RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

Sacramento River Temperature Task Group Meeting

September 26, 2019 | 1:00 pm – 3:00 pm

Location: Joint Operations Center, 3310 El Camino Ave, Sacramento, CA

Conference Line: 877-417-6209

Participant code: 1593030

Agenda

- Introductions
- Meeting Purpose and Overview
- Fishery update
- 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
- Temperature Studies
    - 90% Runoff Exceedance: 25% and 50% L3MTO Meteorology
    - Cold Water Pool Tracking
- Updates
- Next Meeting: October24, 2019 – Joint Operations Center – Room 302, 3310 El Camino Ave, Sacramento

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

DAILY CVP WATER SUPPLY REPORT

SEPTEMBER 24, 2019

RUN DATE: September 25, 2019

RESERVOIR RELEASES IN CUBIC FEET/SECOND

RESERVOIR	DAM	WY 2018	WY 2019	15 YR MEDIAN
TRINITY	LEWISTON	464	451	463
SACRAMENTO	KESWICK	7,576	7,927	7,530
FEATHER	OROVILLE (SWP)	6,000	8,000	4,000
AMERICAN	NIMBUS	1,775	2,167	1,604
STANISLAUS	GOODWIN	303	403	204
SAN JOAQUIN	FRIANT	409	0	344

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	1,451	1,510	2,063	142
SHASTA	4,552	2,514	2,455	3,450	137
FOLSOM	977	487	477	720	148
NEW MELONES	2,420	1,384	1,788	2,034	147
FED. SAN LUIS	966	305	384	470	154
TOTAL NORTH CVP	11,363	6,142	6,614	8,737	142
MILLERTON	520	250	277	0	0
OROVILLE (SWP)	3,538	1,819	1,410	2,305	127

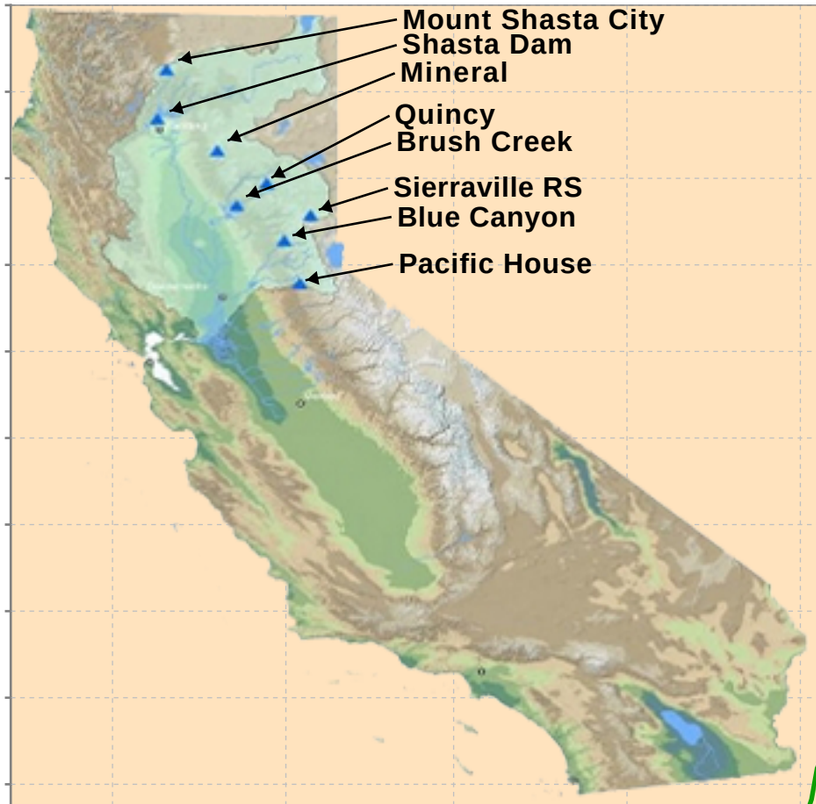
ACCUMULATED INFLOW FOR WATER YEAR TO DATE IN THOUSANDS OF ACRE-FEET

RESERVOIR	CURRENT WY 2019	WY 1977	WY 1983	15 YR AVG	% OF 15 YR AVG
TRINITY	1,622	218	2,883	1,223	133
SHASTA	7,150	2,566	10,740	5,293	135
FOLSOM	4,045	352	6,508	2,808	144
NEW MELONES	1,735	----	2,737	1,133	153
MILLERTON	2,650	369	4,662	1,774	149

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	38.03	15.44	58.10	32.24 (57)	118	0.00
SACRAMENTO AT SHASTA DAM	89.19	24.23	116.50	62.72 (62)	142	0.00
AMERICAN AT BLUE CANYON	92.65	17.57	104.31	67.33 (44)	138	0.00
STANISLAUS AT NEW MELONES	42.47	----	46.58	27.69 (41)	153	0.00
SAN JOAQUIN AT HUNTINGTON LK	57.56	17.60	83.40	42.37 (44)	136	0.00

Northern Sierra Precipitation: 8-Station Index, September 24, 2019



Percent of Average for this Date: 136%

2016-2017 Daily Precip (wettest) 94.7

1982-1983 (2nd wettest) 88.5

1997-1998 82.4

70.1

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)

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

Storage/Release Management Conditions:

- Reservoir Inflow Uncertainty: Meteorological projections: Shorter term forecasts (8-14 day) suggest above chances of precipitation
- Longer term forecasts (one-month outlook) suggest equal chances of above normal or below normal precipitation
- Current release from Keswick Dam: 7,500 cfs for storage conservation
- USFWS BiOp RPA Action 4 – Fall X2
- Fall Sacramento River release reduction coordination is on-going: Balancing tradeoffs between winter-run, fall-run, in-stream demands, and storage conservation.

Temperature Management:

- Temperature management: Active management
- Selective withdrawal: 1 Middle and 4 PRG TCD gates
- End of September Cold-Water-Pool volume < 56°F is expected to be greater than 1.2 MAF
- Meteorological Uncertainty: Recent wide swings in climatic conditions. Shorter term forecasts (8-14 day) suggest cooling to below normal temperatures
- Longer term forecasts (one-month outlook) suggest above normal chances of warmer 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 September 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)

		Sep	Oct	Nov	Dec	Jan	Feb
Shasta	3658	3363	3160	3129	3151	3301	3606
Elev.		1023	1015	1013	1014	1021	1033

Monthly River Releases (cfs)

	Sep	Oct	Nov	Dec	Jan	Feb
Sacramento	8400	7500	5000	5000	4000	4000
Clear Creek	150	200	200	200	200	200

Trinity Diversions (TAF)

	Sep	Oct	Nov	Dec	Jan	Feb
Carr Power Plant	19	23	26	12	3	2
Spring Creek PP	10	45	20	12	10	20

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)

		Sep	Oct	Nov	Dec	Jan	Feb
Shasta	3658	3363	3180	3199	3281	3580	3897
Elev.		1023	1015	1016	1020	1032	1044

Monthly River Releases (cfs)

	Sep	Oct	Nov	Dec	Jan	Feb
Sacramento	8400	7500	5000	5000	5000	8000
Clear Creek	150	200	200	200	240	200

Trinity Diversions (TAF)

	Sep	Oct	Nov	Dec	Jan	Feb
Carr Power Plant	19	23	25	9	0	2
Spring Creek PP	10	45	20	12	20	35

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)

		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Trinity	**2116**	**2042**	**2004**	**1980**	**1989**	**2021**	**2106**	**2183**	**2292**	**2283**	**2179**	**2026**	**1872**
	Elev.	2344	2341	2340	2340	2342	2348	2353	2360	2360	2353	2343	2332
Whiskeytown	**238**	**238**	**206**	**206**	**206**	**206**	**206**	**206**	**238**	**238**	**238**	**238**	**238**
	Elev.	1209	1199	1199	1199	1199	1199	1199	1209	1209	1209	1209	1209
Shasta	**3658**	**3351**	**3117**	**3086**	**3109**	**3259**	**3564**	**3993**	**4141**	**4120**	**3988**	**3509**	**3074**
	Elev.	1023	1013	1013	1012	1019	1031	1047	1053	1052	1047	1029	1011
Folsom	**755**	**693**	**574**	**495**	**433**	**434**	**495**	**640**	**833**	**949**	**807**	**659**	**514**
	Elev.	439	426	416	408	408	416	433	453	463	450	435	418
New Melones	**2052**	**2026**	**1976**	**1982**	**1989**	**1994**	**2000**	**1934**	**1917**	**1856**	**1771**	**1680**	**1596**
	Elev.	1055	1050	1051	1051	1052	1052	1046	1045	1039	1031	1022	1013
San Luis	**485**	**508**	**616**	**743**	**941**	**974**	**960**	**912**	**809**	**644**	**424**	**182**	**33**
	Elev.	486	484	493	518	538	532	535	508	472	423	395	365
Total		8858	8493	8491	8667	8887	9331	9867	10229	10090	9407	8293	7327

Monthly River Releases (TAF/cfs)

Trinity	TAF	52	23	18	18	18	17	18	32	180	47	66	53
	cfs	**870**	**373**	**300**	**300**	**300**	**300**	**300**	**540**	**2,924**	**783**	**1,073**	**857**
Clear Creek	TAF	9	12	12	12	12	11	12	13	13	17	9	9
	cfs	**150**	**200**	**200**	**200**	**200**	**200**	**200**	**218**	**216**	**288**	**150**	**150**
Sacramento	TAF	512	492	297	307	246	222	246	351	417	506	768	707
	cfs	**8600**	**8000**	**5000**	**5000**	**4000**	**4000**	**4000**	**5900**	**6784**	**8500**	**12500**	**11500**
American	TAF	167	154	119	123	111	100	96	89	123	238	231	215
	cfs	**2807**	**2500**	**2005**	**2000**	**1800**	**1806**	**1568**	**1500**	**2000**	**4000**	**3750**	**3500**
Stanislaus	TAF	24	52	18	18	22	20	101	42	96	56	18	18
	cfs	**400**	**842**	**300**	**300**	**358**	**364**	**1648**	**700**	**1555**	**940**	**300**	**300**

Trinity Diversions (TAF)

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Carr PP	19	23	26	12	3	2	35	32	12	132	99	100
Spring Crk. PP	**10**	**45**	**20**	**12**	**10**	**20**	**50**	**10**	**10**	**120**	**90**	**90**

Delta Summary (TAF)

