RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

Sacramento River Temperature Task Group Meeting

February 28, 2019, 1:00 pm Joint Operations Center, Rm 302

Agenda

- Hydrology & Operations update (information is available on web-pages)
  - Daily Operation
  - Summary
  - 8-Station Index and Snow Water Content
  - Operations Outlook
  - Mean Daily Water Temperatures
  - Redding 10-Day Forecasted Air Temperatures
  - Sac River Gage temp plot and air temp plot
  - Lake Shasta Isothermobath Plot
  - Lake Shasta Isotherm Statistics Plots
  - Lake Shasta Current TCD Configuration
  - Trinity Lake Isothermobath Plot
  - Whiskeytown Lake Isothermobath Plot

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. BUREAU OF RECLAMATION-CENTRAL VALLEY PROJECT-CALIFORNIA

DAILY CVP WATER SUPPLY REPORT

FEBRUARY 27, 2019

RUN DATE: February 28, 2019

RESERVOIR RELEASES IN CUBIC FEET/SECOND

RESERVOIR	DAM	WY 2018	WY 2019	15 YR MEDIAN
TRINITY	LEWISTON	322	302	303
SACRAMENTO	KESWICK	3,170	7,037	3,744
FEATHER	OROVILLE (SWP)	2,250	1,750	1,750
AMERICAN	NIMBUS	2,907	24,613	2,250
STANISLAUS	GOODWIN	2,115	1,804	253
SAN JOAQUIN	FRIANT	300	614	140

STORAGE IN MAJOR RESERVOIRS IN THOUSANDS OF ACRE-FEET

RESERVOIR	CAPACITY	15 YR AVG	WY 2018	WY 2019	% OF 15 YR AVG
TRINITY	2,448	1,579	1,786	1,726	109
SHASTA	4,552	3,157	3,411	3,867	122
FOLSOM	977	490	529	596	122
NEW MELONES	2,420	1,484	1,923	2,004	135
FED. SAN LUIS	966	709	847	918	129
TOTAL NORTH CVP	11,363	7,419	8,496	9,111	123
MILLERTON	520	309	329	366	118
OROVILLE (SWP)	3,538	2,094	1,458	2,131	102

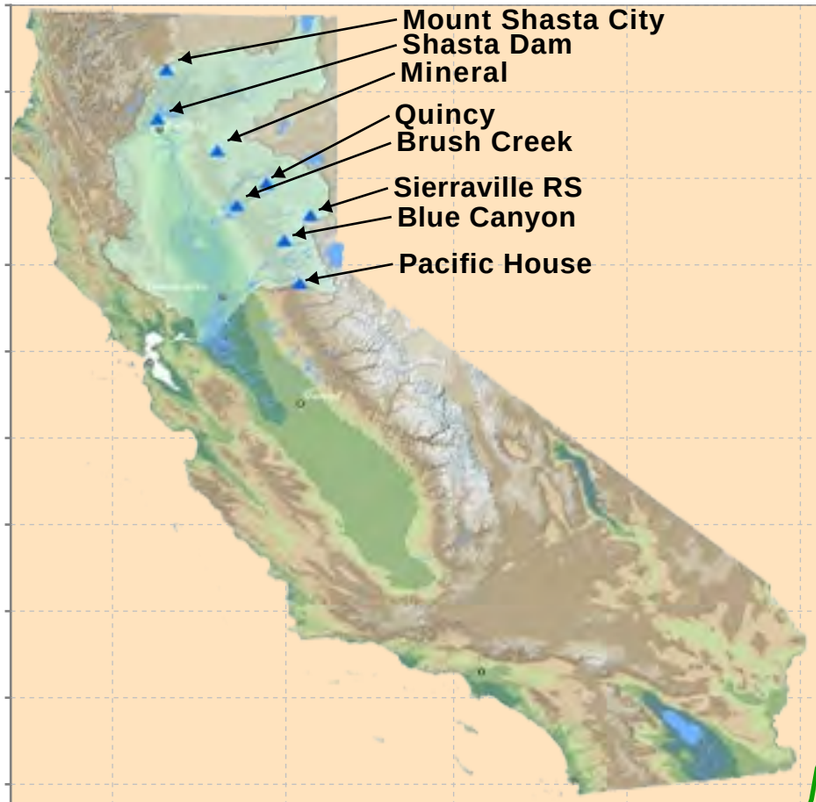
ACCUMULATED INFLOW FOR WATER YEAR TO DATE IN THOUSANDS OF ACRE-FEET

RESERVOIR	CURRENT WY 2019	WY 1977	WY 1983	15 YR AVG	% OF 15 YR AVG
TRINITY	370	56	738	406	91
SHASTA	2,555	1,142	4,167	2,302	111
FOLSOM	1,136	160	2,282	1,016	112
NEW MELONES	365	----	760	342	107
MILLERTON	401	99	1,125	351	114

ACCUMULATED PRECIPITATION FOR WATER YEAR TO DATE IN INCHES

RESERVOIR	CURRENT WY 2019	WY 1977	WY 1983	AVG (N YRS)	% OF AVG	LAST 24 HRS
TRINITY AT FISH HATCHERY	23.91	6.47	34.76	22.71 (57)	105	2.07
SACRAMENTO AT SHASTA DAM	56.01	7.82	65.82	43.20 (62)	130	7.20
AMERICAN AT BLUE CANYON	58.36	11.54	69.50	45.51 (44)	128	0.00
STANISLAUS AT NEW MELONES	27.66	----	29.64	18.76 (41)	147	0.00
SAN JOAQUIN AT HUNTINGTON LK	38.63	7.80	56.90	28.07 (44)	138	0.00

Northern Sierra Precipitation: 8-Station Index, February 28, 2019



Percent of Average for this Date: 133%

2016-2017 Daily Precip (wettest) 94.7

1982-1983 (2nd wettest) 88.5

1997-1998 82.4

47.7

Average (1966-2015) 51.8

2017-2018 Daily Precip 41.0

2014-2015 Daily Precip 37.2

1976-1977(2nd driest & driest thru Aug) 19.0

Cumulative Daily/Monthly Precipitation (inches)

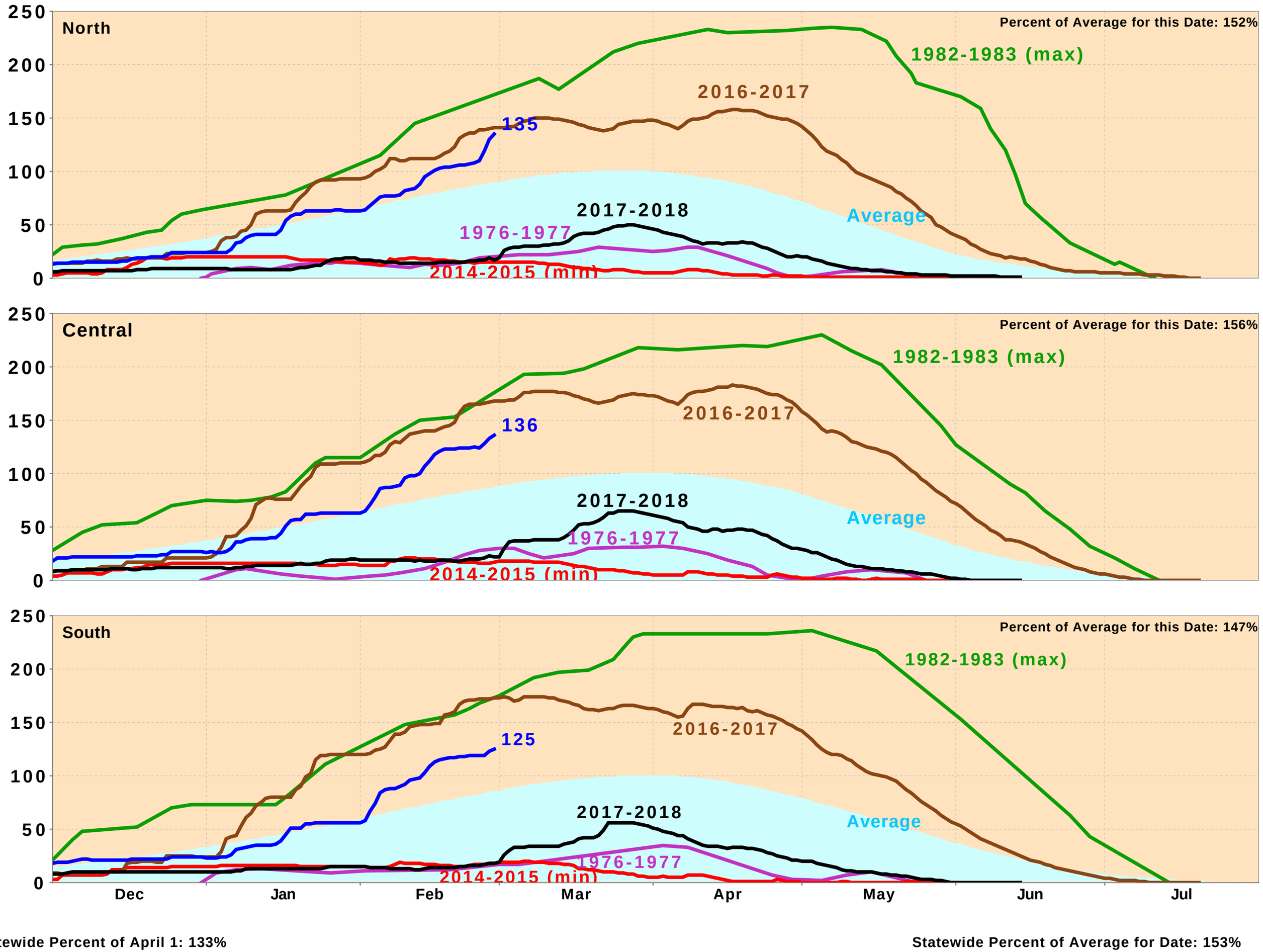
Total Water Year Precipitation

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

Oct 1 Nov 1 Dec 1 Jan 1 Feb 1 Mar 1 Apr 1 May 1 Jun 1 Jul 1 Aug 1 Sep 1 Oct 1

Water Year (October 1 - September 30)

California Snow Water Content, February 28, 2019, Percent of April 1 Average



Statewide Percent of April 1: 133%

Statewide Percent of Average for Date: 153%

Upper Sacramento River Summary Conditions – February (On-going):

Storage/Release Management Conditions:

- Meteorological Uncertainty: Shorter term forecasts (8-14 day) suggest increased chances of precipitation
- Longer term forecasts (one-month outlook) suggest equal chances of above or below precipitation
- Current Lake Shasta encroachment into the flood space: 34%
- Current release from Keswick Dam: 25,000 cfs Keswick side flow and Shasta flood space management

Temperature Management:

- Temperature management: Active management has concluded for the season. Seasonal cooling is controlling water temperatures.
- Selective withdrawal: Releases are made from Upper and Middle Gates – rebuilding cold water pool reserves
- Meteorological Uncertainty: Shorter term forecasts (8-14 day) suggest below normal temperatures
- Longer term forecasts (one-month outlook) suggest equal chances of above or below normal temperatures.

Resources:

- Excellent link for short term precipitation forecasts, overlay with burn areas, debris flow potential, etc: https://www.cnrfc.noaa.gov/
- Comprehensive Upper Sacramento fishery information: https://www.calfish.org/ProgramsData/ConservationandManagement/CentralValleyMonitoring/CDFWUpperSacRiverBasinSalmonidMonitoring.aspx

CVP Northern System Operation Outlooks

DRAFT February 2019

90% Runoff Exceedance Outlook:

Inflow based on DWR B120 90%; Historical Inflows Oct and future months

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

		Feb	Mar	Apr	May	Jun	Jul	Aug
Shasta	2912	3517	3996	4045	3863	3583	3199	2887
Elev.		1029	1048	1049	1043	1032	1016	1003

Monthly River Releases (cfs)

	Feb	Mar	Apr	May	Jun	Jul	Aug
Sacramento	3250	3250	7517	8593	10500	10885	9610
Clear Creek	200	200	218	216	288	150	150

Trinity Diversions (TAF)

	Feb	Mar	Apr	May	Jun	Jul	Aug
Carr Power Plant	8	92	72	7	135	130	131
Spring Creek PP	10	99	42	0	120	120	120

50% Runoff Exceedance Outlook:

Inflow based on DWR B120 50%; Historical Inflows Oct and future months

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

		Feb	Mar	Apr	May	Jun	Jul	Aug
Shasta	2912	3542	4127	4404	4359	4108	3684	3336
Elev.		1030	1052	1062	1060	1052	1036	1022

Monthly River Releases (cfs)

	Feb	Mar	Apr	May	Jun	Jul	Aug
Sacramento	3250	3250	5500	8000	10000	11500	10000
Clear Creek	200	200	218	216	288	150	150

Trinity Diversions (TAF)

	Feb	Mar	Apr	May	Jun	Jul	Aug
Carr Power Plant	0	5	51	1	91	89	90
Spring Creek PP	35	30	30	2	80	80	80

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.

