Sacramento River Temperature Task Group Meeting

May 3, 2016 -- 1:00 pm

Agenda

1. Introductions

2. Review SRTTG process outline

<u>Start of regular Meeting</u>

3. Fishery update
    a. Life Cycle -- condition on the river (present and upcoming)

4. Hydrology & Operations update (information is available on CVO's web-page page)

    a. Mean Daily Water Temperatures
    b. Reading 10-Day Forecasted Air Temperatures
    c. Sac River Gage temp plot and air temp plot
    d. Lake Shasta Isothermalbaths Plot
    e. Lake Shasta Current TCD Configuration

5. April Temperature studies
    a. April Temperature Packet
    b. Temperature control point (currently and seasonally)

6. Updates:
    a. Oak Bottom Curtain
    b. Trinity Pulse
    c. Clear Creek Pulse

7. Next meeting

Northern CVP Water Temperature Report

April - 2016

Page	Description
1	- Mean Daily Water Temperature, Release Flow Rates and Air Temperatures with Monthly Averages
2	- Redding 10-Day Forecasted Air Temperatures
3	- Sacramento River Mean Daily Water Temperature, Air Temperature and 10-Day Forecasted Air Temperature Plot
	- Water Temperature Measuring Station Details
	- Temperature Control Point Details
4	- Lake Shasta Isothermalbaths Plot
5	- Lake Shasta Current TCD Configuration

All Data in this Report is Preliminary and Subject to Change

DATE	Mean Daily Water Temperatures (°F)													Mean Daily Release (CFS)			Mean Daily Air Temperatures (°F)			
	TCD[1]	SHD	SPP[1]	KWK	SAC	CCR[2]	BSF	JLF	BND	RDB	IGO	LWS	-----[3]	Shasta Generation	Spring Creek P.P.	Keswick Total	RDD	BSF	RDB	LWS
Mar	49.4	48.8	49.1	49.8	50.2	50.4	52.0	51.9	52.0	52.6	50.5	48.2	-	6043	1206	7445	56.7	54.7	59.6	47.5
04/01	50.9	49.6	50.3	51.4	52.2	52.8	# -	55.9	56.1	57.0	52.4	51.2	-	4584	28	4991	61.5	58.7	59.6	57.1
04/02	50.9	49.5	50.5	51.7	52.5	53.1	# -	56.7	57.0	58.0	52.8	51.6	-	2167	14	4900	63.5	60.5	62.4	58.2
04/03	50.8	49.8	50.5	51.6	52.6	53.3	# -	57.5	57.8	59.0	53.2	51.6	-	5460	219	4919	66.0	62.9	64.7	57.5
04/04	51.1	50.0	50.4	51.8	52.6	53.2	# -	57.3	57.8	59.2	52.4	51.7	-	4787	15	4840	64.0	63.0	64.3	54.9
04/05	52.6	50.9	50.5	51.6	52.4	52.9	# -	56.4	56.7	58.0	52.3	51.9	-	4678	15	4728	72.0	67.0	69.1	55.1
04/06	52.3	50.7	50.7	51.9	52.7	53.4	# -	57.1	57.4	58.4	52.9	52.5	-	5183	28	4587	↑ 76.0	67.1	71.2	61.8
04/07	51.7	50.3	50.7	52.8	53.7	54.2	# -	58.0	58.3	59.6	53.2	52.9	-	5124	18	4594	↑ 72.0	65.7	69.0	63.9
04/08	51.4	50.0	50.7	53.0	53.9	54.5	# -	58.5	58.9	60.1	53.3	53.5	-	4644	14	4587	66.0	63.9	65.1	63.7
04/09	50.8	49.5	50.2	52.4	52.9	53.4	# -	57.8	58.3	59.5	52.4	53.3	-	3622	893	4582	63.0	61.0	60.5	58.1
04/10	51.1	49.5	50.7	52.0	52.5	53.0	# -	56.1	56.5	57.7	52.6	53.1	-	4799	18	4588	62.5	60.0	60.9	58.3
04/11	50.9	49.6	50.1	51.3	52.1	52.7	# -	56.5	56.8	58.0	52.7	53.5	-	3401	1124	4588	65.0	63.3	63.9	58.8
04/12	51.2	50.0	50.6	51.1	51.5	52.0	# -	56.4	56.9	58.2	52.8	? 53.7	-	4462	18	4612	61.0	61.1	61.8	57.8
04/13	51.0	49.9	50.8	51.4	52.0	52.5	# -	55.8	56.0	57.3	52.1	52.5	-	4229	14	4659	58.5	57.6	59.8	51.8
04/14	50.9	49.8	51.1	51.5	51.5	51.8	# -	55.0	55.4	56.8	51.4	51.2	-	4694	14	4645	53.5	51.1	52.9	43.7
04/15	51.7	50.4	51.6	51.6	52.3	52.7	# -	54.6	54.7	55.5	51.5	52.3	-	4492	14	4648	57.5	54.5	57.7	48.9
04/16	52.4	50.9	51.9	51.7	52.5	53.2	# -	56.2	56.4	57.2	52.4	52.8	-	4442	14	4644	↑ 67.5	61.3	64.3	55.8
04/17	52.3	50.5	52.2	52.1	52.9	53.7	# -	57.4	57.8	58.8	53.0	53.0	-	4760	14	4647	↑ 69.5	64.5	68.0	60.1
04/18	52.3	51.4	52.4	52.7	53.7	54.3	# -	58.4	58.8	60.1	53.2	53.4	-	4887	14	4648	70.0	64.9	67.2	61.9
04/19	? 52.4	50.9	52.7	53.2	54.0	54.6	# -	59.2	59.7	61.0	53.5	53.9	-	4468	0	4648	71.5	66.0	68.5	62.0
04/20	? 52.1	50.5	52.8	53.2	54.1	54.9	# -	59.5	60.0	61.3	53.4	54.3	-	4598	14	4650	69.5	65.2	65.8	61.0
04/21	51.5	50.6	53.0	53.2	53.8	54.4	# -	58.6	59.2	60.6	52.2	52.6	-	4025	14	4667	63.5	61.2	63.0	54.2
04/22	51.9	? 51.0	53.2	53.0	53.0	53.3	# -	57.1	57.7	58.8	51.9	53.0	-	4535	14	4669	54.5	55.2	55.8	49.7
04/23	52.3	51.3	53.2	52.0	53.0	53.8	# -	56.1	56.2	57.0	51.8	53.0	-	4982	14	4667	57.5	55.6	56.4	51.0
04/24	52.3	50.7	52.8	52.5	53.1	53.7	# -	57.2	57.6	58.6	52.2	52.3	-	4781	14	4669	60.0	59.0	60.4	50.8
04/25	53.5	52.0	52.5	52.7	53.2	53.7	# -	56.4	56.7	57.7	51.8	51.8	-	4818	14	4669	58.0	56.0	57.6	46.4
04/26	53.2	51.7	52.7	52.8	53.2	53.5	# -	56.1	56.4	57.3	51.4	51.2	-	4708	14	4589	61.5	58.2	59.6	49.1
04/27	52.6	51.5	52.9	53.6	54.0	54.5	# -	56.3	56.6	57.2	52.0	50.3	-	4508	14	4689	59.0	57.5	58.1	48.6
04/28	53.0	51.6	53.1	53.6	54.5	55.1	# -	57.7	57.8	58.4	52.8	49.1	-	4550	14	4717	67.0	63.0	64.5	53.4
04/29	53.5	52.0	53.4	53.7	54.4	55.1	# -	58.7	59.2	60.2	53.2	48.9	-	4381	14	4743	69.5	62.8	65.4	54.7
04/30	53.9	! -	53.6	54.0	54.7	55.2	# -	58.4	58.8	59.8	53.0	49.4	-	4757	14	4743	69.5	65.3	67.5	54.8
-																				
Apr	51.9	50.6	51.7	52.4	53.1	53.6	-	57.1	57.5	58.5	52.5	52.2	-	4518	88	4684	64.3	61.1	62.8	55.4
												Total CFS		135526	2642	140527				
												Total AF		268810	5240	278730				