		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Tracy		260	265	209	260	107	100	78	54	55	80	100	141
USBR Banks		0	0	0	0	0	0	0	0	0	0	9	9
Contra Costa		14.0	16.8	18.4	18.3	14.0	14.0	12.7	12.7	12.7	9.8	11.1	12.7
Total USBR		274	282	227	278	121	114	91	66	68	90	120	163
COA Balance		197	224	173	188	188	147	126	126	114	117	117	117
Vernalis	TAF	113	99	66	81	85	90	181	101	176	141	109	110
Vernalis	cfs	1896	1606	1107	1325	1383	1625	2950	1700	2856	2369	1780	1797
Old/Middle River Std.													
Old/Middle R. calc.		-8,344	-4,950	-4,873	-6,736	-4,991	-2,383	-2,904	-1,144	-619	-2,317	-6,241	-5,815
Computed DOI		6068	7581	5715	4506	8687	11400	11403	9531	7109	7463	8036	9386
Excess Outflow		0	0	0	0	2684	0	0	34	0	0	33	2229
% Export/Inflow		55%	40%	47%	64%	44%	22%	28%	12%	15%	25%	40%	36%
% Export/Inflow std.		65%	65%	65%	65%	65%	45%	35%	35%	35%	35%	65%	65%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	1625		7,196		4,066		1742	
Year to Date + Forecasted % of mean	135%		130%		149%		165%	

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Estimated CVP Operations 50% Exceedance

Storages

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

		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Trinity	**2116**	**2042**	**2006**	**1993**	**2022**	**2086**	**2196**	**2280**	**2424**	**2370**	**2207**	**2059**	**1907**
	Elev.	2344	2341	2340	2342	2347	2354	2360	2369	2365	2355	2345	2334
Whiskeytown	**238**	**238**	**206**	**206**	**206**	**206**	**206**	**206**	**238**	**238**	**238**	**238**	**238**
	Elev.	1209	1199	1199	1199	1199	1199	1199	1209	1209	1209	1209	1209
Shasta	**3658**	**3363**	**3180**	**3199**	**3281**	**3580**	**3897**	**4157**	**4479**	**4524**	**4331**	**3953**	**3558**
	Elev.	1023	1015	1016	1020	1032	1044	1053	1065	1066	1059	1046	1031
Folsom	**755**	**699**	**621**	**561**	**550**	**547**	**559**	**716**	**870**	**960**	**938**	**743**	**607**
	Elev.	439	431	424	423	422	424	441	456	465	462	444	429
New Melones	**2052**	**2026**	**1981**	**1992**	**2009**	**2034**	**2080**	**2057**	**2048**	**2092**	**2067**	**1989**	**1923**
	Elev.	1055	1051	1052	1053	1055	1059	1057	1057	1060	1058	1051	1045
San Luis	**485**	**488**	**593**	**769**	**966**	**966**	**966**	**966**	**820**	**583**	**432**	**226**	**68**
	Elev.	478	482	505	535	535	535	535	505	462	415	376	333
Total		8856	8586	8719	9034	9419	9904	10381	10879	10766	10213	9207	8300

Monthly River Releases (TAF/cfs)

Trinity	TAF	52	23	18	18	18	17	18	28	258	126	66	53
	cfs	**870**	**373**	**300**	**300**	**300**	**300**	**300**	**477**	**4,189**	**2,120**	**1,073**	**857**
Clear Creek	TAF	9	12	12	12	15	11	12	13	13	17	9	9
	cfs	**150**	**200**	**200**	**200**	**240**	**200**	**200**	**218**	**216**	**288**	**150**	**150**
Sacramento	TAF	500	461	297	307	307	444	615	297	430	595	676	676
	cfs	**8400**	**7500**	**5000**	**5000**	**5000**	**8000**	**10000**	**5000**	**7000**	**10000**	**11000**	**11000**
American	TAF	161	154	149	123	154	250	154	268	369	238	307	226
	cfs	**2704**	**2500**	**2500**	**2000**	**2500**	**4500**	**2500**	**4500**	**6000**	**4000**	**5000**	**3674**
Stanislaus	TAF	24	52	18	18	22	20	93	83	96	56	18	18
	cfs	**400**	**842**	**300**	**300**	**358**	**364**	**1521**	**1400**	**1555**	**940**	**300**	**300**

Trinity Diversions (TAF)

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Carr PP	19	23	25	9	0	2	45	31	9	131	99	100
Spring Crk. PP	**10**	**45**	**20**	**12**	**20**	**35**	**70**	**10**	**10**	**120**	**90**	**90**

Delta Summary (TAF)

		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Tracy		248	265	260	261	75	115	149	54	55	252	265	265
USBR Banks		0	0	0	0	0	0	0	0	0	0	11	11
Contra Costa		14.0	16.8	18.4	18.3	14.0	14.0	12.7	12.7	12.7	9.8	11.1	12.7
Total USBR		262	282	278	279	89	129	162	66	68	262	287	289
COA Balance		187	187	197	197	197	197	197	197	197	197	197	189
Vernalis	TAF	113	130	105	109	127	244	330	161	219	130	109	110
Vernalis	cfs	1896	2111	1762	1780	2066	4399	5376	2701	3556	2184	1780	1797
Old/Middle River Std.													
Old/Middle R. calc.	cfs	-7,969	-6,176	-7,335	-7,571	-1,589	-2,230	-1,599	-694	-304	-4,225	-6,955	-7,155
Computed DOI		5967	7727	5715	8833	21814	31770	32388	18222	16105	7716	8182	7320
Excess Outflow		0	81	0	4327	15812	20370	20985	8724	8996	252	179	0
% Export/Inflow		55%	46%	59%	52%	10%	12%	12%	7%	8%	35%	42%	46%
% Export/Inflow std.		65%	65%	65%	65%	65%	45%	35%	35%	35%	35%	65%	65%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
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Northern CVP Water Temperature Report

September - 2019

DATE	Mean Daily Water Temperatures (°F)																Mean Daily Release (CFS)			Mean Daily Air Temperatures (°F)			
	TCD[1]	SHD	SPP[1]	KWK	SAC	CCR	APR[4]	BSF[2]	JLF	BND	RDB	IGO	LWS	DGC[3]	Shasta Generation	Spring Creek P.P.	Keswick Total	RDD	BSF	RDB	LWS
Aug	50.7	49.9	56.1	51.6	52.4	52.9	53.8	54.6	56.1	56.9	58.0	58.4	52.8	-	9183	1112	10729	83.1	77.2	77.8	-
09/01	50.4	49.6	56.8	51.3	52.1	53.0	53.7	**54.4**	55.9	! -	57.8	58.3	53.9	58.7	8175	431	9501	81.0	75.5	76.8	-
09/02	50.5	49.7	57.0	51.2	52.3	52.7	53.5	**54.2**	55.7	! -	57.7	58.2	51.4	54.9	8665	187	9477	82.5	75.7	77.6	-
09/03	50.6	49.8	56.7	51.0	51.7	52.4	53.1	**53.9**	55.5	! -	57.5	58.1	50.9	53.0	8865	521	9450	79.0	74.0	74.4	-
09/04	50.6	49.6	56.7	51.2	? 51.9	52.5	53.2	**53.8**	55.2	! -	56.7	57.8	50.8	53.3	8250	398	9006	80.0	73.1	76.2	-
09/05	50.9	49.7	56.8	51.2	51.9	52.7	53.4	**54.1**	55.7	! -	57.3	58.5	52.8	55.1	8273	300	8988	82.5	76.5	77.8	-
09/06	50.7	49.6	56.8	51.5	? 52.1	52.8	53.4	**54.0**	55.5	56.2	57.3	58.0	53.3	57.0	7766	658	8502	76.5	70.4	71.7	-
09/07	50.5	? 49.4	56.6	51.6	52.2	52.9	53.5	**54.0**	55.6	56.3	57.2	57.5	52.8	56.5	6848	967	8497	74.5	69.0	68.8	-
09/08	51.0	49.8	57.2	51.5	? 52.3	53.1	53.8	**54.4**	55.9	56.5	57.4	57.6	52.6	55.9	8313	113	8478	72.0	69.0	69.2	-
09/09	50.7	49.7	57.4	51.4	? 52.1	52.8	53.3	? **53.9**	55.5	56.2	57.4	58.0	52.5	55.8	7929	19	8501	71.0	67.7	70.5	-
09/10	50.8	49.5	# -	51.4	52.1	52.9	53.4	**54.0**	55.5	56.1	57.0	57.9	52.9	55.3	7670	0	8491	72.5	68.7	69.5	-
09/11	50.8	49.7	# -	51.1	51.8	52.6	53.2	**53.8**	55.4	56.1	57.1	57.8	53.2	55.7	8386	0	8483	75.0	68.9	70.8	-
09/12	50.7	49.8	# -	51.2	51.8	52.6	53.2	**53.7**	55.2	55.8	56.8	57.8	53.5	55.8	7915	0	8489	79.0	70.1	73.2	-
09/13	51.0	50.0	# -	51.2	51.8	52.7	53.2	**53.7**	55.3	55.9	56.7	57.9	53.4	56.3	8566	0	8494	78.5	71.3	73.2	-
09/14	50.9	50.0	# -	51.3	51.9	52.7	53.2	**53.7**	55.3	56.0	56.9	57.9	54.1	56.7	8147	0	8485	77.0	70.8	73.7	-
09/15	50.9	50.0	# -	51.3	52.0	52.9	53.4	**53.8**	55.3	55.9	56.9	57.2	54.2	57.0	8240	0	8495	72.0	69.0	69.8	-
09/16	50.9	50.1	# -	51.4	52.1	52.7	53.4	**54.0**	55.6	56.3	57.1	56.8	54.2	56.9	7978	0	8484	68.5	66.5	67.5	-
09/17	? 50.7	50.0	# -	51.1	51.8	52.5	53.0	**53.5**	54.8	55.3	56.2	56.1	53.7	54.7	7346	0	8008	65.0	61.5	64.0	-
09/18	50.4	49.5	56.7	51.3	51.7	52.3	52.8	**53.4**	54.9	55.6	56.4	56.4	54.0	55.6	6901	16	8003	62.5	61.0	62.6	-
09/19	50.2	49.4	57.1	51.2	51.7	52.4	52.9	**53.3**	54.6	55.0	55.6	56.2	53.4	55.1	6901	382	7935	65.0	61.5	63.5	-
09/20	50.1	49.2	# -	51.3	51.8	52.5	53.0	**53.4**	54.8	55.4	56.2	56.5	53.4	55.0	6454	1128	7934	72.0	67.3	69.7	-
09/21	50.3	49.3	# -	51.6	52.1	52.8	53.4	**53.9**	55.3	55.8	56.6	56.7	52.5	55.2	6245	1254	7937	76.0	70.2	71.7	-
09/22	50.4	? 49.4	# -	51.7	51.9	52.4	53.0	**53.5**	55.0	55.6	56.4	56.5	51.5	54.0	5727	1489	7938	70.0	65.0	66.3	-
09/23	50.4	49.7	# -	51.7	52.4	53.3	53.8	**54.3**	55.6	56.0	56.6	57.1	51.3	54.6	7408	785	7936	77.5	73.1	75.0	-
09/24	50.5	49.5	# -	51.7	52.2	53.1	53.8	**54.4**	56.0	56.7	57.8	57.4	51.0	54.6	6729	1119	7927	86.0	79.8	81.5	-
09/25																					
09/26																					
09/27																					
09/28																					
09/29																					
09/30																					
-																					
Sep	50.6	49.7	56.9	51.3	52.0	52.7	53.3	53.9	55.4	55.9	56.9	57.4	52.8	55.5	7654	407	8477	74.8	69.8	71.5	-
													Total CFS		183697	9767	203439				
													Total AF		364356	19372	403513				

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] DGC is only reported in September
[4] APR = Airport Road. This is a virtual site interpolated linearly between CCR and BSF based on distance.