Estimated CVP Operations 90% Exceedance

Storages

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

		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Trinity	**1587**	**1657**	**1664**	**1715**	**1756**	**1663**	**1511**	**1328**	**1225**	**1194**	**1163**	**1145**	**1144**
	Elev.	2316	2316	2320	2323	2316	2304	2288	2279	2276	2273	2271	2271
Whiskeytown	**207**	**206**	**206**	**238**	**238**	**238**	**238**	**238**	**238**	**206**	**206**	**206**	**206**
	Elev.	1199	1199	1209	1209	1209	1209	1209	1209	1199	1199	1199	1199
Shasta	**2912**	**3517**	**3996**	**4045**	**3863**	**3583**	**3199**	**2887**	**2650**	**2451**	**2398**	**2422**	**2503**
	Elev.	1029	1048	1049	1043	1032	1016	1003	992	982	979	980	984
Folsom	**523**	**609**	**656**	**798**	**911**	**917**	**761**	**669**	**618**	**542**	**474**	**415**	**384**
	Elev.	430	435	449	460	461	446	436	430	422	413	405	401
New Melones	**1871**	**1975**	**1940**	**1882**	**1821**	**1740**	**1670**	**1606**	**1558**	**1507**	**1509**	**1513**	**1515**
	Elev.	1050	1047	1041	1036	1028	1021	1014	1009	1004	1004	1005	1005
San Luis	**813**	**897**	**924**	**799**	**579**	**292**	**95**	**4**	**36**	**157**	**340**	**553**	**682**
	Elev.	537	540	523	498	465	438	424	437	452	468	507	528
Total		8860	9386	9477	9168	8433	7474	6731	6325	6057	6090	6254	6434

Monthly River Releases (TAF/cfs)

Trinity	TAF	17	18	32	180	47	28	53	52	23	18	18	18
	cfs	**300**	**300**	**540**	**2,924**	**783**	**450**	**857**	**870**	**373**	**300**	**300**	**300**
Clear Creek	TAF	11	12	13	13	17	9	9	9	12	12	12	12
	cfs	**200**	**200**	**218**	**216**	**288**	**150**	**150**	**150**	**200**	**200**	**200**	**200**
Sacramento	TAF	180	200	447	528	625	669	591	436	428	296	246	246
	cfs	**3250**	**3250**	**7517**	**8593**	**10500**	**10885**	**9610**	**7334**	**6955**	**4968**	**4000**	**4000**
American	TAF	555	184	89	92	89	219	154	113	111	108	111	92
	cfs	**10000**	**3000**	**1500**	**1500**	**1500**	**3570**	**2505**	**1896**	**1800**	**1807**	**1800**	**1500**
Stanislaus	TAF	83	93	83	92	56	18	18	18	49	12	12	14
	cfs	**1500**	**1521**	**1400**	**1500**	**940**	**300**	**300**	**300**	**797**	**200**	**200**	**232**

Trinity Diversions (TAF)

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Carr PP	8	92	72	7	135	130	131	50	14	25	21	15
Spring Crk. PP	**10**	**99**	**42**	**0**	**120**	**120**	**120**	**40**	**35**	**15**	**12**	**10**

Delta Summary (TAF)

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Tracy	200	170	54	55	89	231	265	260	260	250	258	180
USBR Banks	0	0	0	0	0	18	18	18	0	0	0	0
Contra Costa	14.0	12.7	12.7	12.7	9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0
Total USBR	214	183	66	68	99	260	296	292	277	268	276	194
Total Export	396	295	102	105	159	318	377	447	391	327	534	374
COA Balance	0	0	0	0	0	0	0	82	94	0	0	0
Old/Middle River Std.												
Old/Middle R. calc.	-4,839	-2,967	-848	-790	-1,988	-4,198	-4,969	-5,983	-4,782	-4,375	-6,731	-4,709
Computed DOI	29807	21099	12355	9500	7699	4490	3156	2807	3611	4202	7499	9988
Excess Outflow	18406	10801	2252	2635	840	0	0	0	0	0	3432	4571
% Export/Inflow	19%	18%	10%	12%	19%	36%	46%	57%	53%	50%	52%	39%
% Export/Inflow std.	45%	35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%

Hydrology

	Trinity	Shasta	Folsom	New Melones
Water Year Inflow (TAF)	948	4,460	2,281	956
Year to Date + Forecasted % of mean	78%	81%	84%	90%

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2/14/2019

Estimated CVP Operations 50% Exceedance

Storages

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

		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Trinity	**1587**	**1703**	**1850**	**2014**	**2024**	**1929**	**1822**	**1691**	**1553**	**1528**	**1515**	**1542**	**1606**
	Elev.	2319	2330	2342	2343	2336	2328	2318	2308	2305	2304	2307	2312
Whiskeytown	**207**	**206**	**206**	**238**	**238**	**238**	**238**	**238**	**238**	**206**	**206**	**206**	**206**
	Elev.	1199	1199	1209	1209	1209	1209	1209	1209	1199	1199	1199	1199
Shasta	**2912**	**3542**	**4127**	**4404**	**4359**	**4108**	**3684**	**3336**	**3124**	**2964**	**2925**	**3011**	**3371**
	Elev.	1030	1052	1062	1060	1052	1036	1022	1013	1006	1004	1008	1023
Folsom	**523**	**609**	**676**	**788**	**932**	**877**	**745**	**665**	**618**	**569**	**540**	**529**	**526**
	Elev.	430	437	448	462	457	444	436	430	425	421	420	420
New Melones	**1871**	**1975**	**1966**	**1926**	**1893**	**1866**	**1803**	**1739**	**1695**	**1654**	**1670**	**1694**	**1726**
	Elev.	1050	1049	1046	1042	1040	1034	1028	1023	1019	1021	1023	1026
San Luis	**813**	**888**	**947**	**801**	**564**	**420**	**219**	**94**	**114**	**235**	**411**	**621**	**780**
	Elev.	535	542	519	485	458	440	438	453	467	493	527	546
Total		8923	9772	10171	10011	9437	8512	7763	7341	7156	7267	7602	8215

Monthly River Releases (TAF/cfs)

Trinity	TAF	17	18	28	258	126	68	53	52	23	18	18	18
	cfs	**300**	**300**	**477**	**4,189**	**2,120**	**1,102**	**857**	**870**	**373**	**300**	**300**	**300**
Clear Creek	TAF	11	12	13	13	17	9	9	9	12	12	12	15
	cfs	**200**	**200**	**218**	**216**	**288**	**150**	**150**	**150**	**200**	**200**	**200**	**240**
Sacramento	TAF	180	200	327	492	595	707	615	476	428	355	307	246
	cfs	**3250**	**3250**	**5500**	**8000**	**10000**	**11500**	**10000**	**8000**	**6955**	**5975**	**5000**	**4000**
American	TAF	555	307	208	184	208	222	161	126	123	119	123	154
	cfs	**10000**	**5000**	**3500**	**3000**	**3500**	**3612**	**2611**	**2113**	**2000**	**2002**	**2000**	**2500**
Stanislaus	TAF	83	93	83	96	56	18	18	18	49	12	12	14
	cfs	**1500**	**1521**	**1400**	**1555**	**940**	**300**	**300**	**300**	**797**	**200**	**200**	**232**

Trinity Diversions (TAF)

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Carr PP	0	5	51	1	91	89	90	89	13	25	12	0
Spring Crk. PP	**35**	**30**	**30**	**2**	**80**	**80**	**80**	**80**	**35**	**20**	**15**	**20**

Delta Summary (TAF)

		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Tracy		200	208	54	55	259	270	265	265	265	246	260	215
USBR Banks		0	0	0	0	0	22	22	22	0	0	0	0
Contra Costa		14.0	12.7	12.7	12.7	9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0
Total USBR		214	221	66	68	269	303	300	301	282	264	278	229
Total Export		414	421	102	105	356	560	612	605	436	472	538	424
COA Balance		0	0	0	0	0	3	77	215	240	239	239	239
Old/Middle River Std.													
Old/Middle R. calc.		-3,841	-3,440	-46	281	-4,212	-6,995	-7,707	-7,839	-5,119	-5,956	-6,577	-5,028
Computed DOI		39623	29167	18575	16414	7833	5872	3611	2807	3611	4202	9760	29102
Excess Outflow		28222	18870	8069	6865	0	0	0	0	0	0	5694	23685
% Export/Inflow		16%	19%	7%	8%	35%	47%	56%	64%	56%	60%	46%	19%
% Export/Inflow std.		45%	35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	1266		4,990		2,755		1097	
Year to Date + Forecasted % of mean	105%		90%		101%		104%	

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2/14/2019

Northern CVP Water Temperature Report

February - 2019

DATE	Mean Daily Water Temperatures (°F)													Mean Daily Release (CFS)			Mean Daily Air Temperatures (°F)			
	TCD[1]	SHD	SPP[1]	KWK	SAC	CCR	BSF[2]	JLF	BND	RDB	IGO	LWS	-----[3]	Shasta Generation	Spring Creek P.P.	Keswick Total	RDD	BSF	RDB	LWS
Jan	51.5	51.0	48.6	50.3	50.1	50.4	49.3	49.2	48.9	49.1	47.9	42.9	-	2334	743	3587	50.7	47.4	48.8	40.3
02/01	50.5	49.6	48.1	50.0	50.0	50.4	**51.0**	51.5	# -	52.0	48.4	# -	-	2251	327	3151	53.5	53.0	54.5	-
02/02	50.2	49.8	47.9	50.2	# -	50.6	**50.8**	51.0	# -	51.5	49.1	# -	-	2097	538	3163	52.0	50.8	51.6	-
02/03	50.3	49.7	48.0	49.9	# -	50.3	**50.3**	50.5	# -	50.8	49.0	# -	-	2223	340	3236	48.5	47.8	49.7	-
02/04	50.0	49.4	48.1	49.8	# -	49.8	**47.7**	48.3	# -	49.1	47.8	# -	-	2039	906	3235	44.0	43.5	45.7	-
02/05	49.9	49.3	48.0	49.4	# -	49.5	**47.0**	47.0	# -	47.2	46.0	# -	-	989	1647	3228	41.0	40.6	42.2	-
02/06	50.0	49.3	48.0	49.0	! -	49.0	**47.3**	46.9	# -	46.9	46.2	# -	-	1978	542	3314	40.0	39.8	40.9	-
02/07	49.9	49.4	47.8	48.8	48.6	48.6	**47.0**	46.6	# -	46.4	46.5	# -	-	1833	729	3388	40.5	37.8	39.2	-
02/08	50.0	49.3	47.8	48.7	48.5	48.7	**47.8**	47.5	# -	47.0	46.8	# -	-	2217	481	3397	43.5	42.4	43.0	-
02/09	49.9	49.0	47.7	48.5	48.2	48.3	**47.8**	47.7	# -	47.7	46.1	# -	-	2254	469	3300	42.0	43.4	43.9	-
02/10	49.4	48.9	47.5	48.4	47.9	47.9	**46.0**	45.9	# -	46.4	45.2	# -	-	1987	382	3296	38.0	38.4	39.8	-
02/11	49.4	48.7	47.6	48.4	48.1	48.1	**46.5**	46.2	# -	45.7	45.6	# -	-	2866	556	3303	40.5	43.0	42.1	-
02/12	49.4	48.7	47.4	? 48.2	47.9	48.0	**47.2**	47.0	# -	46.6	? 45.8	# -	-	1718	1355	3291	43.5	41.6	42.0	-
02/13	49.3	48.5	46.8	? 47.1	44.8	? 45.2	**39.6**	40.4	# -	42.3	? 41.9	# -	-	2130	990	3292	36.0	35.0	37.9	-
02/14	49.3	48.9	46.8	46.9	43.9	45.4	**40.7**	40.3	# -	40.2	44.4	# -	-	802	1404	3361	43.5	43.3	47.1	-
02/15	49.6	48.5	46.9	47.0	46.6	47.1	**45.2**	44.4	# -	43.7	45.8	# -	-	673	1654	3389	43.5	46.3	46.3	-
02/16	48.8	48.3	46.8	47.2	47.1	47.5	**46.8**	46.4	# -	45.9	46.0	# -	-	2022	585	3391	47.0	46.1	46.3	-
02/17	48.9	48.4	46.6	47.7	47.4	47.6	**46.9**	46.7	# -	46.9	45.1	# -	-	1962	494	3391	44.5	42.3	44.0	-
02/18	49.0	48.3	46.5	47.7	47.5	47.8	**46.4**	46.0	# -	46.3	44.5	# -	-	1428	1877	3389	44.5	42.9	44.7	-
02/19	49.3	48.3	46.6	47.5	47.3	47.6	**46.4**	46.1	# -	46.1	44.5	# -	-	2442	406	3345	44.5	43.2	45.0	-
02/20	49.1	48.2	46.5	47.8	47.7	48.1	**47.4**	47.3	# -	47.0	45.0	# -	-	1867	731	3346	44.5	44.9	45.7	-
02/21	48.8	48.2	46.4	47.7	47.7	47.9	**47.3**	47.2	# -	47.4	44.5	# -	-	1938	1363	3346	45.0	43.9	45.2	-
02/22	48.7	48.3	46.3	47.5	47.4	47.6	**46.6**	46.3	# -	46.5	44.2	# -	-	2245	1003	3339	47.0	43.3	44.7	-
02/23	48.6	47.9	46.4	47.5	47.3	47.5	**46.8**	46.4	# -	46.5	44.6	# -	-	2812	470	3340	42.0	41.8	42.7	-
02/24	48.5	47.7	46.2	47.7	47.4	47.6	**47.3**	47.3	# -	47.1	45.2	# -	-	2125	887	3339	46.5	47.3	47.5	-
02/25	48.9	47.8	46.2	47.4	47.2	47.5	**47.3**	47.4	# -	47.4	45.3	# -	-	1208	663	3342	49.5	50.7	49.4	-
02/26	50.2	48.8	46.3	47.8	47.8	48.0	**47.9**	47.9	# -	47.9	? 47.3	# -	-	25	428	5047	50.5	50.9	50.0	-
02/27	48.1	48.6	46.2	48.0	48.4	48.5	**48.7**	48.3	# -	48.2	? 47.7	# -	-	1690	1692	7037	53.5	52.9	52.6	-
02/28																				
-																				
-																				
-																				
Feb	49.4	48.7	47.1	48.2	47.5	48.2	47.0	46.8	-	46.9	45.9	-	-	1845	849	3518	44.8	44.3	45.3	-
												Total CFS		49821	22919	94996				
												Total AF		98818	45459	188421				