Legend

- ? = 1-9 hours of data missing (Average includes estimations)
- ! = 10 or more hours of data missing (Average not calculated)
- # = Station out of service
- ↑ = Record high air temperature
- ↓ = Record low air temperature
- = Monthly Averages

Notes

[1] Temperatures are weighted averages based on individual penstock flow and temperature
[2] Current control point (see page 3 for more details)
[3] Column not used this month

DATE	Redding (RDD) Daily Air Temperatures (°F)																																			
	Actual			Forecasted																																
	Previous Day			Current Day			1 Day			2 Days			3 Days			4 Days			5 Days			6 Days			7 Days			8 Days			9 Days			10 Days		
	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg
04/01	44	76	60.0	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/02	47	76	61.5	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/03	50	77	63.5	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/04	53	79	66.0	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/05	51	77	64.0	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/06	59	85	72.0	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/07	59	**93**	76.0	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/08	51	**93**	72.0	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/09	52	80	66.0	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/10	58	68	63.0	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/11	58	67	62.5	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/12	59	71	65.0	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/13	53	69	61.0	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/14	47	70	58.5	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/15	42	65	53.5	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/16	40	75	57.5	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/17	49	**86**	67.5	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/18	47	**90**	68.5	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/19	52	88	70.0	56	88	72.0	52	81	66.5	54	77	65.5	54	69	61.5	51	77	64.0	51	76	63.5	51	74	62.5	47	76	61.5	47	77	62.0	49	80	64.5	NR	NR	
04/20	55	88	71.5	56	81	68.5	52	76	64.0	51	65	58.0	47	74	60.5	49	71	60.0	47	73	60.0	50	74	62.0	50	78	64.0	49	82	65.5	53	80	66.5	NR	NR	
04/21	56	83	69.5	50	75	62.5	51	63	57.0	45	72	58.5	48	70	59.0	47	70	58.5	45	71	58.0	47	70	58.5	48	82	65.0	55	90	72.5	51	84	67.5	54	80	67.0
04/22	50	77	63.5	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/23	47	62	54.5	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/24	47	68	57.5	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/25	49	71	60.0	NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
04/26	45	71	58.0	52	72	62.0	47	70	58.5	51	81	66.0	52	84	68.0	51	84	67.5	53	90	71.5	53	90	71.5	52	88	70.0	53	86	69.5	54	85	69.5	54	79	66.5
04/27	51	72	61.5	50	69	59.5	49	80	64.5	51	83	67.0	50	81	65.5	54	87	70.5	54	85	69.5	52	83	67.5	50	86	68.0	51	82	66.5	51	77	64.0	53	85	69.0
04/28	49	69	59.0	55	80	67.5	50	80	65.0	50	82	66.0	54	86	70.0	53	84	68.5	52	82	67.0	56	80	68.0	49	78	63.5	53	88	70.5	57	88	72.5	57	84	70.5
04/29	53	81	67.0	59	80	69.5	50	83	66.5	55	86	70.5	52	83	67.5	51	84	67.5	53	79	66.0	50	79	64.5	53	70	61.5	50	78	64.0	52	80	66.0	55	85	70.0
04/30	58	81	69.5	58	83	70.5	59	87	73.0	53	85	69.0	53	83	68.0	55	78	66.5	50	79	64.5	52	80	66.0	56	83	69.5	54	86	70.0	54	83	68.5	57	83	70.0
-	57	82	69.5																																	