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
09/01	62	99	80.5	65	98	81.5	63	99	81.0	63	99	81.0	64	96	80.0	63	94	78.5	60	96	78.0	60	94	77.0	64	90	77.0	59	87	73.0	61	90	75.5	59	92	75.5
09/02	63	99	81.0	66	96	81.0	63	98	80.5	63	96	79.5	63	90	76.5	60	96	78.0	60	94	77.0	60	93	76.5	61	98	79.5	60	94	77.0	60	89	74.5	59	93	76.0
09/03	65	100	82.5	61	99	80.0	62	98	80.0	65	94	79.5	60	94	77.0	61	93	77.0	58	90	74.0	57	90	73.5	60	90	75.0	61	94	77.5	62	92	77.0	59	92	75.5
09/04	61	97	79.0	62	97	79.5	65	97	81.0	61	95	78.0	59	90	74.5	57	86	71.5	57	89	73.0	56	89	72.5	60	97	78.5	60	99	79.5	62	95	78.5	59	93	76.0
09/05	60	100	80.0	68	98	83.0	61	97	79.0	61	90	75.5	56	89	72.5	56	87	71.5	55	85	70.0	56	89	72.5	60	88	74.0	60	96	78.0	62	93	77.5	59	92	75.5
09/06	66	99	82.5	60	96	78.0	60	90	75.0	56	89	72.5	55	84	69.5	53	83	68.0	54	89	71.5	57	92	74.5	59	95	77.0	59	97	78.0	58	90	74.0	59	92	75.5
09/07	59	94	76.5	61	90	75.5	56	88	72.0	54	85	69.5	53	82	67.5	53	88	70.5	57	94	75.5	59	94	76.5	62	93	77.5	62	89	75.5	59	88	73.5	58	89	73.5
09/08	59	89	74.0	57	87	72.0	56	84	70.0	55	82	68.5	54	88	71.0	56	94	75.0	59	94	76.5	59	94	76.5	63	87	75.0	58	91	74.5	59	90	74.5	58	90	74.0
09/09	57	87	72.0	58	84	71.0	52	81	66.5	53	88	70.5	57	95	76.0	59	96	77.5	58	94	76.0	58	91	74.5	60	98	79.0	59	97	78.0	59	91	75.0	58	87	72.5
09/10	57	85	71.0	61	84	72.5	52	89	70.5	57	97	77.0	58	98	78.0	59	96	77.5	59	90	74.5	56	81	68.5	56	82	69.0	57	87	72.0	60	89	74.5	58	91	74.5
09/11	61	84	72.5	60	90	75.0	56	97	76.5	58	98	78.0	59	97	78.0	59	88	73.5	56	78	67.0	51	78	64.5	55	83	69.0	57	89	73.0	59	90	74.5	57	90	73.5
09/12	59	91	75.0	67	97	82.0	58	99	78.5	59	98	78.5	57	89	73.0	54	72	63.0	48	78	63.0	53	87	70.0	62	89	75.5	59	93	76.0	61	92	76.5	58	92	75.0
09/13	63	95	79.0	61	100	80.5	60	98	79.0	57	90	73.5	55	70	62.5	49	78	63.5	52	85	68.5	57	85	71.0	57	81	69.0	57	85	71.0	58	87	72.5	57	89	73.0
09/14	58	99	78.5	59	97	78.0	56	89	72.5	55	74	64.5	49	80	64.5	53	78	65.5	53	80	66.5	53	85	69.0	64	89	76.5	60	93	76.5	61	92	76.5	58	92	75.0
09/15	58	96	77.0	58	89	73.5	54	76	65.0	48	80	64.0	53	75	64.0	49	78	63.5	52	85	68.5	54	89	71.5	60	92	76.0	61	94	77.5	61	92	76.5	57	88	72.5
09/16	55	89	72.0	54	75	64.5	48	79	63.5	53	75	64.0	48	79	63.5	51	87	69.0	55	91	73.0	55	88	71.5	62	91	76.5	59	93	76.0	59	89	74.0	57	87	72.0
09/17	61	76	68.5	52	78	65.0	54	73	63.5	49	80	64.5	51	86	68.5	53	90	71.5	56	89	72.5	56	89	72.5	67	88	77.5	62	90	76.0	60	89	74.5	57	87	72.0
09/18	51	79	65.0	59	71	65.0	49	79	64.0	52	85	68.5	54	89	71.5	56	86	71.0	54	86	70.0	57	92	74.5	67	90	78.5	59	84	71.5	60	84	72.0	52	86	69.0
09/19	54	71	62.5	50	79	64.5	51	84	67.5	55	89	72.0	56	83	69.5	54	86	70.0	57	94	75.5	60	96	78.0	63	92	77.5	60	82	71.0	56	83	69.5	53	85	69.0
09/20	50	80	65.0	61	85	73.0	55	90	72.5	55	84	69.5	54	86	70.0	57	95	76.0	61	95	78.0	58	86	72.0	58	77	67.5	54	77	65.5	55	79	67.0	52	80	66.0
09/21	59	85	72.0	62	89	75.5	55	85	70.0	55	88	71.5	59	96	77.5	62	95	78.5	59	86	72.5	51	73	62.0	51	74	62.5	52	80	66.0	53	81	67.0	52	84	68.0
09/22	62	90	76.0	56	84	70.0	57	87	72.0	63	97	80.0	68	97	82.5	60	89	74.5	53	72	62.5	45	68	56.5	51	72	61.5	52	77	64.5	52	80	66.0	52	83	67.5
09/23	55	85	70.0	67	86	76.5	62	97	79.5	67	97	82.0	64	93	78.5	56	78	67.0	47	72	59.5	44	68	56.0	54	74	64.0	50	82	66.0	53	83	68.0	53	85	69.0
09/24	66	89	77.5	74	99	86.5	67	100	83.5	63	96	79.5	58	84	71.0	54	78	66.0	47	74	60.5	44	72	58.0	49	73	61.0	48	81	64.5	51	82	66.5	50	83	66.5
09/25	73	99	86.0	81	101	91.0	64	98	81.0	58	85	71.5	53	77	65.0	45	72	58.5	43	69	56.0	41	72	56.5	48	80	64.0	50	83	66.5	52	80	66.0	51	80	65.5
09/26																																				
09/27																																				
09/28																																				
09/29																																				
09/30																																				
-																																				