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
Highlighted cells in the TCD column indicate a TCD change was made on that day
[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
02/01	41	69	55.0	51	57	54.0	47	55	51.0	42	54	48.0	35	48	41.5	28	51	39.5	28	55	41.5	29	55	42.0	35	56	45.5	37	58	47.5	36	61	48.5	43	62	52.5
02/02	50	57	53.5	49	55	52.0	43	52	47.5	38	48	43.0	30	50	40.0	28	51	39.5	27	52	39.5	32	50	41.0	38	53	45.5	40	53	46.5	36	57	46.5	39	63	51.0
02/03	48	56	52.0	47	52	49.5	38	47	42.5	28	47	37.5	28	51	39.5	28	50	39.0	32	49	40.5	34	49	41.5	39	57	48.0	39	57	48.0	37	60	48.5	39	63	51.0
02/04	46	51	48.5	42	47	44.5	28	48	38.0	27	51	39.0	28	51	39.5	32	50	41.0	33	49	41.0	35	51	43.0	40	55	47.5	39	52	45.5	38	58	48.0	40	56	48.0
02/05	38	50	44.0	32	49	40.5	28	50	39.0	29	51	40.0	36	50	43.0	35	49	42.0	35	49	42.0	33	50	41.5	37	52	44.5	37	58	47.5	40	60	50.0	40	59	49.5
02/06	31	51	41.0	30	50	40.0	28	50	39.0	34	49	41.5	34	48	41.0	36	49	42.5	30	49	39.5	33	50	41.5	37	57	47.0	43	60	51.5	40	61	50.5	39	59	49.0
02/07	30	50	40.0	31	50	40.5	34	49	41.5	34	48	41.0	35	47	41.0	30	49	39.5	33	50	41.5	34	53	43.5	37	58	47.5	38	51	44.5	35	55	45.0	39	58	48.5
02/08	31	50	40.5	37	50	43.5	34	48	41.0	30	47	38.5	30	48	39.0	35	50	42.5	35	50	42.5	36	52	44.0	38	50	44.0	38	53	45.5	36	57	46.5	38	60	49.0
02/09	36	51	43.5	36	48	42.0	29	47	38.0	32	47	39.5	37	50	43.5	36	49	42.5	32	52	42.0	36	49	42.5	39	52	45.5	37	53	45.0	35	56	45.5	40	60	50.0
02/10	35	49	42.0	30	47	38.5	33	45	39.0	39	49	44.0	36	50	43.0	32	53	42.5	35	50	42.5	35	50	42.5	36	54	45.0	38	60	49.0	38	63	50.5	41	64	52.5
02/11	28	48	38.0	33	44	38.5	37	46	41.5	38	49	43.5	34	53	43.5	37	52	44.5	35	52	43.5	34	51	42.5	44	59	51.5	40	63	51.5	42	65	53.5	42	64	53.0
02/12	32	49	40.5	41	47	44.0	38	49	43.5	39	55	47.0	37	50	43.5	35	51	43.0	33	52	42.5	31	54	42.5	35	56	45.5	44	60	52.0	40	63	51.5	42	65	53.5
02/13	41	46	43.5	33	42	37.5	41	55	48.0	36	48	42.0	36	49	42.5	33	51	42.0	30	53	41.5	30	53	41.5	35	57	46.0	43	61	52.0	39	63	51.0	42	65	53.5
02/14	33	39	36.0	38	55	46.5	38	48	43.0	37	50	43.5	32	52	42.0	32	53	42.5	32	53	42.5	35	51	43.0	38	55	46.5	39	56	47.5	37	58	47.5	39	64	51.5
02/15	36	51	43.5	36	48	42.0	38	51	44.5	32	51	41.5	32	53	42.5	32	52	42.0	35	51	43.0	34	51	42.5	35	56	45.5	41	58	49.5	36	61	48.5	39	65	52.0
02/16	36	51	43.5	38	50	44.0	31	51	41.0	30	54	42.0	29	52	40.5	32	50	41.0	30	47	38.5	29	51	40.0	36	58	47.0	40	58	49.0	40	58	49.0	42	62	52.0
02/17	38	56	47.0	37	51	44.0	27	53	40.0	27	53	40.0	30	50	40.0	30	50	40.0	30	53	41.5	32	52	42.0	40	58	49.0	46	56	51.0	44	61	52.5	42	66	54.0
02/18	36	53	44.5	35	52	43.5	29	54	41.5	32	51	41.5	30	52	41.0	30	53	41.5	33	52	42.5	37	51	44.0	43	59	51.0	40	61	50.5	45	67	56.0	46	70	58.0
02/19	34	55	44.5	33	55	44.0	34	51	42.5	30	53	41.5	32	55	43.5	31	51	41.0	35	51	43.0	34	52	43.0	39	54	46.5	37	59	48.0	42	65	53.5	44	70	57.0
02/20	31	58	44.5	36	52	44.0	34	54	44.0	30	56	43.0	35	52	43.5	37	51	44.0	35	52	43.5	37	51	44.0	45	59	52.0	42	61	51.5	40	63	51.5	40	62	51.0
02/21	35	54	44.5	37	53	45.0	31	56	43.5	34	52	43.0	38	53	45.5	41	53	47.0	42	55	48.5	43	56	49.5	46	58	52.0	46	65	55.5	45	65	55.0	42	66	54.0
02/22	35	55	45.0	35	56	45.5	33	52	42.5	39	53	46.0	42	53	47.5	44	55	49.5	44	58	51.0	43	61	52.0	47	59	53.0	49	59	54.0	47	61	54.0	42	63	52.5
02/23	35	59	47.0	32	52	42.0	40	54	47.0	43	53	48.0	45	55	50.0	46	58	52.0	43	59	51.0	40	57	48.5	41	55	48.0	47	60	53.5	46	63	54.5	42	63	52.5
02/24	31	53	42.0	43	51	47.0	43	52	47.5	43	53	48.0	45	58	51.5	41	56	48.5	37	58	47.5	41	55	48.0	43	59	51.0	44	62	53.0	41	61	51.0	41	63	52.0
02/25	43	50	46.5	50	52	51.0	45	53	49.0	45	57	51.0	38	56	47.0	35	58	46.5	40	54	47.0	42	58	50.0	36	61	48.5	43	63	53.0	41	65	53.0	41	66	53.5
02/26	48	51	49.5	49	53	51.0	45	56	50.5	37	56	46.5	36	58	47.0	40	54	47.0	41	61	51.0	39	61	50.0	40	61	50.5	43	63	53.0	46	63	54.5	45	61	53.0
02/27	49	52	50.5	49	56	52.5	38	55	46.5	36	57	46.5	39	55	47.0	42	60	51.0	43	61	52.0	43	57	50.0	46	61	53.5	46	62	54.0	46	65	55.5	44	66	55.0
02/28	48	59	53.5	40	54	47.0	38	55	46.5	41	58	49.5	42	58	50.0	44	60	52.0	42	58	50.0	45	57	51.0	44	59	51.5	40	60	50.0	40	64	52.0	41	70	55.5
-																																				
-																																				
-																																				

Web Links

[10-Day Min/Max Forecast]

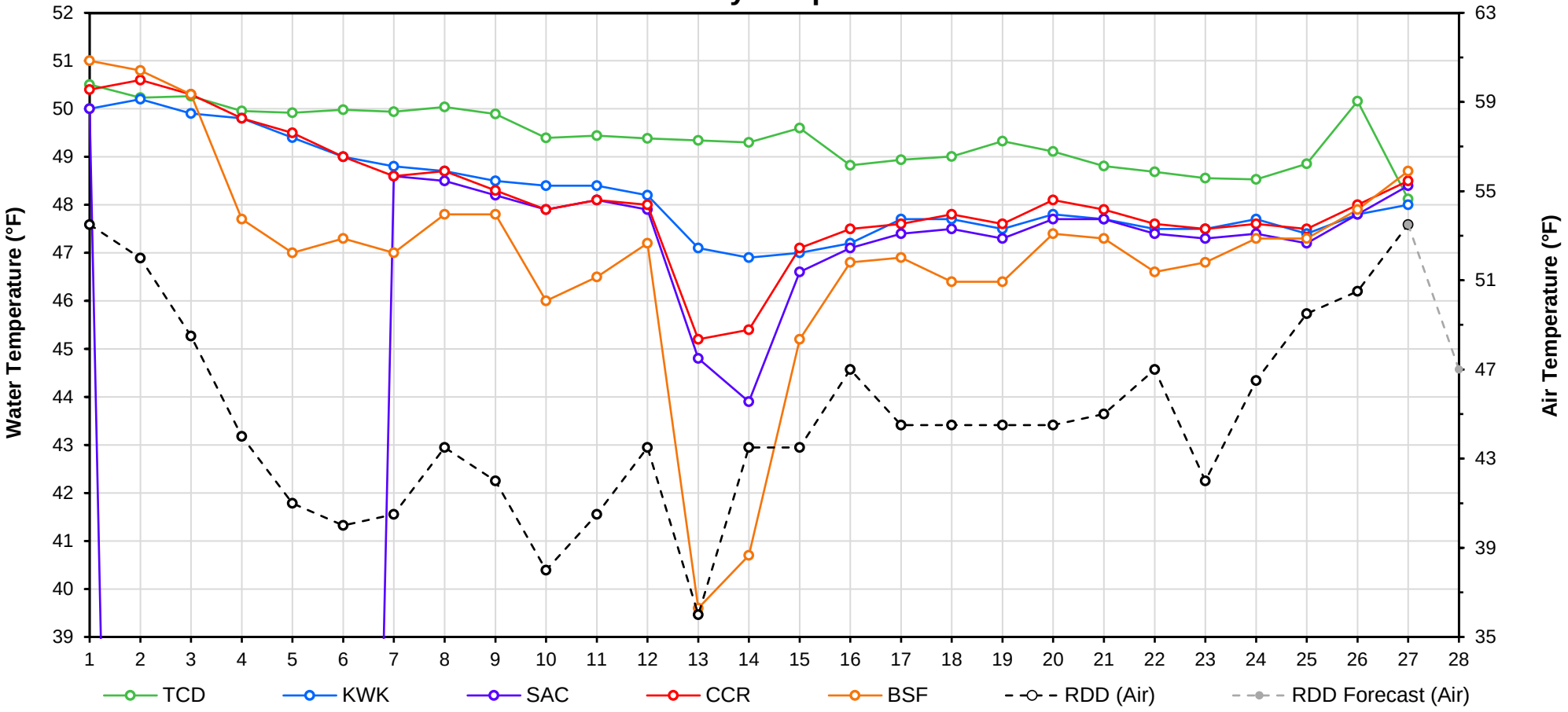
[Previous Days Min/Max Actuals]

Legend

NR = Forecasted temperatures not recorded

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

Mean Daily Temperatures



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	Clear 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)	Begin Date
BSF	**56.0**	**05/25/2018**

Notes

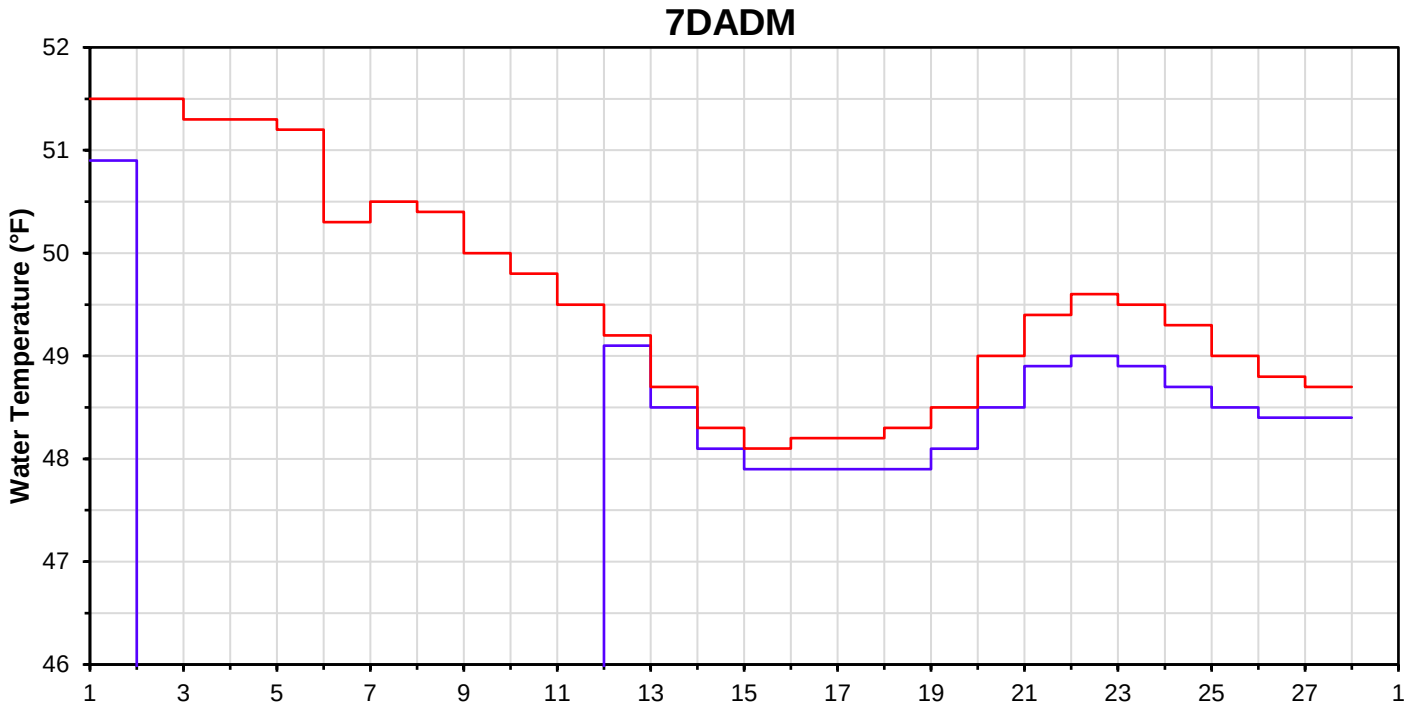
[1] Distances are approximate
[2] DGC is only reported in September
[3] NFH is only reported in October, November and December

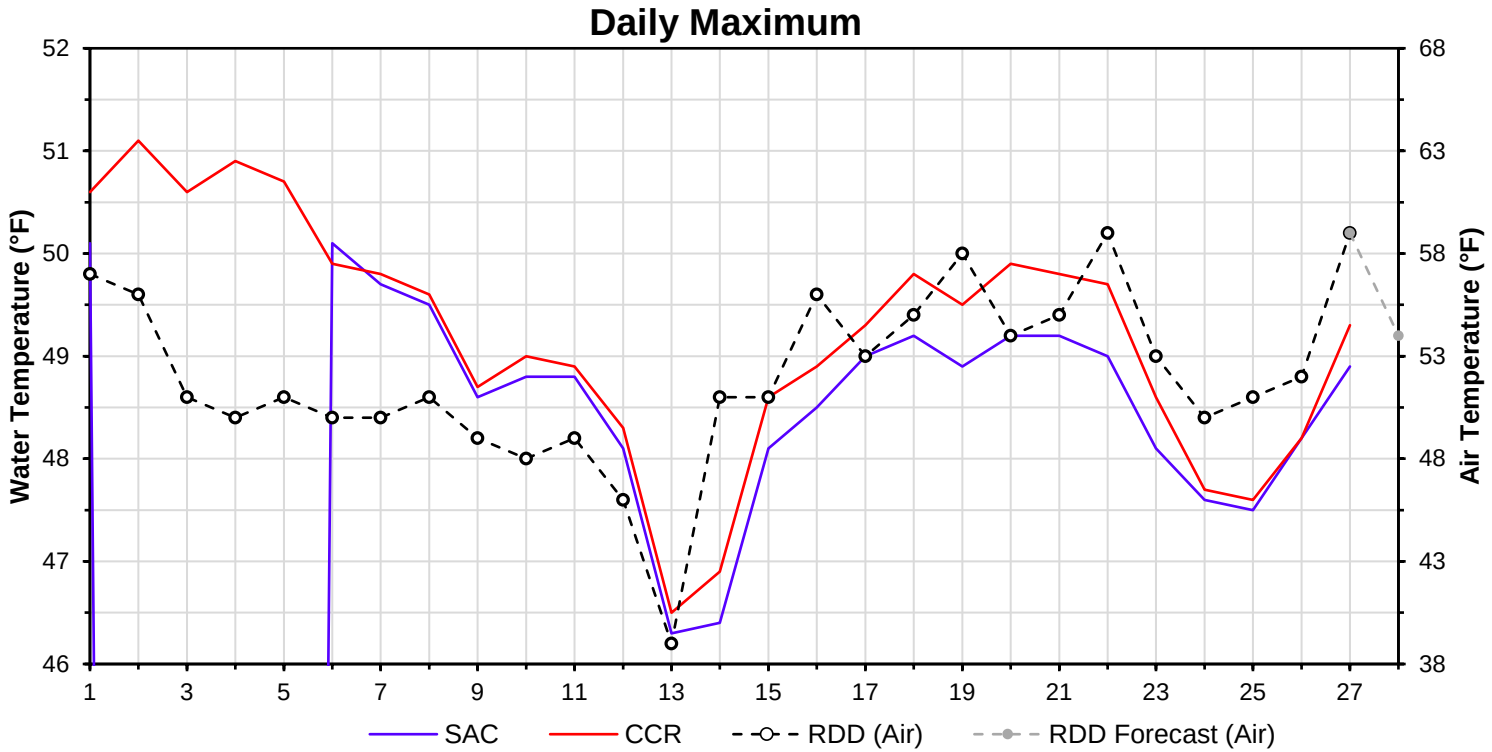
DATE	Daily Max		7DADM[1]		DAT[2]
	SAC	CCR	SAC	CCR	BSF
02/01	50.1	50.6	50.9	51.5	51.0
02/02	-	51.1	-	51.5	50.8
02/03	-	50.6	-	51.3	50.3
02/04	-	50.9	-	51.3	47.7
02/05	-	50.7	-	51.2	47.0
02/06	50.1	49.9	-	50.3	47.3
02/07	49.7	49.8	-	50.5	47.0
02/08	49.5	49.6	-	50.4	47.8
02/09	48.6	48.7	-	50.0	47.8
02/10	48.8	49.0	-	49.8	46.0
02/11	48.8	48.9	-	49.5	46.5
02/12	48.1	48.3	49.1	49.2	47.2
02/13	46.3	46.5	48.5	48.7	39.6
02/14	46.4	46.9	48.1	48.3	40.7
02/15	48.1	48.6	47.9	48.1	45.2
02/16	48.5	48.9	47.9	48.2	46.8
02/17	49.0	49.3	47.9	48.2	46.9
02/18	49.2	49.8	47.9	48.3	46.4
02/19	48.9	49.5	48.1	48.5	46.4
02/20	49.2	49.9	48.5	49.0	47.4
02/21	49.2	49.8	48.9	49.4	47.3
02/22	49.0	49.7	49.0	49.6	46.6
02/23	48.1	48.6	48.9	49.5	46.8
02/24	47.6	47.7	48.7	49.3	47.3
02/25	47.5	47.6	48.5	49.0	47.3
02/26	48.2	48.2	48.4	48.8	47.9
02/27	48.9	49.3	48.4	48.7	48.7
02/28					
-					
-					
-					

