, therefore, spawning gravel deposits and spawning habitat were mapped in detail and compared to results from previous surveys. These results can be found in Section 5.4 of the W&AR-4 Study Report. Also refer to the Districts' response to NMFS (6) above.
2-14	W&AR-04	Variance	USFWS	4	p. 3	The Districts need to establish the amount, distribution, and thus availability of coarse salmon spawning gravel within the extent of the pre-defined study area.	The Districts disagree. In accordance with the FERC SPD and approved study plan, spawning gravel deposits and spawning habitat were mapped over the entire study length (RM 52.1 to RM 23) for this study element. Refer to the W&AR-4 Study Report Section 4.4 for methods and Section 5.4 for results.
2-15	W&AR-04	Study Modification	USFWS	6	p. 3	The Districts should modify the study to include the entire spatial extent of salmonid spawning habitat.	The Districts disagree. The extent of spawning gravel availability between RM 52.1 to RM 23 of the lower Tuolumne River, the full gravel-bedded reach, was evaluated in W&AR-04, in accordance with the FERC SPD. The study methods and results implemented in W&AR-04 provide the information needed to address the potential cumulative effects of the Project on changes in coarse bed material storage and spawning gravel in the lower Tuolumne River, which was the intent of the approved study.
2-16	W&AR-04	PM&E	SWRCB	SWRCB-3	p.6	The Spawning Gravel Study utilizes the DREAM-2 Sediment Transport Model. While the study looked at current conditions, it did not look at any possible future flows.	In accordance with FERC's SPD, W&AR-04 study methods and results provide the information necessary, when combined with the Operations Model, to evaluate the potential cumulative effects to the resource over the next license term. The evaluation of possible future flows was not a stated goal of the FERC SPD or approved W&AR-4 study plan. The evaluation of future flows would be developed through scenarios in the Operations Model.
2-17	W&AR-05/06	Study Modification /	USFWS	8	p. 3-4	The collection of data on the quantity and quality of juvenile rearing habitat should be included in the information integration. USFWS recommends	The USFWS request proposes the gathering of entirely new information, or is at least a study modification. USFWS makes no attempt in this comment to address either Section 5.15(d) or

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		New Study				collecting data on the attributes of successful rearing habitat, such as temperature, LWM abundance, prey availability, over story cover, and marine-derived 2-nutrients.	(e) requirements. The Districts' study was conducted in accordance with the FERC-approved Study Plan. Individual components of this comment are addressed under Section II of the Districts' response (*II. Response to Study Modifications and Study Variances).* As reported in the W&AR-05 ISR, the ongoing IFIM Study (Stillwater Sciences 2013 Draft) reports on the relationship between flow and the quantity and quality of juvenile rearing habitat. FERC should reject this request for the collection of additional data.
2-18	W&AR-05	Study Modification	USFWS	9	p. 4	Further study is needed to determine the prevalence of infection in juvenile Chinook salmon.	The Districts disagree. This study request/study modification was previously submitted during the original study development process and was not approved by FERC in its SPD. As reported in the W&AR-05 ISR, disease incidence was specifically evaluated and although low levels of infection were identified in prior juvenile health surveys (Nichols and Foott 2002), no clinical levels of infection were found in the Tuolumne River. Although the results have not been published, it is the Districts' understanding that more recent 2012 USFWS health data for the Tuolumne are consistent with the prior 2001-2002 surveys. No additional study is required.
2-19	W&AR-05	Study Comment	USFWS	7	p. 3	This study (W&AR-05) is not complete because the supporting studies are not complete.	The Districts disagree. The study was completed consistent with the Study Plan and Consultation required under the 2011 FERC SPD. Conceptual models presented in the W&AR-05: *Salmonid Population Information Integration and Synthesis Study* ISR are based upon existing information and form the basis of inter-related population modeling that will examine the relative importance of modeled factors. Any modifications to W&AR-05 study findings as a result of these or other inter-related studies will be made as part of the Final License Application.
2-20	W&AR-05	Study Comment	CDFW	n/a	p. 10-11	We note that issues pertaining to bioenergetics of juvenile salmon are classified by the Districts as "inconclusive" or "unlikely" or "not available" for the Tuolumne River. The Districts build upon this lack of information by failing to mention juvenile growth or health in the ISR presentation on W&AR-05 study findings for the in-river rearing life stage for Chinook salmon. To address the apparent data gap [in the Districts population model] and the Districts apparent intention to not include bioenergetics relationships within the Chinook salmon model, we reiterate our recommendation for a bioenergetics model.	The W&AR-05 ISR states that based upon juvenile Chinook stomach content analysis (TID/MID 1992, App 16, TID/MID 1997, Report 96-9) as well as recent smolt condition and health assessments (Nichols and Foott 2002), there is no evidence that suggests that food resources are limiting for Tuolumne River salmon. Contrary to CDFW's statement, it should be noted that bioenergetics modeling will be used as the basis for growth under various temperature regimes associated with alternative flow scenarios in the Districts' model under Study W&AR-06: *Tuolumne River Chinook Salmon Population*. The CDFW request for a new Bioenergetics study is further discussed in Section I of this response to comments.
2-21	W&AR-05	Study Comment	CDFW	n/a	p. 11	Again referring to the June 24, 2012 Workshop 2 draft meeting notes, in-river migration timing and survival is not listed at all, not even as an "unlikely" issue. It is also absent from the ISR summary of W&AR-05 findings.	Timing of upmigration, fry emergence and emigration timing are specifically discussed in the W&AR-05 ISR, which acknowledges that water temperature is an important driver of life history timing. It should be noted that timing of life history progression and transitions are explicitly included in the W&AR-

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							06 population model.
2-22	W&AR-05	Study Comment	SWRCB		p. 6	In the Salmonids Population Information Integration and Synthesis Study Report (Study Report) the Districts state that importance of temperature as a factor contributing to Chinook salmon spawning success is unknown because the Water Temperature Criteria Assessment Study Plan (W&AR Study Plan No. 14) is ongoing.	This statement is not in the W&AR-05 report. While this statement cannot be found, it should be noted that water temperature effects on spawner preference, egg incubation, as well as fry and juvenile growth and survival are incorporated in the W&AR-06: *Tuolumne River Chinook Salmon Population* and W&AR-10: *Oncorhynchus mykiss Population* models.
2-23	W&AR-05	Study Modification	Cons. Groups		p. 3	We recommend that the Districts revise their Study Report and matrix to reflect that a controversy exists over the causes of and the potential PM&Es for lack of juvenile salmonid outmigration success. We also recommend that the models offer flexibility to evaluate various hypotheses regarding this lifestage and potential improvements	As filed with FERC, the W&AR-05 report incorporated all information provided by RPs in support of particular comments as part of the required Consultation Workshop process. Regarding potential factors limiting outmigration success, it should be noted that several factors were identified in the W&AR-05 report and the inter-related W&AR-06 model is being developed to evaluate a range of potential scenarios regarding potentially limiting factors. The Districts believe it is premature to state that there is controversy over PM&Es when none have yet been proposed.
2-24	W&AR-05	Study Comment	Cons. Groups		p. 4	If the Districts follow through on their proposal to use this study's key findings to inform the life cycle models that will be built in Study W&AR-06 (Salmon) and W&AR-10 (*O.mykiss*), we anticipate that the models will single out predation as the primary stressor to juveniles of both species, and probably the single most important in-river stressor overall. The models are only as good as the assumptions and data on which they are built. If there are concerns about the inputs, there will likely be disputes about the outputs.	Although the presentation of the relative importance of identified factors for Chinook salmon and *O. mykiss* was updated based upon additional literature and data review occurring between the 2nd Consultation workshop and the ISR report issuance, it should be noted that the W&AR-06 and W&AR-10 models are intended to evaluate the relative importance of these factors. Specifically, mechanistic representations of the effects of flow, temperature, food availability, and predation upon juvenile production have been incorporated in these models based upon RP comments and discussions.
2-25	W&AR-06	Study Modification	USFWS	14	p. 5	The USFWS recommends that age structure be a component of the model or be modeled separately and used as a model input.	The USFWS request is not based on a showing that the study did not conform with the FERC-approved Study Plan as required by Section 5.15(d)(1). Although age structure was not proposed to be modeled separately in the FERC-approved W&AR-06 study plan, age composition and fecundity will be explicitly included as data inputs to the W&AR-06 population model.
2-26	W&AR-06	Study Comment	USFWS	10	p. 4	Reduced quantity and quality of juvenile rearing habitat is a well-known stressor on salmonid populations.	Although the W&AR-05 ISR provides an initial assessment that juvenile rearing habitat is unlikely to be of greater importance than other factors, fry and juvenile rearing will be explicitly modeled as part of the interrelated W&AR-06 and -10 population model studies. In addition, the separate IFIM study quantifies juvenile rearing habitat.
2-27	W&AR-06	Study Comment	USFWS	11	p. 4	Only looking at Predation Study as a primary stressor will likely bias modeling and decision-making.	Contrary to this USFWS comment, factors contributing to predation and other sources of mortality have been well detailed in the W&AR-05 ISR. In addition to predation mortality, flow, habitat, and water temperature factors contributing to growth and mortality have been included in the interrelated W&AR-06 and -10 population models.

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2-28	W&AR-06	Study Comment	USFWS	12	p. 4	The model may misrepresent the underlying predatory/prey relationships and the true sources of mortality affecting juvenile Chinook Salmon. For instance, the most significant health issue that has been observed in the San Joaquin tributaries is infection in the out-migrant Chinook salmon during April and May	Reviews on disease incidence in the Central Valley and Tuolumne River are summarized in the W&AR-05 ISR (Attachment B to the ISR). Only smolts sampled from the lower San Joaquin River showed any evidence of clinical levels of infection and no clinical levels were identified in health surveys of juvenile Chinook from the Tuolumne River during the spring of 2000 and 2001 (Nichols and Foott 2002).
2-29	W&AR-06	Study Comment	USFWS	13	p. 5	The relationship between Large Woody Material (LWM) and large woody debris (LWD) with nutrients, prey availability, and cover has been overlooked in the model.	As reported in the W&AR-05 ISR, the relationship of LWD and invertebrate production as well as the importance of cover to juvenile rearing are acknowledged. The interrelated W&AR-06 and -10 population models rely upon WUA estimates from the ongoing IFIM study (Stillwater Sciences 2013 draft) that includes cover attributes of the sampled habitats. Lastly, based upon juvenile Chinook stomach content analysis (TID/MID 1992, App 16, TID/MID 1997, Report 96-9) as well as recent smolt conditions assessments (Nichols and Foott 2002), food resources do not appear to be limiting for Tuolumne River salmon.
2-30	W&AR-07	Study Comment	NMFS	14	p. A-11	In 2012, the spring "pulse flow" release did not occur until late in the spring (May), and it should be recognized that greater out-migration success may occur in years when pulse flows are released earlier in the year (when predators are likely less abundant and less active, due to colder stream temperatures). NMFS is concerned that too much weight is given to the results of this single-year study.	Predation rate sampling was conducted during March and May. If predators were less effective earlier in the year, the results from sampling in March should have indicated lower predation rates than during May. No difference in predation rates was found between the two events. NMFS' position is not supported by the available data.
2-31	W&AR-07	Study Modification	NMFS, SWRCB, USFWS	NMFS 15 and 18, SWRCB-9, USFWS-20	p. A-11 & A-12	The NMFS, SWRCB, and USFWS request additional samplings of both predator stomach contents and predator abundance to increase the certainty of study conclusions. The samples should be collected concurrently and should be collocated. Predator abundance data collected later in time cannot be expected to accurately depict the predator abundances that existed earlier in time (when the juvenile salmon are out-migrating)....Warm and cool water predatory fishes are much more likely to move upstream into the lower Tuolumne River in late summer, and exist there in larger numbers and higher densities than in the late winter and early spring.	Predator densities observed during predation rate sampling in March and May and during summer abundance sampling were similar indicating that the predator abundance estimates from 2012 are representative of abundance during the salmon migration period. In developing a plan to repeat the study in 2014 the Districts will coordinate with RPs regarding the timing of sampling. Predator abundance sampling is planned for summer 2013 pending receipt of permits. Predator density data will be added to the final report.
2-32	W&AR-07	Study Comment	USFWS	22	p. 7	Use of shoreline lengths to estimate abundance is inappropriate….therefore, the Districts' abundance estimates of piscivore-sized fish between Waterford and Grayson may have been overestimated.	The approach used to calculate river wide abundance is appropriate. Two methods of estimating predator abundance were described in the study plan. The correlation plots were provided to show that the ratio-regression estimator would not be appropriate to use because of the poor positive correlation (or in some cases, no correlation) between the unit sizes (measured as unit shoreline lengths or unit areas) and unit abundances (derived from the k-pass depletion methods). Due to the lack of strong

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							positive correlation between unit sizes and unit abundances, the ratio-regression estimator was not used to produce any predator abundance estimates. Reported abundance estimates were derived from the first general estimator described in section 4.2.2.3, which does not depend on the correlation between unit size and unit abundance.
2-33	W&AR-07	Study Comment	NMFS	17	p. A-12	Information from the trap catches at Waterford and Grayson are compared with the predation mortality estimates and the report notes consistency and states as plausible that the overwhelming majority of the mortality was due to predation. But are the mortality estimates between these locations (based on rotary screw trap information) accurate? To what degree are the catch differences (attributed to predation losses) due to inefficient trapping? How much of the juvenile Chinook migration period was sampled?	The mortality estimates between the traps are not based on differences in catch. Trapping efficiency is estimated by mark-recapture and is used in conjunction with daily catch data to estimate abundance at each site. As described on page 6-5 of the report, rotary screw trap monitoring was conducted between January 3 and June 15, 2012, encompassing the entire juvenile outmigration period. More information regarding rotary screw trap operation is available in the annual report.
2-34	W&AR-07	Study Comment	NMFS	19	p. A-13	The information in the Predation Study Report may represent highly uncertain input to the salmon model now under development; this requires FERC staff oversight.	The findings of this study represent the best available science regarding quantification of predator abundance and predation rates in the lower Tuolumne River. This information will be interpreted in the context of findings from long-term monitoring efforts such as seining and rotary screw trap monitoring, in addition to previous predation work and survival studies.
2-35	W&AR-07	Study Modification	SWRCB	SWRCB-6	p.7	In an attempt to fulfill the Predation Study goal of determining relative habitat use by juvenile Chinook salmon and predator species during the outmigration period, the report presents habitat types, locations, and sizes of each sampled area. CDFW's California Salmonid Stream Habitat Restoration Manual (CDFW 1998) defines habitat as "the place where a population lives and its surroundings, both living and nonliving; includes the provision of life requirements such as food and shelter." Using this definition, the habitat information presented is insufficient with no information regarding the substrate, instream structures, complexity, instream cover, and riparian cover. SWRCB requests that the Predation Study Plan be amended to include the collection of this information during the second year of study.	Habitat typing was never planned to be undertaken and was not included as part of the approved study plan. Habitat typing was not necessary to fulfilling the stated study objective. The study plan clearly states that the objective was to determine *relative* habitat use, or in other words, whether predators and juvenile Chinook salmon were using the same areas or were segregated. Answering this question does not require detailed information regarding specific habitat features, nor would such information contribute to answering the question of whether high flows were effective in separating juvenile Chinook salmon from predators. FERC should reject this request.
2-36	W&AR-07	Study Comment	SWRCB	SWRCB-8	p.8	When calculating predation rates, the Districts used gastric evacuation rates which assume that the rate of food consumption is constant and a predator's ability to constantly feed is not affected by river conditions or predator/prey behavior. Of the 246 stomachs examined during the study, only 30 contained juvenile Chinook salmon. This is a small sample size from which to extract a representative predation rate....SWRCB staff believe that due to the many uncertainties of the Districts assumptions and the	This is incorrect. The sample size was 295 total (180 examined from March sampling event and 115 examined from May sampling event), not 246, and certainly not 30. Of the 295 stomachs sampled, 49 were empty resulting in 246 samples which were analyzed. Standard methods to estimate predation proportions and associated error terms as well as predation ratios and associated error terms were followed. The sample size equals the denominator in these estimators, not the numerator (e.g. number of successes / number of trials = proportion of interest with number of trials equal to the sample size). The

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						small sample sizes, the predation rates presented in the Predation Study Report cannot be considered representative of actual predation rates occurring in the Tuolumne River.	Districts contend that this data is represented clearly and accurately in sections 5.3.3 and 5.3.5 of the report. The Districts maintain that the predation rates presented are representative of actual predation occurring in the Tuolumne River.
2-37	W&AR-07	Study Comment	SWRCB USFWS	SWRCB-11 USFWS-21	p.9 p.6	Include hydrophone array information from Grayson in the second year study report and provided to relicensing participants now.	Districts will include this information in the Final Report.
2-38	W&AR-07	Study Modification	USFWS	17	p. 6	The USFWS requests that [the river-wide predator abundance estimates in Table 5.2-6] be removed and that the study plan be modified to use the mark-and-recapture method…to estimate predator population size…and that the Districts consult with the USFWS on appropriate analytical techniques that can be used to assess the cumulative impacts of predation.	USFWS misreads the draft report. Two methods of estimating predator abundance were described in the study plan. The correlation plots were provided to show that the ratio-regression estimator would not be appropriate to use because of the poor positive correlation (and in some cases, no correlation) between the unit sizes (measured as unit shoreline). The abundance estimates are accurate and will remain in the report.
2-39	W&AR-07	Study Comment	USFWS	15	P. 5	The analysis used to estimate depletion estimates may not be appropriate because the k-pass removal estimator used for this study is mainly used in shallow streams that can be waded and thoroughly sampled with electrofishing gear. The Special Run Pool habitat...may be too deep to effectively use a depletion method. The mark-and-recapture method is generally preferred over the depletion method and has been shown to be unbiased when more than 50 percent of a population is marked (Jensen 1992).	The Districts maintain that the methods used to estimate predator abundance are statistically valid, appropriate, and consistent with the study plan. The approved study plan was thoroughly discussed with and reviewed by RPs during the study plan development process. The Districts note that none of the RPs, including USFWS, previously raised any concerns regarding the proposed depletion sampling method. While mark-recapture may under certain conditions provide less biased estimates, there are many instances where required assumptions cannot be met and/or the approach is not logistically feasible, not cost effective, and carries the potential for undue harm. Mark-recapture sampling requires multiple sampling events - one to mark the fish and at least one, but preferably more, recapture events. This substantial increase in the level of effort required is not justified. In addition to substantially increased cost, the increased sampling effort presents an increased risk of adverse impacts to the target species and other fish that may be present in the study sites, including ESA listed CV *O. mykiss*. The Districts also note that depletion estimates are more likely to underestimate abundance. The depletion model overestimates sampling efficiency and underestimates population size under conditions of decreasing sampling efficiencies (Zippin 1958; Riley and Fausch 1992). Fish that remain after initial capture occasions may be less catchable due to physiological or behavioral response to the disturbance of the previous passes (Mesa and Schreck 1989). Also, the depletion model would be expected to overestimate sampling efficiency and therefore underestimate population size if fish are present in some deep areas that are beyond the range of the electrofisher (greater than approximately 6 ft).
2-40	W&AR-07	Study Comment	USFWS	16	p. 5	It is inappropriate to use the referenced estimator to expand the site specific predator population estimates and calculate river wide abundance.	The Districts maintain that the approach used to calculate river wide abundance is appropriate. Two methods of estimating predator abundance were described in the study plan. The correlation plots were provided to show that the ratio-regression

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							estimator would not be appropriate to use because of the poor positive (or in some cases, no correlation) correlation between the unit sizes (measured as unit shoreline lengths or unit areas) and unit abundances (derived from the k-pass depletion methods). Due to the lack of strong positive correlation between unit sizes and unit abundances, the ratio-regression estimator was not used to produce any predator abundance estimates. Reported abundance estimates were derived from the first general estimator described in section 4.2.2.3, which does not depend on the correlation between unit size and unit abundance.
2-41	W&AR-07	Study Modification	USFWS	18	p. 6	Additional age and growth information would provide invaluable insight regarding the reproductive success of predators and what environmental conditions might be influencing the reproductive success and recruitment of *Micropterus* spp. residing in the Tuolumne River. The USFWS recommends that scales and/or otoliths be collected from all sampled predators for use in describing population dynamics...of the various predator species.	The Districts will include the collection of otoliths in future predation rate and predator abundance sampling efforts. The suggestion by USFWS was not made during the study plan development process for the 2012 study, but can be included in future sampling.
2-42	W&AR-07	Study Comment	USFWS	19	p. 6	There is a lot of variability in the reported predation rates from the various studies that have been implemented in the Tuolumne River and very low sample sizes used to estimate predation rates, especially since the majority of predator stomachs that were examined were without any salmon.	The sample size equals the total number of fish examined for stomach contents regardless of whether juvenile Chinook salmon were found. Standard methods to estimate both predation proportions and associated error terms as well as predation ratios and associated error terms were followed. The Districts maintain that the sample sizes to estimate predation rates for largemouth bass (n=132) and smallmouth bass (n=131), and striped bass (n=26) were adequate to provide reliable estimates and exceeded sample sizes from all previous efforts to document predation rates in the Tuolumne River.
2-43	W&AR-07	Study Comment	USFWS	22	p. 7	The Districts reported an estimated 21,701 largemouth bass instead of 2,701 on page 6-4.	The estimate of 21,701 largemouth bass on p. 6-4 is a typographical error and should have read 2,701 as reflected both in the example calculation of the estimated number of juvenile Chinook salmon consumed (two sentences later, bottom of pg. 6-4) and in the Table 6.3-1 on the following page.
2-44	W&AR-07	Study Modification	CDFW	CDFW-6	p.14	In 2012, the Districts' implementation of a flow schedule consistent with the Commission-approved W&AR-07 study, but against requests by CDFW to alter the study to prevent significant impact to resources as well as provide a more natural test flow regime, made a drier than normal water supply situation even more extreme. This caused river temperatures to soar well above the USEPA 2003 criteria and resulted in high mortality of juvenile Chinook salmon indicated by rotary screw trap data. To avoid such undesirable impacts in the future, CDFW recommends a blanket amendment to Commission-approved study plans for this project which involve intentional manipulation of natural	The Districts must point out that the flow schedule implemented by the Districts in 2012 was developed in coordination with CDFW, USFWS, NMFS, and DWR, and was very similar to the schedule suggested by the agencies themselves, including CDFW, on April 26, 2012. Following discussion with the agencies, the schedule implemented by the Districts was approved by all parties, including CDFW, on April 27, 2012. The Districts also note that CDFW's decision to allocate hatchery fish for this study was conditional on agreement to a satisfactory flow schedule. The Districts appreciate CDFW's cooperation in allocating hatchery fish for this study to be completed in 2012. The rise in water temperatures did not occur until after the May sampling event. In fact, the river temperatures in May during the sampling event were lower than normal.