Web Links

10-Day Min/Max Forecast

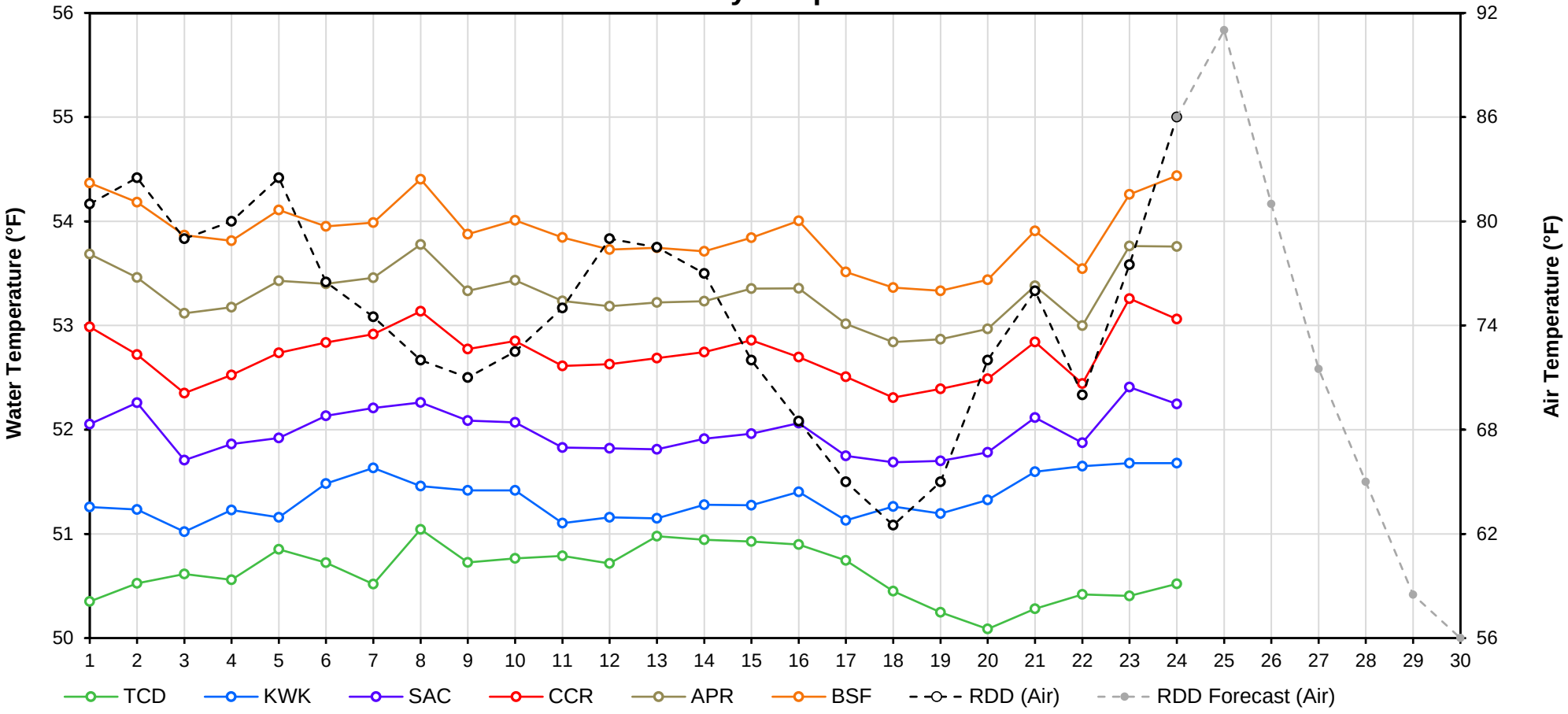
Previous Days Min/Max Actuals

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

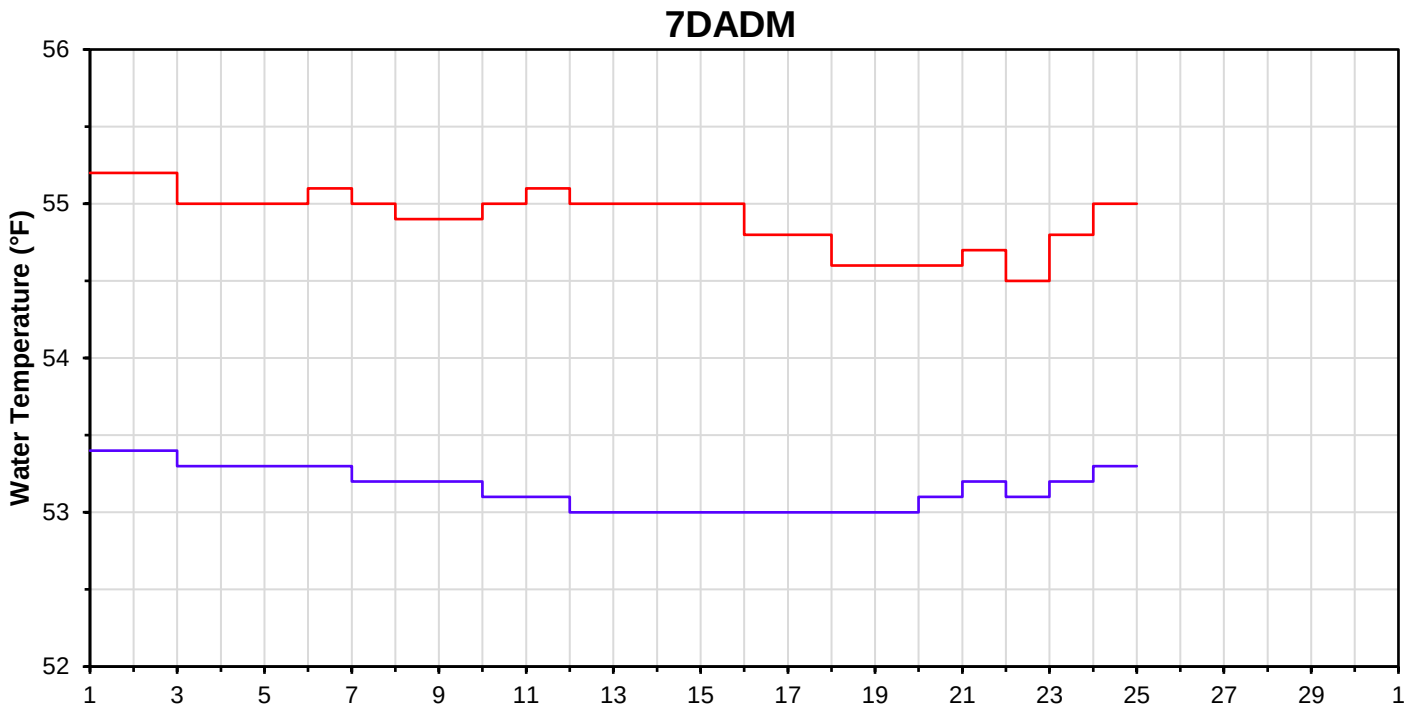
[1] Distances are approximate
[2] DGC is only reported in September
[3] NFH is only reported in October, November and December

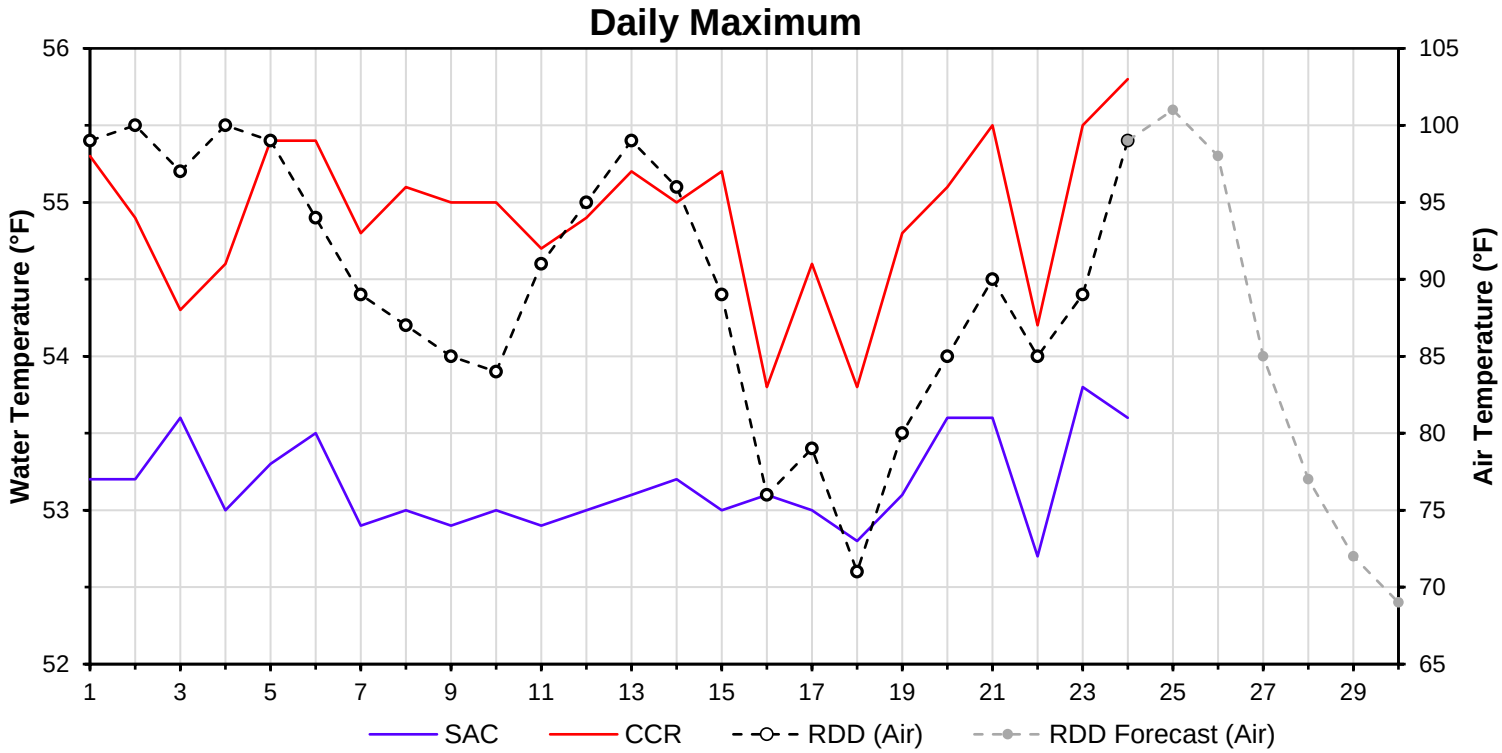
DATE	Daily Max		7DADM[1]		DAT[2]
	SAC	CCR	SAC	CCR	BSF
09/01	53.2	55.3	53.4	55.2	54.4
09/02	53.2	54.9	53.4	55.2	54.2
09/03	53.6	54.3	53.3	55.0	53.9
09/04	53.0	54.6	53.3	55.0	53.8
09/05	53.3	55.4	53.3	55.0	54.1
09/06	53.5	55.4	53.3	55.1	54.0
09/07	52.9	54.8	53.2	55.0	54.0
09/08	53.0	55.1	53.2	54.9	54.4
09/09	52.9	55.0	53.2	54.9	53.9
09/10	53.0	55.0	53.1	55.0	54.0
09/11	52.9	54.7	53.1	55.1	53.8
09/12	53.0	54.9	53.0	55.0	53.7
09/13	53.1	55.2	53.0	55.0	53.7
09/14	53.2	55.0	53.0	55.0	53.7
09/15	53.0	55.2	53.0	55.0	53.8
09/16	53.1	53.8	53.0	54.8	54.0
09/17	53.0	54.6	53.0	54.8	53.5
09/18	52.8	53.8	53.0	54.6	53.4
09/19	53.1	54.8	53.0	54.6	53.3
09/20	53.6	55.1	53.1	54.6	53.4
09/21	53.6	55.5	53.2	54.7	53.9
09/22	52.7	54.2	53.1	54.5	53.5
09/23	53.8	55.5	53.2	54.8	54.3
09/24	53.6	55.8	53.3	55.0	54.4
09/25					
09/26					
09/27					
09/28					
09/29					
09/30					
-					