Notes

[1] 7DADM = 7-Day Average Daily Maximum

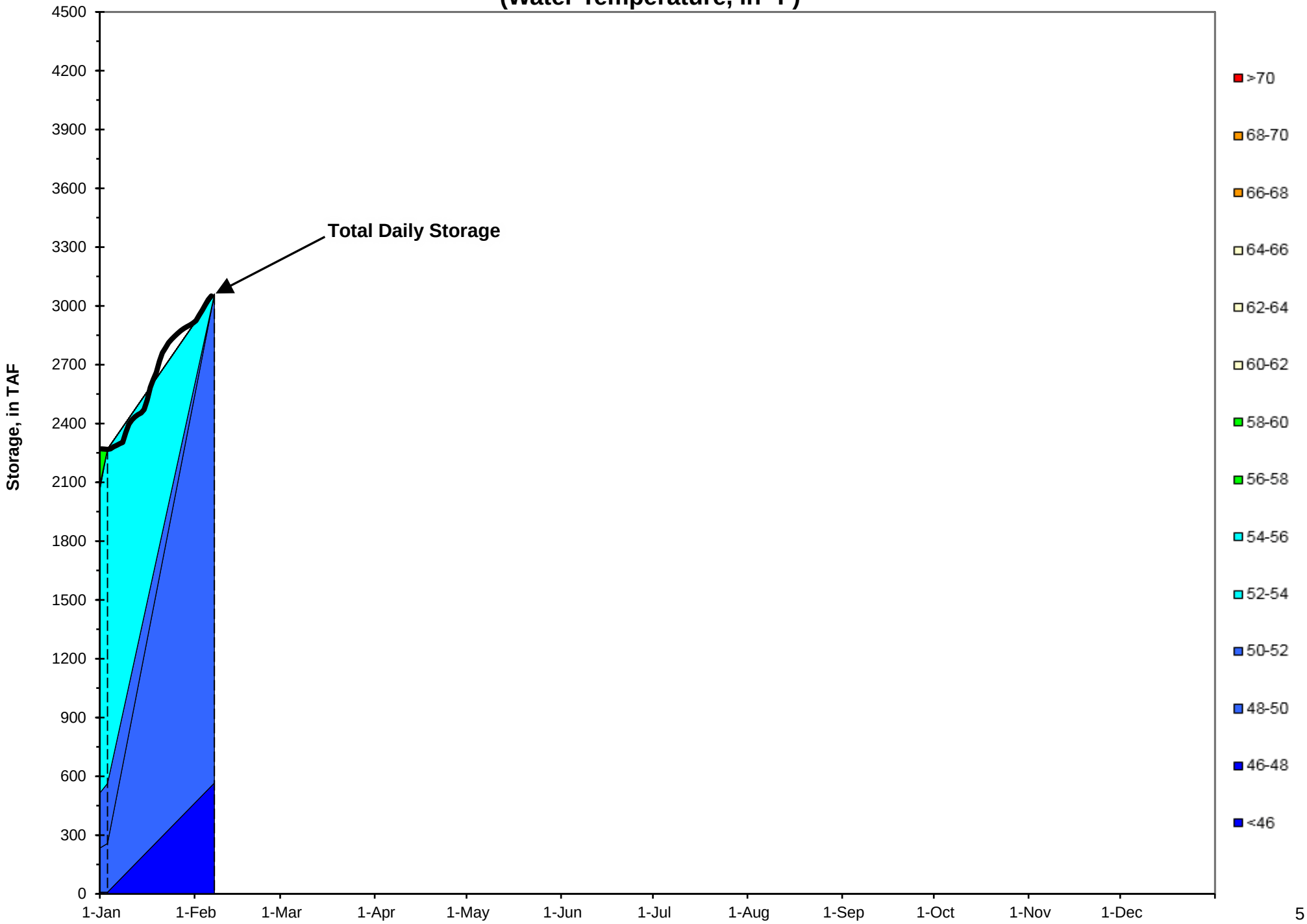
[2] DAT = Daily Average Temperature





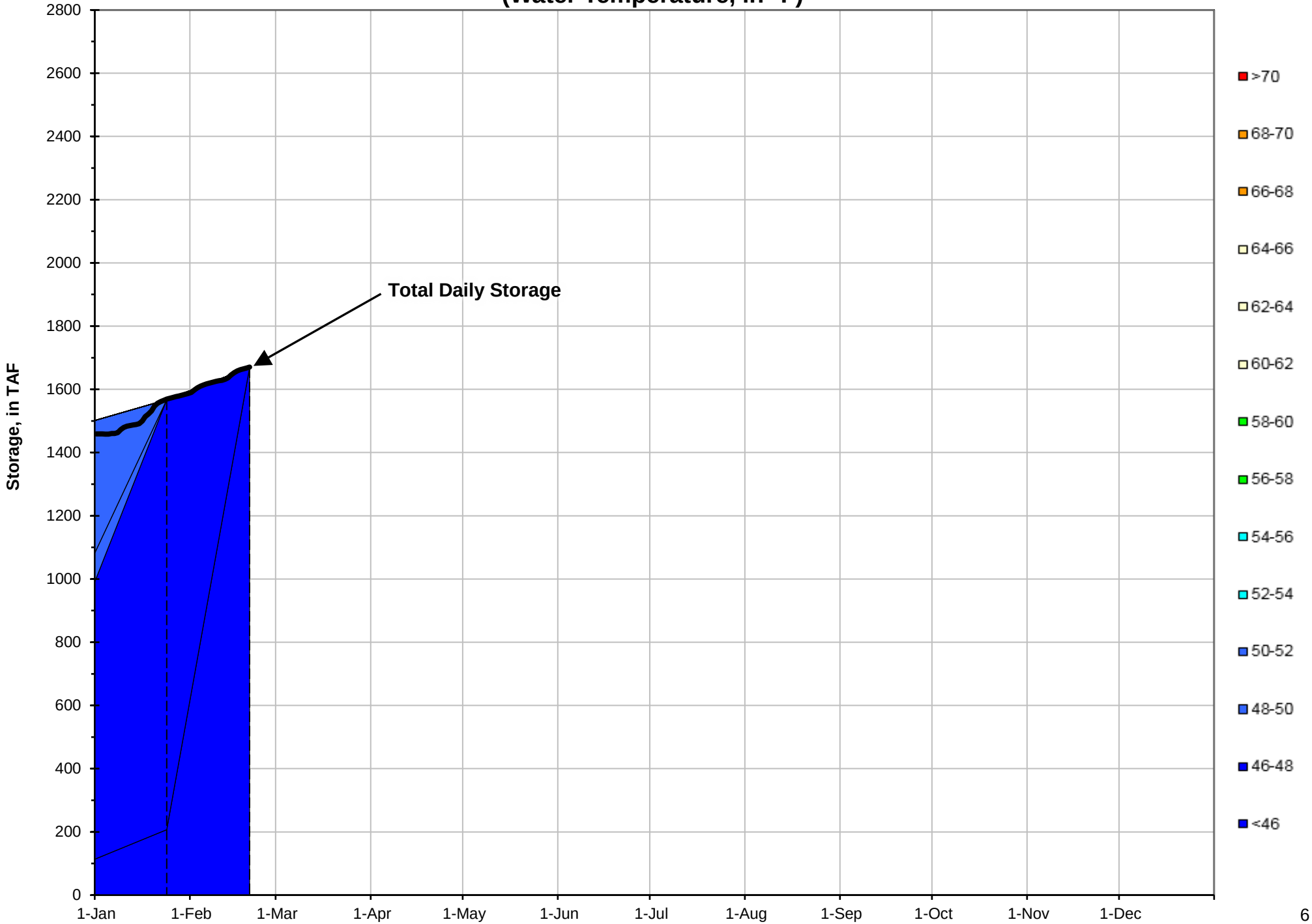
Latest Profile Date: 02/07/2019

Shasta Lake Isothermobaths - 2019
(Water Temperature, in °F)



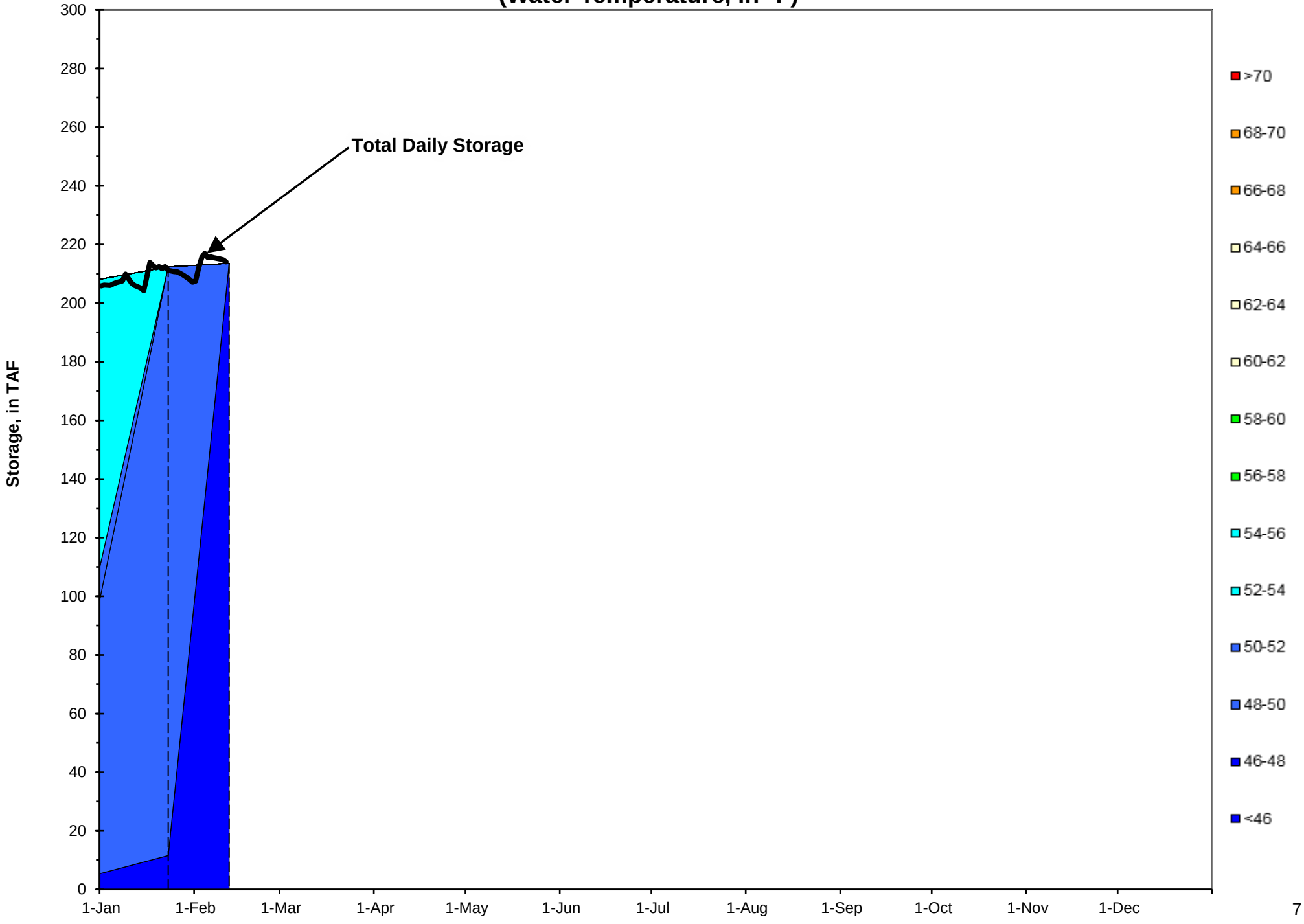
Latest Profile Date: 02/20/2019

Trinity Lake Isothermobaths - 2019
(Water Temperature, in °F)



Latest Profile Date: 02/12/2019

Whiskeytown Lake Isothermobaths - 2019
(Water Temperature, in °F)