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						resources, to include the following general concept in each respective Methods Section: "Resource protection is an important consideration of this study. If a Trustee Agency determines the information cannot be collected in a manner that avoids unacceptable impacts on natural resources, the Trustee Agency will notify the Commission, the Districts, and fellow relicensing participants as soon as possible via email to discuss alternative approaches to perform the study." We urge the Commission to require the inclusion of such a provision in any other studies approved for the remainder of this preceding that involve potential resource manipulation.	
2-45	W&AR-10	Study Comment	USFWS	25	p. 8	Information included in this study did not include essential stressors and limiting factors that must be addressed in order to sustain populations. For example, reduced quantity and quality of juvenile rearing habitats is a well-known stressor on salmonid populations. In addition, the energetics of prey availability is an essential population driver.	Initial factors of greater relative importance identified in the interrelated W&AR-05 ISR include juvenile rearing habitat, particularly during summer. Fry and juvenile rearing habitat as well as bioenergetic modeling of growth rates as a function of water temperature and ration will be explicitly modeled as part of the W&AR-10 population model study. See also the response to USFWS-22.
2-46	W&AR-10	Study Modification	USFWS	27	p. 8	The USFWS recommends that age structure be analyzed so that decisions and interpretations can be made regarding the health of *O. mykiss* populations in the lower Tuolumne River.	The USFWS request for study modification does not meet the requirements of 5.15(d)(1) or (2) and does not identify any instance where the study did not conform with the FERC-approved study plan. Although the FERC-approved study plan does not include any assessment of the "health" of the Tuolumne River *O. mykiss* population, age composition and fecundity will be explicitly included as data inputs to the W&AR-10 population model.
2-47	W&AR-12	Study Comment	NMFS	20	p. A-13	Contrary to FERC's July 25, 2012 Order, the W&AR-12 study report does not propose to conduct a second season of quantitative wood surveys in Don Pedro Reservoir: "therefore no additional studies on LWD are recommended."	NMFS is incorrect. The study was completed consistent with FERC's study plan approval of July 25, 2012, which stated "we recommend that the Districts produce an estimate of the average annual volume and frequency of LWD removed from Don Pedro reservoir using quantitative and anecdotal historical data, including appropriate aerial photography analysis methods, such as those described by NMFS in its April 24, 2012 comment letter, as well as two annual quantitative surveys of LWD in Don Pedro reservoir to be conducted upon the cessation of seasonal high flow events." Multiple years of quantitative LWD raft and burn pile volume data were collected by the DPRA from 2009-2012 following the cessation of seasonal high flow events. Stillwater Sciences conducted additional inventory data on burn piles in 2012, consistent with the approved study plan. NMFS misuses the study report statement "therefore no additional studies on LWD are recommended" to imply that it referred to the Don Pedro Reservoir LWD assessment. The correct context of this quote can be seen in report section 7.0 Variances and Modifications where it refers to the reason why a second LWD inventory is unnecessary on the **lower Tuolumne River**, not in

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							Don Pedro Reservoir.
2-48	W&AR-12	Study Modification	NMFS	23	p. A-14	NMFS recommends modification of the W&AR-12 study to include a census of all the wood raft volumes upstream of Wards Ferry Bridge for the 2009 to 2012 analysis, or at the very least explain how they were accounted for.	This is actually a request for additional information, not a study modification. The Districts will provide the additional information in the Draft and Final License Applications, including a census of wood raft volumes upstream of Wards Ferry Bridge for the 2009-2012 analysis and explain how they were accounted for.
2-49	W&AR-12	Study Comment	NMFS	21 & 22	p. A-14	The single reservoir survey conducted (March 15, 2012) occurred in a dry year where little to no wood was transported into the reservoir (Table 5.3-1), and the wood pieces that were surveyed were remnants from 2011 DPRA burn piles (not the much large wood rafts that are typically left perched on the shoreline when the reservoir recedes). Districts should conduct a second-year quantitative wood survey in Don Pedro Reservoir, as ordered by FERC (on July 25, 2012).	The study was completed consistent with the study plan approved by FERC in the July 25, 2012 letter, which stated "we recommend that the Districts produce an estimate of the average annual volume and frequency of LWD removed from Don Pedro reservoir using quantitative and anecdotal historical data, including appropriate aerial photography analysis methods, such as those described by NMFS in its April 24, 2012 comment letter, as well as two annual quantitative surveys of LWD in Don Pedro reservoir to be conducted upon the cessation of seasonal high flow events." Multiple years of quantitative LWD raft and burn pile volume data were collected by the DPRA from 2009-2012 following the cessation of seasonal high flow events, and Stillwater Sciences conducted an additional inventory of large partially burned logs that were left over from 2011 rafts and in 30 unburned burn piles in 2012. The context for the NMFS comment was that the Don Pedro Reservoir LWD piece size inventory was skewed toward not capturing larger pieces of LWD due to the survey being conducted after burning of the rafts. However, the study did inventory many large (>16 inches in diameter and >13 ft long) remnant logs (partially burned and unburned), which led to the conclusion that the percentage of large logs was more than double in the reservoir than below La Grange Dam (Table 5.4-1, pg. 5-17). In addition, the calculated W&AR-12 Don Pedro Reservoir LWD volumes overestimate the amount of large wood in the rafts and burn piles. This is because a significant portion of these DPRA wood accumulations are composed of piece sizes that are smaller than the minimum LWD size criteria of 4 inches in diameter and 3 feet long (i.e. sticks, bark, and chunks). A considerable amount of small woody debris in the wood rafts and piles can be seen in Figures 4.1-2 to 4.1-4 on pages 4-6 and 4-7 of the W&AR-12 report.
2-50	W&AR-12	Study Modification	USFWS, CG	USFWS-29, CG-1		The USFWS and CG requested additional years of data collection, ranging from one to five years of additional study for LWD removed from the Don Pedro Reservoir in order to provide for a much improved, quantitative, and empirically based estimate of annual LWD.	The study was completed consistent with the approved study plan, which stated "we recommend that the Districts produce an estimate of the average annual volume and frequency of LWD removed from Don Pedro reservoir using quantitative and anecdotal historical data, including appropriate aerial photography analysis methods, such as those described by NMFS in its April 24, 2012 comment letter, as well as two annual quantitative surveys of LWD in Don Pedro reservoir to be

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							conducted upon the cessation of seasonal high flow events." Multiple years of quantitative LWD raft and burn pile volume data were collected by the DPRA from 2009-2012 following the cessation of seasonal high flow events, and Stillwater Sciences conducted an additional inventory of burn piles in 2012. The request for study modification does not meet the requirements of Section 5.15(d)(1) or (2). In addition, the study used data collected over a range of water year types (dry to wet) that would result in varying levels of LWD recruitment.
2-51	W&AR-12	Study Modification	USFWS	30	p. 9	USFWS also believes that in order for the Districts to better estimate (quantitatively/empirically) the average annual frequency of LWD removed from Don Pedro Reservoir (per high flow event, as directed), LWD surveys within the reservoir should also be conducted prior to such high flow events (and not just after such events).	The study was completed consistent with the approved study plan. Multiple years of quantitative LWD raft and burn pile volume data were collected by the DPRA from 2009-2012 following the cessation of seasonal high flow events, and Stillwater Sciences conducted an additional inventory of burn piles in 2012. The requested study modification does not meet the requirements of Section 5.15(d)(1) or (2), nor any of the requirements of Section 5.15 (e).
2-52	W&AR-12	Study Comment	USFWS	31	p. 9	Note that the USFWS believes that an annual survey period of 3-5 years, as opposed to just 2 years, should also help to account for variation caused by water year type.	Multiple years of quantitative LWD raft and burn pile volume data were collected over the 4-year period from 2009-2012 following the cessation of seasonal high flow events, and Stillwater Sciences conducted an additional inventory of large partially burned logs that were left over from 2011 rafts and in 30 unburned burn piles in 2012. The study was conducted using data over a range of water year types (dry to wet) that would result in varying levels of LWD recruitment. In addition, the calculated W&AR-12 Don Pedro Reservoir LWD volumes overestimate the amount of large wood in the rafts and burn piles. This is because a significant portion of these DPRA wood accumulations are composed of piece sizes that are smaller than the minimum LWD size criteria of 4 inches in diameter and 3 feet long (i.e. sticks, bark, and chunks). A considerable amount of small woody debris in the wood rafts and piles can be seen in Figures 4.1-2 to 4.1-4 on pages 4-6 and 4-7 of the report.
2-53	W&AR-12	Study Modification	USFWS	32	p. 9	Applicants should specify what the annual flow percent exceedance was for 2009-2011. The USFWS recommends looking at additional years of DPRA data, particularly for a very wet year, such as 1996-97 (Section 4.1.2.3).	Multiple years of quantitative LWD raft and burn pile volume data were collected by the DPRA from 2009-2012 following the cessation of seasonal high flow events, and Stillwater Sciences conducted an additional inventory of burn piles in 2012. The study was conducted using data over a range of water year types (dry to wet) that would result in varying levels of LWD recruitment. The DPRA did not collect burn pile and wood raft data prior to 2005; therefore no data are available for water years 1996 or 1997. The Districts will include the requested flow exceedance information in the final report.
2-54	W&AR-12	Study Comment	USFWS	33	p. 9	The text is missing an explanation of how average shelter rating values were computed. The explanation should be included in the text or as a footnote (Table 5.1-5).	This information will be provided in the final report.
2-55	W&AR-	Study	USFWS	34	p. 9	The USFWS recommends calculating a weighted	The study was conducted using data over a range of water year

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	12	Modification				average based on the percentage of years in the historic record with each water year type and the water year type of 2009-12, because it would better represent the long-term average delivery of wood to the Tuolumne River (Table 5.3-1).	types (dry to wet) that would result in varying levels of LWD recruitment. In addition, a weighted average estimate based on the historical flow record would not necessarily be more precise, since recruitment into the reservoir is a function of more than just the water year type (e.g., intervals between particular year types may have significant effects on a weighted estimate).
2-56	W&AR-12	Study Comment	USFWS	35	p. 10	The report is inconsistent with the study plan in that data is not presented on similar stream systems outside of the Central Valley. The Yakima River is an excellent example of a similar stream outside of the Central Valley. Other similar stream systems could be selected and evaluated. In addition, the comparison given for the Central Valley is weak: Wood delivery from the upper watershed is impacted for both the Tuolumne and Merced. The USFWS is aware that there are data available for other streams in the Central Valley (e.g., the Mokelumne River), and data is currently being collected for the Yuba River. The USFWS recommends a comparison with the Cosumnes River, given that it is unregulated and does not have a large upstream reservoir capturing LWD (Section 6.1).	The Districts will include additional information regarding the Mokelumne River's instream habitat and LWD. The Districts do not believe that the Yakima River in central Washington is a similar stream as this is a watershed on the east side of the Cascade Range. No information is provided by USFWS showing why the Yakima River would be similar to the Tuolumne. In fact, LWD quantities are highly basin specific, and great care should be taken in the use of any such comparison. The Cosumnes River, being undammed, does not have similar recruitment potential as a system with dams throughout the watershed, as the Tuolumne does.
2-57	W&AR-12	Study Comment	SWCRB	SWRCB-0	p. 10	State Water Board staff strongly disagree that trapping fine sediment in Don Pedro Reservoir would result in less embedded cobble/boulder substrates downstream of La Grange Dam.	Please refer to the Coarse Sediment Management Plan for the Lower Tuolumne River (McBain and Trush 2004) for a discussion of the sediment trapping ability of Don Pedro Reservoir. In 2001, Stillwater Sciences conducted a three-day reconnaissance-level snorkel survey from Riffle A3/4 (RM 52.0) to Roberts Ferry Bridge (RM 39.5) to estimate the volume of fine sediment accumulation in pools and other discrete fine sediment deposits (within the bankfull channel), and to assess the contribution of fine sediment from small tributary inputs (Stillwater Sciences 2001). Only limited sand deposits were observed in pools in the reach upstream of Basso Bridge (RM 47.5). The amount of sand in the pools increased in a downstream direction as inputs from tributaries and bank scour accumulated. Habitat typing conducted as part of the W&AR-12 study recorded dominant and subdominant substrate composition within the La Grange tailrace to Martins Ferry Bridge reach (RM 51.8 to 39.5). Sand was not identified as a dominant substrate in any recorded habitat unit within that reach (pg. 5-4, Table 5.1-6). Sand was identified as the subdominant substrate in 17 percent of the reach, primarily in pools and flatwaters (pg. 5-4, Table 5.1-7). In addition, 87 percent of the pooltails/riffle crests had cobble embeddedness levels of 1 (<25% embedded. This level of

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							embeddedness indicates relatively "clean" cobble/gravel substrates within the survey reach. The W&AR-4 study also concluded that total volume of discrete fine bed material (<2mm in size) deposits in the reach from La Grange (RM 52.1) to Roberts Ferry Bridge (RM 39.6) decreased by 44 percent from 2001 to 2012. In addition, fine bed material storage in the low flow channel diminished 36 percent from approximately 67,229 yd^3 in 2001 to approximately 42,770 yd^3 in 2012. These results indicate that trapping of fine sediment in the Don Pedro Reservoir may be reducing the supply of fine sediment to downstream reaches and coarsening the lower Tuolumne River substrate. SWRCB does not offer any evidence to support its basis for disagreement.
2-58	W&AR-12	Study Modification	SWCRB	SWRCB-12	p.9	The *O. mykiss* Habitat Survey Study reports on LWD under current conditions but should also identify LWD that would be available for *O. mykiss* to use under different flow conditions.	The study was completed consistent with the study plan and identified LWD that was within the active channel, which includes the area inundated under different flow conditions. Identification of LWD that would be available under flow conditions beyond the active channel would require additional field surveys at different flows, and given the general scarcity, small size, and high mobility of the LWD in general, would be unlikely to provide significant useful data (e.g., flows beyond the active channel would likely scour much of the existing LWD away). SWRCB's request for study modification does not met the requirement of Section 5.15(d)(1) or (2).
2-59	W&AR-12	Study Modification	CG	CG-2	p.7	For the W&AR-12 study, the methodology for calculating average annual LWD supply was not identified and described in the approved study plan. The Conservation Groups request that the Districts provide copies of the original data sheets as an appendix to the report, along with a detailed description of the methodology used in collecting the data, size classes of LWD, etc. The Conservation Groups also request that the Districts provide copies of the Google aerial images for the years that were studied in an appendix and that these images encompass the reservoir upstream along the Tuolumne arm to the max pool location and downstream to the Jacksonville Road.	The Districts will provide the requested additional information in the final report.
2-60	W&AR-12	Study Modification	CG	CG-3	p.10	The W&AR-12 Study compared LWD on the Tuolumne River to the Merced River. However the Districts have not shown that this single comparison provides useful information. The Conservation Groups request that the Districts examine LWD data, information, and reports from the Cosumnes River, an undammed west slope Sierran stream as it would offer	The study was completed consistent with the Study Plan, which stated "...place LWD function in the lower Tuolumne River in context with other streams of similar stream order, recruitment potential, and sources." The Cosumnes River, being undammed, does not have similar recruitment potential as a system with dams throughout the watershed, as the Tuolumne does. Such a comparison would not inform the development of PM&E

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						a base case comparison of LWD storage in a Central Valley stream on an unregulated system.	measures. The Districts will include information relating to LWD and instream habitat in the Mokelumne River in the license application.
2-61	W&AR-15	Study Comment	Tuolumne River Trust	TRT-1	p. 1	The Tuolumne River Trust (TRT) is concerned that the Socioeconomics Study for the relicensing of Don Pedro Dam is focusing solely on the potential negative impacts of increasing instream flows and ignoring the potential economic benefits to commercial and sport fishing, recreation and tourism.	The proposed study is intended to document the baseline economic values associated with Project operations under current conditions. This information will be used to estimate changes in economic benefits and costs and related socioeconomic effects under proposed alternatives that may alter Project operations; these alternatives have not been defined at this point in time. In addition, the Districts believe that extending the analysis to commercial and sport fishing, recreation, and tourism in the lower Tuolumne River is not appropriate for several reasons: (1) measurement of the effects on recreation and fisheries downstream of Don Pedro Dam is an issue for the cumulative analysis and those effects are not appropriately attributable solely to the Project, (2) complexities associated with measuring fishery-related effects and ancillary implications for recreation, and (3) recreation conditions in the lower Tuolumne River are not expected to change significantly with changes in stream flows. The river is primarily a swift-water/flat -water resource. This will not change appreciably under future flow conditions.
2-62	W&AR-15	Study Modification	Tuolumne River Trust	TRT-2	p.1	Furthermore, we believe the Study should take into consideration ways MID and TID might adapt to improved instream flow requirements in order to reduce the potential negative economic impacts. The Socioeconomic Study should consider ways MID and TID might adjust to an improved flow regime in order to minimize negative economic impacts. Through better monitoring of the snowpack, water use efficiency, and modest crop-shifting, agriculture could remain a vibrant economic driver while reducing the negative impacts of water diversion on the Tuolumne River ecosystem.	Regarding potential adaptations to reduced water supplies, the Districts contend that analyzing changes in their customers' consumptive use or on-farm practices would not inform the development of license requirements, and therefore, are not included in the proposed study. Further, such actions do not represent mitigation measures to address potential adverse impacts of the Project in the context of NEPA, but instead represent anticipated behavior by farmers. Similar study requests were made by the RPs in their June 2011 study requests. FERC's SD2 (pages 16-17) addressed these requests when FERC indicated that "recommended alternatives, that address the consumptive use of water in the Tuolumne River through construction of new structures or methods designed to alter or reduce consumptive use of water (bullets 2 through 6), are alternative mitigation strategies that could not replace the Don Pedro hydroelectric project. As such, these recommended alternatives do not satisfy the NEPA purpose and need for the proposed project and are not reasonable alternatives for the NEPA analysis."
2-63	W&AR-15	Study Comment	Tuolumne River Trust	TRT-3	p.1	Through improved monitoring of the snowpack, more water could be released from Don Pedro Reservoir in the spring to enhance the out-migration of juvenile salmon, and then late season run-off could be captured for storage. Currently, in many years water is captured when the salmon need it most, and then released later in the season to create capacity for flood water storage. Better management would allow for	This comment pertains to Project operations, which is addressed by Operations Modeling. This request can be modeled but TRT needs to provide a more detailed specification of potential operations.