Web Links

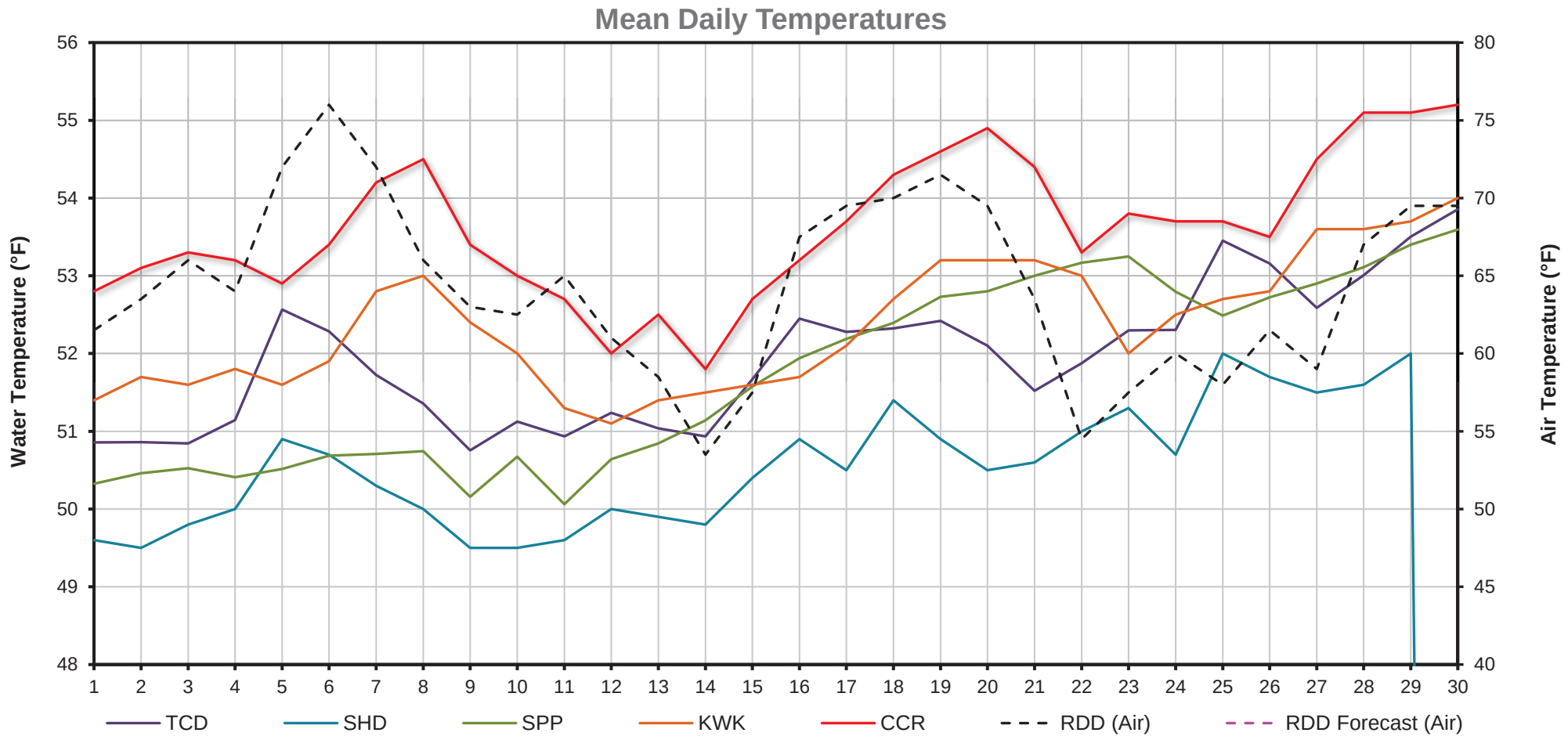
10-Day Min/Max Forecast

Previous Days Min/Max Actuals

Legend

NR = Forecasted temperatures not recorded

100 = Previous day actual temperatures in red and bolded indicate a record temperature for that date



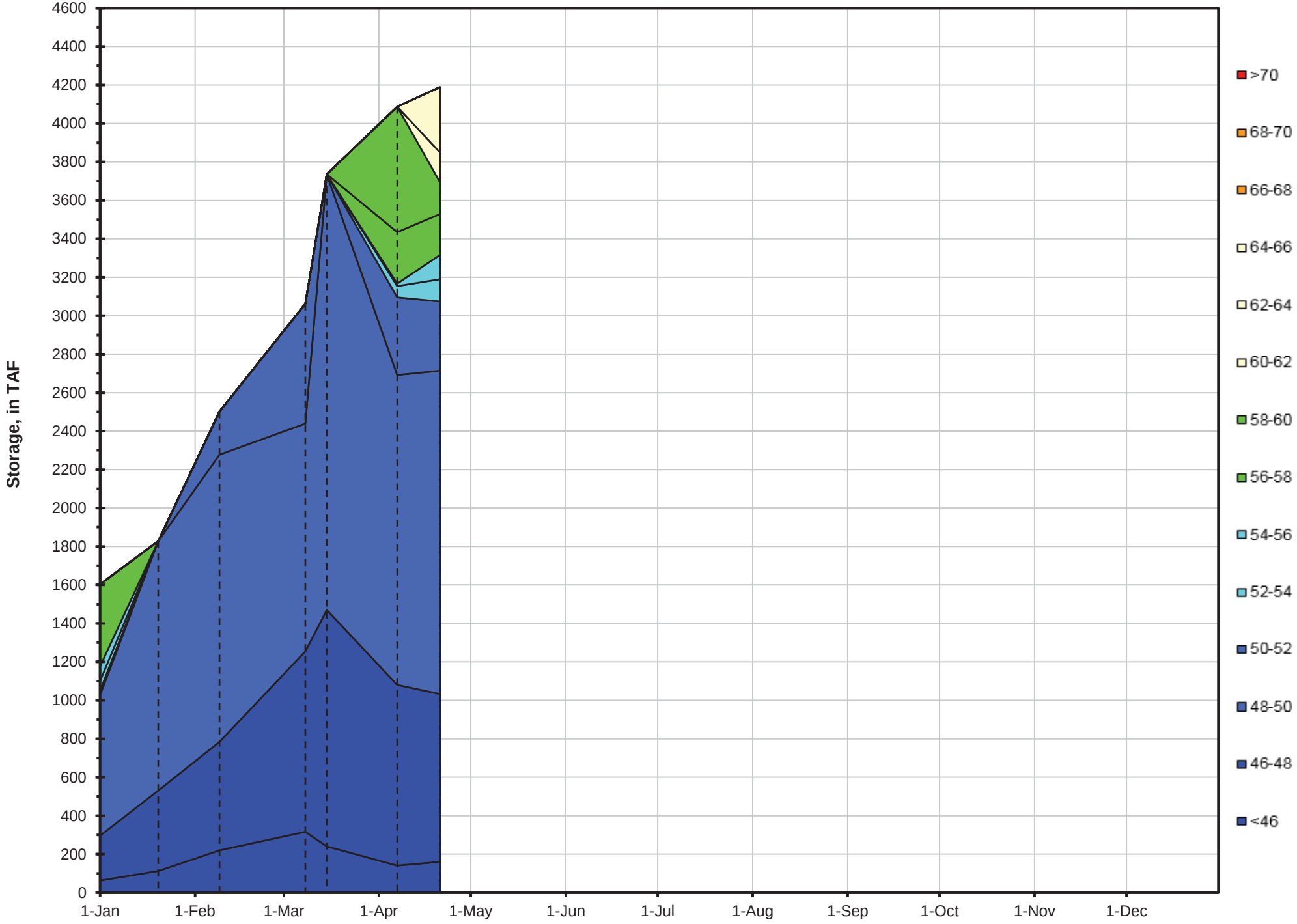
Station Details			
Code	Body of Water	Location[1]	CDEC Link
TCD	N/A	Shasta Power Plant	N/A
SHD	Sacramento River	0.3 miles downstream of Shasta Power Plant	Click Here
SPP	N/A	Spring Creek Power Plant	N/A
KWK	Sacramento River	0.8 miles downstream of Keswick Dam	Click Here
SAC	Sacramento River	4.8 miles downstream of Keswick Dam	Click Here
CCR	Sacramento River	9.7 miles downstream of Keswick Dam	Click Here
BSF	Sacramento River	25 miles downstream of Keswick Dam	Click Here
JLF	Sacramento River	34 miles downstream of Keswick Dam	Click Here
BND	Sacramento River	41 miles downstream of Keswick Dam	Click Here
RDB	Sacramento River	58 miles downstream of Keswick Dam	Click Here
IGO	Cleer Creek	7.3 miles downstream of Whiskeytown Dam	Click Here
LWS	Trinity River	1.1 miles downstream of Lewiston Dam	Click Here
DGC[2]	Trinity River	19 miles downstream of Lewiston Dam	Click Here
NFH[3]	Trinity River	38 miles downstream of Lewiston Dam	Click Here