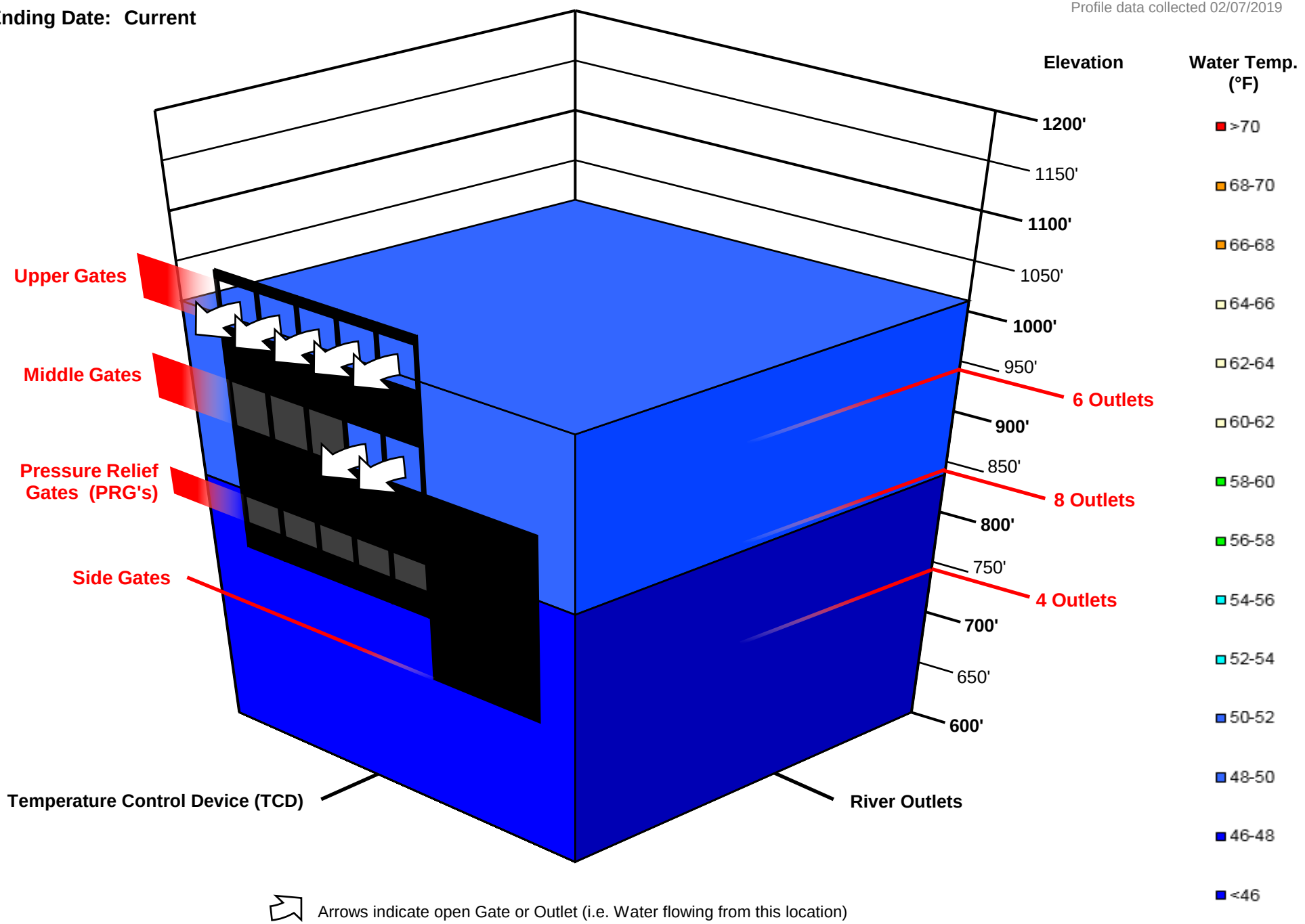


Shasta TCD Configuration

Starting Date: 02/25/2019

Ending Date: Current

Profile data collected 02/07/2019



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

February 14, 2019

Upper Sacramento River – February 2019 Preliminary Temperature Analysis

Location (°F DAT)	APR	MAY	JUN	JUL	AUG	SEP*	OCT*
February 90%-Exceedance Outlook – 50% Historical Meteorology							
Keswick Dam KWK	52.8	52.3	52.8	53.6	53.6	See Figures 1 and 2	See Figures 1 and 2
Sac. R. abv Clear Creek CCR	53.1	52.8	53.3	54.0	54.0	See Figures 1 and 3	See Figures 1 and 3
Balls Ferry BSF	55.3	55.7	55.5	55.8	55.8	See Figures 1 and 4	See Figures 1 and 4

Model Run	End of September Cold Water Pool <56°F (TAF)	First Side Gate	Full Side Gates
90% Hydro, 50% Met	580	8/25	9/22

Model Run Date February 14, 2019

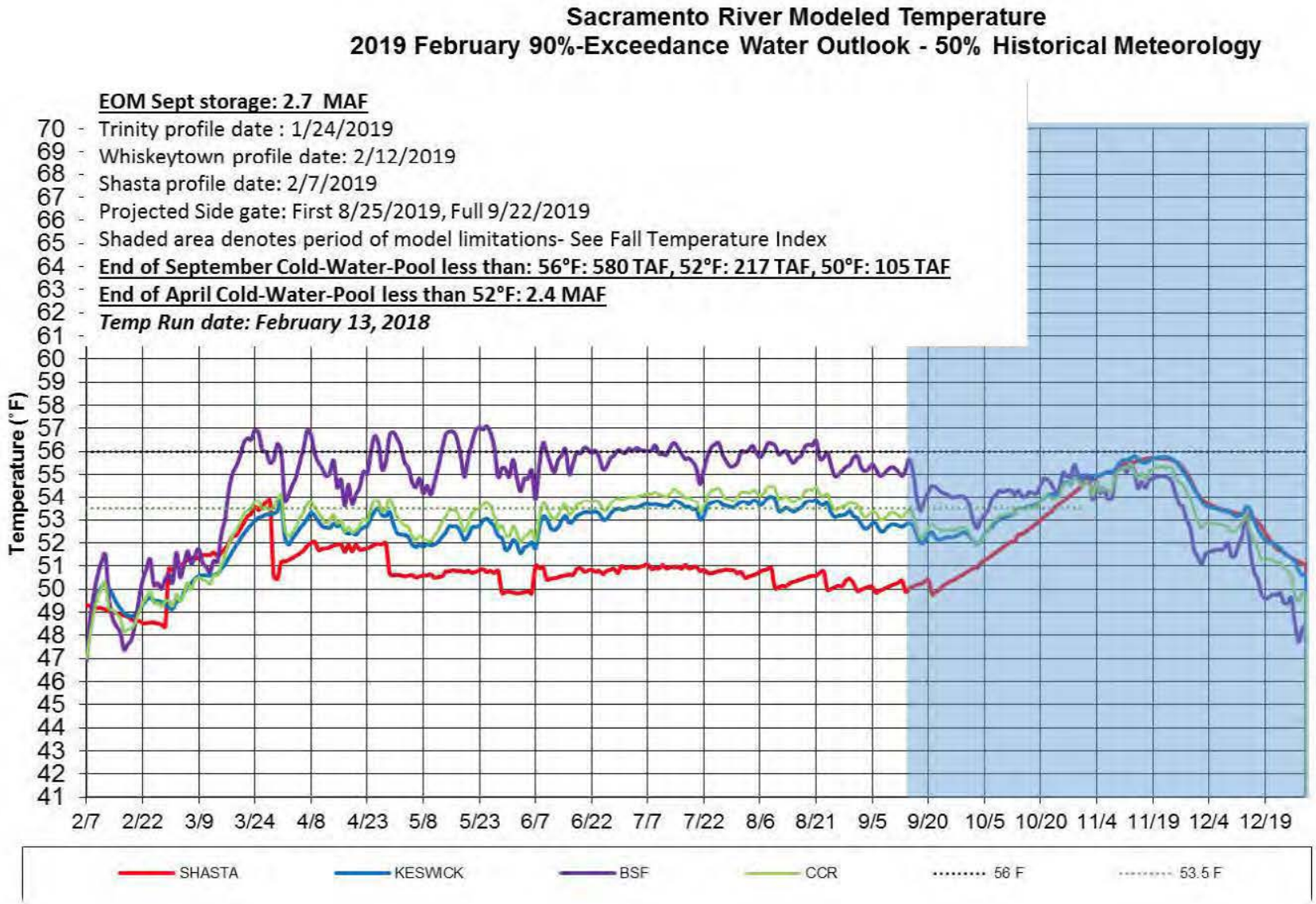


Figure 1. February 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 50% historical meteorology.

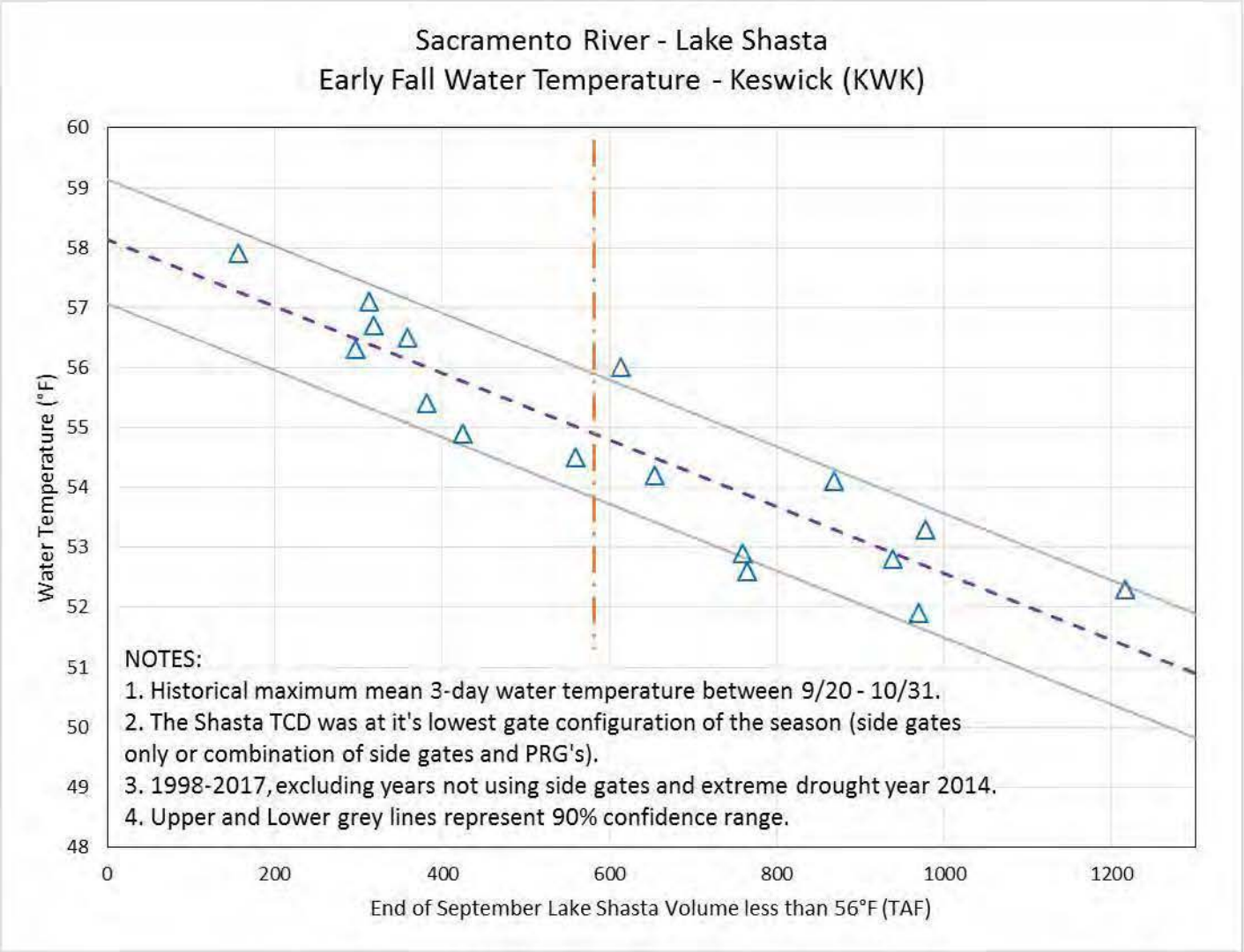


Figure 2. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Keswick water temperature and identifying relationship with 580 TAF end of September of cold-water-pool.

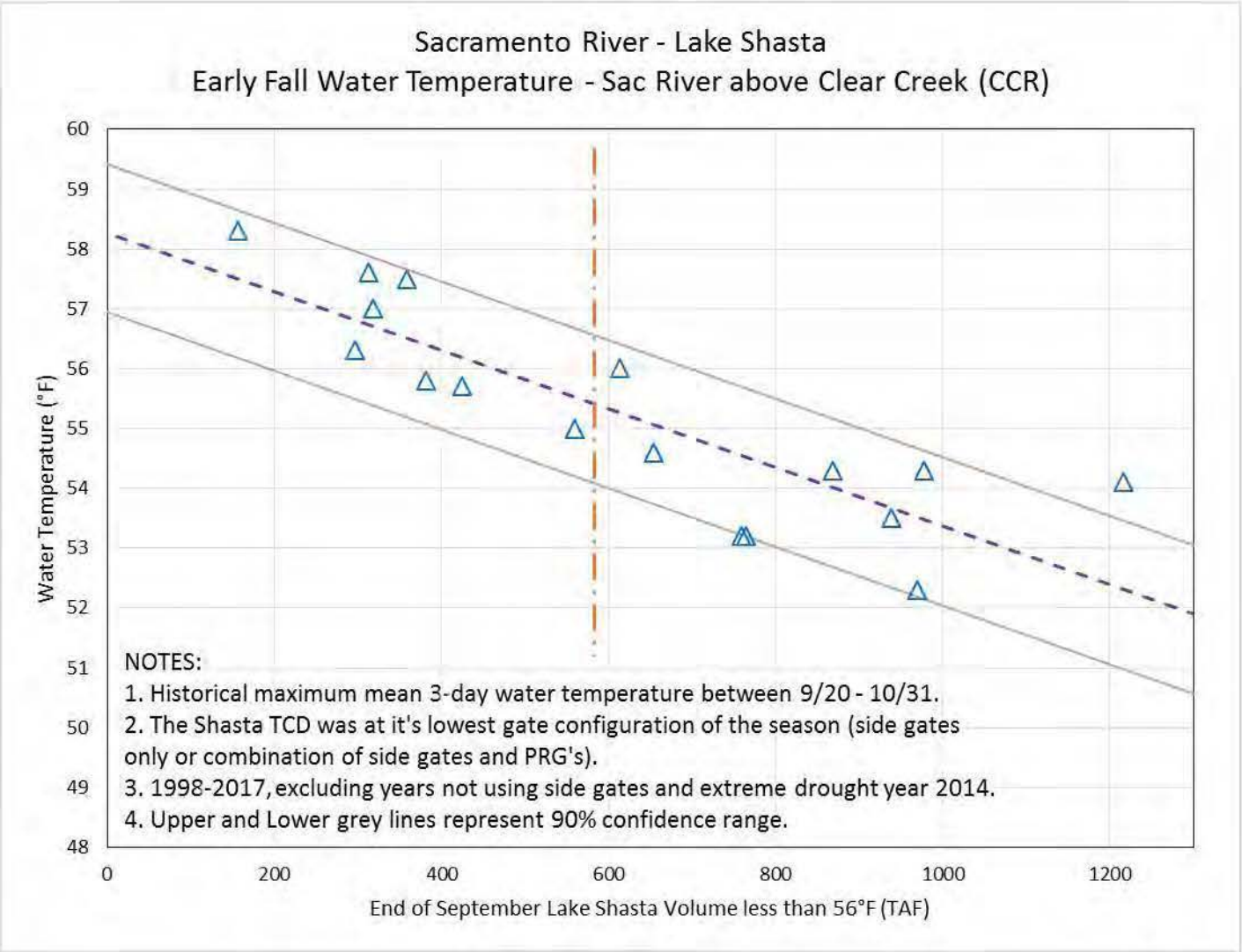


Figure 3. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Sacramento River above Clear Creek confluence water temperature and identifying relationship with 580 TAF end of September of cold-water-pool.