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						both beneficial releases and storage.	
2-64	W&AR-15	Study Comment	Tuolumne River Trust	TRT-4 TRT-5 TRT-6 TRT-7	p.1 p.2	MID and TID could encourage greater implementation of water efficient technologies by providing rebates for equipment to offset initial capital investments. MID and TID could further encourage efficiency by providing educational and technical assistance to their customers. Providing farmers with meteorological and hydrological information on climate, soil conditions and crop water needs would be very beneficial. MID and TID might consider water pricing, or crop shifting, or water efficient crops as a means of promoting best management practices. Through water budgets and tiered pricing, efficiency would be rewarded and encouraged.	This comment is not directly related to the Socioeconomics Study; instead, it represents recommendations to the Districts to modify their irrigation practices and alter their consumptive use of water. FERC's SD2 has addressed these types of requests (see SD2, pages 16/17 where FERC states that "recommended alternatives, that address the consumptive use of water in the Tuolumne River through construction of new structures or methods designed to alter or reduce consumptive use of water (bullets 2 through 6), are alternative mitigation strategies that could not replace the Don Pedro hydroelectric project. As such, these recommended alternatives do not satisfy the NEPA purpose and need for the proposed project and are not reasonable alternatives for the NEPA analysis."
2-65	W&AR-16	Study Comment	USFWS	36	p. 10	Districts should incorporate the EPA (2003) temperature standards for Pacific Salmonids and set spatial and temporal points in the Lower Tuolumne River to evaluate Project effects.	The Districts maintain this is best done in collaboration with RPs. The 3-D Reservoir Model and the river HEC-RAS model are well suited to evaluate such alternatives, including EPA (2003) guidance and other temperature goals. Developing alternative spatial and temporal temperature goals is envisioned within the current study plan.
2-66	W&AR-16	Study Modification	NMFS	25	p. A-16	NMFS is concerned with the HEC-RAS model's ability to be integrated with the existing CalFed San Joaquin River Basin water temperature model, which has not been adequately demonstrated….NMFS seeks information about the Project's effects on Endangered Species Act (ESA) critical habitat for anadromous fish, not only in the lower Tuolumne River, but also in freshwater rearing sites, freshwater migration corridors, and estuarine areas extending downstream into the Delta; these include potential thermal influences that could be most efficiently evaluated with a (HEC-5Q) model that integrates the Tuolumne River.	The FERC-approved study plan explicitly indicated that the geographic extent of the Districts' river temperature model was from the Don Pedro project to its confluence with the San Joaquin River, as other river models can be used for the purpose of SJR and Delta temperatures. FERC's approved study plan also required the Districts model output to be in a format appropriate for use as input to the CalFed SJR model. This is readily accomplished. If NMFS or CDFW would indicate the preferred format, the Districts will make certain the output from its HEC-RAS model can serve as input to the CalFed model. At this point, RPs have provided no specifications for this format. By this comment, the Districts are formally requesting the RPs preferred format.
2-67	W&AR-16	Study Comment	SWRCB	SWRCB-13	p.11	The final Lower Tuolumne River Temperature Model Study Report (Study Report) must include adequate discussion and analysis of temperature in the Tuolumne River and must contain information regarding: • The Tuolumne River's listing under Section 303(d) of the Clean Water Act as impaired for temperature; • How the Project is impacting temperature in the Tuolumne River; • Temperatures that would be protective of the various designated beneficial uses (USEPA 2003); and • How temperature in the Tuolumne River is	In accordance with the approved study plan W&AR-16: *Lower Tuolumne River Temperature Model*, the report is to include the model itself and a discussion of the calibration and validation work. The Districts will also include a description of the base case. The items identified by SWRCB will be thoroughly discussed in the Draft and Final License Applications.

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						influenced by different flows.	
2-68	W&AR-16	Study Comment	SWRCB	SWRCB-14	p.11	It is imperative that the model accurately represents conditions in the Tuolumne River. The SWCRB requests that the Districts hold a workshop to discuss model calibration efforts with interested RPs.	The Districts have held two Workshops related to W&AR-16. The Districts will hold an additional Workshop. The Districts have already informed the RPs that they will conduct a training session on use of the model and a session dedicated to the use of all three models together through an Integrated Model Training Session. We will work with SWRCB to set a date for the Workshop.
2-69	W&AR-16	Study Modification	CDFW	n/a	p.5	The Districts propose to modify the original study plan methodology and change the modeling platform to HEC-RAS. CDFW does not support this change and considers this to be inconsistent with study plan criterion 6, namely utilizing a method that is generally accepted practice in the scientific community. A shift in the analytical tool and outputs will unnecessarily complicate the interface between these closely related modeling efforts in neighboring watersheds. Validating results with those predicted by the existing HEC-5Q will be a time consuming exercise that further delays preparation of a comprehensive analysis. Based on the historical use of HEC-5Q within the basin and the high priority of obtaining seamless output from related modeling efforts, CDFW believes there is large benefit in continuing to utilize the HEC-5Q platform to assess the water temperature effects of different operational scenarios on the lower Tuolumne River. CDFW does not support the Districts rationale for the change in modeling platforms, and believes that even there is limited benefited in shifting from HEC-5Q. CDFW consulted the HEC-5Q developer, who stated that there is at most a 0.05C difference between the six-hour time step calculations of the HEC-5Q model and the one-hour time step of HEC-RAS.	CDFW does not agree with the Districts' use of the HEC-RAS model instead of the HEC-5Q model. CDFW indicates this in its March 7, 2013 comments, a full 4 months after the Districts explained the significant improvements that HEC-RAS model provide and why use of the HEC-5Q platform would not meet the study needs. CDFW states that the HEC-RAS model should not be considered as a generally accepted model in the scientific community because CDFW is unaware of it being used in California for water temperature modeling, The HEC-RAS software may be the most widely used hydraulic model in the country, if not the world. HEC-RAS is an acronym for the Army Corps of Engineers Hydrologic Engineering Center's River Analysis **System**. HEC-RAS is a complete **set of software**, one component of which is the one-dimensional flow hydraulic software that is used extensively around the world (and in California). Another component of this same **software system** is the water quality component, including temperature. It is completely without basis to acknowledge that the hydraulic component of the HEC-RAS package is world-class, but the water quality component of the same HEC-RAS model is not "generally accepted" in the scientific community. CDFW then goes on to state that the HEC-5Q model is the preferred model because it has been used previously by CDFW for its San Joaquin River Basin-Wide Temperature Model. CDFW points out correctly that the Districts original W&AR-16 study plan indicated that the Districts planned to use the same model. After months of working with the HEC-5Q model, the Districts had uncovered a number of concerns about the model which led the Districts to move to the HEC-RAS platform, which is the next generation software of the HEC-5Q software. The Districts shared this with RPs, including CDFW, at the October 26, 2012 Consultation Workshop, and explained the improvements that would result from moving to this most recent HEC modeling tool. On November 14, 2012, the Districts reiterated several of the reasons for migrating to the HEC-RAS package in an email to Robert Hughes of CDFW and offered to further meet with CDFW and others for further discussion if this were necessary. CDFW later indicated this would not be necessary, and no further meeting occurred (see Attachment 3 to this submittal--draft Meeting Notes dated December 14 and asking for

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							comments by January 14, 2013 in accordance with the Consultation Workshop protocols). No comments were received. Below, the Districts provide a number, but not all, of their concerns with the HEC-5Q model proposed to be used by CDFW: 1) Contrary to the designation, the Districts found that the version of the model being used by CDFW for the San Joaquin basin modeling is not a HEC model and should not be indicated to be a HEC model. The HEC designation improperly implies that this particular model would be a Corp-supported, open code model. It is not. Because of concerns encountered in trying to use the model, the Districts attempted to obtain the source code and were informed that source code would not be available. The proper designation of the model, we believe, should be SJR5Q which would eliminate the impression of HEC endorsement. On the other hand, HEC-RAS is a fully supported HEC program, including all of its components. 2) This non-transparency of the SJR5Q model, and the difficulties the Districts were experiencing with trying to get it to validate using all the available lower Tuolumne River data, is a significant concern to the Districts. The study goal of the Districts was to employ a fully transparent model. SJR5Q is not. HEC-RAS is. Without code transparency, the Districts' challenges with model use could not be resolved. In other discussions, CDFW has raised significant concerns that the Districts models be open code and transparent, and readily usable by RPs. 3) The Districts had committed to provide all RPs with a user-friendly model that they could be taught to use with little computer skill. SJR5Q does not meet that goal. It is extremely difficult to use, indeed some input files are still in binary code. 4) Contrary to CDFW's statement, the HEC-RAS output can be made compatible with the SJR5Q input, and the Districts will provide this. 5) As an example of Districts' concerns on technical matters, the Tuolumne River portion of the SJR5Q model contains a 1-D depiction of the Don Pedro Reservoir which the Districts have already moved away from with their 3-D reservoir model. Depicting a reservoir as complex as the Don Pedro Reservoir as a 1-D model cannot be justified. Further, the Districts discovered that the SJR5Q model has no reservoir inflow temperature data directly from the Tuolumne River, and it is not apparent from model inspection or

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							documentation how the reservoir inflow temperature data set is obtained. This is a concern. The Districts are surprised by CDFW's willingness to accept a 6-hour time step for temperature when the HEC-RAS provides a 1-hour time step. The Districts have shared data with all RPs showing the significant summertime variations in diurnal temperature fluctuations that occur along the lower Tuolumne River. CDFW reports on an analysis performed by Mr. Smith regarding the difference between the 1-hour and 6-hour time step. By this response, the Districts request a copy of Mr. Smith's analysis.
2-70	W&AR-18	Study Comment	USFWS	37	p. 10	Spawning of Southern DPS green sturgeon has been confirmed in the Feather River through collection of fertilized eggs on artificial substrate samplers.	The Feather River is a tributary to the Sacramento River and has been identified by NMFS as critical habitat for Southern DPS green sturgeon. The report will be revised to state that spawning occurs in the Sacramento River Basin.
2-71	W&AR-18	Study Comment	USFWS	38	p. 10	Until the USFWS initiated a sturgeon spawning survey in the San Joaquin River in 2011, white sturgeon were not known to spawn there either. The second year of the USFWS San Joaquin River Sturgeon Spawning Survey documented at least six distinct white sturgeon spawning events and three newly identified spawning locations. Perhaps most importantly, sturgeon do not only spawn in wet years, as evidenced by the multiple spawning events documented during 2012 (Below Normal Water Year) on the San Joaquin River (Jackson and Van Eenennaam 2013).	White sturgeon spawning has long been suspected to occur in the San Joaquin River based on the observation of adults in spawning condition. Recent evidence of white sturgeon spawning was acknowledged in the Districts' report, and the report also acknowledges that spawning appears to occur in other years, and during various water year types. No information was found to suggest that adult green sturgeon migrate into, spawn, or in any way occupy the Tuolumne River.
2-72	W&AR-18	Study Comment	USFWS	39, 40	p. 11	Rotary screw trap operation in the Tuolumne River has not occurred during the appropriate time period.	This is incorrect. Rotary screw traps have operated during roughly half or more of the May 16-August 29 period cited by USFWS. In addition to juveniles, spawning migrations have been documented in the Sacramento River. No information was found to suggest that adult green sturgeon migrate into, spawn, or in any way occupy the Tuolumne River so there is no reason to expect juveniles to be present. Also, USFWS cites fyke netting as an appropriate technique for sampling green sturgeon. As reflected in the report, fyke netting was conducted during eight years. Electrofishing, snorkeling, and angling conducted during spring and summer would also be expected to detect green sturgeon which would be expected to migrate and spawn during March through July.
2-73	W&AR-18	Study Comment	SWCRB	SWRCB-15	p.12	The Sturgeon Study Report found that there are "some habitat features within the river that meet requirements for various lifestages," but then states that "this does not imply that the green sturgeon could utilize this habitat, particularly since spawning adults appear to select areas containing a suite of habitat suitability components that are not readily separable."	The statement is supported. For example, suitable substrate for spawning may not be utilized if depth, velocity, and water temperature conditions are not suitable. The Districts also note SWRCB's inconsistent use of "habitat" between this comment and comment SWRCB-6 regarding W&AR-07 Predation Study. The comment regarding W&AR-07 cited to CDFW's California Salmonid Stream Habitat Restoration Manual (CDFW 1998)

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						The second part of this statement is not supported and should be removed from the Study Report. If habitat is available, it is possible that it has or could be used.	definition of habitat as "the place where a population lives and its surroundings, both living and nonliving; includes the provision of life requirements such as food and shelter." The Districts report analyzed each of the individual primary constituent elements of green sturgeon habitat identified by NMFS (2009) including food resources, substrate type and size, water quality, migratory corridor, water depth, sediment quality, and flow. Here the SWRCB is suggesting that habitat does not consist of a suite of factors.
2-74	W&AR-19	Study Comment	USFWS	42	p. 12	Final Restoration Plan (USFWS 2001) is called out in the References section (Section 8.0) of the report; however, there is no indication that this reference was actually used as part of the literature review component of this study. All the existing information on the Project effects that are associated with floodplain and riparian habitat are discussed in the Final Restoration Plan (USFWS 2001), and this reference should therefore be included in the Methodology (Section 4.0) of the study and evaluated accordingly.	The information from USFWS (2001) was used in development of the report, and will be cited in the Final Report, along with the citation of similar information from other sources.
2-75	W&AR-20	Study Comment	USFWS	43	p. 12	Service disagrees with the Applicants' assertion that a population of mature *O. mykiss* that range in size from 194 to 523 mm (fork length) could be described as in "good condition." In addition the data from this study shows that *O. mykiss* are not living more than 4 years, which is another indicator that the population is not in good condition. Service suggests that for this study to be informative, input to the *O. mykiss* population model must contain a comparison of the results to other regional and national systems and that these should be discussed in the report. Focusing on local studies should not be discussed, because it is misleading. Brouder et al. (2009) (in Enclosure 6) provides some national and regional results that would be a beneficial addition to this report	The study was completed consistent with the approved Study Plan and FERC's SPD. It must be noted that an error was detected by Stillwater Sciences in the W&AR-20 report regarding the Zimmerman et al. (2009) *O. mykiss* age classes. Zimmerman et al. (2009) grouped all age 4 and older fish into a single age 4 category. This error will be corrected in the final report by deleting all comparisons of W&AR-20 age 4 fish to the Zimmerman et al. (2009) age 4+ fish. In the event that older age-classes cannot be separated from the age 4+ category, the W&AR-20 report will still contain a comparison of the study's ages 1 to 3 fish to Zimmerman et al's (2009) ages 1 to 3 fish. Contrary to the USFWS comment, nowhere in the W&AR-20 report is the assertion that a population that ranges in size from 194 to 523 mm is described as being in "good condition." The words "good condition" or any description of the condition of *O. mykiss* (other than growth rates) in the lower Tuolumne River do not appear in the report. The data within the W&AR-20 report do not show that *O. mykiss* in the Tuolumne River are not living more than 4 years. The fact that no fish were collected from the 450-550 mm size group (potentially 5+ year old fish) does not indicate that 5+ year old fish are not present in the river. Page 4-1 in the report states the reason why the largest size group was not collected. "… continuing to try and collect fish to fill in the 50–150 and 450–

Response No.	Study No.	Type of Comment	Organization	Comment No.	Page No.	RP Comment (quote or paraphrase)	Districts' Response
							550 mm size groups would have required capturing large numbers of *O. mykiss* in the already filled 150–250 mm, 250–350 mm, 350–450 mm categories. That could have potentially resulted in injury, and possibly mortality, to a significant number of fish, so the sampling was halted." In addition, the fact that Zimmerman et al. (2009) did capture 38 age 4+ fish in the Tuolumne River shows that older age classes do exist. In regard to the USFWS comment that "Focusing on local studies should not be discussed, because it is misleading," the table below shows comparisons of fork lengths of the fish Zimmerman et al. (2009) captured in the non-local Stanislaus, Calaveras, and Yuba river, as well as the Tuolumne River. As can be seen, the Tuolumne River size ranges match closely with, and in some cases are larger than, the Stanislaus, Calaveras, and Yuba rivers. Note that the 700 mm fish in the Calaveras River column was a steelhead that had ocean residency. The next largest Calaveras fish was 535 mm and also a steelhead.

Age	Size range (mm)			
	Stanislaus	Calaveras	Yuba	Tuolumne
0	nd	76-158	33-157	nd
1	142-195	170-203	225-229	145-192
2	200-295	204-296	230-296	205-310
3	300-398	298-382	301-389	325-398
4+	412-535	405-700	390-510	400-523
n=	155	180	141	151

As stated in the W&AR-20 report, the reason for the relatively smaller size fish captured for this study compared to Zimmerman et al. (2009) was due to differences in the time of sample collection; the fish in this study were collected during the winter and early spring when annuli would be forming and only early season growth occurred, while Zimmerman et al. (2009) samples were collected between October and May when substantial growth would have followed annulus formation.

Table 3. Comments on Cultural Resource Studies.

Response No.	Study No.	Type of Request	Organization	Comment No.	Page No.	Comment (Quote or Paraphrase)	District's Draft Response
3-1	CR-01	Study	BLM	BLM-1-CR-	p. 2	The BLM requests that the schedule in Results 5.0 of the	The Districts will modify the schedule in Results 5.0 to reflect

Response No.	Study No.	Type of Request	Organization	Comment No.	Page No.	Comment (Quote or Paraphrase)	District's Draft Response
		Modification		01		ISR for the Historic Properties Study plan be updated to give the BLM, the Tribes, and other appropriate parties the opportunity to review the draft reports from May 2013 to the end of October 2013.	a new review period from May 2013 to the end of October 2013 for the BLM, the Tribes, and other appropriate parties to review the study report.
3-2	CR-01	Study Modification	BLM	BLM-2-CR-01	p. 2	The BLM requests that the SHPO review of the study report not occur until agency and tribal review is complete.	The Districts, on behalf of FERC, will not request SHPO's review and concurrence on the study report until agencies and tribes have been provided the opportunity to review the report.
3-3	CR-01	Study Modification	BLM	BLM-3-CR-01	p. 2	The BLM requests that the schedule in Results 5.0 of the ISR for the Historic Properties Study plan be updated to give the BLM, the Tribes, and other appropriate parties an opportunity to review the draft HPMP and that the review period be in January and February 2014.	The Districts will modify the schedule in Results 5.0 to reflect a review period from January to February 2014 for the BLM, the Tribes, and other appropriate parties to review the HPMP.
3-4	CR-01	Study Modification	BLM	BLM-4-CR-01	p. 2	The BLM requests that the HPMP not be submitted to SHPO for review and concurrence until agency and tribal review is complete.	The Districts, on behalf of FERC, will not request SHPO's review and concurrence of the HPMP until agencies and Tribes have been provided the opportunity to review the HPMP as specified in response to Comment BLM-3-CR-01.
3-5	CR-01	Study Modification	BLM	BLM-5-CR-01	p. 2-3	The BLM disagrees with the following footnote found in the ISR section titled Results 5.0: "The Tuolumne River arm of the Don Pedro Reservoir could not be safely accessed during the field season; however, the Districts will attempt to access this area when it is safe to do so. It appears that the area can be safely accessed when the reservoir is near full (at least 815 feet above mean sea level) and motorized water craft can safely travel close to the end of the Project boundary in this area." The BLM requests that this statement be modified to consider other alternatives such as hiking overland on the Mohican Trail (accessed on Ferretti Road out of Groveland) to this trail's terminus on the Tuolumne River. From here, a professional rafting company can pick up the consultants and safely boat them down the river, providing opportunities to inventory within the Project area of potential effects.	The Districts and the Districts' consultants do not agree that white water rafting is a reasonable mode of transportation to access a site, especially as a safer alternative will be available (i.e. motorized boating during high water levels). Districts' subconsultant, Far Western, which has performed numerous cultural resource studies for the BLM, indicated that they were not willing to ask their employees to undertake the inherent risk in a rafting trip with Class 4 rapids to document resources along the way. It would be inappropriate of the Districts to ask another subconsultant to undertake this risk if a recognized professional in this field thought it unwise.