Temperature Control Point		
Point	Temp. (°F)	Date Range
CCR	58.0	04/01/16 - Present

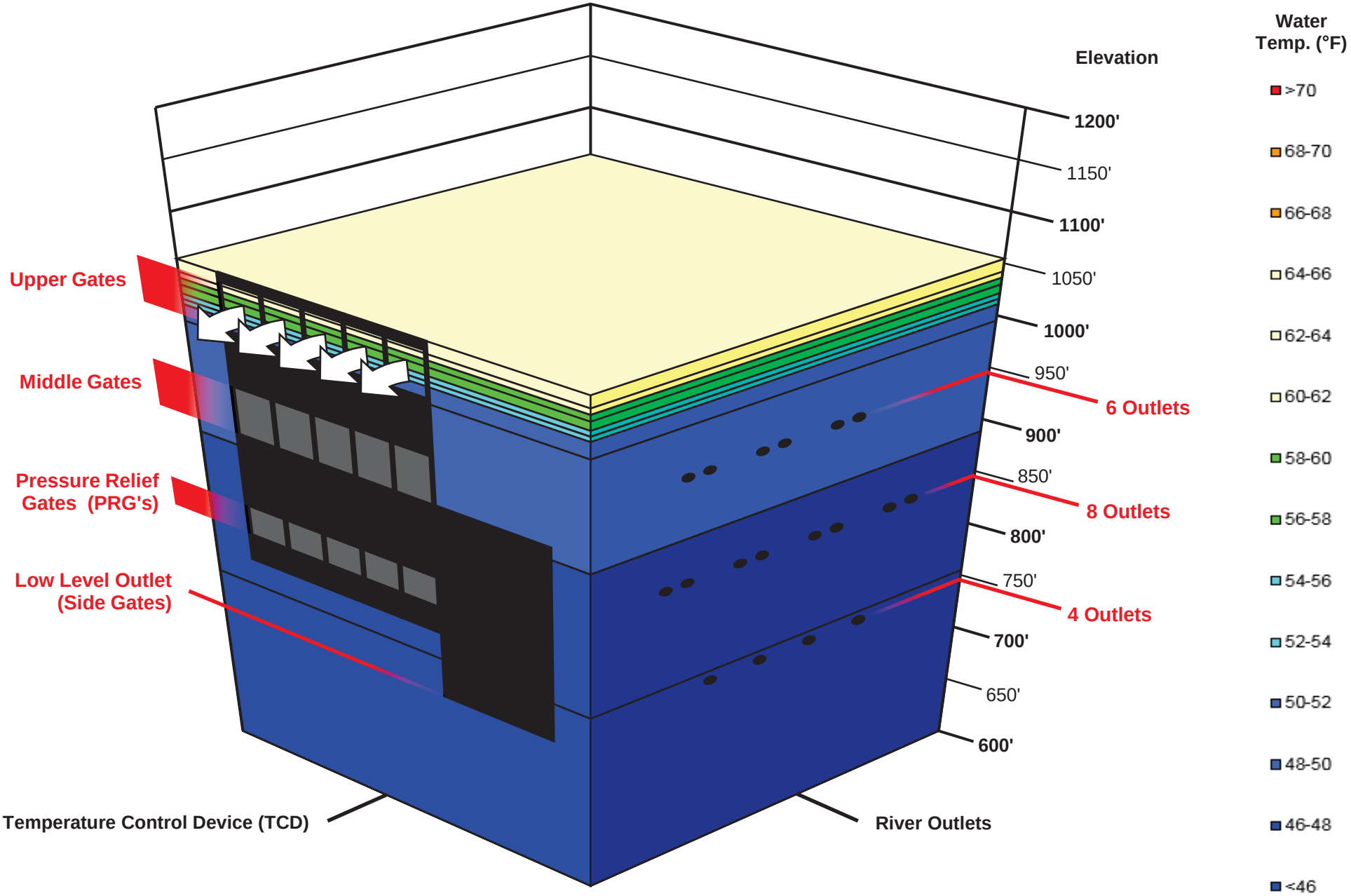
Notes

[1] Distances are approximate
[2] DGC is only reported in September
[3] NFH is only reported in October, November and December

Lake Shasta Isothermalbaths - 2016
(Water Temperature, in °F)



Current Shasta TCD Configuration



Arrows indicate open Gate or Outlet (i.e. Water flowing from this location)

Profile data collected 04/21/2016

DRAFT April 2016

90% Runoff Exceedance Outlook:

Federal End of the Month Storage/Elevation (TAF/Feet)

		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trinity	1280	1489	1404	1311	1187	1089	980	966	955	958
	Elev.	2302	2295	2287	2275	2265	2253	2251	2250	2250
Shasta	4027	4242	4218	3976	3498	3096	2801	2627	2552	2605
	Elev.	1056	1056	1047	1029	1012	999	991	987	989

Monthly River Releases (cfs)

Trinity	540	4677	2526	1102	734	744	373	300	300
Sacramento	5000	6500	9000	11500	10000	8500	6500	5500	4500

50% Runoff Exceedance Outlook:

Federal End of the Month Storage/Elevation (TAF/Feet)

		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trinity	1280	1550	1483	1414	1291	1183	1068	1016	1009	1047
	Elev.	2307	2302	2296	2285	2274	2263	2257	2256	2260
Shasta	4027	4389	4377	4175	3798	3440	3159	2998	3046	3173
	Elev.	1061	1061	1054	1040	1026	1015	1008	1010	1015

Monthly River Releases (cfs)

Trinity	467	4677	2526	1102	855	870	373	300	300
Sacramento	5000	8000	9000	10500	10000	9000	6900	4500	4500

Please note:
CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.
CVP operational forecasts or outlooks consider general system-wide dynamics and do not necessarily address specific watershed/tributary details.
CVP releases represent monthly averages.
CVP operations are updated monthly as new hydrology information is made available December through May.