Notes

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

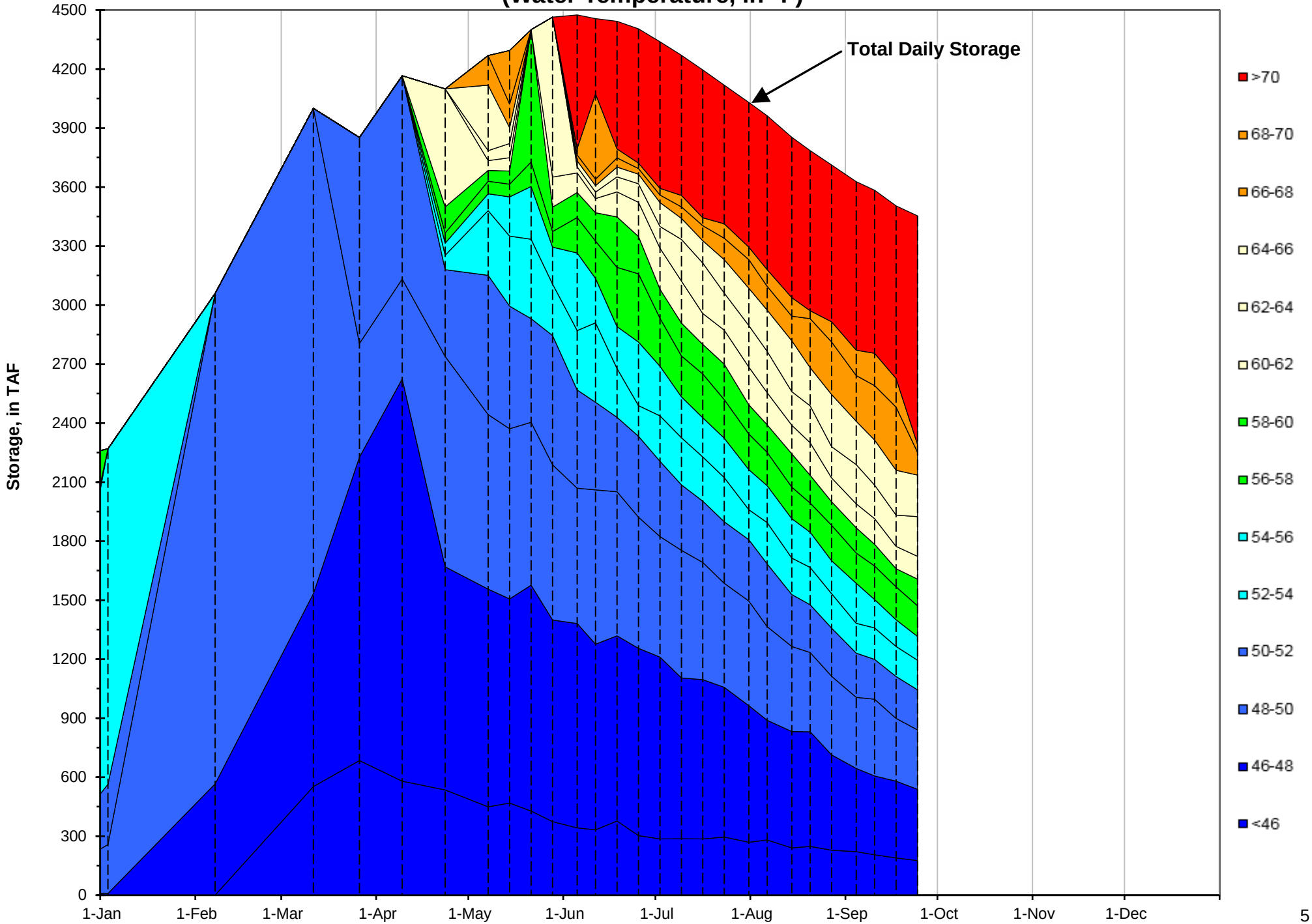
[2] DAT = Daily Average Temperature





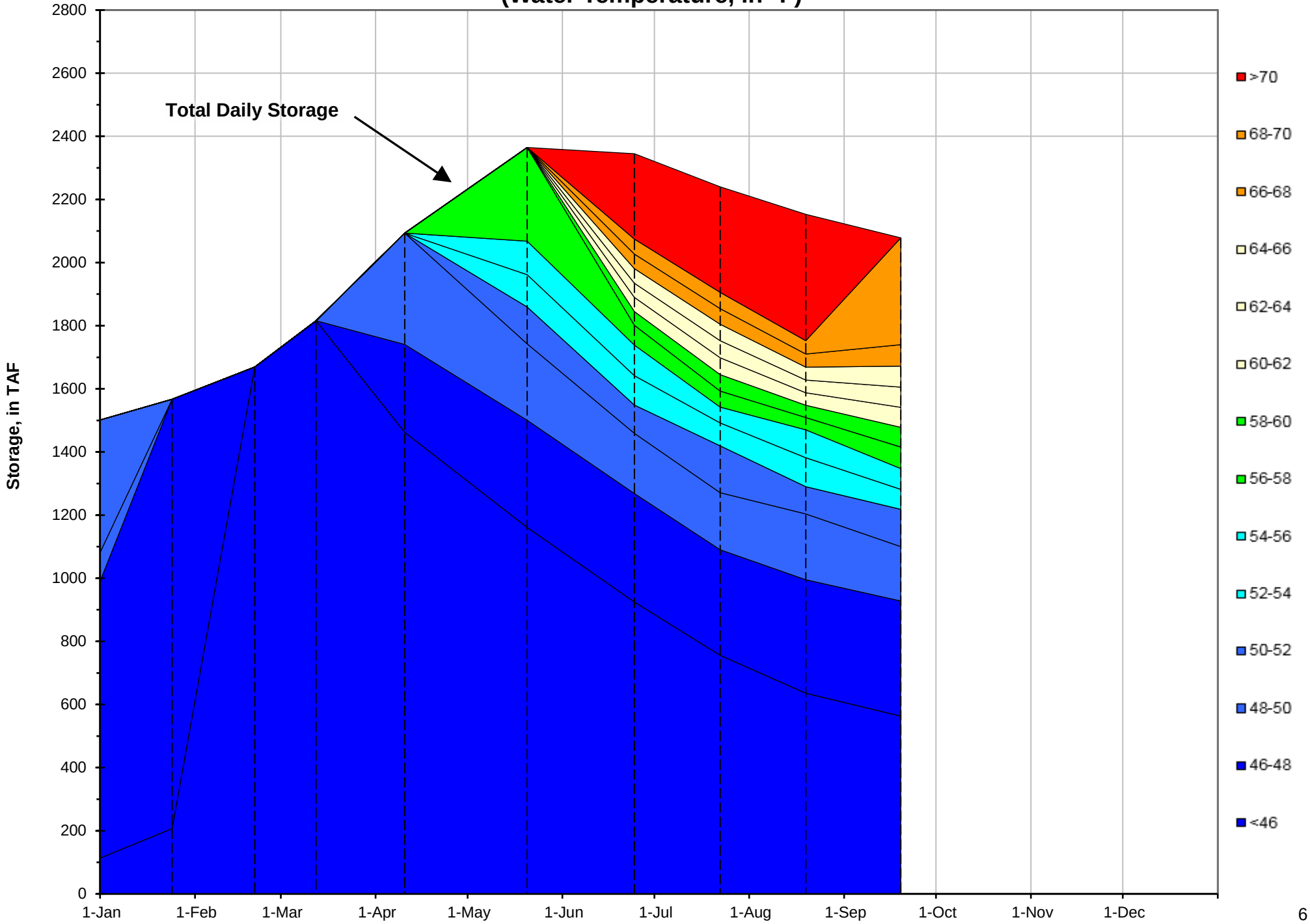
Latest Profile Date: 09/24/2019

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



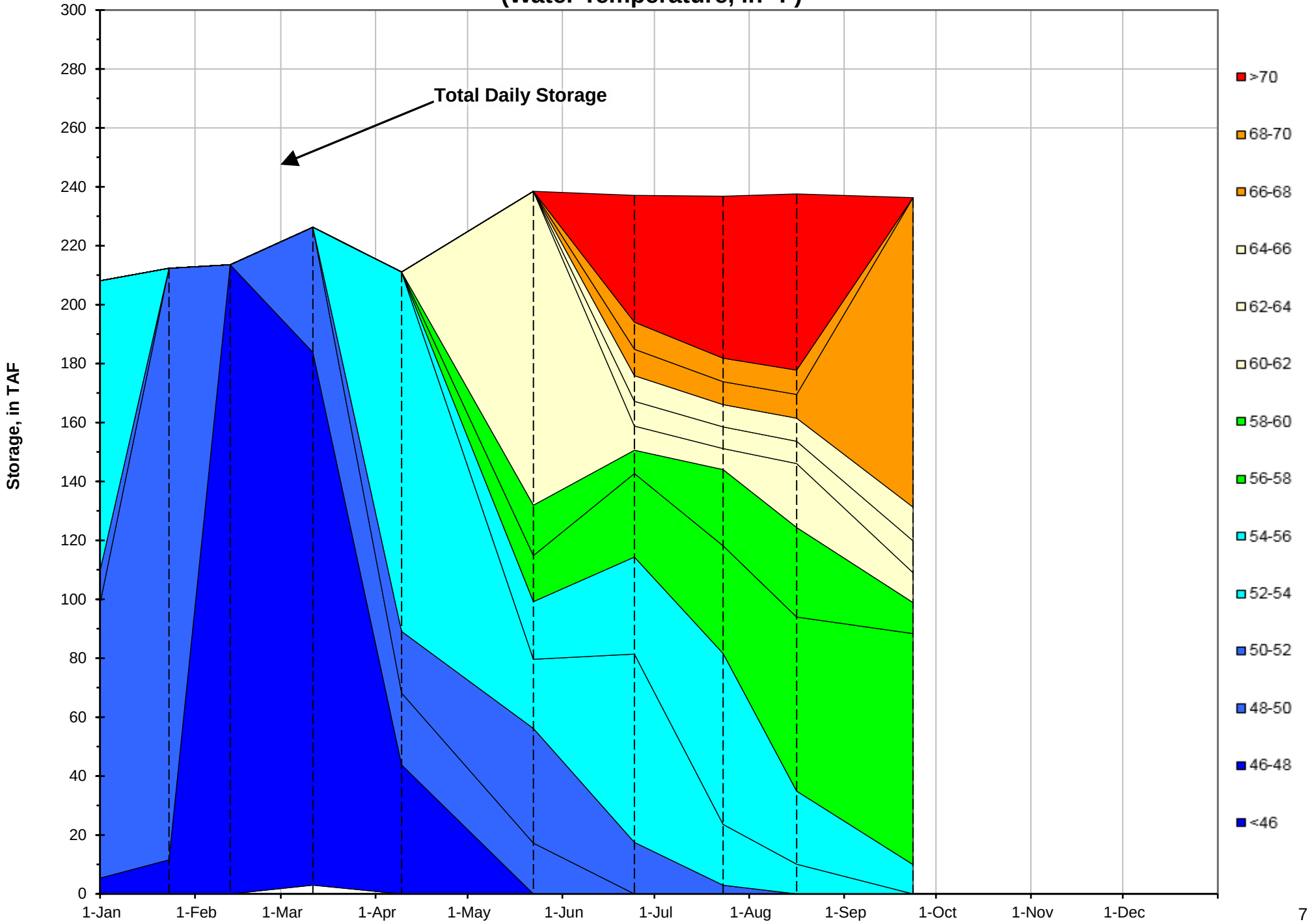