Table 4. Comments on Recreation Resource Studies.

Response No.	Study No.	Type of Request	Organization	Comment No.	Page No.	Comment (Quote or Paraphrase)	District's Draft Response
4-1	RR-02	Study Modification	BLM, NPS, USFS Stanislaus, and Private Citizens and organizations	BLM-19 NPS-1 NPS-2 NPS-4 USFS-12 BLM-13 BLM-18 BLM-21 BLM-22	p.12 p.4 p.4 p.5 p.4 p.11 p.12 p.13 p.13	Multiple RPs requested that the study report include a more detailed description of what considerations were taken into account in the study, and made a number of requests for study of additional interests. The comments included requests for additional analysis regarding expansion and enhancement of the Ward's Ferry take-out, including multiple lanes, parking options, staging areas and restrooms, as well as the environmental impacts associated with the various alternatives.	The report includes engineering drawings and materials and cost estimating sheets at an appropriate level of detail for a feasibility study. The alternatives presented for improvements on either river right or river left at the Ward's Ferry Bridge demonstrate that at least one functional option exists to make improvements for whitewater boating take-out at the conclusion of Upper Tuolumne River trips. The engineering feasibility study starts with the stated purpose to investigate improvements to the existing take-out at Wards Ferry. The purpose of the

				BLM-23 NPS-1 NPS-3 NPS-4 USFS-2 USFS-5 Hackamack-1 SierraMac-2 Hackamack-6 Hackamack-7 Hackamack-8	p.13 p.4 p.4 p.5 p.3 p.4 p.2 p.2 p.6 p.6 p.6		take-out facility is to consider alternatives to address specific problems being experienced with the existing take-out, these being getting boats and boaters off the river safely and efficiently and minimizing traffic problems and hazardous conditions at the bridge and public roadway. The study was not ever intended to be the development of a new recreation facility at Wards Ferry. The feasibility study examined alternatives, focusing first, as would be expected, on whether this could be accomplished at the Wards Ferry site. The study determined it could. It was evident by inspection that the Deer Creek area would be considerably more expensive and result in significant new environmental impact. It would only be considered if egress at Wards Ferry was not feasible. Goals in engineering studies are always to identify the least cost alternative that meets the purpose. There is no need to have ramps on both sides of the river. The final report will be expanded to provide more details on the Ward's Ferry alternatives such as parking, bathroom location, and road width.
4-2	RR-02	Study Modification	BLM, NPS, USFS Stanislaus, CG, and Private Citizens and organizations	CG-5 BLM-12 NPS-2 BLM-15 BLM-17 BLM-20 BLM-24 NPS-2 USFS-3 USFS-4 Hackamack-2 Hackamack-4 Hackamack-5 AO-1 SierraMac-1 SierraMac-3 SierraMac-4 OARS-1	p.14-15 p.11 p.4 p.12 p.12 p.13 p.14 p.4 p.3 p.4 p.3 p.5 p.6 p.1 p.2 p.2 p.3 p.1	Several RPs requested additional study or made comments regarding the alternative locations for whitewater boating take-out locations. The requests for study modification include additional analysis of the Deer Creek location, as well as river left at Ward's Ferry Bridge, and that more input from take-out users be incorporated.	The final report will be expanded to provide more details on the apparent constraints associated with development of the Deer Creek and Deer Flats locations, and other locations included in the analysis. The request that security matters be included in the study is a new request presented without any explanation of why the request was not made earlier. Also, law enforcement is not the responsibility of FERC licensees.
4-3	RR-02	Study Comment	BLM	BLM-7	p.6	The whitewater boating take-out at Ward's Ferry Bridge should be treated the same in the license as any other developed project related recreation facility managed by the Don Pedro Recreation Agency (DPRA). This needs to be clarified […].	The whitewater boating take-out does not provide access to the Don Pedro Reservoir in the same manner as facilities at Blue Oak, Fleming Meadows, and Moccasin Point. These DPRA-managed recreation areas are highly developed sites on the modern end of the recreation opportunity spectrum where encounters with others are expected, management is highly visible, and amenities are of an improved nature (e.g., plumbing, pavement, buildings). The take-out for non-motorized whitewater boating at the terminus of a Class IV and V wilderness experience, on the other hand, is appropriately maintained and managed as primitive facility, providing for

							challenging, unimproved conditions balanced with development only to the extent necessary for sanitation and long-term maintenance. Intensively developed improvements at Ward's Ferry Bridge would lead to user conflicts and diminished functionality as a whitewater boating take-out as motorboaters, anglers, and general recreationists would be drawn any amenities made available at the site.
4-4	RR-02	Study Comment	BLM	BLM-9	p.10	In the study report, and elsewhere, it is inferred that Ward's Ferry is "above the project" which is incorrect.	The Project Boundary extends upstream on the Tuolumne Arm above the Ward's Ferry Bridge. This will be clarified in the final report.
4-5	RR-02	Study Comment	BLM and USFS	BLM-11 USFS-4	p.11 p.2	The BLM and Forest Service do not consider Moccasin Point to be a viable option for whitewater rafting take-out.	The Moccasin Point Recreation Area is a physically viable take-out alternative, as evidenced by statements made at the focus group meeting and the fact that it is used by some whitewater boaters at times. The Districts understand that the opinion of most boaters who have participated in the relicensing process is that the Moccasin Point alternative for whitewater boating take-out is not preferred when compared to a take-out closer to the terminus of the whitewater run.
4-6	RR-02	Study Modification	BLM	BLM-14 BLM-16	p.12	A summary of the conclusions from the focus group and ranking of the various alternatives should be included in the body of the main report.	The Districts maintain that the summary is adequate in its content and comprehensiveness. Participants in the focus group meeting may submit their own meeting summaries to the record.
4-7	RR-02	Study Modification	NPS	NPS-5	p.5	Request for engineering feasibility assessment including drawings, costs, and environmental constraints, geotechnical surveys and topography surveys for river right at Deer Flat and the Deer Creek side of the river.	The request for geotechnical surveys and topography surveys is a new request presented without any explanation of why the request was not made earlier. The approved study did not include performing such work. This level of investigation is appropriate as part of a final design effort, and was not needed for this feasibility study.
4-8	RR-02	Study Modification	USFS Stanislaus	USFS-1	p.1	Site visits and take-out studies should be conducted with RPs.	The communication and meeting requirements of the approved study plan were adhered to. Nonetheless, further communication, including site visits can be conducted without a study modification during the upcoming stages of the ILP.
4-9	RR-02	Study Comment	USFS Stanislaus	USFS-03	p. 2	The ISR did not take into consideration mitigating the loss of a major recreation use, whitewater boating, which was a direct result of the construction of the project and how it is operated.	This request was made earlier in the ILP process and was not adopted because the appropriate baseline for relicensing studies is the Project as currently licensed.
4-10	RR-02	Study Comment	USFS Stanislaus	USFS-07 And -15	p. 3	The Forest Service is concerned about what is being characterized as "reasonable" fee recovery for capital improvements of Ward's Ferry. There is no precedent for the entire cost of capital improvements being amortized and shifted on to users as has been suggested by HDR. The Forest Service would also like to elevate the importance of the economic impact that commercial rafting has on the economy of Groveland, California.	This is not a study modification or a new study request, but a consideration to be taken into account during development and analysis of PM&Es.
4-11	RR-02	Study Comment	USFS Stanislaus	USFS-08	p. 3	Currently, there are no fees associated with parking, permits, or access required to boat the Tuolumne WSR. As DPRA and the BLM are the principle land owners at the Ward's Ferry Bridge site, and the Forest Service is the lead agency in managing the Tuolumne WSR, the Forest Service is available to meet with DPRA and the	This is not a study modification or a new study request, but an offer to collaborate on recreation improvements and site management.

						BLM to discuss operations and maintenance strategies and user fees for any improvements built at Ward's Ferry Bridge or any other location that may be selected.	
4-12	RR-02	Study Modification	All-Outdoor and ARTA	AO-1 ARTA-1	p.1 p.1	Additional information should be included in the study, such as draft proposals, boater surveys, additional focus group meetings, analysis from outside engineering firms, and collaboration with users.	This is a new request for a revised methodology presented without any explanation of why the request was not made earlier. Study goals were achieved: 1) assessing the feasibility of improving the existing take-out location for continued use by whitewater boaters on the upstream end of the Don Pedro Project, and 2) evaluating the feasibility of physical improvements to the Ward's Ferry Bridge location and also assess the feasibility of alternative take out locations.
4-13	RR-02	Study Comment	Hackamack USFS Stanislaus	Hackamack-3 USFS-9	p.4 P.4	The study should consider the projected future growth of whitewater rafting, including commercial and non-commercial interests.	The final report will be expanded to discuss the capacity of proposed facilities compared to current facilities and projected future use.
4-14	RR-03	Study Comment	BLM	BLM-29	p.15	The study plan, in the methodology section step 5, calls for "the lowest boatable flow reported by study participants for each type of non-motorized boating opportunity." This information cannot be provided by the existing study's results.	This variance from the study plan was acknowledged in the ISR. The study report details that in spite of this variance, the study goals and objectives were achieved. While study methods described the number of volunteers and watercraft type sought, it was not a goal of the study to have any specific level of volunteer participation.
4-15	RR-03	Study Modification	BLM	BLM-38	p.17	The BLM would also like to see more qualitative information (i.e. preferences, crowding and user conflict issues) in the new study.	This request is a new request presented without any explanation of why the request was not made earlier. There is no information available that indicates crowding or conflicts are issues on the lower Tuolumne; and anecdotal observations during the 2012 study identified no potential for conflict or crowding issues under current conditions. This request should be rejected.
4-16	RR-03	Study Comment	BLM	BLM-26	p.14	Standard practices and due diligence for recruiting boating flow study volunteers did not occur. For example, the flow studies were simply announced once in a brief email and in the case of the first 2-day flow study less than 7 days advance notice was given. But regardless of the instance of the short notice, one email with minimal follow-up is not an adequate outreach plan.	The record reflects that the Districts' contractor solicited participation via several emails. Also, RPs assisted in the development of the study plan and therefore were aware of the plan to engage volunteer boaters.
4-17	RR-03	Study Modification	BLM, CG, Hackamack	BLM-25 BLM-27 BLM-28 Hackamack-2 CG-10		The number of volunteers and types of watercrafts used in the volunteer lowest boatable flow study were inadequate to make a determination. The study should include an additional survey to include more boaters and types of boats.	This variance from the study plan was acknowledged in the ISR. The study report details that in spite of this variance, the study goals and objectives were achieved. While study methods did describe the number of volunteers and watercraft type sought, it was not a goal of the study to have any specific level of volunteer participation.
4-18	RR-03	Study Comment	BLM	BLM-30	p.15	Due to the flow gage calibration problem last summer flow estimates were off by about 50-60 cfs. That's an error of about 25% which is significant. Given this problem we never did even get down to the minimal flow, which was the objective.	This variance from the study plan was acknowledged in the ISR. As explained in the study report, in spite of early season recalibration of the USGS gage which revised the flow estimates for May and June study events, the flows prescribed in the study plan were provided September 29-October 1 for a volunteer boater study event. The study report details that in spite of this variance, the study goals and objectives were achieved.
4-19	RR-03	Study Comment	BLM	BLM-31	p.15	While this is a minimum boatable flow study, boatable implies a safe boating experience and given the amount	The lower Tuolumne River at flows in the 100 cfs range as measured at the La Grange gage provides a boating

						of times most boaters had to exit their watercraft the flows recorded in the ISR do not represent a safe minimum boating experience. Minimum flows should be evaluated using the craft that draws the most water to assist us in determining the minimum.	experience suitable for beginners to learn boating skills in a relatively safe environment. An experienced boater can navigate the lower Tuolumne at flows in the 100 cfs range without the need of exiting the boat.
4-20	RR-03	Study Comment	BLM	BLM-33	p.16	The ISR states that, "Flows as low as 100 cfs as recorded at the USGS La Grange gage were determined to be boatable in the reach between Old La Grange Bridge and Turlock Lake State Recreation Area (Turlock SRA)." This conclusion was based on the opinion of one boater in an inflatable kayak which has the lowest draw of any of the watercraft intended to be included in the study and by no means should be considered a conclusion of the study.	Clearly watercraft with greater draw will require a higher flow. A conclusion of the study is that the lower Tuolumne is boatable in some recreational watercraft in the 100 cfs range as measured at the La Grange gage.
4-21	RR-03	Study Modification	BLM, Hackamack, NPS	BLM-34 Hackamack-4 NPS-4	p.16 p.8 p.8	The boatable flow survey was not sufficient and needs to be performed again with better defined goals (i.e., preferences, crowding, and user conflict issues).	The survey instrument for the *Lower Tuolumne River Lowest Boatable Flow Study* was developed in consultation with RPs and included as Attachment A in the RSP that was submitted to FERC and approved in the SPD.
4-22	RR-03	Study Modification	BLM, Hackamack	BLM-35	p.16	As we have requested in the past, the Shiloh Bridge access site to be included in the study.	The final report will be expanded to provide information about the Shiloh Bridge access site.
4-23	RR-03	Study Modification	BLM	BLM-37	p.17	The study should be revised to include a better definition of a minimum boatable flow. Additional study should also explicitly name the take-out sites where data will be collected, outline specific protocols for ensuring participation, and state an adequate lead-time for announcing study days.	This is a new request presented without any explanation of why the request was not made earlier.
4-24	RR-03	Study Modification	NPS	NPS-1, Hackamack-1	p.6	Modified study should include a second season of flow study between June 1 and November 30, 2013.	A second season of flow study is not warranted. The flows prescribed in the study plan were provided September 29-October 1 for a volunteer boater study event. The ISR reports on the variances from the approved study plan and describes how the study goals were achieved in spite of variances from specific steps of the approved study method. The final report will be expanded to include additional information as requested by RPs in comments on the ISR. Regarding boatable flows, RPs who have boated the lower Tuolumne River may provide information on their opinions of boatability to the record.
4-25	RR-03	Study Modification	Hackamack	Hackamack-3	p.8	Include November in the revised study because this is prime time for viewing salmon and boats may be heavier due to cold weather gear.	This request is a new request presented without any explanation of why the request was not made earlier.
4-26	RR-03	Study Modification	Hackamack	Hackamack-6	p.8	A new study should clearly classify data by segment where data is collected. Outline specific protocols for ensuring participation, and provide adequate lead-time for announcing study days.	It is not clear what is meant by "classify data by segment where data is collected." The report clearly describes segment of the lower Tuolumne and clearly reports results of volunteer and contractor runs at various flows by river segment. The request for participation protocols is a new request presented without any explanation of why the request was not made earlier. The lead time for announcing the September 29-October 1 study days was six weeks, an adequate time.
4-27	RR-03	Study Modification	Hackamack	Hackamack-7	p.9	Provide more days of steady flow to accommodate repeat runs at different flows.	It is not clear why more days would be needed at any one flow to achieve the goals and objectives of the study. Nonetheless,

							this request is a new request presented without any explanation of why the request was not made earlier.

Table 5. Comments on Terrestrial Resource Studies.

Response No.	Study No.	Type of Request	Organization	Comment No.	Page No.	Comment (Quote or Paraphrase)	District's Draft Response
5-1	TR-01	Study Comment	BLM	BLM-39	p.17	The BLM requests that all of the raw data on special status plants collected by the licensee be sent to BLM Mother Lode Field Office Botanist Beth Brenneman electronically.	These data will be provided to the BLM as requested.
5-2	TR-02	Study Comment	BLM	BLM-40	p.17	The BLM requests that all of the raw data on ESA-CESA listed plants collected by the licensee be sent to BLM Mother Lode Field Office Botanist Beth Brenneman electronically.	These data will be provided to the BLM as requested.
5-3	TR-07	Study Comment	BLM	BLM-41	p.18	The study is not complete. Step 5 of the Study Plan (Consult with USFWS) has not been completed. Step 5 is intended to identify additional data that is needed and to discuss the potential for Project activities to affect California red-legged frogs.	The Districts have completed the CRLF study consistent with the FERC-approved study plan, including step 5, which requires that the Districts engage in informal consultation with the USFWS. The Districts have been designated FERC's non-federal representative for the purposes of informal consultation under the Endangered Species Act (ESA). The Districts' PAD and study plan development process as well as the provision of study reporting and data in the ISR and during the ISR meeting fulfills this study plan requirement, and provides FERC with the information needed for FERC to engage in ESA consultation with USFWS. The Districts look forward to continuing discussions with the USFWS in developing a Draft Biological Assessment that analyzes Project effects on ESA-listed species such as CRLF.
5-4	TR-07	Study Comment	BLM	BLM-42	p.18-19	The BLM disagrees with the statement, "None of these sites will be potentially affected by Project O&M due to proximity to project facilities or Don Pedro Reservoir" (Section 5.3, page 5-3, paragraph 2).	The Districts recognize that CRLF, although not likely to be present in the Tuolumne basin or Project vicinity, could potentially use sites within the Project Boundary and surrounding one-mile area, because the sites meet basic CRLF habitat criteria. (No CRLF are reported to occur within five miles of the Project, and the study results indicated generally poor habitat conditions for CRLF within the study area.) Regardless, the majority of potential sites (320 of 337) that met basic CRLF habitat criteria (20 weeks of water present during the CRLF breeding season) are geographically removed from any Project-related O&M activity and are not properly considered Project-affected sites. The hypothetical potential that reservoir fluctuations could trigger bullfrog dispersal to these areas is not relevant, as bullfrogs are already ubiquitous in the study area and much of California as a whole.
5-5	TR-07	Study Comment	BLM	BLM-43	p.20	The BLM disagrees with the conclusion that "the presence of bullfrogs diminishes the potential suitability of most of the sites." Bullfrogs were detected in a sufficient number of locations to indicate both the presence of potential California red-legged habitat and the potential that those	While bullfrog presence can be suggestive of suitable hydrologic conditions for CRLF, the literature clearly shows that CRLF are detrimentally affected by bullfrogs. Research in California has shown that CRLF populations decline and eventually disappear after bullfrogs become established

Response No.	Study No.	Type of Request	Organization	Comment No.	Page No.	Comment (Quote or Paraphrase)	District's Draft Response
						bullfrogs are a significant stressor on the local California red-legged frog population(s). Because bullfrogs optimize the best California red-legged frog habitat, they are an excellent indicator of the potential suitability of the site (Section 5.3.1, page 5-3). The BLM also disagrees that ponds and streams within the one-mile action area boundary are not affected by Project operations and maintenance (Section 5.3.2, page 5-5).	(Fisher and Shaffer 1996). The presence of predatory fish, particularly bass and sunfish, is also a good indicator of bullfrog habitat suitability, but diminishes CRLF habitat suitability because bullfrogs enjoy an advantage from the presence of fish which are deleterious to CRLF (Kruse and Francis 1977, Werner and McPeek 1994, Adams et al. 2003, Gilliland 2010). As noted in the BLM's comments (p. 20, "as a non-native predator, bullfrogs have the ability to adversely affect the aquatic ecosystem where they become established."
5-6	TR-07	Study Comment	USFWS	USFWS TR-1	p.12	Step 5 of the Study Plan (Consult with USFWS) has not been completed. Step 5 is intended to identify additional data gathering that is needed and to discuss the potential for Project activities to affect California red-legged frogs.	See response to BLM Comments 41-43.
5-7	TR-07	Study Comment	USFWS	USFWS TR-2	p.13	The USFWS disagrees with the statement "None of these sites will be potentially affected by Project operations and maintenance (O&M) due to proximity to project facilities or Don Pedro Reservoir" (Section 5.3, page 5-3, paragraph 2).	See response to BLM Comments 41-43.
5-8	TR-07	Study Comment	USFWS	USFWS TR-3	p.14	The USFWS disagrees with the conclusion that "the presence of bullfrogs diminishes the potential suitability of most of the sites" (Section 5.3.1, page 5-3).	See response to BLM Comments 41-43.
5-9	TR-07	Study Comment	USFWS	USFWS TR-4	p.14	The USFWS disagrees that ponds and streams within the one-mile action area boundary are not affected by Project operations and maintenance (Section 5.3.2, page 5-5).	See response to BLM Comments 41-43.
5-10	TR-10	Study Modification	USFWS	USFWS TR-5	p.15	The USFWS is concerned that this study was not implemented in a manner that could be used to determine Project effects and determine the level of take of bald eagles that could occur from disturbance (agitation or bothering) of nesting eagles as a result of recreational activities. The USFWS recommends that a second year of study is needed to better understand the Project effects to bald eagles associated with O&M and recreational activities occurring in the FERC Project Boundary.	The Bald Eagle study was completed consistent with the FERC-approved study plan and as specified in agency comments requesting the study. The Districts contend the study results document that Project operations are fully compatible with successful bald eagle nesting and breeding at Don Pedro Reservoir. No evidence of detrimental Project effects on bald eagles has been presented. Nevertheless, the Districts will conduct a second year of bald eagle nest observations as requested, consisting of one survey visit in April (to confirm nest occupancy) and one in June-July (to confirm nest success).
5-11	TR-10	PM&E	USFWS	USFWS TR-6	p.15	The Applicant should assess and report measures to reduce collision mortality to bald eagles from the distribution circuit power lines associated with the Project. Transmission and distribution power lines should be designed according to guidelines provided in the "Avian Protection Plan" [Avian Power Line Interaction Committee (APLIC) and USFWS 2005].	Compliance with APLIC guidelines will be described in the Draft and Final License Applications for the Project.
5-12	TR-10	PM&E	USFWS	USFW STR-7	p.15	The Applicants should assess and report all rodenticide use within the Project footprint.	The Districts will make this information available to the USFWS.
5-13	TR-10	PM&E	USFWS	USFW STR-9	p.16	The USFWS recommends that the Applicants coordinate with the USFWS regarding their responsibilities under the BGEPA and MBTA for the bald eagle to address potential	The Districts agree, and assert the Bald Eagle study results provide information sufficient to inform this discussion.