May 2, 2016

Upper Sacramento River – April 2016 Preliminary Temperature Analysis

Summary of Temperature Compliance Results by Month

Control Point*	JUN	JUL	AUG	SEP	OCT
90%-Exceedance Outlook					
Keswick	**52.5**	**52.5**	**52.5**	**52.5**	**53.5**
CCR	**52.9**	**52.8**	**52.9**	**52.8**	**52.9**

Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

1. Operation is based on the April 2016 Operation Outlooks (monthly flows, reservoir release, and end-of-month reservoir storage).
2. The initial profiles used for Shasta, Trinity and Whiskeytown were taken on April 7, April 12, and April 5, respectively.
3. Guidance on forecasted flows from the creeks (e.g., Cow, Cottonwood, Battle, etc.) between Keswick Dam and Bend Bridge is not available beyond 5 days. Model input side flows (Cottonwood Cr & Bend Bridge local flow w/o Cottonwood Cr) were selected from the historical record, and are consistent with the forecast exceedance frequency. During spring, the relatively warm creek flows can be a significant percentage of the flows at Bend Bridge.
4. Although mean daily flows and releases are temperature model inputs, they are based on the mean monthly values from the operation outlooks. Mean daily flow patterns are user defined.
5. Cottonwood Creek flows, Keswick to Bend Bridge local flows, and diversions are mean daily synthesized flows based on the available historical record for a 1922-2002 study period.
6. Meteorological inputs were derived from a database of 86 years of meteorological data (1920-2005). To be conservative, a 10% exceedance L3MTO was used (May ’66, June ’73, July ’00, Aug ’88, Sept ’22, Oct ’52, and Nov ’62)
7. Meteorology, as well as flow volume and pattern, significantly influences reservoir inflow temperatures and downstream tributary temperatures; and consequently, the development of the cold-water pool during winter and early spring.