Latest Profile Date: 09/19/2019

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



Latest Profile Date: 09/23/2019

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

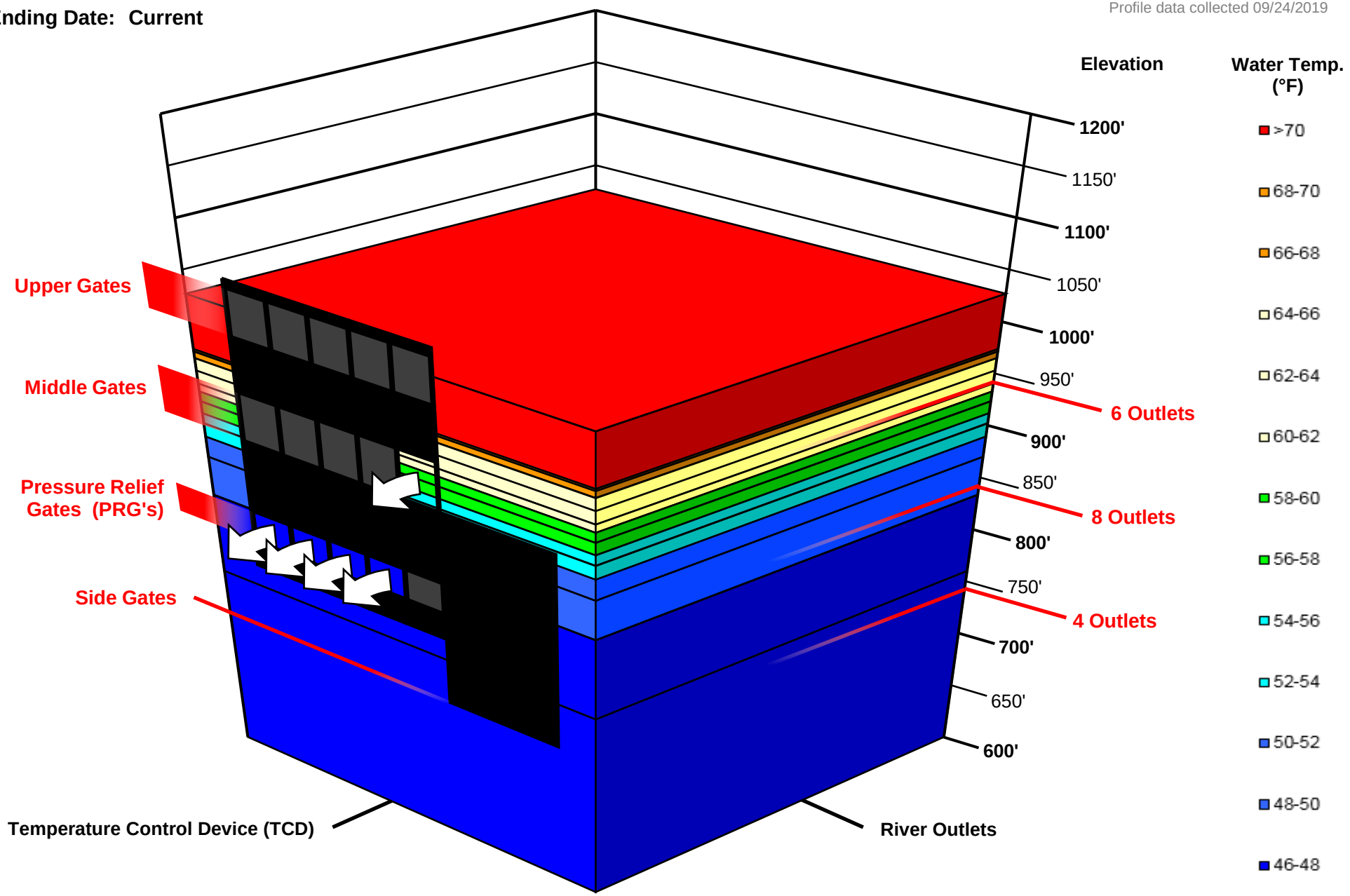


Shasta TCD Configuration

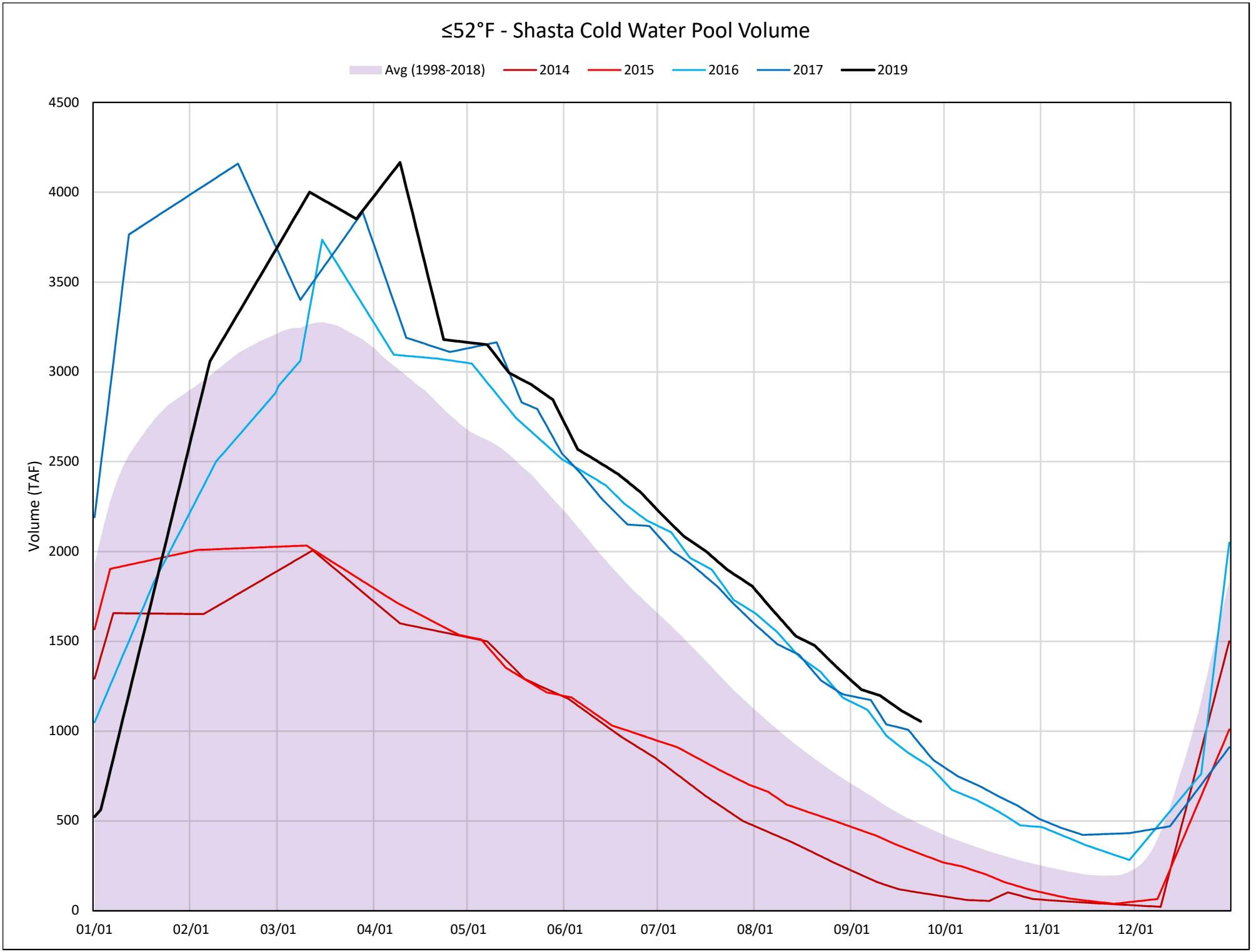
Starting Date: 09/18/2019