Response No.	Study No.	Type of Request	Organization	Comment No.	Page No.	Comment (Quote or Paraphrase)	District's Draft Response
						Project effects.	
5-14	TR-10	PM&E	USFWS	USFWS TR-10	p.16	The USFWS recommends that, in addition to conducting a second year of studies for the Bald Eagle Study Report, that the Applicant develops a Bald Eagle Management Plan and apply for a programmatic eagle take permit under BGEPA to determine if a permit is necessary and avoid unpermitted take of eagles.	The Districts will develop a Bald Eagle Management Plan and engage in BGEPA-related coordination with the USFWS. The information provided by the Districts' Bald Eagle Study is sufficient to support these discussions and ensure the protection of bald eagles within the Project Boundary.

REFERENCES

CDFW (California Department of Fish and Wildlife; formerly known as California Department of Fish and Game). 1998. California Salmonid Stream Habitat Restoration Manual, Third Edition, January 1998.

Mesa. M.G., and C.B. Schreck. 1989. Electrofishing mark-recapture and depletion methodologies evoke behavioral and physiological changes in cutthroat trout. Transactions of the American Fisheries Society 118:644-658.

Nichols, K., and J.S. Foott. 2002. Health monitoring of hatchery and natural fall-run Chinook salmon juveniles in the San Joaquin River and tributaries, April - June 2001. FY 2001 Investigation Report by the U.S. Fish and Wildlife Service, California-Nevada Fish Health Center, Anderson, CA.

Stillwater Sciences. 2001. Results of summer 2001 snorkel surveys of fine sediment deposits in the Lower Tuolumne River – Technical Memorandum. Berkeley, California. Appendix F in Coarse sediment management plan for the lower Tuolumne River. Revised Final Report. Prepared by McBain and Trush, Arcata, California for Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation Districts, USFWS Anadromous Fish Restoration Program, and California Bay-Delta Authority, July 2004.

Stillwater Sciences. 2013. Lower Tuolumne River Instream Flow Study. Draft Report. Prepared by Stillwater Sciences, Davis, California for Turlock and Irrigation District and Modesto Irrigation District, California. February.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 1992. Report of Turlock Irrigation District and Modesto Irrigation District pursuant to Article 39 of the license for the Don Pedro Project. Turlock, California. 8 Volumes. April.

_____. 1997. 1996 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. 6 Volumes. March.

McBain and Trush. 2004. Coarse sediment management plan for the lower Tuolumne River. Revised Final Report. Prepared by McBain and Trush, Arcata, California for Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation Districts, USFWS Anadromous Fish Restoration Program, and California Bay-Delta Authority.

NMFS 2009. Endangered and threatened wildlife and plants: threatened status for Southern Distinct Population Segment of North American green sturgeon – final rule. Federal Register 71:17757-17766.

Riley, S.C. and K.D. Fausch. 1992.Underestimation of trout population size by maximum=likelihood removal estimates in small streams. North American Journal of Fisheries Management 12:768-776.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 1992. Lower Tuolumne River Predation Study Report. Appendix 22 to Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 39 of the License for the Don Pedro Project. No.2299 Vol. III. Prepared by T. Ford, Turlock and Modesto Irrigation Districts and EA Engineering, Science, and Technology, Lafayette, California.

U.S. Fish and Wildlife Service and Anadromous Fish Restoration Program Core Group. 2001. Final Restoration Plan for the Anadromous Fish Restoration Program: a plan to increase natural production of anadromous fish in the Central Valley of California. January 9, 2011

Zippin, C. 1958. The removal method of population estimation. Journal of Wildlife Management 22:82-90.

ATTACHMENT 2

Draft Notes for March 27, 2013 Hydrology Workshop #4

ATTACHMENT 2

DON PEDRO RELICENSING

HYDROLOGY WORKSHOP No. 4
March 27, 2013 – 1:00 P. M.
HDR OFFICE – SACRAMENTO, CA

DRAFT NOTES

Participants (All in person; no phone participants):

CCSF:	Ellen Levin
CDFW:	Robert Hughes, Annie Manji
CSPA:	Chris Shutes
HDR:	John Devine, Rick Jones, Rob Sherrick, and Dan Steiner
MID:	Bill Johnston
TID:	Steve Boyd
SWRCB:	Peter Barnes
For TRT:	Bob Hackamack
USFWS:	Alison Willy

The participants began the meeting by reviewing the unimpaired hydrology "strawman" provided by HDR on March 25, 2013. Rob Sherrick described his process for "refining" the unimpaired hydrology for the Tuolumne River. The "strawman" Mr. Sherrick described provides unimpaired hydrology for four locations of the Tuolumne River watershed – La Grange, Hetch Hetchy, Cherry/Eleanor, and the remaining unregulated watershed above La Grange. The daily hydrologic record Mr. Sherrick described eliminates the negative and somewhat erratic flows that show up in the unimpaired hydrology previously developed for the Operations Model.

The "Gage Proration" method has been developed by using unimpaired stream gage flows from gages within and nearby the Tuolumne River watershed where the gage data provide a more complete record for various elevations represented within the Tuolumne River watershed.

This "Gage Proration" method is basically another estimate of the unimpaired flow of the Tuolumne River. The monthly volumes of water are not changed from the total used by the Districts and CCSF in developing historical water records. However, there are adjustments made to the daily shaping of flows within the monthly periods.

Mr. Sherrick showed a series of smoothing hydrographs to illustrate how the smoothing process depicted in the "strawman" added and subtracted volumes of water to eliminate the negative flows, but maintained the same monthly volume of runoff. Storm differences between watersheds are obvious in the hydrographs for storms that produce unequal precipitation over small areas. The methods illustrated by Mr. Sherrick were the same ones provided in the HDR memo that was issued to relicensing participants on March 25, 2013. Mr. Sherrick walked

through each step of the daily hydrology contained in the "strawman." He noted that October 2002 was the only month where "new water" (2,000 acre-feet) had to be added to account for an overall negative total watershed volume at La Grange and to make the proration come into line with the two adjacent months.

All the parties agreed that the resulting unimpaired flow estimates provided in the "strawman" were reasonable and acceptable. These flows will be used as appropriate for the Operations Model. Dan Steiner did note that use of these flows will affect the shares of water supply between the Districts and CCSF in the base case. However, since the Operations Model is used to make comparisons between a base case and potential future scenarios, it will not affect comparisons between alternatives. The unimpaired flows resulting from the smoothing contained in the "strawman" will look more like an expected hydrograph, but it will not change the overall results on comparing one scenario against another.

It was clearly stated that the Districts and CCSF will not change the way they calculate the water in the water bank or the division of water between the agencies. This "Gage Proration" method will only be used to estimate unimpaired flow for the base case and other models used for the FERC relicensing, and will not be used to redefine the computation of historical operations.

John Devine mentioned that Tuesday, April 16, 2013, is now the tentative date for the roll-out of the Operations Model Base Case, and that the Districts will confirm this next week. All the parties also agreed that the meeting notes should reflect the agreement reached and these notes should then be added to the Districts' upcoming April 9, 2013 filing with FERC that deals with responses to relicensing participant comments on the Initial Study Report.

Districts "Strawman" for Considering Further Development of Unimpaired Hydrology for the Tuolumne River in Advance of Workshop On March 27, 2013

1.0 Objective

Relicensing participants and the Districts are continuing to consider and discuss Tuolumne River hydrology for use in the Tuolumne River Operations Model (W&AR-02). This draft report is intended to be an initial "strawman" describing one possible approach to discuss further on March 27, 2013. The objective of this particular "strawman" is to develop a daily flow dataset that contains no negative values, results in more gradual changes in day-to-day flows, and conforms to the historical monthly volumes previously recorded by the Districts and CCSF. The period of record under consideration is Water Year 1971 – 2009. It is noted that the period of record may be extended to 2012 for use in the development of the river and reservoir temperature models.

2.0 Background

On September 10, 2012, the California Department of Fish & Wildlife (CDFW), provided comments to the State Water Resources Control Board (SWRCB) related to the unimpaired hydrology for the operations/water balance model being developed for the Don Pedro Project relicensing. In summary, CDFW is concerned "that the Districts' proposed method of estimating unimpaired hydrology is not appropriate for the purpose of the state of California's environmental review process required for a new license."

The Districts subsequently undertook an investigation of CDFW's suggested approach and submitted its report to SWRCB, CDFW and FERC on December 21, 2012. This report was also provided as Attachment A, Appendix A, of the W&AR-2 initial study report issued January 17, 2013. On February 14, 2013, representatives from CDFW, SWRCB, and CCSF met with the Districts to discuss the Districts' report and the comparison of the two approaches. The Districts maintained that there was insufficient Tuolumne River gauge data to support the gauge proration approach for the period of record of the Operations Model. CDFW and SWRCB expressed interest in using all available gauge proration hydrology even if the period of record was not as complete as might be desired. CDFW and SWRCB suggested that alternatives be developed collaboratively in a workshop environment. CDFW and SWRCB agreed that the monthly mass balance from the existing gauge summation hydrology was sound and need not be adjusted. The Districts agreed to continue to discuss and consider alternative approaches, and agreed to provide a "strawman" for to advance and promote dialogue at a meeting to be held on March 27.

3.0 Methods

Hydrologic input to the Operations Model currently includes daily unimpaired hydrology estimates for three locations in the watershed: "La Grange" (at the USGS gage), "Hetch Hetchy Reservoir", and Lake Lloyd Reservoir/Lake Eleanor combined "Cherry/Eleanor". The Operations Model uses these inputs to calculate a fourth dataset of operational significance: the unimpaired flow from the unregulated portion

of the watershed above Don Pedro Reservoir ("Unregulated"). Details of these calculations are described in the ISR of W&AR-2, Attachment A.

3.1 Gauge Proration "Strawman"

To promote and advance discussions for the March 27 Workshop, the Districts, as agreed with SWRCB, CCSF and CDFW, have evaluated approaches to developing a hybrid flow record for the Tuolumne River using a combination of gauge proration conforming to the existing monthly mass balances underlying the Operations Model. This "strawman" is described below.

In order to prorate the gauged data to a larger ungauged area (application basin), three physical variables were considered – elevation, drainage area, and average annual precipitation (precipitation). Each gauged basin, along with each application basin (Hetch Hetchy, Cherry/Eleanor, and Unregulated), was divided into 100-foot "elevation bands" for its entire drainage area. This was done using USGS National Elevation Dataset, 1/3 arc-second (USGS, 2009), which equates to about a 30 foot pixel size. Each elevation band for each gauge had attributes added for the drainage area within this band (e.g., the number of square miles of the Tuolumne River drainage that exists between elevation 500 and 600 feet) and precipitation (e.g. the average annual precipitation for the drainage area between elevation 500 and 600 feet).

The Oregon Climate Service's PRISM model results were used to estimate average annual precipitation from 1971 – 2000 (PRISM, 2006) for each of the elevation bands represented by the basins being evaluated (elevation beginning 100 to 13,000 feet). PRISM uses the observed precipitation gauge and radar data network, in conjunction with an orographic precipitation and atmospheric model, to develop an estimate of average annual precipitation for the contiguous United States at a pixel size resolution of 2,500 feet. Bi-linear interpolation was used to resample the PRISM values to the same pixel size as the elevation model.

Areas at low elevations and high elevations in each of the application basins that are poorly represented or not represented at all by the reference gauges were "artificially added" into the elevation distributions of the most representative gauges in order to provide some amount of coverage for those elevation ranges. When artificial areas were added to the gauges, the amount of area added for each gauge was nominally established as one percent of the total application basin area for that elevation bin. For precipitation in artificially augmented elevation bands, a multiplier was applied to the application basin precipitation values equal to the multiplier for the nearest observed elevation band for that gauge.

The proration calculation includes two main steps. First, the daily flow for a given gauge is divided across the elevation range that the gauge represents, in equal proportion to the drainage area represented within each 100-foot elevation band. Second, the sum of each of the individual "elevation band flows" for each gauge is scaled up to the area of that elevation band in the application basin. Each of these steps includes a scaling factor for both area and precipitation. Equation 1 shows the calculation for prorated flow on a single day, with the first step in the left set of parenthesis, and the second step in the right set of parenthesis (mathematical summation form).

$$q_u = \sum_{e=1}^{n} \sum_{g=1}^{n} q_g \left(\frac{a_{ge} p_{ge}}{\sum_e a_{ge} p_{ge}} \right) \left(\frac{a_{ue} p_{ue}}{\sum_g a_{ge} p_{ge}} \right)$$

Equation 3.1.1 Daily unimpaired flow where q is daily average flow, a is area, and p is average annual precipitation. Where g is each gauged basin, u is the application basin, and e is the lower limit of each 100-foot elevation band divided by 100.

It is worth noting here that a few of the reference gauge basins had facilities that resulted in measurable amounts of stream regulation and/or diversion during the period of data use; no effort was made to modify the observed data to account for these hydrologic effects. However, it is not expected that these water regulation facilities would have a meaningful impact on the results of this analysis.

The following three sections of the "strawman" contain specific data to each application basin. Figure 3.1.1 shows where all the gauges used provide elevation coverage in reference to the application basin. The first table in each subbasin description contains a list of gauges used for gauge proration hydrology in that subbasin. The final table in each subbasin description shows gauge data availability from USGS, where white is unavailable, light gray is available but not used, and dark gray means it is being used in the subbasin gauge proration calculation. Some gauged data went unused when better gauged data (closer, more similar in elevation range) were available.

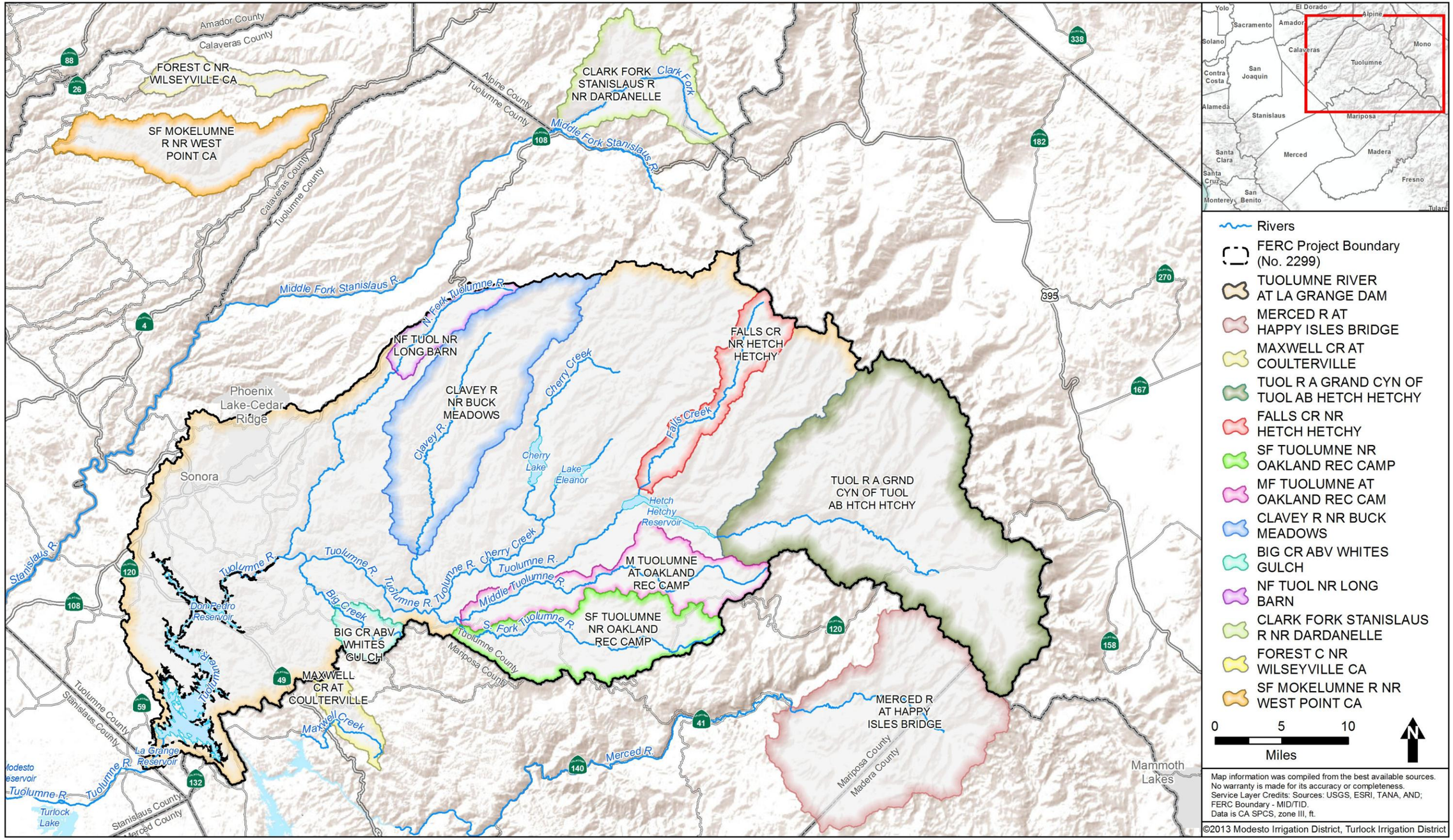

Figure 3.1.1 Map of gauges used in proration method for unimpaired hydrology

3.1.1 Hetchy Hetchy Subbasin

Table 3.1.1 Gauges used for gauge proration of Hetch Hetchy subbasin

11292500	CLARK FORK STANISLAUS R NR DARDANELLE CA
11274790	TUOLUMNE R A GRAND CYN OF TUOLUMNE AB HETCH HETCHY
11264500	MERCED R A HAPPY ISLES BRIDGE NR YOSEMITE CA
11275000	FALLS C NR HETCH HETCHY
11282000	M TUOLUMNE R A OAKLAND RECREATION CAMP CA