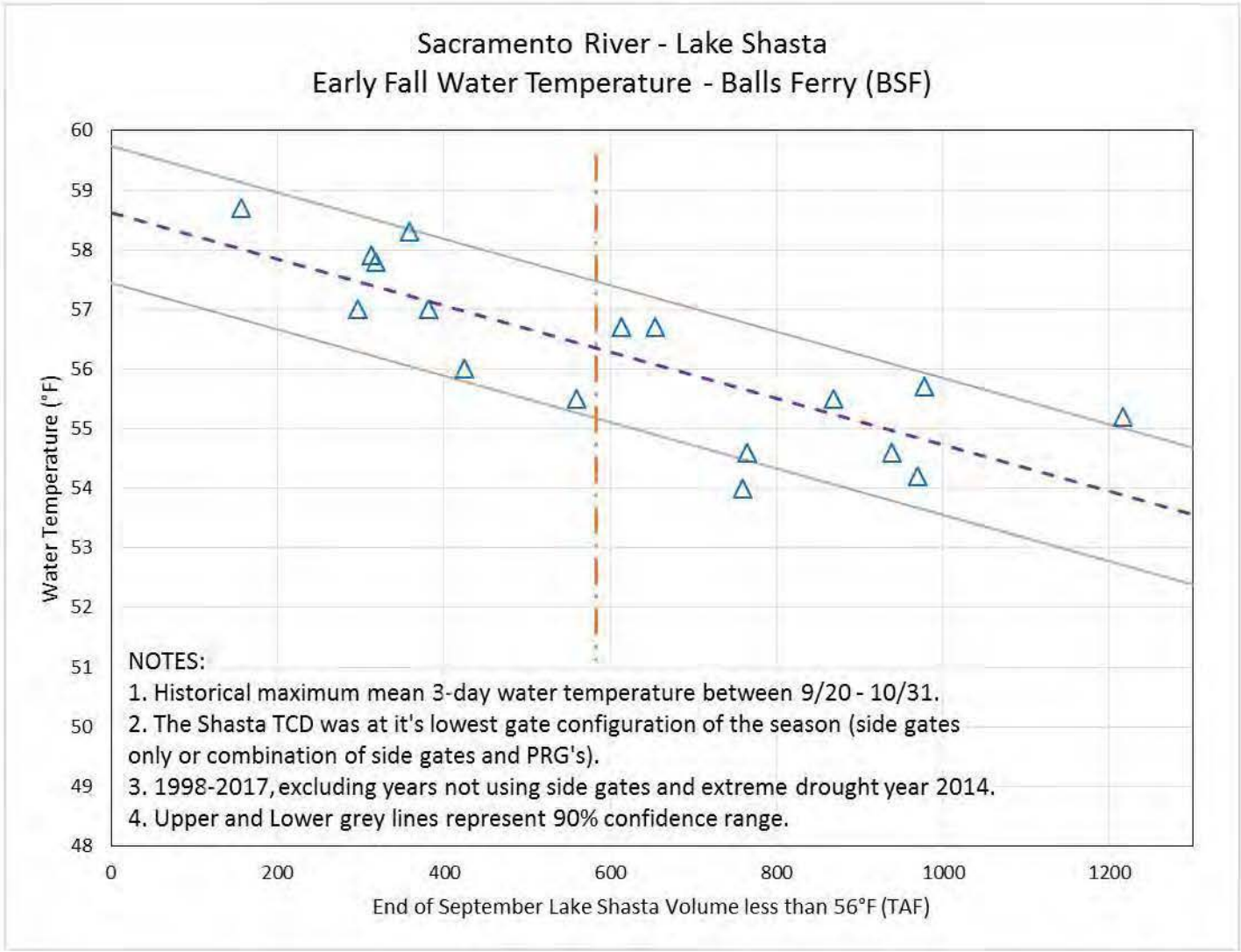


Figure 4. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Balls Ferry water temperature and identifying relationship with 580 TAF end of September of cold-water-pool.

* The HEC5Q model output is displayed above for the months April through August. Based on past analysis, the temperature model does not perform well in late September and October. 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. For the months of September and October, ranges in possible outcomes are illustrated with the Fall Temperature Index (graphics above Figures 2-4). This relationship is an end of September Lake Shasta Volume less than 56°F and likely downstream temperature performance for the early fall months.

Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

1. The latest available profiles for Shasta, Trinity, and Whiskeytown were taken on February 7, January 24, and February 12, respectively. Model results are sensitive to initial reservoir temperature conditions and the model performs best under highly stratified conditions. The February 2018 temperature profile does not yet exhibit conditions for ideal model computations (still nearly isothermal conditions). The model performs well after the reservoir stratifies, typically in late spring (i.e. end of April). The concern this year is assuming over or under estimations with variable hydrologic and meteorological conditions and not capturing the stratification with sufficient detail to project into the future with confidence.
2. Guidance on forecasted flows from the creeks (e.g., Cow, Cottonwood, Battle, etc.) between Keswick Dam and Bend Bridge are not available beyond 5 days. Creek flows developed from the historical record that most closely reflects current conditions were used for all model runs. The resulting low creek flows cause significant additional warming in the upper Sacramento River during spring.
3. Operation is based on the February 2019 Operation Outlooks (monthly flows, reservoir release, and end-of-month reservoir storage) for the 90%- and 50%-exceedances. Trinity Lake inflows are updated with the CNRFC 90% runoff exceedance for both the 90% and 50% runoff exceedance studies.
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 and are generalized representations. It is important to note that these outlooks do not suggest a certain actual future outcome, but rather the statistical likelihood of an event occurring, including, but not limited to, projected storage and releases. Thus, the outlooks do not provide exact end of month storages or flow rates but general projections that will likely fall within the range of uncertainty based on the different hydrologic runoff conditions between the 90% and 50% runoff exceedance hydrology.
5. Cottonwood Creek flows, Keswick to Bend Bridge local flows, and ACID diversions are mean daily synthesized flows based on the available historical record for a 1922-2002 study period. Inflows were adjusted to a 50% historical exceedance for both the 90% and 50% runoff exceedance studies.
6. Meteorological inputs represent historical (1985 – 2017) monthly mean equilibrium temperature exceedance at 50% patterned after like months on a 6-hour time-step. Assumed inflows temperature remain static inputs and do not vary with the assumed meteorology. Tools to use long-term three-month-temperature outlooks, driven by the NOAA NWS Climate Prediction Center (CPC) are available beginning April, prior to April historical meteorology is used.

7. Meteorology, as well as the 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, still uncertain prior to the end of April.
8. Modified model coefficients more closely represent actual Keswick Dam temperatures. As a result, temperature predictions downstream of Keswick Dam are likely to be warmer than actual.
9. The model is specifically being applied to generate the most accurate results at the Sacramento River above Clear Creek confluence location.

Supplemental Modeling Information

Summary of Temperature Results by Month (Monthly Average Temperature °F)

Location (°F DAT)	APR	MAY	JUN	JUL	AUG	SEP*	OCT*
February 90%-Exceedance Outlook – 10% Historical Meteorology							
Keswick Dam KWK	53.1	52.3	53.1	53.9	53.8	See Figures 5 and 8	See Figures 5 and 8
Sac. R. abv Clear Creek CCR	53.5	52.9	53.7	54.4	54.3	See Figures 5 and 9	See Figures 5 and 9
Balls Ferry BSF	55.9	56.1	56.0	56.4	56.2	See Figures 5 and 10	See Figures 5 and 10
February 50%-Exceedance Outlook – 50% Historical Meteorology							
Keswick Dam KWK	52.8	52.4	52.7	53.2	53.3	See Figures 6 and 8	See Figures 6 and 8
Sac. R. abv Clear Creek CCR	53.3	53.0	53.2	53.6	53.7	See Figures 6 and 9	See Figures 6 and 9
Balls Ferry BSF	55.9	56.0	55.6	55.3	55.5	See Figures 6 and 10	See Figures 6 and 10

Location (°F DAT)	APR	MAY	JUN	JUL	AUG	SEP*	OCT*
February 50%-Exceedance Outlook – 10% Historical Meteorology							
Keswick Dam KWK	52.3	51.9	53.0	53.5	53.8	See Figures 7 and 8	See Figures 7 and 8
Sac. R. abv Clear Creek CCR	53.0	52.6	53.5	54.0	54.2	See Figures 7 and 9	See Figures 7 and 9
Balls Ferry BSF	56.1	56.0	56.0	55.9	56.0	See Figures 7 and 10	See Figures 7 and 10

Model Run	End of September Cold Water Pool <56°F (TAF)	First Side Gate	Full Side Gates
90% Hydro, 10% Met	403	7/31	9/1
50% Hydro, 50% Met	674	8/27	9/25
50% Hydro, 10% Met	444	7/30	9/1

Model Run Date February 14, 2019

* The HEC5Q model output is displayed above for the months April through August. Based on past analysis, the temperature model does not perform well in late September and October. 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. For the months of September and October, ranges in possible outcomes are illustrated with the Fall Temperature Index (graphics below Figures 8-10). This relationship is an end of September Lake Shasta Volume less than 56°F and likely downstream temperature performance for the early fall months.

Temperature Analysis Results:

Modeling runs explore Sacramento River compliance performance above Clear Creek confluence and Balls Ferry locations by varying hydrology and meteorology. The temperature results for the Sacramento River between Keswick Dam and Balls Ferry are shown in Figures 5 through 7. The relationship between end-of-September lake volume below 56°F and a Balls Ferry compliance through fall is based on the Figures 8-10.

Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

1. The latest available profiles for Shasta, Trinity, and Whiskeytown were taken on February 7, January 24, and February 12, respectively. Model results are sensitive to initial reservoir temperature conditions and the model performs best under highly stratified conditions. The February 2018 temperature profile does not yet exhibit conditions for ideal model computations (still nearly isothermal conditions). The model performs well after the reservoir stratifies, typically in late spring (i.e. end of April). The concern this year is assuming over or under estimations with variable hydrologic and meteorological conditions and not capturing the stratification with sufficient detail to project into the future with confidence.
2. Guidance on forecasted flows from the creeks (e.g., Cow, Cottonwood, Battle, etc.) between Keswick Dam and Bend Bridge are not available beyond 5 days. Creek flows developed from the historical record that most closely reflects current conditions were used for all model runs. The resulting low creek flows cause significant additional warming in the upper Sacramento River during spring.
3. Operation is based on the February 2019 Operation Outlooks (monthly flows, reservoir release, and end-of-month reservoir storage) for the 90%- and 50%-exceedances. Trinity Lake inflows are updated with the CNRFC 90% runoff exceedance for both the 90% and 50% runoff exceedance studies.
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 and are generalized representations. It is important to note that these outlooks do not suggest a certain actual future outcome, but rather the statistical likelihood of an event occurring, including, but not limited to, projected storage and releases. Thus, the outlooks do not provide exact end of month storages or flow rates but general projections that will likely fall within the range of uncertainty based on the different hydrologic runoff conditions between the 90% and 50% runoff exceedance hydrology.
5. Cottonwood Creek flows, Keswick to Bend Bridge local flows, and ACID diversions are mean daily synthesized flows based on the available historical record for a 1922-2002 study period. Inflows were adjusted to a 50% historical exceedance for both the 90% and 50% runoff exceedance studies.
6. Meteorological inputs represent historical (1985 – 2017) monthly mean equilibrium temperature exceedance at 10% and 50% patterned after like months on a 6-hour time-step. Assumed inflows temperature remain static inputs and do not vary with the assumed meteorology. Tools to use long-term three-month-temperature outlooks, driven by the NOAA NWS Climate Prediction Center (CPC) are available beginning April, prior to April historical meteorology is used.
7. Meteorology, as well as the 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, still uncertain prior

to the end of April.
8. Modified model coefficients more closely represent actual Keswick Dam temperatures. As a result, temperature predictions downstream of Keswick Dam are likely to be warmer than actual.
9. The model is specifically being applied to generate the most accurate results at the Sacramento River above Clear Creek confluence location.

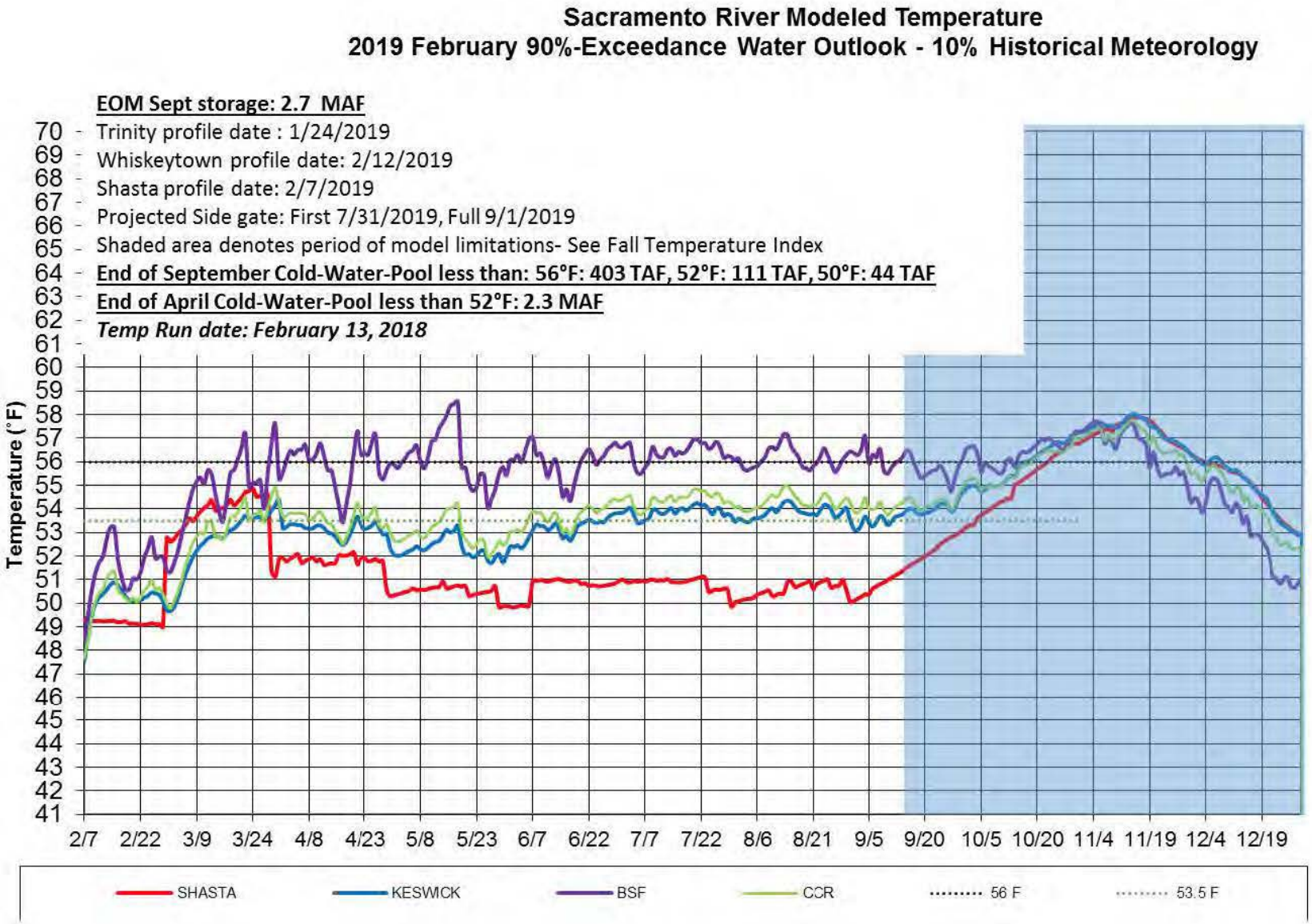


Figure 5. February 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 10% historical meteorology.