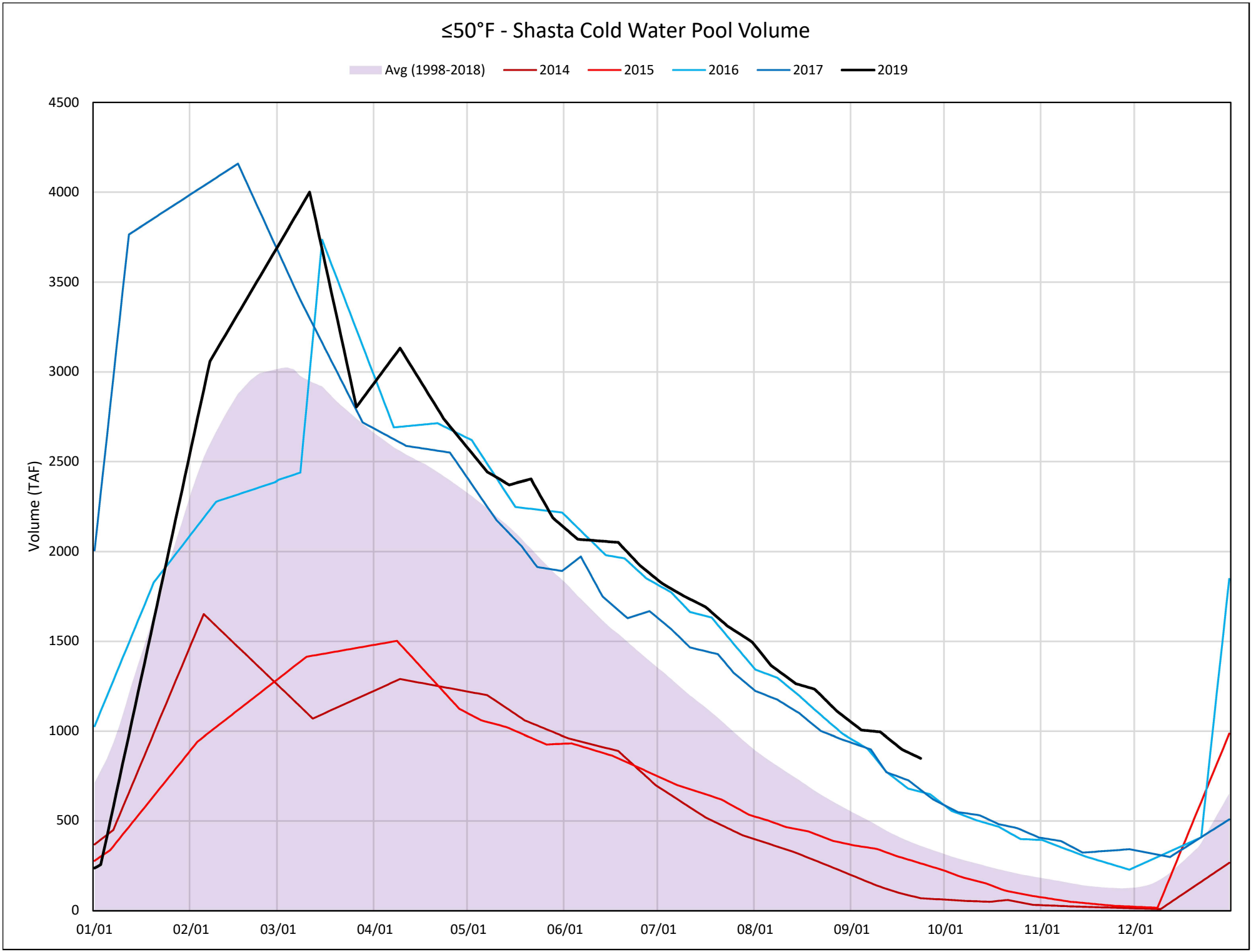
Ending Date: Current

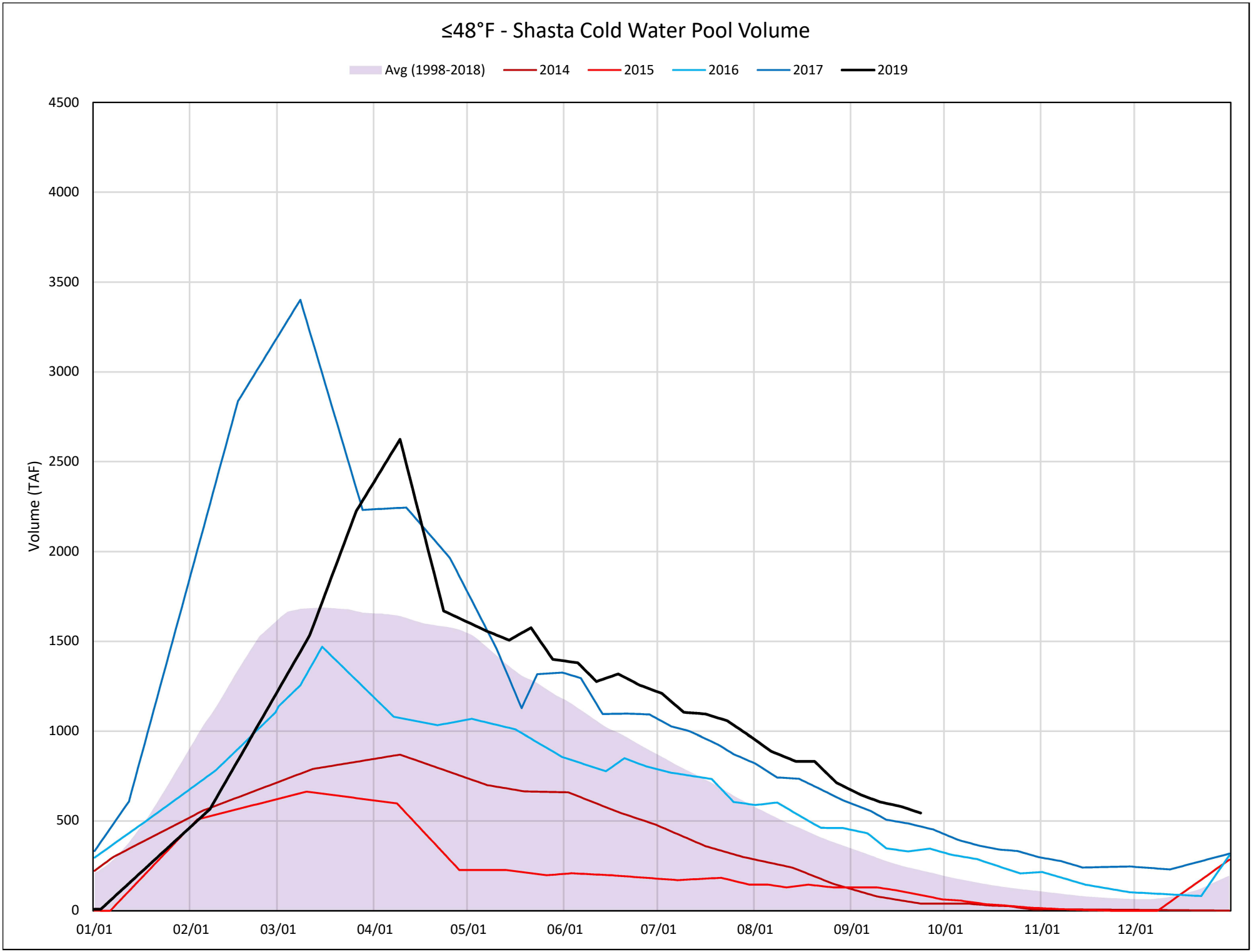
Profile data collected 09/24/2019

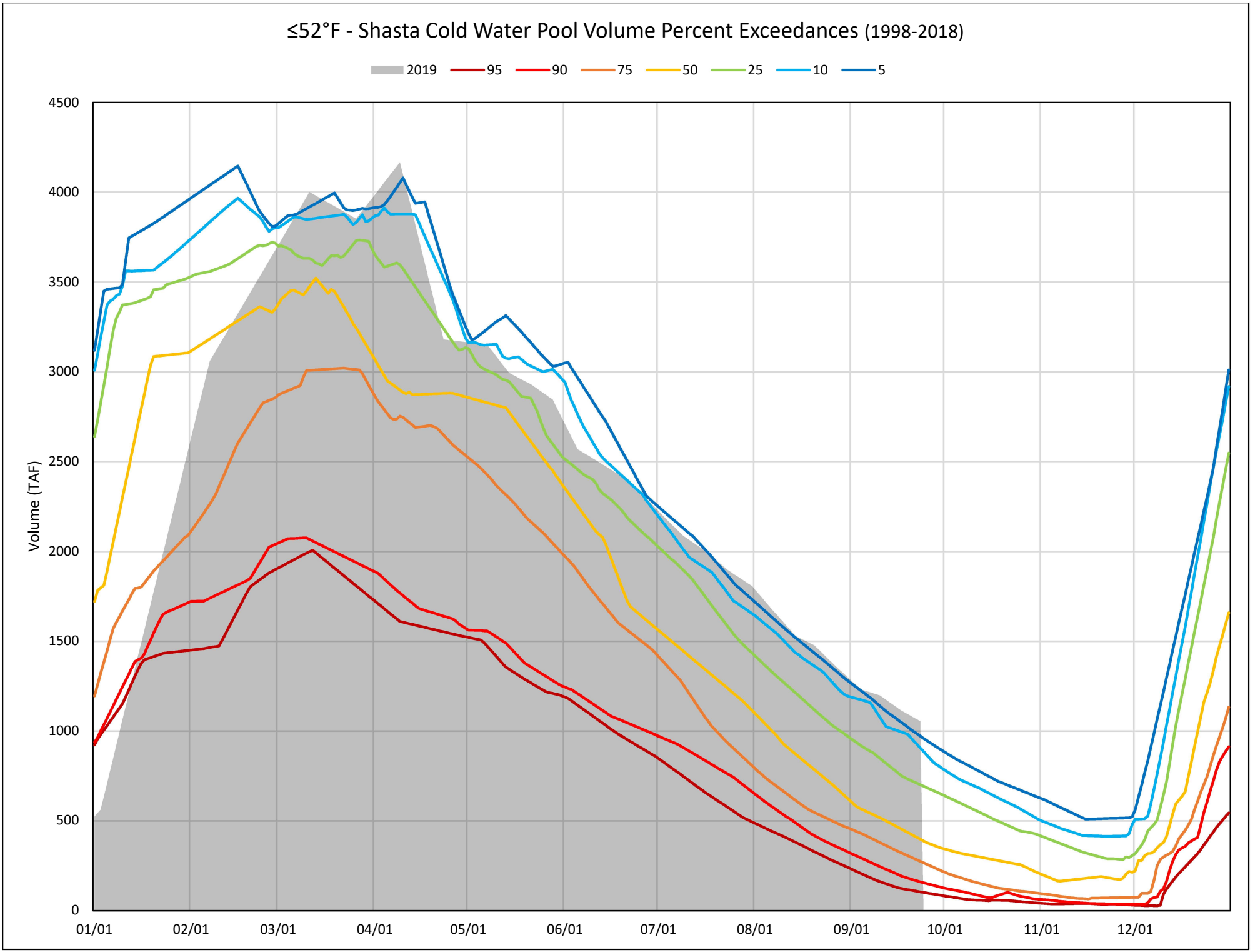


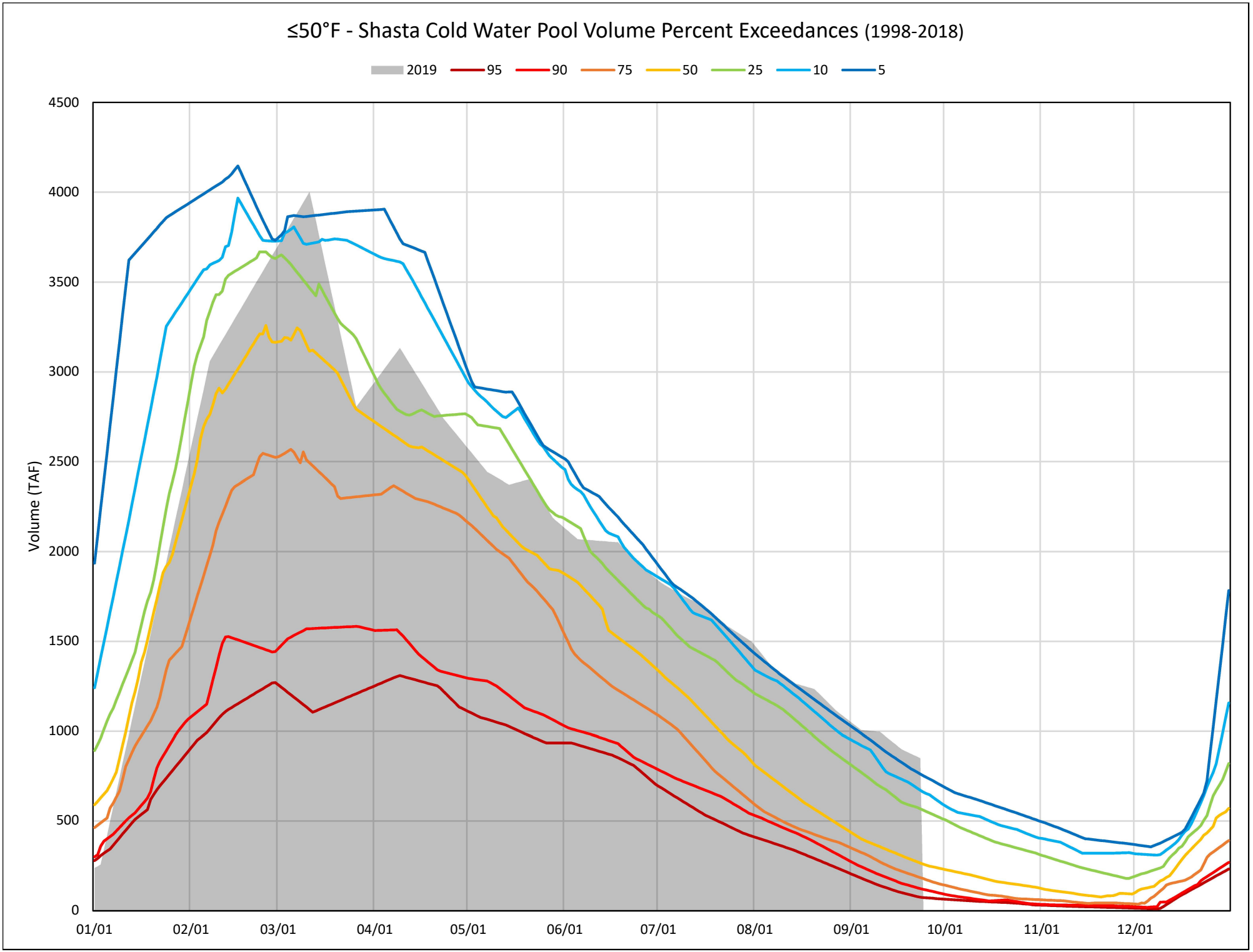
Arrows indicate open Gate or Outlet (i.e. Water flowing from this location)