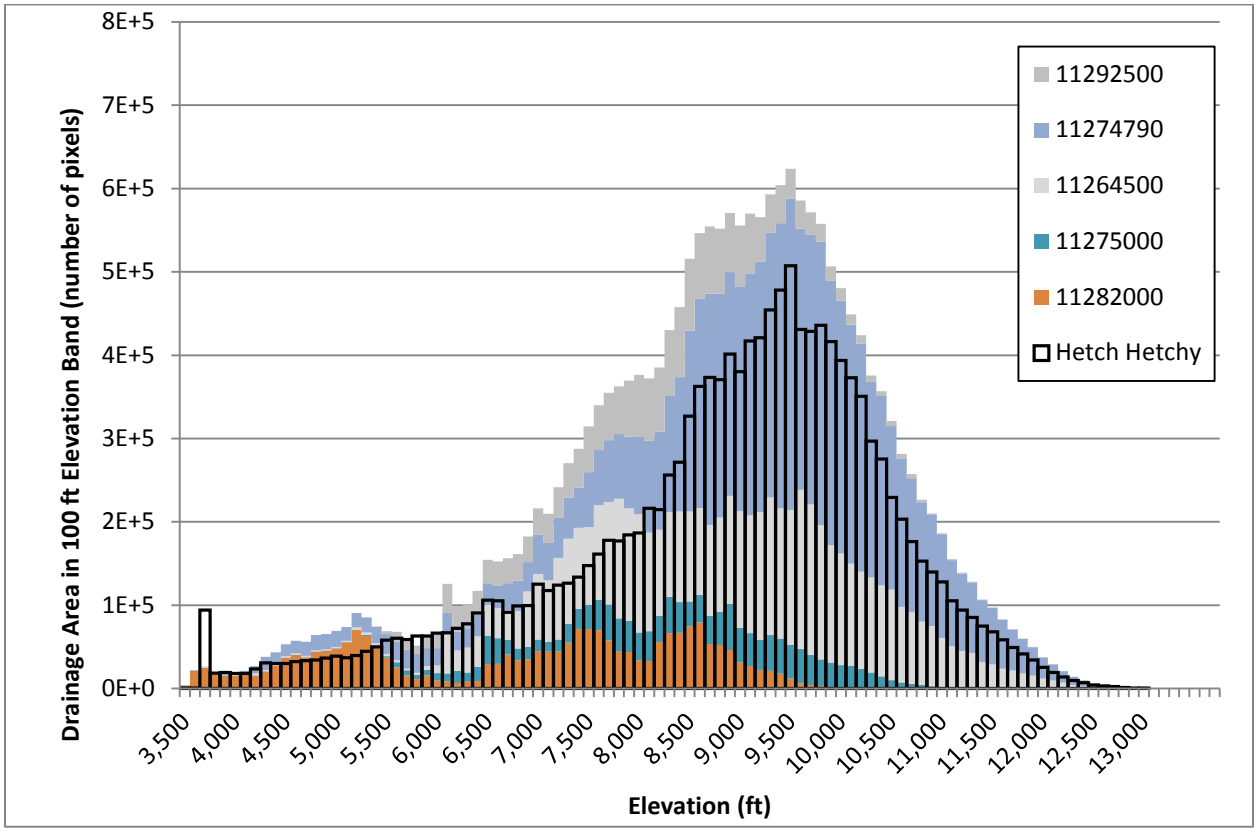

Figure 3.1.2 Elevation histograms for unimpaired gauges, compared to the Hetch Hetchy subbasin

Table 3.1.2 Gauge inventory for gauge proration of Cherry/Eleanor subbasin

WY	11292500	11274790	11264500	11275000	11282000
1971					
1972					
1973					
1974					
1975					
1976					
1977					
1978					

WY	11292500	11274790	11264500	11275000	11282000
1979					
1980					
1981					
1982					
1983					
1984					
1985					
1986					
1987					
1988					
1989					
1990					
1991					
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2008					
2009					
2010					
2011					
2012					

3.1.2 Cherry/Eleanor Subbasin

Table 3.1.3 Gauges used for gauge proration of Cherry/Eleanor subbasin

11292500	CLARK FORK STANISLAUS R NR DARDANELLE CA
11274790	TUOLUMNE R A GRAND CYN OF TUOLUMNE AB HETCH HETCHY

11264500	MERCED R A HAPPY ISLES BRIDGE NR YOSEMITE CA
11283500	CLAVEY R NR BUCK MEADOWS CA
11275000	FALLS C NR HETCH HETCHY
11282000	M TUOLUMNE R A OAKLAND RECREATION CAMP CA
11284700	NF TUOLUMNE R NR LONG BARN CA
11281000	SF TUOLUMNE R NR OAKLAND RECREATION CAMP CA

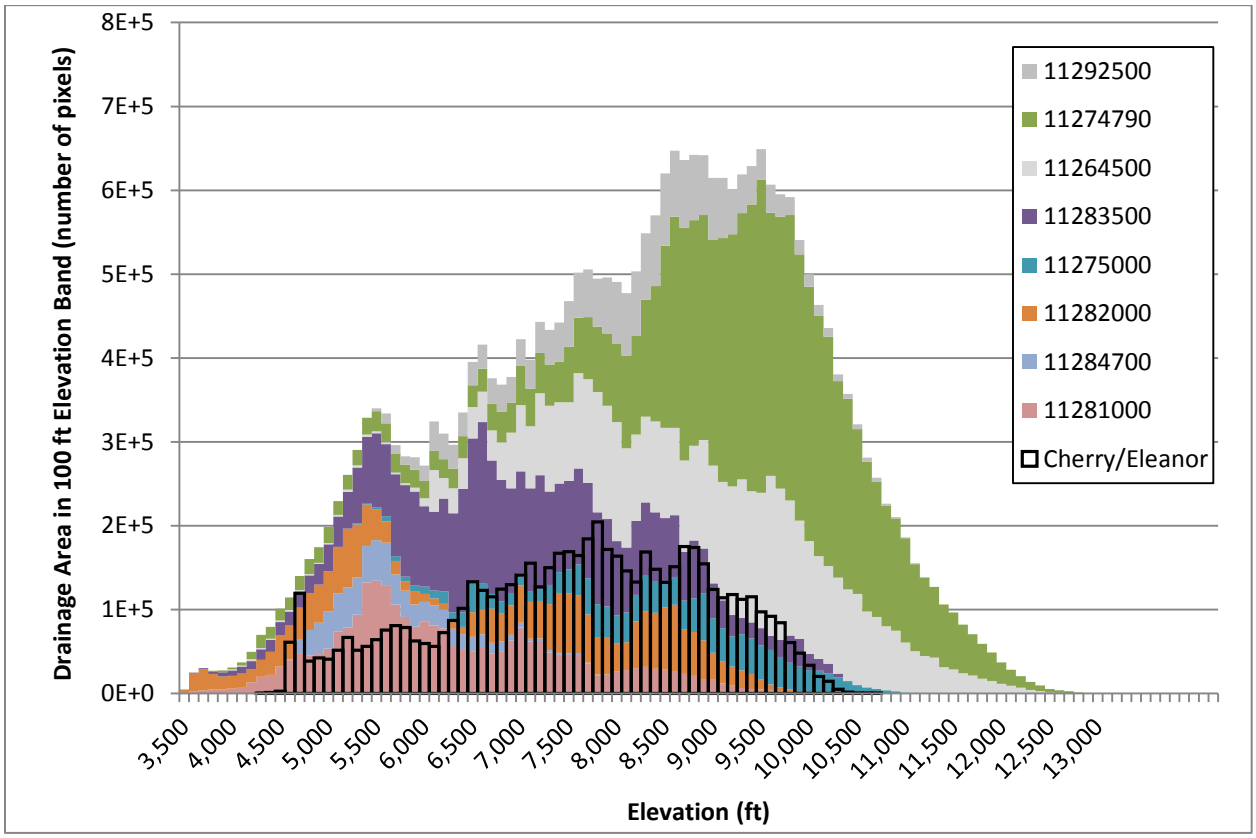

Figure 3.1.3 Elevation histograms for unimpaired gauges, compared to the Cherry/Eleanor subbasin

Table 3.1.4 Gauge inventory for gauge proration of Cherry/Eleanor subbasin

WY	11292500	11274790	11264500	11283500	11275000	11282000	11284700	11281000
1971								
1972								
1973								
1974								
1975								
1976								
1977								
1978								
1979								
1980								

WY	11292500	11274790	11264500	11283500	11275000	11282000	11284700	11281000
1981								
1982								
1983								
1984								
1985								
1986								
1987								
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3.1.3 Unregulated Subbasin

Table 3.1.5 Gauges used for gauge proration of Unregulated subbasin

11**3185**00	SF MOKELUMNE R NR WEST POINT CA
11**2693**00	MAXWELL C A COULTERVILLE CA
11**3168**00	FOREST C NR WILSEYVILLE CA
11**2844**00	BIG CR ABV WHITES GULCH

11**2835**00	CLAVEY R NR BUCK MEADOWS CA
11**2645**00	MERCED R A HAPPY ISLES BRIDGE NR YOSEMITE CA
11**2820**00	M TUOLUMNE R A OAKLAND RECREATION CAMP CA
11**2847**00	NF TUOLUMNE R NR LONG BARN CA
11**2810**00	SF TUOLUMNE R NR OAKLAND RECREATION CAMP CA

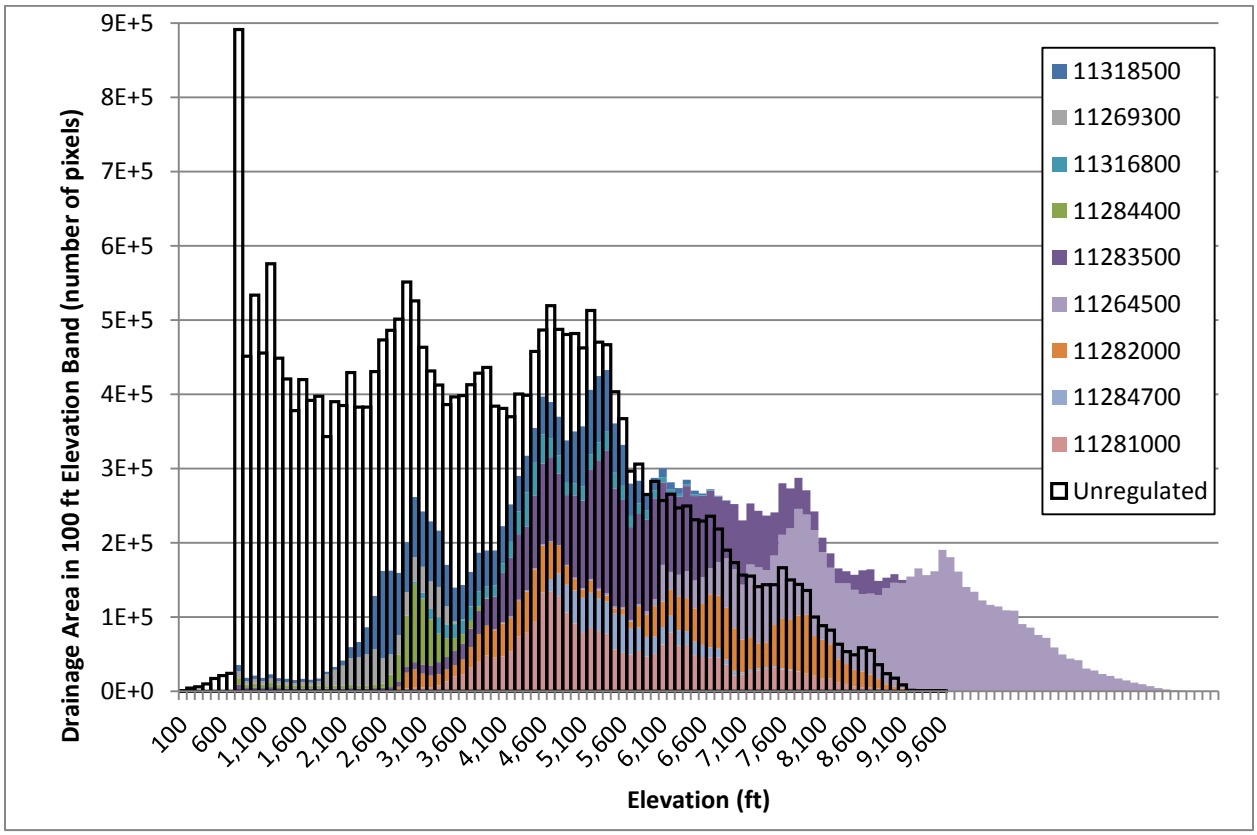

Figure 3.1.4 Elevation histograms for unimpaired gauges, compared to the Unregulated subbasin

Table 3.1.6 Gauge inventory for gauge proration of Unregulated subbasin

WY	3185	2693	3168	2844	2835	2645	2820	2847	2810
1971									
1972									
1973									
1974									
1975									
1976									
1977									
1978									
1979									
1980									
1981									

WY	3185	2693	3168	2844	2835	2645	2820	2847	2810
1982									
1983									
1984									
1985									
1986									
1987									
1988									
1989									
1990									
1991									
1992									
1993									
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2010									
2011									
2012									

3.2 Monthly Volume

In order to scale the gauge proration hydrology to the observed historical monthly volumes, some adjustments had to be made to deal with months where the total monthly volume was calculated negative. Negative monthly volumes in the current Tuolumne record are an artifact of gauge summation calculations involving numerous flow and reservoir level gauges, each with small errors. These calculations are described in detail in Attachment A of the ISR of W&AR-2. Negative monthly volumes occur during certain low flow periods (August-January) of Cherry/Eleanor, Hetch Hetchy, and

unregulated inflow to Don Pedro. In total, adjustments were needed in 39 of the 504 months of the extended period of record (WY 1971 – WY 2012). This resulted in small changes to the annual volume from contributing subbasins for 22 of the 42 water years.

In order to eliminate negative monthly volumes without disturbing the gauge summation record, each of the upper subbasins (Cherry/Eleanor and Hetch Hetchy) were re-balanced with the Unregulated subbasin so that the monthly unimpaired volume at La Grange remains the same. Rather than transferring just enough volume to 'zero' out the negative month, an attempt was made to use the gauge proration record to find a reasonable value for the month being adjusted.

In the gauge proration hydrology record, typically the gauges being used don't change during a water year due to the way USGS reports data. Monthly volumes were examined as a percentage of the total water year volume for both the gauge summation, and gauge proration data. The monthly percentage of the annual volume was used as a guide to form an 'expected' monthly volume.

When the Unregulated subbasin had a negative month, Cherry/Eleanor and/or Hetch Hetchy volumes for that month were examined for closeness to their 'expected' amount. In many cases, the Cherry/Eleanor subbasin was far wetter than 'expected' and an adjustment down fixed a large portion of the imbalance. In most cases, a blend of both Hetch Hetchy, and Cherry/Eleanor volumes were used to offset a negative volume in the Unregulated subbasin. The exact percentage from each subbasin varies depending on how the adjustment affected each subbasin.

When Cherry/Eleanor or Hetch Hetchy subbasins had a negative month, an 'expected' value was used as a guide for the offset volume. All of the re-balancing volume came from the Unregulated subbasin. In most cases, this volume had to be further adjusted manually in order to keep normal volumes in the Unregulated subbasin. Table 3.2.1 shows these adjustments.

The only "*new water*" adjustment comes in October 2002, where 2000 AF was added to the La Grange gauge. This was the minimum volume that could be used to produce a positive 'expected normal' month in the Unregulated subbasin (and Cherry/Eleanor subbasin). All of the adjustments made to the Unregulated subbasin balance to a net of 2000 acre feet. In other words, for the period of record, CCSF/Districts have the same amount of water flowing into the watersheds. The 2000 AF addition to La Grange goes exclusively to the Unregulated subbasin.

Table 3.2.1 Adjustments to unregulated inflow volume to Don Pedro, in AF. Red indicates water going from the Unregulated subbasin to Cherry/Eleanor, orange to Hetch Hetchy, and green indicates water going from a combination of Cherry/Eleanor and Hetch Hetchy to the Unregulated subbasin.

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1971	-1,633										-3,369	-2,260
1972	-4,146										-3,024	-1,515
1973											-3,271	-4,695
1974												-4,741
1975	-3,518											
1976				8,000								

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1977			-1,041								-1,359	7,287
1978	-1,545											
1981	-6,652											
1987				4,400								-400
1988												-800
1989										6,600	4,500	
1990										3,088	3,600	2,800
1991	1,700		-1,500									
1994				-7,923							-7,500	-981
1995	6,143											
1996	2,400	-200										
2000	-1,527											
2003	**4,400**											
2004	1,945	5,037										
2007												4,200
2012												-500

Monthly scaling factors were used to scale the gauge proration hydrology up or down to the adjusted historical monthly volume. The monthly scaling factor is defined as the adjusted historical monthly volume divided by the gauge proration monthly volume. A scaling factor of less than one means the gauge proration overestimated the historical flow. A scaling factor of greater than one means the gauge proration underestimated the historical flow. When multiplied by the scaling factor, the daily gauge proration flow values will result in adjusted historical monthly volumes. The following three sections show computed scaling factors used for each subbasin, with red to orange indicating a reduction in gauge proration flow, and yellow to green representing an increase in gauge proration flow.

3.2.1 Hetchy Hetchy Subbasin

Table 3.2.2 Hetch Hetchy monthly scaling factors for gauge proration. Bold indicates reduced volume and italics indicates increased volume.