DRAFT

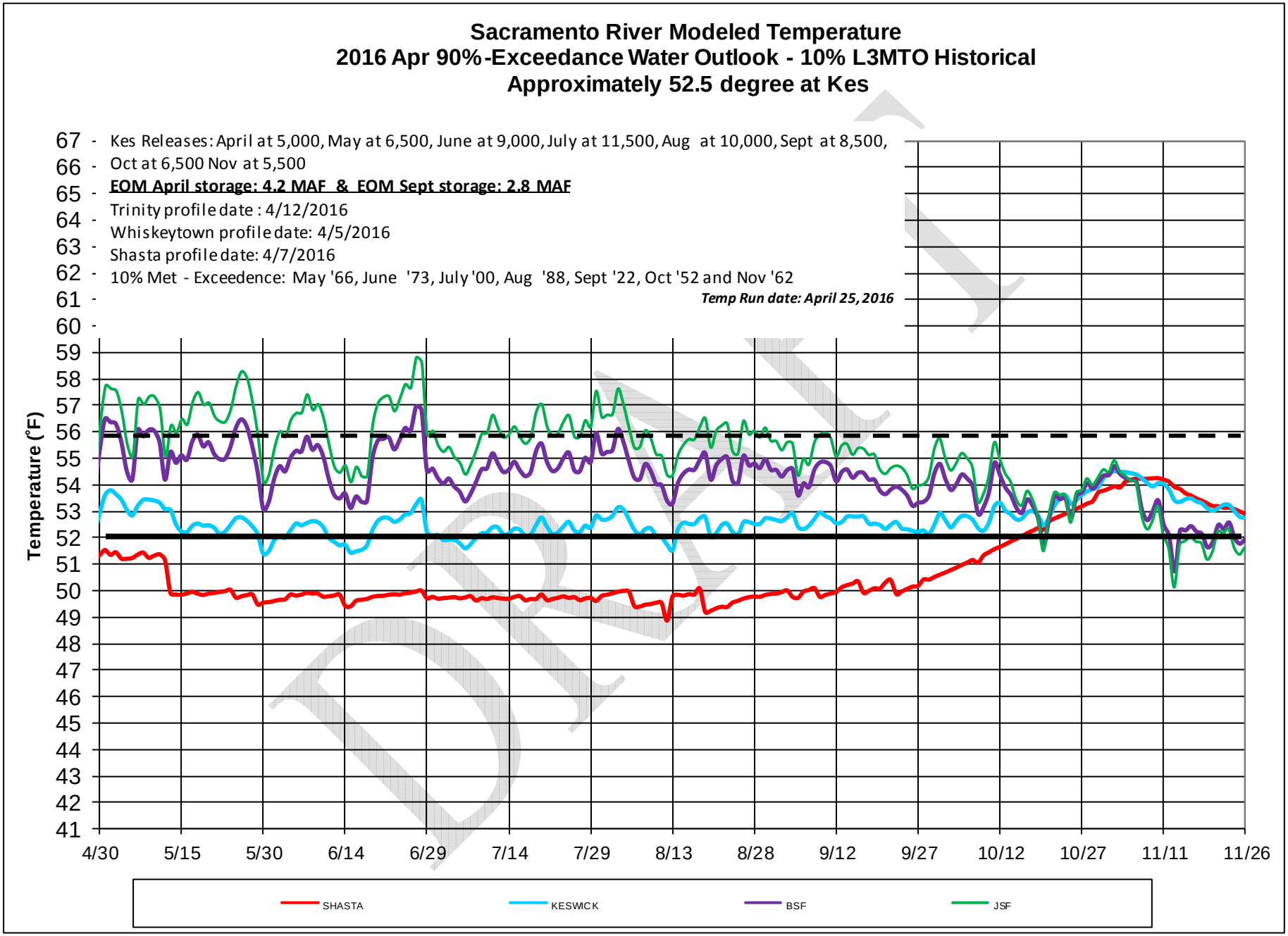

Sacramento River Modeled Temperature
2016 Apr 90%-Exceedance Water Outlook - 10% L3MTO Historical
Approximately 52.5 degree at Kes
Kes Releases: April at 5,000, May at 6,500, June at 9,000, July at 11,500, Aug at 10,000, Sept at 8,500, Oct at 6,500 Nov at 5,500
EOM April storage: 4.2 MAF & EOM Sept storage: 2.8 MAF
Trinity profile date : 4/12/2016
Whiskeytown profile date: 4/5/2016
Shasta profile date: 4/7/2016
10% Met - Exceedence: May '66, June '73, July '00, Aug '88, Sept '22, Oct '52 and Nov '62
Temp Run date: April 25, 2016
Temperature (°F)
67
66
65
64
63
62
61
60
59
58
57
56
55
54
53
52
51
50
49
48
47
46
45
44
43
42
41
4/30
5/15
5/30
6/14
6/29
7/14
7/29
8/13
8/28
9/12
9/27
10/12
10/27
11/11
11/26
SHASTA
KESWICK
BSF
JSF

Figure 1

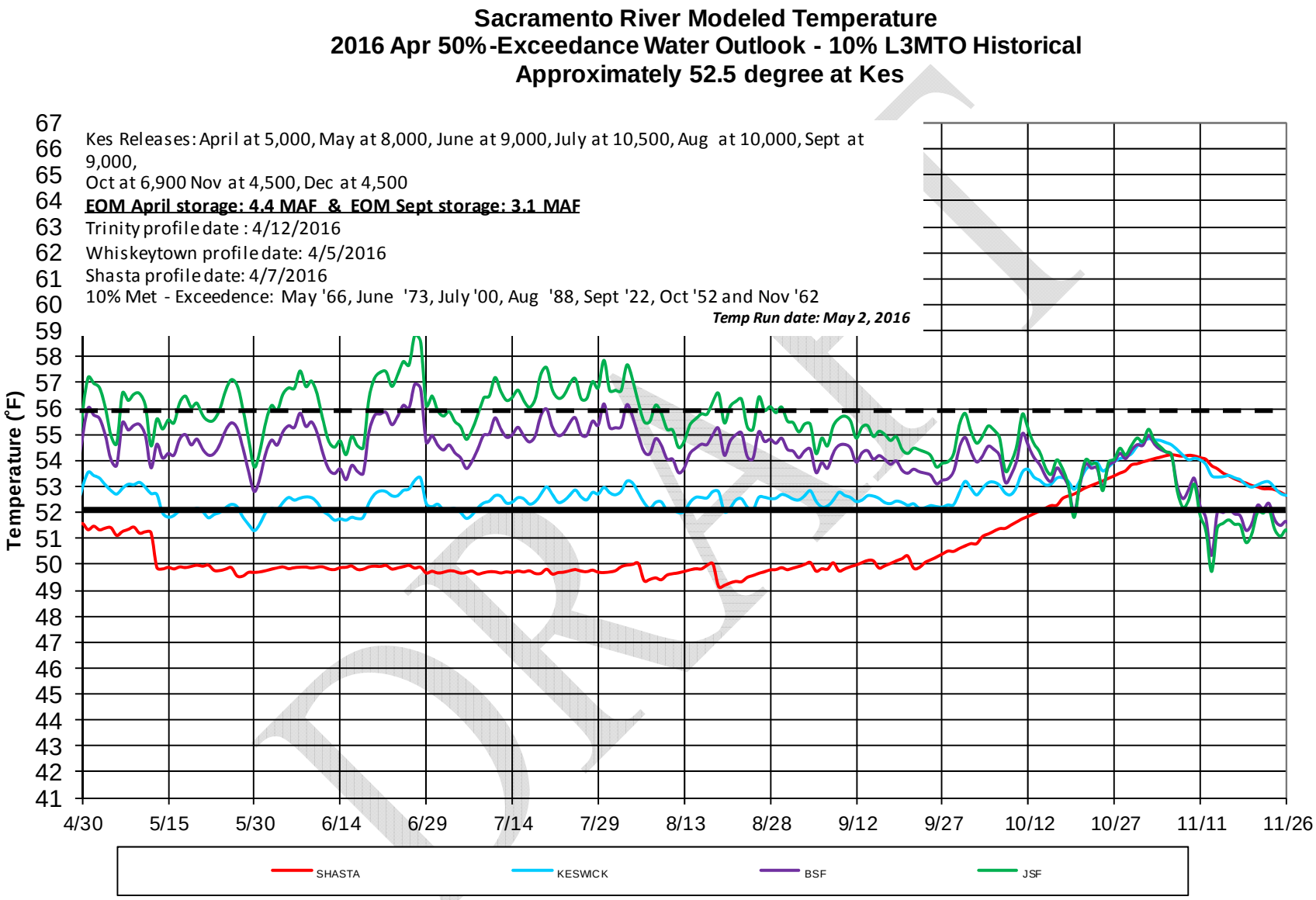

Sacramento River Modeled Temperature
2016 Apr 50%-Exceedance Water Outlook - 10% L3MTO Historical
Approximately 52.5 degree at Kes
Kes Releases: April at 5,000, May at 8,000, June at 9,000, July at 10,500, Aug at 10,000, Sept at 9,000,
Oct at 6,900 Nov at 4,500, Dec at 4,500
EOM April storage: 4.4 MAF & EOM Sept storage: 3.1 MAF
Trinity profile date : 4/12/2016
Whiskeytown profile date: 4/5/2016
Shasta profile date: 4/7/2016
10% Met - Exceedence: May '66, June '73, July '00, Aug '88, Sept '22, Oct '52 and Nov '62
Temp Run date: May 2, 2016
Temperature (°F)
67
66
65
64
63
62
61
60
59
58
57
56
55
54
53
52
51
50
49
48
47
46
45
44
43
42
41
4/30
5/15
5/30
6/14
6/29
7/14
7/29
8/13
8/28
9/12
9/27
10/12
10/27
11/11
11/26
SHASTA
KESWICK
BSF
JSF