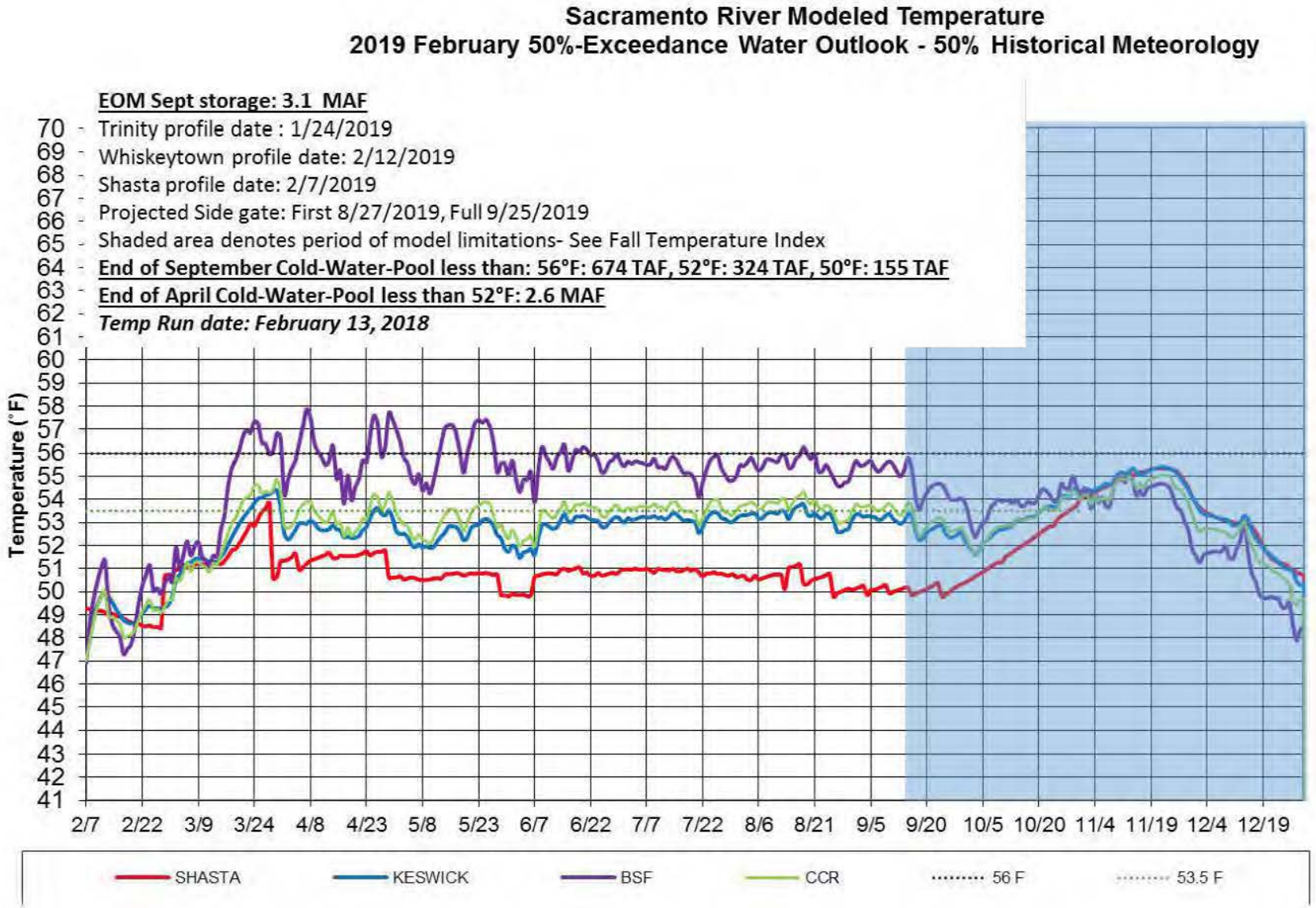


Figure 6. February 2019 simulated Sacramento River temperatures 50% runoff exceedance hydrology and 50% historical meteorology.

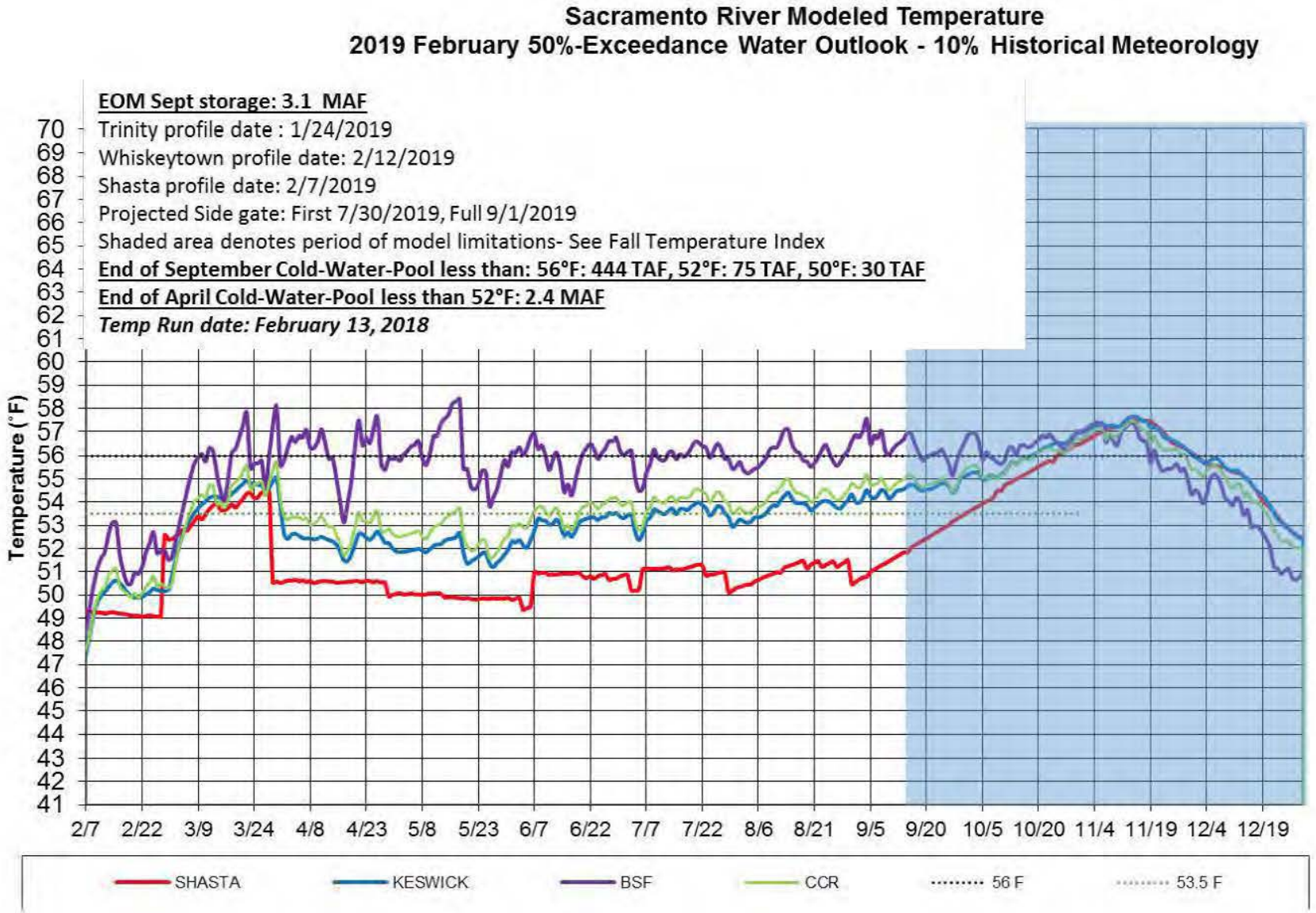


Figure 7. February 2019 simulated Sacramento River temperatures 50% runoff exceedance hydrology and 10% historical meteorology.

Figure 8-10 Model Performance and Fall Temperature Index:

1. Based on past analyses, the temperature model does not perform well in late September and October. 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 good indicator of fall water temperature in the river reach to Balls Ferry.
3. Based on these records and estimates, the charts below illustrates a range of uncertainty in the expected river temperatures based on the end-of-September lake volume less than 56˚F.

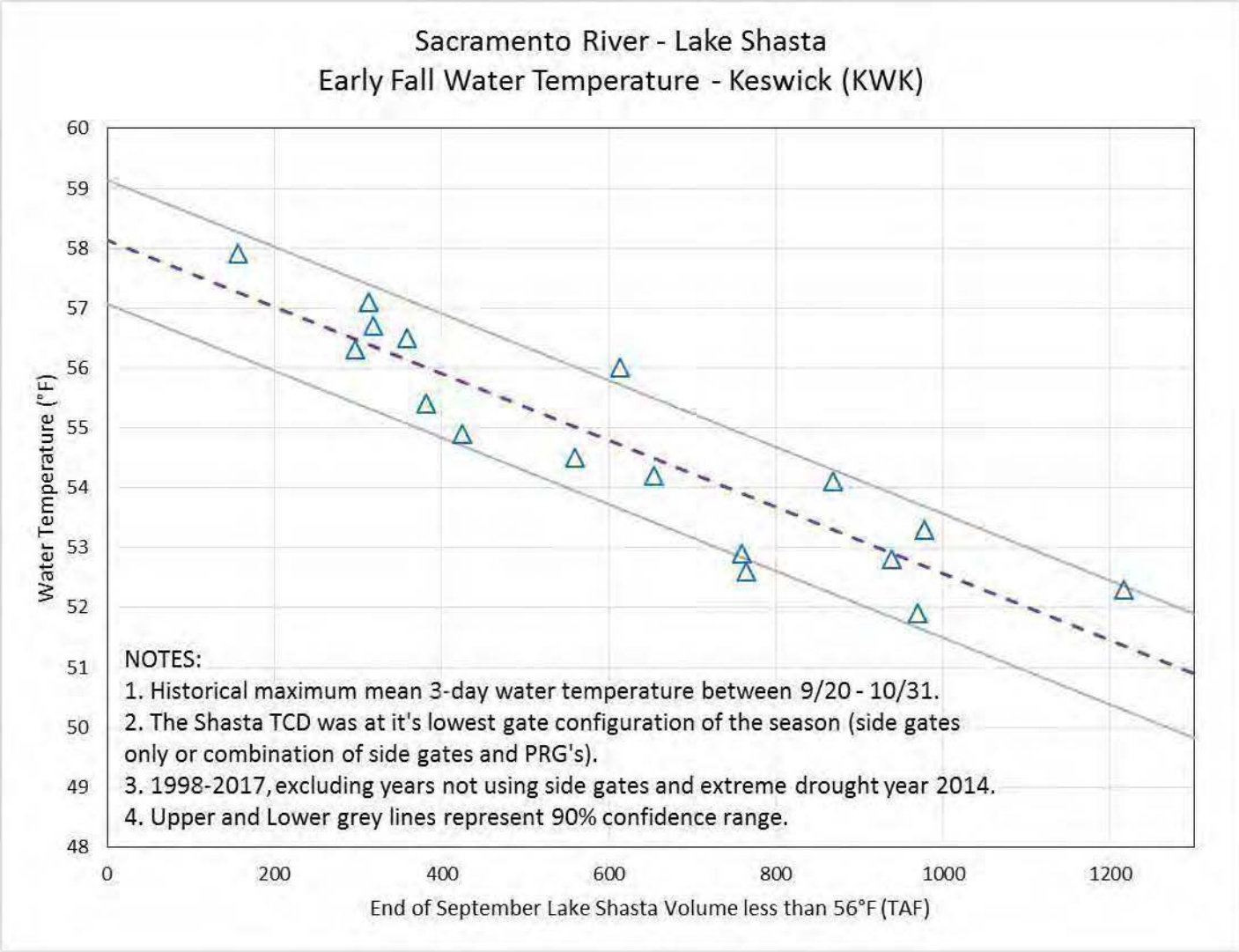


Figure 8. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Keswick water temperature.