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1971	0.11	1.08	1.15	1.00	0.84	0.87	0.82	0.91	0.95	0.79	0.60	0.57
1972	0.48	0.75	1.04	0.98	0.96	0.82	0.81	0.89	0.84	0.56	0.32	0.27
1973	0.54	0.73	0.90	1.00	1.06	1.01	0.80	0.84	0.88	0.64	0.41	0.02
1974	0.32	0.87	1.02	0.94	0.72	0.88	0.79	0.83	0.87	0.85	0.57	0.07
1975	0.12	0.11	0.96	0.93	1.21	1.23	1.00	0.81	0.86	0.84	0.49	0.36
1976	0.81	0.87	0.74	*0.05*	0.98	0.94	0.83	0.93	0.82	0.71	0.70	0.44
1977	0.81	0.68	0.57	0.52	0.69	0.96	0.89	1.01	1.10	1.12	1.04	*0.97*
1978	0.52	0.96	1.25	1.67	1.67	1.15	0.91	0.79	0.88	1.03	0.73	0.64
1979	0.57	0.73	0.84	1.04	1.19	1.09	0.86	0.89	0.86	0.76	0.45	0.09
1980	0.82	0.92	0.83	1.03	0.98	0.93	0.80	0.80	1.00	1.18	0.84	0.36

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1981	0.16	0.26	0.59	0.64	0.95	1.08	0.84	0.94	0.90	0.53	0.41	0.28
1982	0.91	1.09	1.03	1.09	0.94	0.78	0.74	0.81	0.89	0.87	0.86	0.91
1983	0.90	1.06	1.10	1.00	1.05	1.11	0.80	0.77	0.86	0.88	0.93	0.74
1984	0.95	1.80	1.45	0.96	1.06	1.17	1.22	1.58	1.76	1.24	0.79	0.60
1985	0.97	1.83	1.50	1.15	1.36	1.61	1.42	1.65	1.69	0.89	0.54	0.92
1986	1.55	1.63	2.13	1.90	1.57	1.19	1.27	1.45	1.62	1.56	1.01	0.57
1987	1.31	0.70	0.62	*0.50*	1.83	1.87	1.47	1.57	1.34	0.71	0.30	**0.15**
1988	0.56	1.10	1.77	2.03	1.43	1.40	1.55	1.59	1.40	0.80	0.55	0.57
1989	0.15	0.63	1.35	2.10	2.52	2.00	1.40	1.67	1.69	*1.07*	*0.22*	0.58
1990	1.34	1.41	1.50	2.03	2.14	1.81	1.58	1.61	1.50	*0.76*	*0.39*	*0.12*
1991	*0.20*	0.66	0.53	0.50	1.15	2.66	1.62	1.49	1.53	1.16	0.84	0.50
1992	1.18	1.39	1.35	1.44	2.02	1.70	1.39	1.37	1.00	1.02	0.74	0.61
1993	1.17	0.91	1.55	2.03	1.82	1.39	1.19	1.25	1.33	1.30	0.93	0.47
1994	0.88	0.56	1.28	**0.62**	1.84	2.08	1.64	1.70	1.64	0.62	**2.06**	**0.61**
1995	*0.60*	2.05	1.95	2.36	1.86	1.46	1.23	1.19	1.35	1.43	1.48	1.14
1996	*0.39*	0.95	1.91	1.74	1.78	1.34	1.30	1.47	1.84	1.70	1.05	1.01
1997	1.34	1.40	1.76	1.32	1.00	1.03	1.03	1.20	1.48	1.14	0.87	0.71
1998	1.03	1.17	1.96	2.49	1.72	1.58	1.19	1.23	1.34	1.35	0.87	0.77
1999	1.23	1.82	1.86	2.05	1.79	1.51	1.31	1.55	2.06	1.94	1.13	1.05
2000	1.54	1.61	1.26	2.42	1.98	1.54	1.45	1.49	1.50	1.17	1.11	0.92
2001	1.35	1.39	2.19	1.94	2.12	1.83	1.55	1.42	1.17	1.01	1.14	1.38
2002	2.46	1.71	2.09	1.81	1.67	1.51	1.40	1.57	1.61	1.13	1.22	2.06
2003	*0.84*	1.32	1.91	1.43	1.01	1.08	1.20	1.12	1.03	0.74	0.84	0.43
2004	*1.27*	*1.26*	1.90	0.89	0.95	1.20	1.22	1.40	1.33	0.88	0.96	1.55
2005	1.91	1.22	1.46	1.74	1.49	1.39	1.03	0.95	0.92	0.78	0.52	0.60
2006	0.88	1.09	2.14	1.23	1.24	1.14	1.06	0.99	1.10	0.88	0.56	0.27
2007	0.52	1.22	1.62	1.44	1.79	1.43	1.31	1.43	1.16	0.74	0.83	*0.16*
2008	1.28	1.32	1.90	1.52	1.58	1.36	1.26	1.36	1.32	0.83	0.48	0.77
2009	1.67	1.28	1.27	1.60	1.48	1.46	1.24	1.47	1.48	1.00	0.85	0.83
2010	1.31	1.03	1.52	1.56	1.57	1.52	1.49	1.36	1.31	1.06	0.75	1.06
2011	1.67	1.32	1.92	1.42	1.49	1.88	1.38	1.32	1.41	1.42	1.19	0.95
2012	1.02	0.92	0.58	1.38	1.18	1.30	1.32	1.28	1.07	0.69	0.58	0.61

3.2.2 Cherry/Eleanor Subbasin

Table 3.2.3 Cherry/Eleanor monthly scaling factors for gauge proration. Bold indicates reduced volume and italics indicates increased volume.

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1971	**0.52**	2.91	2.04	1.66	1.42	1.46	1.37	1.47	1.37	1.00	**0.52**	**0.52**
1972	**0.53**	2.46	1.63	1.44	1.47	1.64	1.54	1.52	1.41	0.17	**0.53**	**0.52**
1973	0.67	1.80	2.11	1.48	1.15	1.19	1.43	1.45	1.30	0.44	**0.49**	**0.49**
1974	0.83	2.76	1.62	1.44	1.07	1.36	1.29	1.43	1.28	1.09	0.14	**0.52**
1975	**0.48**	0.23	1.52	1.75	1.37	1.38	1.39	1.46	1.28	1.16	0.42	0.39
1976	2.52	1.61	1.28	*0.09*	1.83	1.89	1.90	1.62	0.81	0.24	2.14	1.63
1977	1.65	0.82	**0.71**	1.57	2.40	2.38	2.16	2.25	1.48	0.14	**0.72**	*1.80*
1978	**0.54**	2.54	3.55	2.05	1.32	1.40	1.25	1.49	1.39	1.30	0.78	2.27

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	0.05	1.27	1.78	2.10	1.62	1.41	1.51	1.44	1.28	0.99	1.15	1.62
1980	2.78	3.02	2.55	1.75	1.09	1.08	1.42	1.34	1.76	2.02	1.06	0.76
1981	**0.62**	0.44	1.61	1.65	2.28	1.85	1.98	1.66	1.36	1.27	3.38	2.36
1982	2.76	3.23	1.83	1.13	1.22	1.33	1.16	1.19	1.21	1.09	0.58	1.75
1983	2.39	1.52	1.03	0.96	0.91	0.84	0.99	1.27	1.27	1.32	1.21	1.07
1984	1.49	4.50	2.33	1.39	1.55	2.26	1.95	2.12	1.80	0.97	0.09	0.17
1985	2.47	5.03	3.28	2.01	2.66	3.12	2.95	2.43	1.91	0.81	0.92	1.16
1986	4.32	4.31	5.71	5.17	2.54	2.11	2.15	2.19	2.14	1.79	0.82	1.50
1987	1.38	0.71	0.98	*0.67*	3.76	3.25	3.89	2.65	1.66	0.36	0.76	0.63
1988	2.70	4.08	5.10	1.04	1.69	3.14	3.44	3.05	2.38	1.52	0.08	**0.51**
1989	1.27	4.80	4.05	4.02	3.73	3.25	2.30	2.36	2.02	*0.52*	*0.09*	3.64
1990	6.66	3.93	2.43	3.50	3.47	3.25	3.14	2.80	2.15	*0.80*	*0.17*	*0.32*
1991	*0.47*	0.67	**0.92**	1.02	2.53	5.29	3.43	3.01	2.68	2.25	0.84	0.24
1992	1.65	4.19	1.95	2.56	3.24	2.95	3.10	2.42	1.43	4.22	1.36	0.11
1993	3.35	3.58	3.09	2.44	1.74	2.08	2.02	2.11	2.20	2.36	1.09	0.40
1994	1.37	0.63	2.69	2.39	3.39	3.75	3.71	3.01	1.98	0.70	0.03	0.05
1995	*1.79*	11.40	4.67	1.83	2.07	1.28	1.80	1.96	2.01	1.64	1.38	0.35
1996	*0.37*	**0.003**	6.32	3.28	3.37	2.11	2.13	2.20	1.76	1.19	0.74	0.33
1997	2.40	3.24	5.53	2.56	1.70	2.05	1.69	1.14	1.06	0.52	0.24	1.27
1998	2.36	3.49	4.36	3.74	1.70	2.51	2.09	1.97	1.93	1.69	0.83	0.82
1999	1.13	5.78	3.78	3.34	2.36	2.49	2.28	2.25	2.27	1.52	0.30	0.04
2000	**0.90**	3.37	1.47	5.53	2.69	2.63	2.63	2.19	1.72	0.86	0.72	1.57
2001	3.18	4.09	5.20	5.25	5.16	4.28	2.84	1.78	0.92	1.02	3.35	3.66
2002	2.25	7.05	5.22	4.21	3.31	3.52	2.43	2.08	1.55	0.35	2.15	2.22
2003	*1.43*	4.70	6.20	4.35	2.99	3.03	2.24	1.42	0.99	0.63	1.18	2.60
2004	*1.63*	*3.32*	7.47	4.33	4.91	2.32	1.87	1.44	0.89	0.48	0.58	0.15
2005	7.77	4.56	5.68	4.44	3.54	2.79	1.99	1.64	1.21	0.85	0.27	0.84
2006	3.79	3.65	7.66	3.42	4.13	3.37	2.51	1.15	0.96	0.71	0.50	0.68
2007	2.07	5.46	7.26	6.35	6.84	3.92	2.59	1.74	1.11	1.68	4.46	*2.06*
2008	5.19	0.74	6.16	5.68	3.91	4.03	3.04	1.79	1.14	0.54	0.70	0.32
2009	2.78	4.80	3.51	5.02	4.01	3.55	2.93	2.61	2.19	1.08	1.02	1.47
2010	4.95	1.72	4.10	3.90	2.81	3.22	2.45	2.22	2.09	1.61	0.80	0.84
2011	4.61	4.01	3.06	2.60	2.86	2.26	2.46	2.51	1.78	1.66	1.71	1.71
2012	2.59	2.11	0.89	5.82	3.82	4.49	3.07	1.70	1.21	0.62	0.45	**0.48**

3.2.3 Unregulated Subbasin

Table 3.2.4 Unregulated subbasin scaling factors for gauge proration. Bold indicates reduced volume and italics indicates increased volume.

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1971	*2.11*	1.73	1.42	1.31	1.01	0.92	0.84	0.85	0.93	1.38	*1.51*	*1.48*
1972	*0.59*	1.24	1.20	1.66	1.19	0.87	0.83	0.88	1.15	2.63	*3.78*	*2.21*
1973	1.18	1.98	1.45	1.27	1.43	1.27	0.84	0.78	1.15	1.89	*1.99*	*1.52*
1974	1.98	1.00	1.23	1.04	0.94	0.92	0.92	0.86	1.14	1.55	2.03	*2.77*
1975	*2.45*	1.39	1.24	1.33	1.60	1.30	1.07	0.70	0.81	0.88	1.73	1.77
1976	1.22	1.45	1.47	**0.81**	1.18	1.13	1.01	0.94	1.35	3.25	3.13	2.87

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1977	1.47	1.62	0.39	1.45	1.14	0.95	0.86	0.96	1.03	0.40	*2.77*	**1.02**
1978	*0.61*	1.52	1.44	1.25	1.22	1.05	0.97	0.93	0.92	1.08	2.62	2.40
1979	1.22	2.85	1.45	1.46	1.50	1.17	0.83	0.79	0.96	1.60	1.52	1.79
1980	1.57	0.96	1.05	0.99	1.03	1.00	0.85	0.92	0.79	0.91	1.96	2.79
1981	*1.48*	0.90	1.56	1.76	0.93	1.40	0.83	0.89	1.40	2.88	8.09	3.69
1982	2.04	1.17	1.10	1.41	0.93	1.37	0.92	0.90	1.25	2.07	1.72	2.08
1983	1.09	1.16	1.01	1.22	1.13	1.05	0.97	0.79	0.75	0.90	0.92	1.12
1984	1.64	1.45	1.21	1.25	1.43	1.23	1.08	0.81	0.90	0.57	0.86	0.52
1985	1.22	1.49	1.15	1.06	1.40	1.62	1.07	0.81	0.73	1.25	3.49	2.36
1986	1.50	1.70	1.33	1.21	1.09	1.25	1.01	0.77	0.53	1.22	1.38	1.97
1987	1.19	0.65	0.77	**0.37**	1.12	1.30	0.73	0.81	1.64	1.87	3.59	*0.66*
1988	1.82	1.42	2.59	2.63	1.86	1.14	0.88	0.85	1.07	3.63	3.11	*0.41*
1989	0.56	2.05	1.65	1.45	1.16	0.94	0.78	0.77	0.94	**0.71**	**0.86**	*0.64*
1990	0.86	0.33	0.54	0.98	1.69	0.98	0.83	0.76	0.90	**0.89**	**0.59**	**0.72**
1991	**0.14**	3.34	*0.86*	1.39	1.18	1.59	0.98	0.94	1.00	3.28	6.76	5.02
1992	3.34	0.77	1.04	1.51	1.32	1.00	0.88	1.08	1.72	1.88	4.97	3.45
1993	2.13	0.40	1.49	1.50	1.31	0.94	0.76	0.76	0.89	1.54	2.77	2.74
1994	1.45	0.81	0.89	*1.48*	1.61	0.91	0.94	0.96	1.77	7.56	*9.85*	*7.59*
1995	**0.40**	1.06	1.77	1.28	0.96	1.10	0.95	0.89	0.92	0.94	0.85	0.70
1996	**0.12**	*0.00*	1.17	1.49	1.30	1.27	1.00	0.96	0.82	0.67	0.94	1.80
1997	0.90	1.44	1.44	1.22	1.04	1.41	1.07	0.74	0.25	0.77	1.77	1.18
1998	0.51	1.01	1.11	1.86	1.47	1.35	1.25	1.07	1.03	0.93	0.72	0.64
1999	0.39	1.00	1.13	1.31	1.17	1.09	1.11	0.97	1.02	1.25	1.65	2.27
2000	*0.86*	0.84	0.81	1.25	1.47	1.51	1.16	0.96	1.04	1.04	1.62	1.34
2001	1.23	0.54	0.85	1.22	1.46	1.33	1.11	0.86	0.85	1.51	2.39	2.60
2002	2.83	1.25	1.49	1.31	1.14	1.20	1.10	0.88	0.78	1.50	2.97	2.05
2003	**0.16**	1.16	1.51	0.94	0.93	1.19	0.92	0.76	0.56	0.66	1.75	1.75
2004	**0.28**	**0.91**	1.02	1.11	1.32	0.86	0.88	0.58	0.27	0.36	2.62	1.54
2005	2.52	0.52	1.14	1.61	1.43	1.25	1.10	1.09	0.99	0.84	1.36	2.22
2006	0.67	0.61	1.08	1.09	0.91	1.20	1.12	1.08	0.46	0.25	0.48	0.97
2007	0.92	0.57	0.68	0.18	1.19	0.79	0.82	0.47	0.42	0.68	0.75	**0.55**
2008	0.92	0.33	1.52	1.86	1.62	1.18	0.85	0.74	0.37	0.52	3.70	2.44
2009	0.24	0.88	0.81	1.74	1.20	0.99	0.83	0.80	0.55	1.00	2.01	1.73
2010	0.99	0.07	1.23	1.39	1.35	1.19	0.79	0.69	0.67	0.42	0.38	1.13
2011	1.01	1.28	1.32	1.25	1.20	1.27	1.03	0.76	0.82	0.69	0.96	1.00
2012	0.64	0.65	0.26	0.84	0.79	1.31	0.94	0.59	0.92	1.65	2.01	*2.14*

3.3 Smoothing Between Scaling Factors

It can be seen in the record of scaling factors that most of the period of record contains gradually changing scaling factors each month. In several cases there are some abrupt changes, which have the potential to artificially shape the gauge proration. This is particularly the case during snowmelt recession, when a large factor in June might drop to a very small factor in July. This would make the

hydrograph appear to drop quite rapidly to the baseflow rate, instead of the expected gradual recessional limb of a hydrograph.

In order to alleviate this problem, caused by the boundaries between monthly scaling factors, a smoothing technique was used to gradually shift between scaling factors over the course of two weeks (one week in each month). Any monthly volumetric changes resulting from this smoothing were applied as a multiplier adjustment to the middle two weeks of the month. In most months, where scaling factors do not change significantly, these adjustments do not change the hydrograph in any noticeable way.

The function used to smooth between scaling factors was a cumulative normal distribution with a standard deviation of 1.80. In several cases, in order to maintain the monthly volume, the standard deviation had to be decreased in order to provide a more abrupt transition. An example of typical daily scaling factors can be seen in Figure 3.3.1.

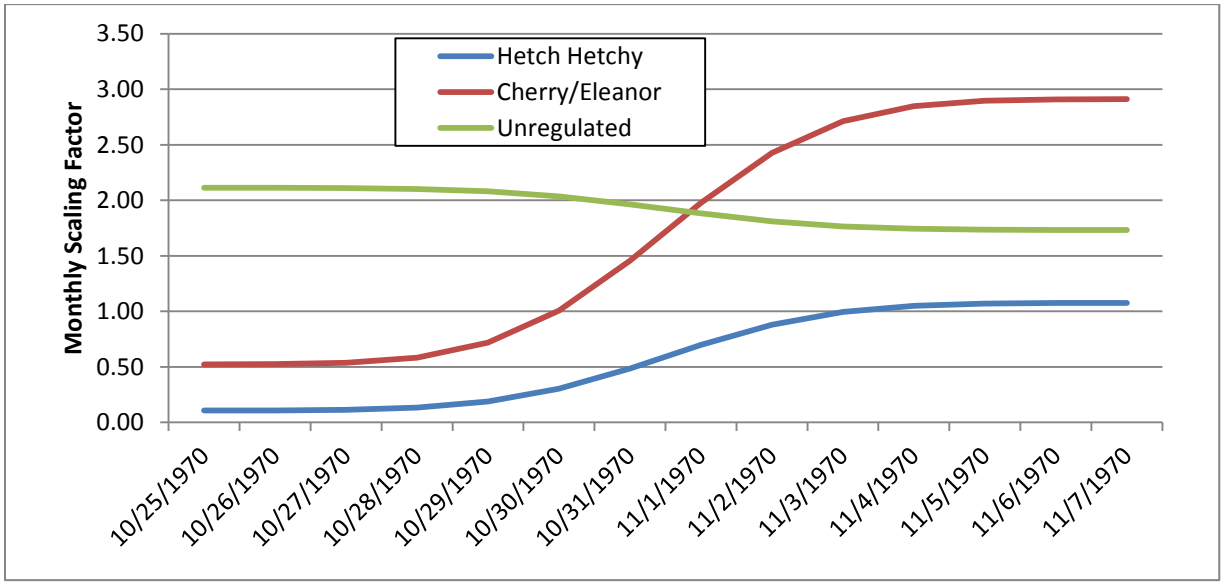

Figure 3.3.1 Typical daily scaling factor smoothing

4.0 Results

The resulting "strawman" can be seen in the attached HEC-DSS database.

5.0 Discussion

In water year 1997, and water years 2003-2008 there are only four unimpaired gauges representing the Unregulated subbasin. Two of those gauges are in the Mokelumne River basin, one in the Merced River basin, and the smallest one is in the Tuolumne River basin. Together, these four gauges provide a poor representation of the Unregulated subbasin, and combined have a drainage area equal to less than 27% of the Unregulated subbasin (Figure 5.1). This period is the poorest representation of any of the application areas for the period of record. Despite the poor match in drainage size, elevation range, and

even overall geography, the gauge proration provides a reasonable looking daily hydrograph when scaled to the historical monthly volumes (Figure 5.2).