Figure 2

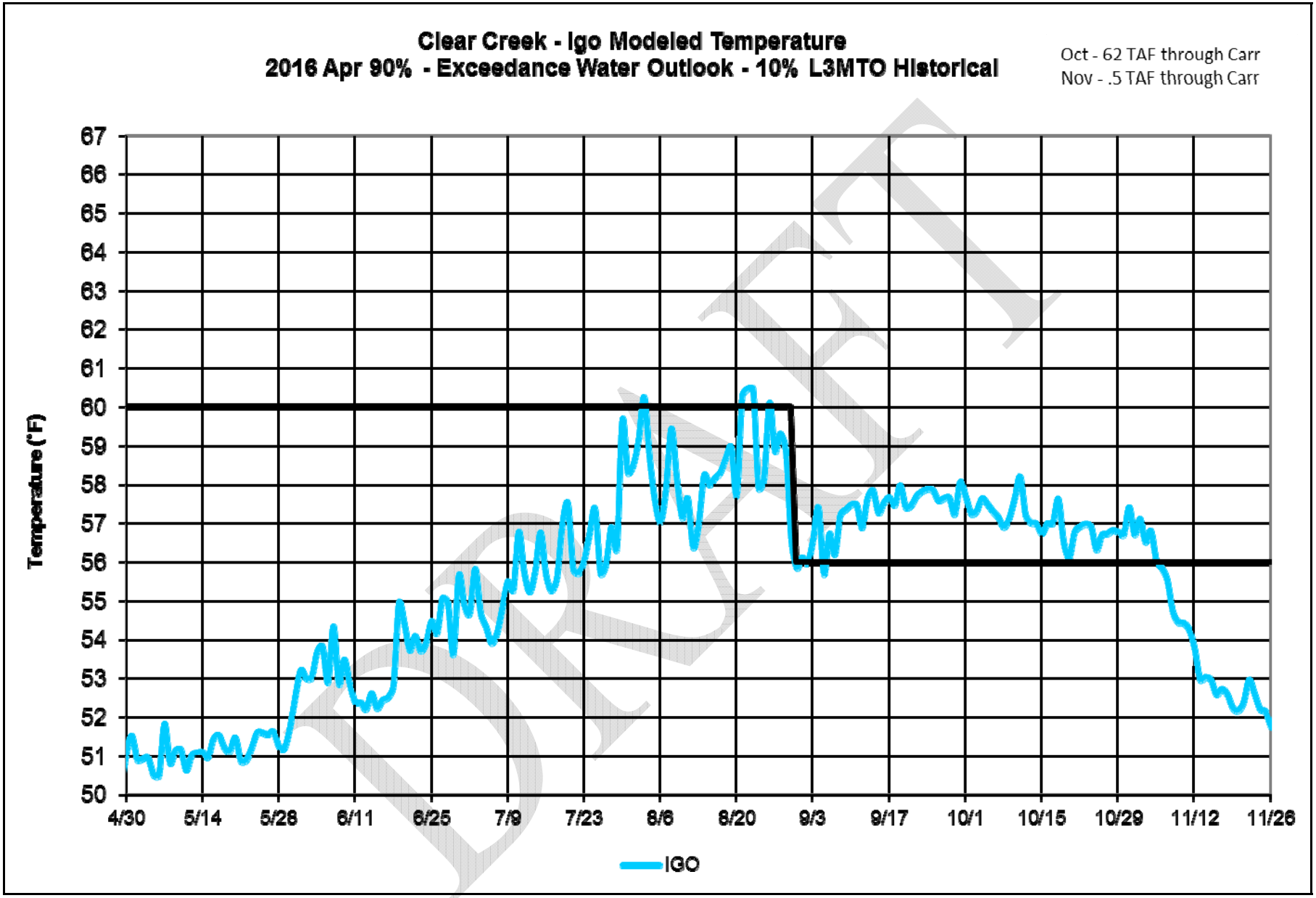

Clear Creek - Igo Modeled Temperature
2016 Apr 90% - Exceedance Water Outlook - 10% L3MTO Historical
Oct - 62 TAF through Carr
Nov - .5 TAF through Carr
Temperature (°F)
67
66
65
64
63
62
61
60
59
58
57
56
55
54
53
52
51
50
4/30
5/14
5/28
6/11
6/25
7/9
7/23
8/6
8/20
9/3
9/17
10/1
10/15
10/29
11/12
11/26
IGO
DRAFT