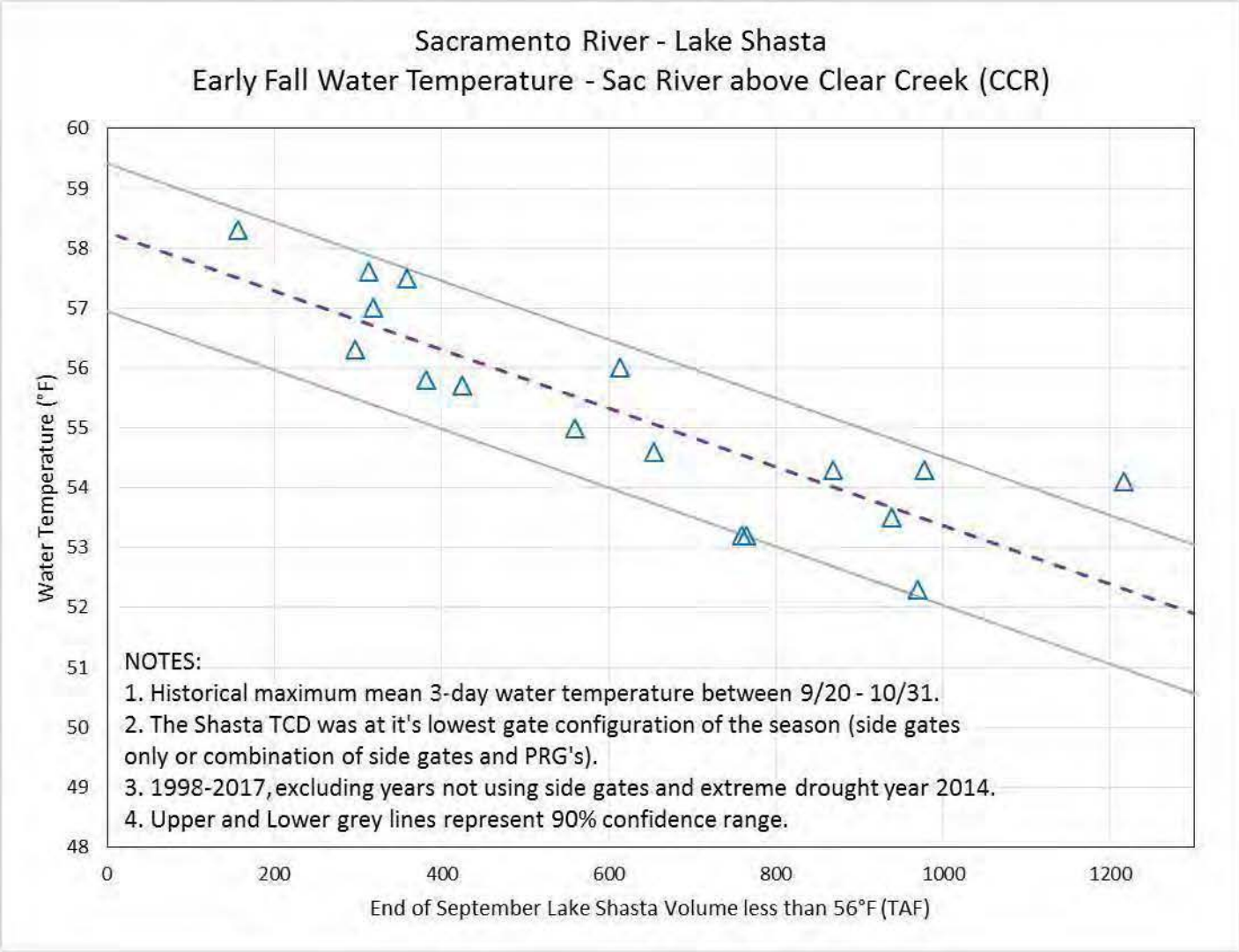


Figure 9. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Sacramento River above Clear Creek confluence water temperature.

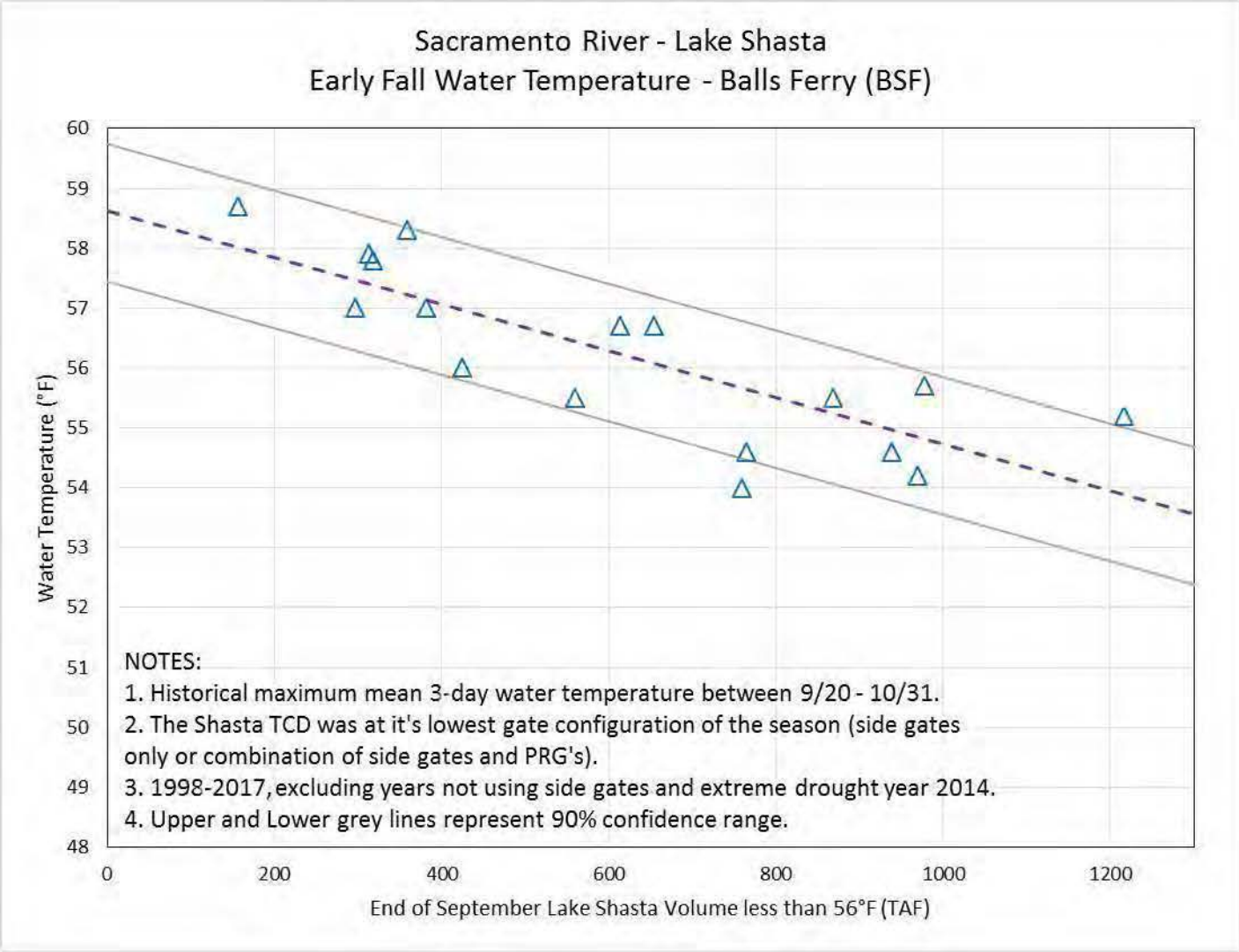
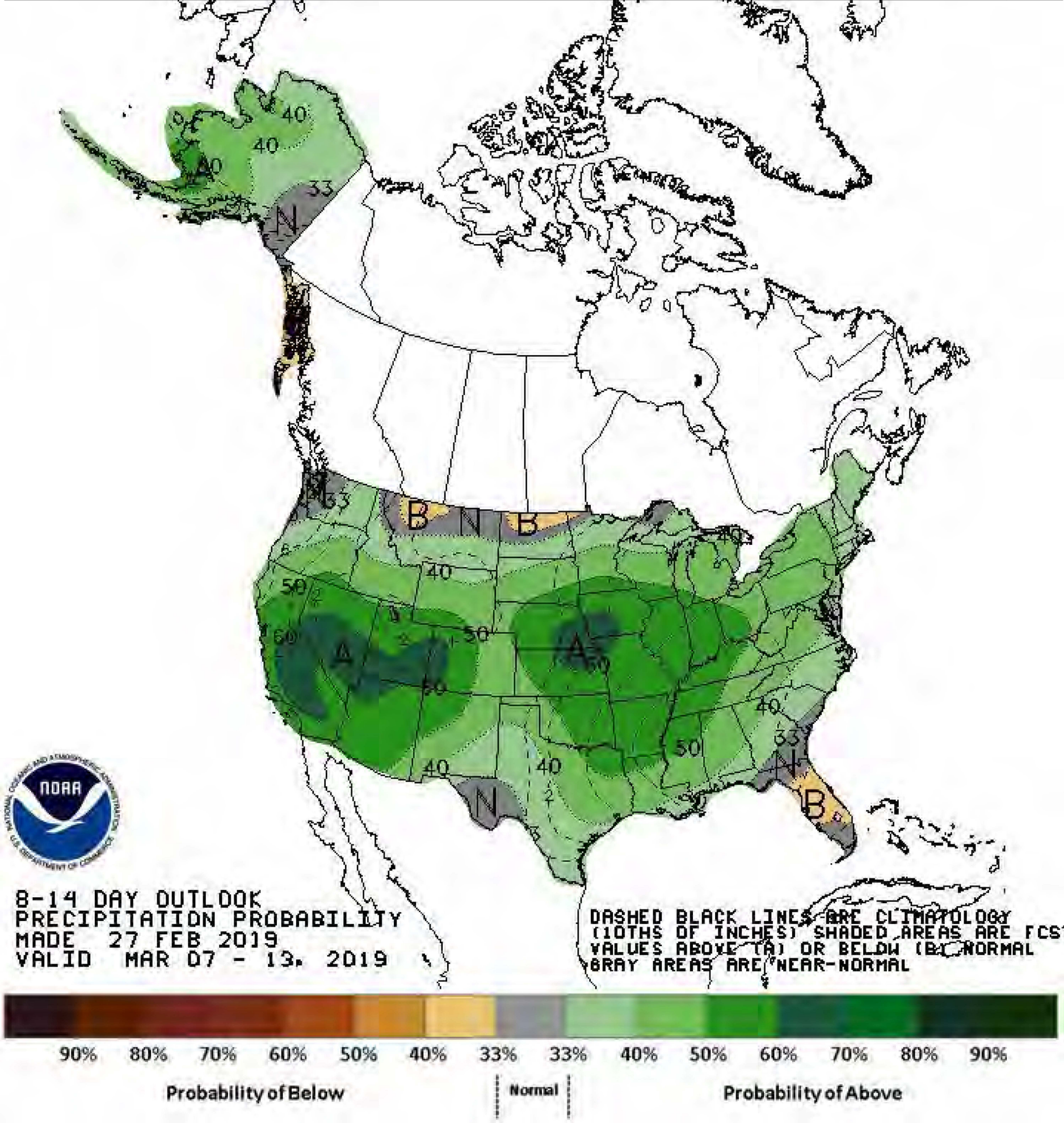
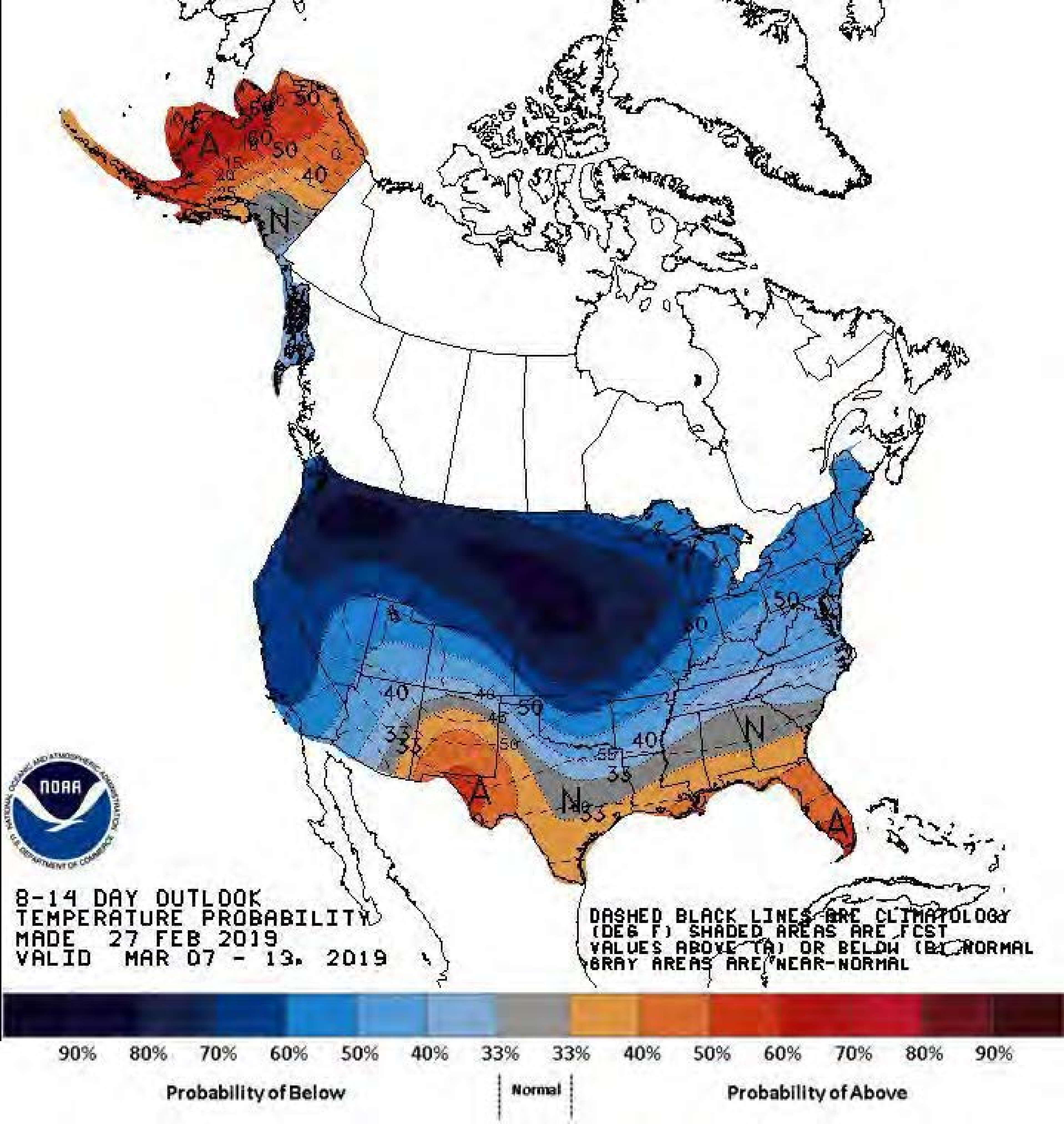


Figure 10. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Balls Ferry water temperature.


8-14 DAY OUTLOOK
PRECIPITATION PROBABILITY
MADE 27 FEB 2019
VALID MAR 07 - 13, 2019
DASHED BLACK LINES ARE CLIMATOLOGY
(10THS OF INCHES) SHADED AREAS ARE FCST
VALUES ABOVE (A) OR BELOW (B) NORMAL
GRAY AREAS ARE NEAR-NORMAL
NOAA
90% 80% 70% 60% 50% 40% 33% 33% 40% 50% 60% 70% 80% 90%
Probability of Below
Normal
Probability of Above


8-14 DAY OUTLOOK
TEMPERATURE PROBABILITY
MADE 27 FEB 2019
VALID MAR 07 - 13, 2019
DASHED BLACK LINES ARE CLIMATOLOGY
(DEG F) SHADED AREAS ARE FCST
VALUES ABOVE (A) OR BELOW (B) NORMAL
GRAY AREAS ARE NEAR-NORMAL
90% 80% 70% 60% 50% 40% 33% 33% 40% 50% 60% 70% 80% 90%
Probability of Below
Normal
Probability of Above

Storm on Track for Mid-Week

March 5-7, 2019

Issued: February 28, 2019 for interior Northern California