In the Operations Model, the function of the model is to allow comparisons to be made of different scenarios. Absolute accuracy is not the goal. Relative differences between modeling scenarios is a powerful decision making tool. While statistically accurate daily values may not be achieved using the gauge proration methods described herein, they do create a dataset that:

- Describes general hydrograph shape, variability, and magnitude of peak flows
- Maintains the historical monthly volumes
- Provides a reasonable depiction of daily flow conditions over the period of record

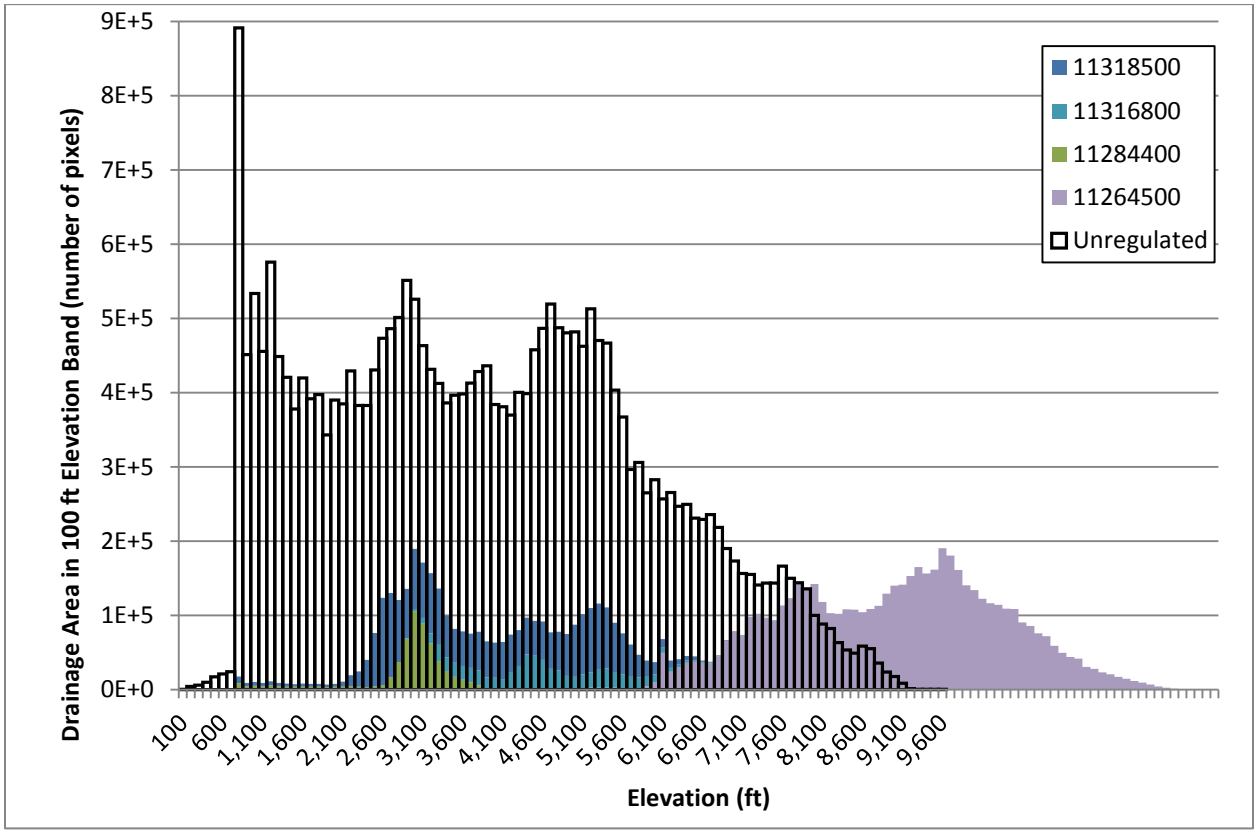

Figure 5.1 Elevation histogram for Unregulated subbasin gauge proration (WY 97, 02-08)

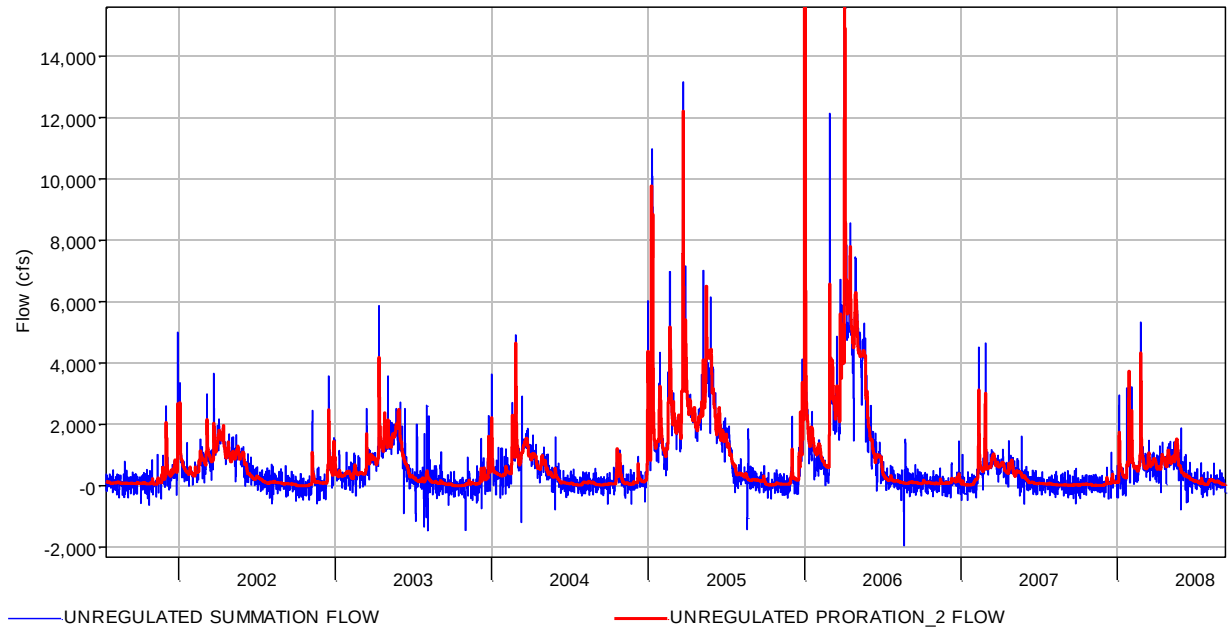

Figure 5.2 Hydrograph comparison gauge summation (W&AR-02) and gauge proration

References

Study Report W&AR-02. Project Operations/Water Balance Model. Attachment A. Tuolumne River Daily Operations Model

PRISM Climate Group, 2006, *United States Average Monthly or Annual Precipitation 1971 – 2000*, <http://prism.oregonstate.edu>, Oregon State University, Created 12 Jun 2006.

United States Geologic Survey (USGS), 2009, *1/3 Arc Second National Elevation Dataset*, <http://seamless.usgs.gov>, USGS Earth Resources Observation & Science (EROS) Center, Sioux Falls, SD, Created 23 March 2009.

INSTRUCTIONS FOR DOWNLOADING AND VIEWING .DSS FILE

The DSS database contains all of the intermediate steps to develop the strawman:

- Gage proration hydrology (not scaled)
- Gage proration hydrology (scaled to monthly volumes)
- Gage proration hydrology (scaled with smoothed factors)
- Gage summation hydrology (original, not smoothed)

You can download the .dss file referenced above via the www.donpedro-relicensing website (CALENDAR Tab / Go to the March Calendar and click on the Workshop notice on the March 27, 2013 date to see the attachments, which include the .dss file).

In order to view the .dss file, you will need to have HEC-DSSVue installed. If you do not have this software, you can download it via a link on the www.donpedro-relicensing website (CALENDAR Tab / Go to the March Calendar and click on the Workshop notice on the March 27, 2013 date to see the attachments, which include instructions/link for viewing the .dss file).

ATTACHMENT 3

Final Meeting Notes for October 26, 2012

W&AR-03 and W&AR-16 Consultation Workshop

Attachment 3

Don Pedro Project Relicensing
River & Reservoir Temperature Models Consultation Workshop #2
Don Pedro Relicensing Studies W&AR-3 & W&AR-16
Final Meeting Notes

Friday, October 26, 2012
9:00 a.m. to 4:00 p.m. - MID Offices

Attendees

Art Godwin (TID)
Bill Johnston (MID)
Bill Paris (MID)
Bill Sears (CCSF)
Bob Hughes (CDFG)
Bob Nees (TID)
Carin Loy (HDR)
Greg Dias (MID)
Jenna Borovansky (HDR)
John Devine (HDR)
Mike Maher (SWRCB)
Scott Lowe (HDR)
Steve Boyd (TID)
Zac Jackson (USFWS)

Attended via phone:
Allison Boucher (FOTR)
Chris Shutes (CalSPA)
Ellen Levin (CCSF)
John Wooster (NMFS)
Tim Findley (BAWSCA)

Purpose of Meeting

The Temperature Model Workshop #2 was held on October 26, 2012 to discuss with the Don Pedro Relicensing Participants (RPs) the status of the temperature models being developed for the Don Pedro Reservoir (W&AR-3) and the Lower Tuolumne River (W&AR-16), including:

(1) Review initial calibration and validation results of both the Don Pedro Reservoir 3D temperature model and the Lower Tuolumne River temperature model

(2) Path forward and schedule for model completion

This Workshop follows the protocols of the consultation workshop process; draft meeting notes are provided for a 30-day review following issuance by the Districts.

The Districts reviewed the FERC ILP process schedule as well and alerted RPs to the fact that the ISR meeting will cover two days, January 30, 2013 and January 31, 2013. A detailed schedule will be forthcoming in early December.

Meeting Materials

Materials provided to Relicensing Participants to support the meeting discussion:

- Don Pedro Reservoir Bathymetric Study Report, October 2012. NOTE: Attachments A & B referenced in this report are extremely large files containing plots of bathymetry data. These plots are available upon request to rose.staples@hdrinc.com.
- W&AR-16: Lower Tuolumne River Temperature Model Status Report, September 2012. An 8 MB file, available on the relicensing website (www.donpedro-relicensing.com).
- W&AR-03: Reservoir Temperature Model: Upstream Water Temperature and Meteorological Data Sets for Model Verification, September 2012.
- Study Reports W&AR-3 and W&AR-16 Reservoir Temperature Model and Lower Tuolumne River Temperature Model Water Temperature Data Set October 2012 Update. NOTE: This report contains extremely large files with plots of Tuolumne River stream temperature and Don Pedro Reservoir temperature data and profiles, the raw data used for the plots, and the data collected from the Districts metrological stations, installed in 2010. Available on Compact Disc (CD), upon request rose.staples@hdrinc.com.

Meeting Summary

The Districts distributed the meeting agenda on October 18, 2012 via email and it was reviewed prior to starting the presentation and discussions. The only suggested change in the agenda was the addition of a discussion of the integration between the operations model and the temperature model.

Don Pedro Reservoir Temperature Model (W&AR-3)

The following topics were covered in the meeting:

- Study Plan Overview
- Reservoir Bathymetry Study
- Model Design and Calculations
- Data Sources and Collection: Meteorology; Inflow Temperatures; Reservoir Profiles
- Calibration
- Validation

Study Plan Overview

The study plan (W&AR-3) specifies the model platform and data acquisition requirements for the Reservoir Temperature Model. DHI's MIKEFM 3D Model is the platform. Data compiled and collected to support the model's development include reservoir bathymetry, reservoir temperature profiles, and local meteorological data.

Reservoir Bathymetry Study (Report distributed)

The bathymetry study plan was part of reservoir model study plan. The Districts collected the bathymetry data in 2011. The effort consisted of joining two surfaces: one measured when the reservoir elevation was 792 feet, the other purchased IFSAR data, acquired (flown) when the reservoir elevation was 760 feet. The overlap between the two surfaces contributes to the bathymetric surface's precision.

The 2011 bathymetric surface was compared to the New Don Pedro Reservoir area-capacity curve (pre-1972). Research by TID indicates that the new Don Pedro Reservoir elevation-storage data incorporated the original elevation-storage data for the Old Don Pedro Reservoir. The two volumes were found to be within 1% of each other at elevation 830 ft and a very close match was found at all of the elevation intervals.

Model Design, Computations, and User Interface

MIKE3 is a three dimensional, time variable hydrodynamic model. The temperature structure of the reservoir was described and the items that can be varied in the model were discussed. Specific discussions included flooding and drying (how the model mesh can adapt to changes in reservoir elevation) and heat balance equations, including, air temperature, humidity, short and long wave radiation.

> Comment: Bob Hughes asked if the ground temperatures of reservoir land areas temporarily not inundated were included in the model.
>
> Response: Scott Lowe indicated they were not and that the temperature of the adjacent ground would not be expected to affect reservoir water temperatures.
>
> Comment: Chris Shutes asked about clearness information and time step used for this information. Mr. Shutes recommended that the actual solar data be provided in the report.
>
> Response: Mr. Lowe answered that monthly average cloud cover is used in the model based on local information. Daily information is not available. With respect to solar radiation, the Districts' meteorological station is collecting hourly solar radiation data. The data will be used to confirm/modify the model's internally calculated solar radiation, but solar radiation is not a direct input. However, it will be included in the report.

Data Sources and Data Collection: Meteorology, Inflow Temperatures, Reservoir Profiles

Sources of model input data consist of the following:

- Inflow and outflow – based on Project Operations Model (daily time step)
- Inflow temperature – recorded on the Tuolumne River at Indian Creek Trail and other upstream locations (hourly time step)
- Met data recorded at Don Pedro
    - Air temperature
    - Humidity
    - Wind speed and direction
- Cloud cover – from Modesto
- Reservoir bathymetry collected by CDFG and the Districts

Model Calibration

Data collected in 2011 are being used to calibrate the model. Initial calibration results were presented. Model results were shown with red triangles and observed results were blue circles.

The calibration figures also included two dark horizontal lines: (1) 830 feet, shows the reservoir's normal maximum pool; and (2) 600 feet, indicating the minimum operating pool.

Other elevations of interest include: (1) the power tunnel inlet, 535 feet at central line; (2) the diversion tunnel/outlet works inlet at approximately 350 feet; (3) the Old Don Pedro top of dam at 611 feet; 4) the spillway crest at about 596 feet; 5) the old Don Pedro Dam gates on top to raise to 604 feet. The Old Don Pedro Dam also had lower level outlet works consisting of two sets of six gates, the upper ones at about centerline 512 ft and the lower ones at about centerline of 422 ft. The Districts believe all of these gates are open.

The modelers have encountered a few inconsistencies in the data that they are in the process of evaluating. Examples of these data inconsistencies were discussed. One of the problems is that data sheets from other sources need to be reviewed to confirm the accuracy of the recorded depth measurements. In addition, it appears that some CDFG data collection sites were moved during low water, so the precise latitude and longitude where the profile was collected needs to be confirmed. The modelers are using the bottom elevations from the interpolated bathymetric surface to help check the reliability of some of the input profile data where it appears that the data collection sites were moved.

Model Validation

A detailed write-up on this topic was distributed, entitled *W&AR-03 Reservoir Temperature Model: Upstream Water Temperature and Meteorological Data Sets for Model Verification, September 2012.*

Data collected in 2012 are being used to validate the model. At the time of the run presented at this meeting, data included was only through June 2012 because that was the latest data retrieved. The validation will be completed upon receipt of all data through November 2012. The study plan (W&AR-3) stated that 2008 data would be used for model validation. Use of the 2012 data for model validation will be a variance, but is preferred because of the availability of actual inflow temperature data. The synthesized 2008 data set, however, may still be used as an additional model check if the water levels in 2008 were significantly lower than in 2012.

The Districts' two meteorological stations installed in 2010 were discussed, along with the data available from local stations.

Model Training and Access

A virtual workstation will be created that will allow external users to connect to the MIKE modeling software and run "what-if" scenarios. Access to the workstation will be provided via the existing Project website. Users will be able to use the models provided as a base to perform other simulations and then have the ability to save and/or print the results.

Next Steps

- Modelers are working with CDFG staff to resolve temperature profile data issues
- Once these data issues are resolved, the calibration will be finalized
- Once all data through November 2012 is available, the validation runs will be completed

- Model access for use by RPs will be established by the time of the ISR Meeting in January 2013
- Training will be scheduled for early-2013 (currently scheduled for January 24, 2013 in HDR's Sacramento office)

Action Items:

- Schedule model training for Relicensing Participants. Proposed dates are:
  - January 24, 2013 – River and Reservoir Model Training
  - March 20, 2013 (preliminary) – Operations and Temperature Model integration training

- The study report and graphs will provide intake structure elevations as a reference on temperature plots.

Lower Tuolumne River Temperature Model (W&AR-16)

The following topics were covered in the meeting:

- Study Plan Overview
- Reservoir Bathymetry Study
- Description, Computations, and User Interface
- Data Sources and Collection: Meteorology; Inflow Temperatures; Reservoir Profiles
- Calibration and Validation

Study Plan Overview

The study plan (W&AR-16) specifies the model platform and data acquisition requirements for the Lower Tuolumne River Temperature Model. The river model platform consists of an existing San Joaquin River basin-wide HEC-5Q model that included the lower Tuolumne River. This basin-wide model was initially developed in part under Bay-Delta funding, and was referred to as the SJR5Q model. Under direction of the 2009 FERC Order on Rehearing, this model was recalibrated using the then most-recent river temperature data and used to evaluate river temperature regimes in the lower Tuolumne River. The report was filed with FERC, after opportunity for comment, in March 2011. This report noted the need for further recalibration of the model using new data to be collected at the La Grange Dam location. The Districts prepared a study plan for accomplishing this recalibration (W&AR-16), and FERC approved the study plan with modification in the December 22, 2011 Study Plan Determination. FERC's modifications were (1) make sure the results of the temperature model would be available to the ongoing CALFED modeling efforts; (2) extend the model to the confluence of the Tuolumne River and the San Joaquin River; and (3) ensure data collected and modeling results are sufficient to calculate the 7-day average daily maximum temperature (7DADM) values.

Description, Computations, and User Interface

The original SJR5Q model of the Tuolumne River began above Don Pedro Reservoir and extended to the mouth. This Districts' river temperature model for relicensing purposes starts at the Don Pedro powerhouse. Like the original SJR5Q model, it has a 6-hour time step. The only significant outflows in the lower Tuolumne River are the Districts' diversions at La Grange Dam. The only significant inflow is Dry Creek. Accretions are not included in the model;

however, the Districts are undertaking accretion flow measurements under study W&AR-2 and may input these flows into the model once they are completed (circa February 2013).

Data Sources and Collection: Meteorology, River Temperatures, Other Data

CDFG and the Districts have been monitoring river temperatures in the lower Tuolumne River for as long as two decades at some sites. A list of monitoring sites was provided. The Districts are maintaining two meteorological stations, one near the Don Pedro Reservoir and one near RM 30. Relevant meteorological data is collected at various nearby locations as described in the attachments provided prior to the Workshop.

Model Calibration and Validation

Like the reservoir temperature model, the Districts plan to use 2011 as a calibration year and 2012 as a validation year.

An initial calibration run has been performed using the HEC-5Q model. Modeled vs. measured data are shown from 2011. Modeled data are shown in red and measured data are shown in black. The model calibration was strong with the exception that the diurnal range in temperatures varies considerably from station to station with upstream stations above RM circa 37 showing expected and predicted diurnal ranges, but farther downstream stations displaying unexpected (and not predicted) smaller diurnal ranges. In addition, the downstream stations are not consistent in displaying these more narrow ranges with measuring stations quite close to one another displaying significantly different diurnal ranges.

To better understand why the model predicted greater temperature ranges during theses months and locations, each data collection site has been visited to examine for variations in shade, substrate, flow, District vs CDFG collection, spikes associated with operational spill, and no correlation was found to explain this inconsistent and unpredicted range in diurnal variation. The Districts discussed the data with RPs and asked for any ideas in regard to explaining such data variances. A good discussion ensued but without resolution. The Districts have concluded that the data are all good and reliable and that the phenomena being observed are real and not a data anomaly. The Districts and RPs agreed that the Districts should evaluate (1) whether similar data ranges occur in other years, (2) do the accretion flow measurements indicate potential groundwater sources that may be reducing the diurnal range.

RPs also indicated that the outflow data temperature showed a relatively sudden reduction of about 2 degrees C in late 2011. The Districts indicated they believed this occurred during a full powerhouse outage that occurred in late October or early November and the low level outlet works had to be opened. The Districts agreed to confirm this and provide the dates of the event.

Districts Shifting to the HECRAS Model

The Districts proposed migrating the Lower Tuolumne River Temperature Model to the HECRAS model platform. The Districts provided their rationale for the change, including the HECRAS model is a publicly available model, it is much more user friendly, and it is completely transparent. Importantly, it performs at an hourly and even sub-hourly time step which is

consistent with the RPs requests for the model and FERC's Determination. Migration to the HECRAS model is underway in order to meet the relicensing schedule.

Comment: Mr. Shutes asked about how the HECRAS model would match up with San Joaquin model.

Response: Mr. Devine answered that they are compatible and that the flows and temperature at the SJR/TR confluence can be fed directly into the SJR5Q model, or the models can be run independently. However, like with any two models, slightly different results are to be expected.

Next Steps

- Refine calibration of both models; validate models using 2012 data; review latest accretion flow results and evaluate year-to-year consistency of observed ranges in river diurnal temperatures.
- Conduct additional Workshop after final calibration/validation; conduct training session, likely in January (now set for January 24, 2013).
- Issue draft report with ISR in January 2013.

Action Items

- The Districts will provide the RPs with details of the powerhouse outage, including the dates and times.
- Bob Hughes observed that California Agencies have not used HECRAS in a FERC water rights forum yet. He will check with other CDFG staff, including Dale Stanton, and ask for suggestions and observations. (Action item complete.)
- Mike Maher will likewise check in with SWRCB staff.
- The Districts will set up a meeting/conference call with agencies to discuss the HECRAS model, if necessary. (Follow-up communication with agencies via email deemed this action item unnecessary.)