Figure 3

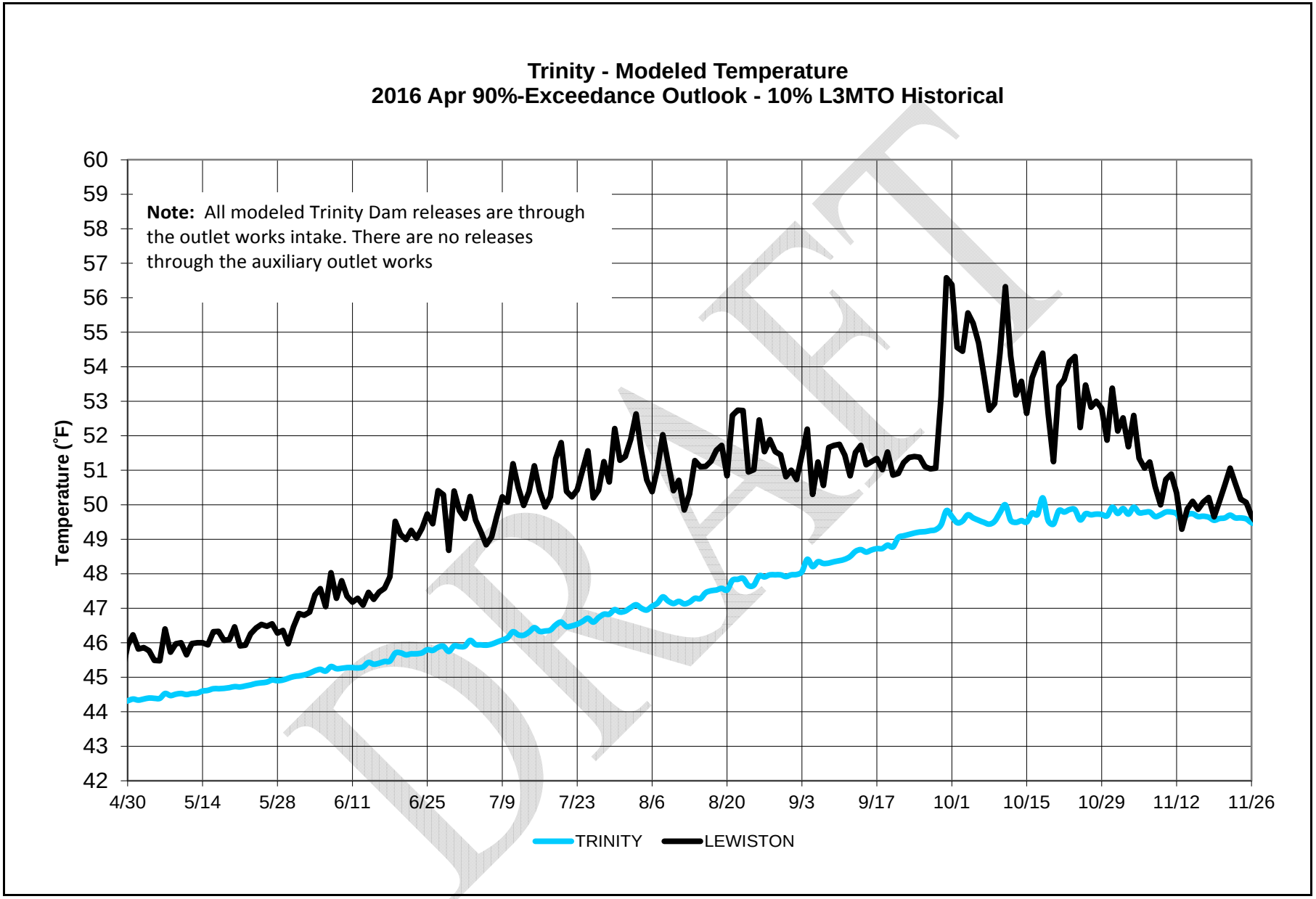
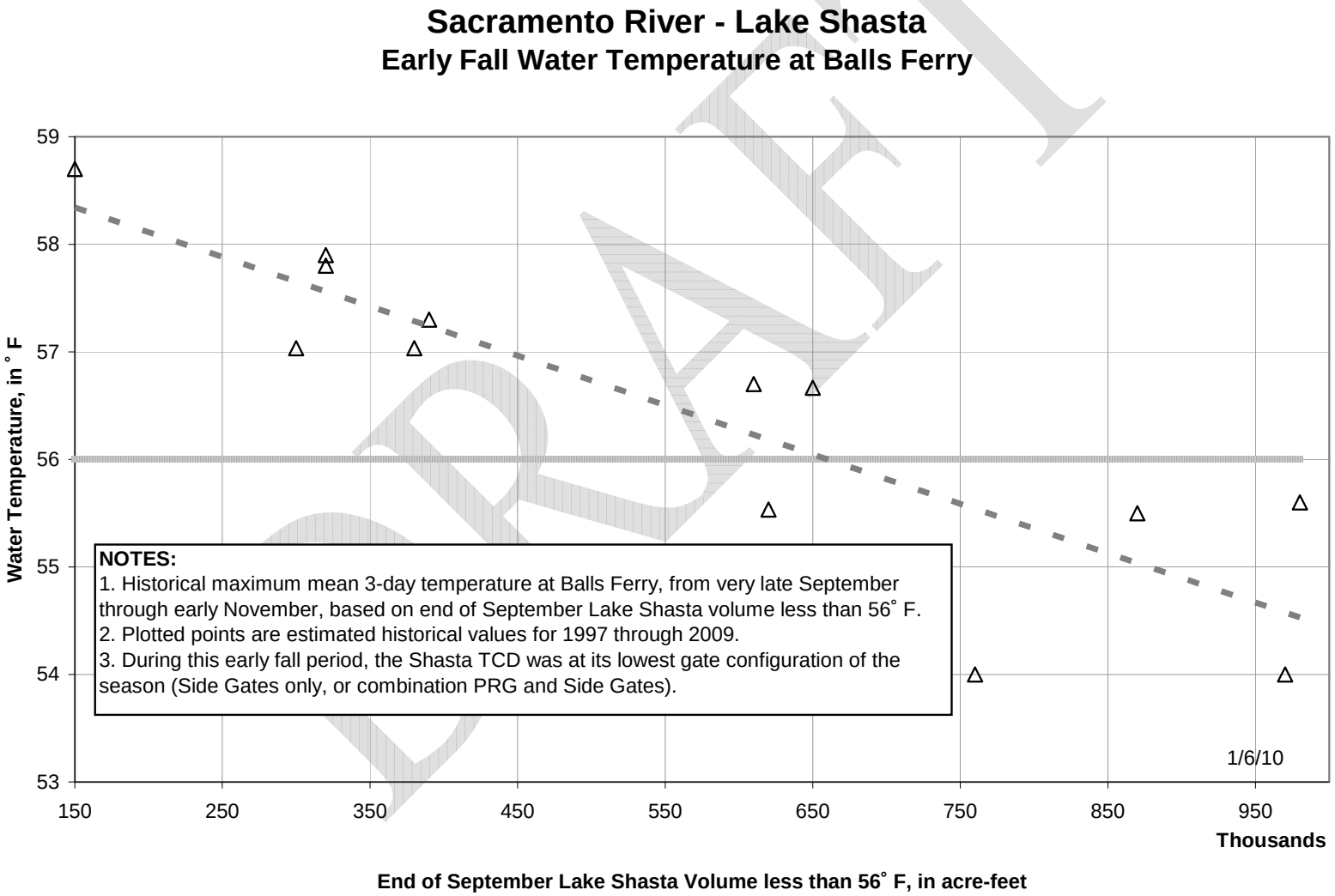

Trinity - Modeled Temperature
2016 Apr 90%-Exceedance Outlook - 10% L3MTO Historical
Note: All modeled Trinity Dam releases are through the outlet works intake. There are no releases through the auxiliary outlet works
Temperature (˚F)
60
59
58
57
56
55
54
53
52
51
50
49
48
47
46
45
44
43
42
4/30
5/14
5/28
6/11
6/25
7/9
7/23
8/6
8/20
9/3
9/17
10/1
10/15
10/29
11/12
11/26
TRINITY
LEWISTON
DRAFT

Figure 4

Model Performance and Fall Temperature Index:

1. Based on past analyses, the temperature model does not perform well from late September through fall. One factor is that the modeled release temperatures are cooler than has historically been achieved when all release is through the side gates (lowest gates), especially when there's a large temperature gradient between the pressure relief gates (PRG) and the side gates.
2. Based on historical records, the end-of-September Lake Shasta volume below 56˚F is a reasonable indicator of fall water temperature in the river reach to Balls Ferry.
3. For river temperatures not to exceed 56 ˚F downstream to Balls Ferry, the end-of-September lake volume less than 56˚F should be greater than about 650 TAF, see figure below:
   **2016 April 90% Exceedance Water Outlook – Full side gates on September 24th.*



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