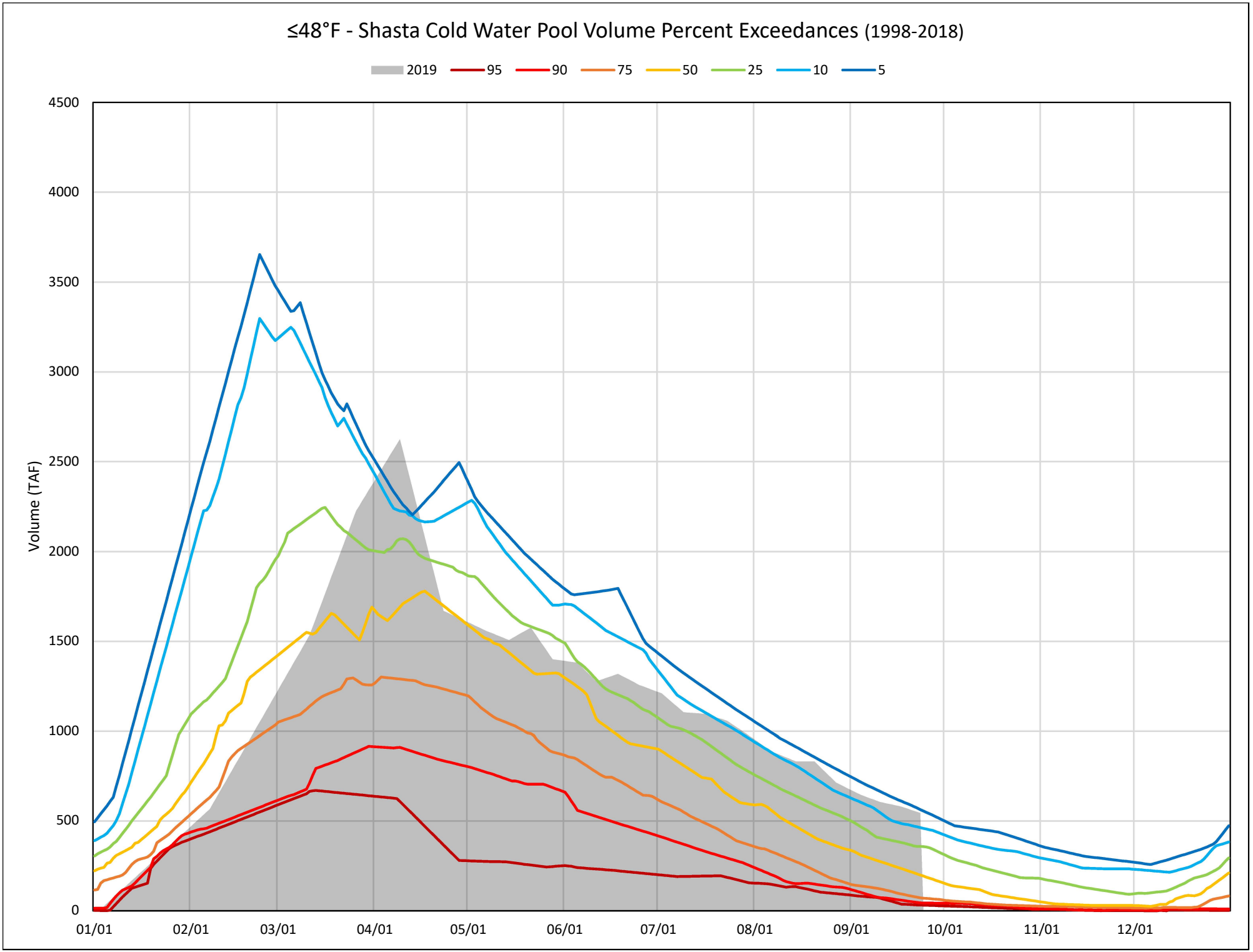

≤52°F - Shasta Cold Water Pool Volume
Avg (1998-2018)
2014
2015
2016
2017
2019
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


≤50°F - Shasta Cold Water Pool Volume
Avg (1998-2018)
2014
2015
2016
2017
2019
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


≤48°F - Shasta Cold Water Pool Volume
Avg (1998-2018)
2014
2015
2016
2017
2019
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01

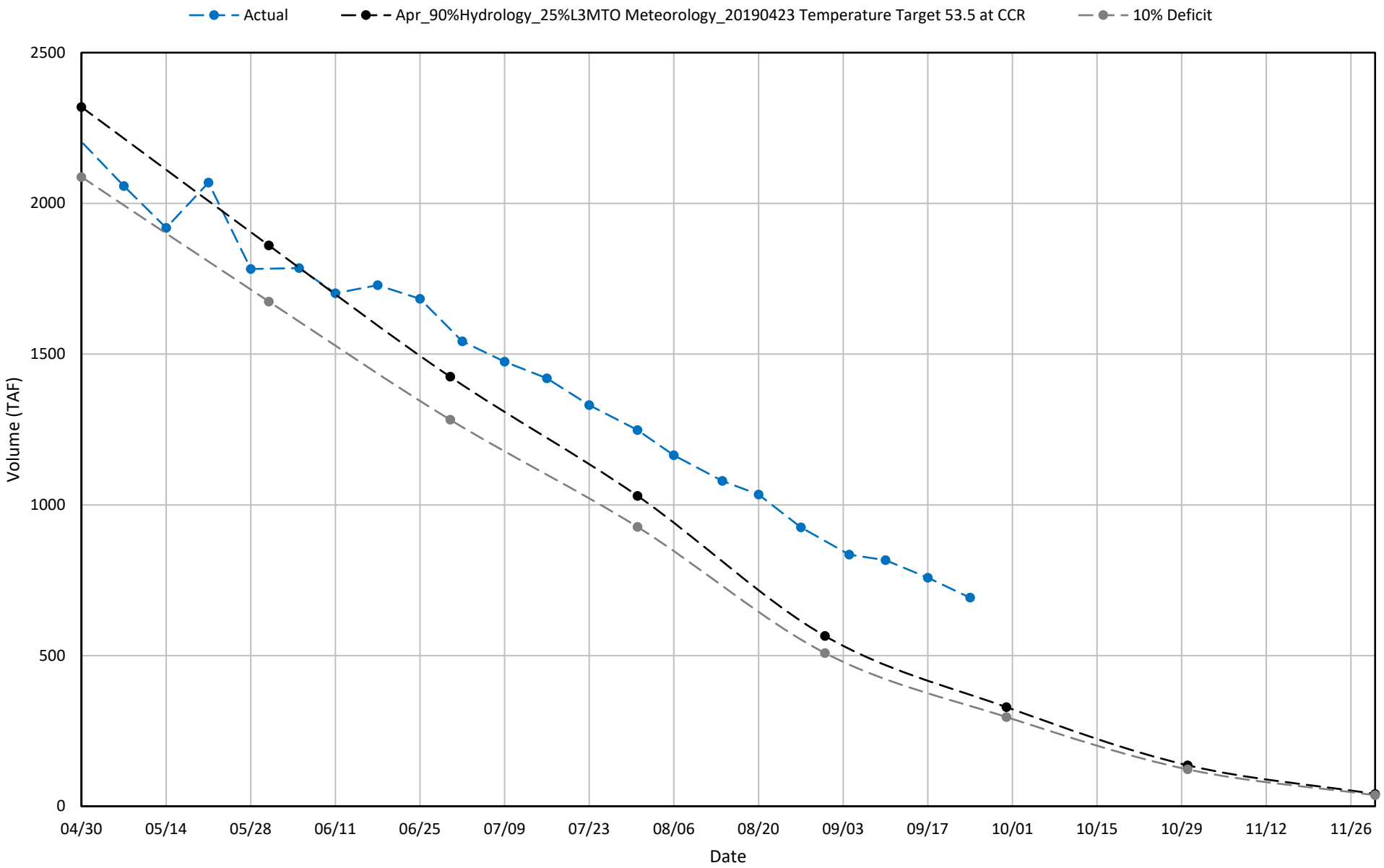

≤52°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2018)
2019
95
90
75
50
25
10
5
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


≤50°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2018)
2019
95
90
75
50
25
10
5
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


≤48°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2018)
2019
95
90
75
50
25
10
5
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01

Printed: 2019.09.24

2019 Shasta Cold Water Pool Volume ≤49°F



September 25, 2019

Upper Sacramento River – September 2019 Preliminary Temperature Analysis

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

Location (°F DAT)	SEP*	OCT*
September 90%-Exceedance Outlook – 25% L3MTO Meteorology		
Keswick Dam KWK	51.8	52.5
Sac. R. abv Clear Creek CCR	52.0	52.5
Airport Road	52.5	52.9
Balls Ferry BSF	53.4	53.5
September 90%-Exceedance Outlook – 50% L3MTO Meteorology		
Keswick Dam KWK	52.0	52.4
Sac. R. abv Clear Creek CCR	52.3	52.4
Airport Road	52.8	52.6
Balls Ferry BSF	53.8	53.2

Model Run	End of September Cold Water Pool <56°F (TAF)	First Side Gate	Full Side Gates
90% Hydro, 25% Met	1,216	11/11/19	NA
90% Hydro, 50% Met	1,228	11/13/19	NA

Model Run Date September 24, 2019

* The HEC5Q model output is displayed 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 3-5). This relationship is an end of September Lake Shasta Volume less than 56°F and likely downstream temperature performance for the early fall months. Estimated temperatures for September and October may fall into a range indicated within the Fall Temperature Index (graphical chart), illustrating historical performance. However, this range should be viewed as an element of uncertainty based on past performance, not a simulation or projection of temperature management operations or results.

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 1 through 2. The relationship between end-of-September lake volume below 56°F and a downstream Sacramento River compliance location through fall is based on the Figures 3-5.

Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

1. The latest available profiles for Shasta, Trinity, and Whiskeytown were taken on September 24, September 19, and September 23, respectively. Model results are sensitive to initial reservoir temperature conditions and the model performs best under highly stratified conditions. The temperature profiles prior to May do 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 creek flows cause significant additional warming in the upper Sacramento River during spring.
3. Operation is based on the September 2019 Operation Outlooks (monthly flows, reservoir release, and end-of-month reservoir storage) for the 90%- and 50%-exceedances, with minor modifications to accommodate for flood management. After September historical information is used for inflow. Trinity Lake inflows are updated with the CNRFC 90% runoff exceedance for the 90% and DWR Bulletin 120 for the 50% runoff exceedance studies. The Operation Outlook assumes a modified USFWS BiOp RPA Action 4

to approximately 80 km. Discussions are on-going and actual conditions may vary.
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. Side-flows were adjusted to a 25% historical exceedance for both the 90% and 50% runoff exceedance studies.
6. Meteorological inputs represent historical (1985 – 2017) monthly mean equilibrium temperature exceedance at 25% and 50% patterned after like months on a 6-hour time-step (for months prior to April). Assumed inflows temperature remain static inputs and do not vary with the assumed meteorology. Tools to use local three-month-temperature outlooks, driven by the NOAA NWS Climate Prediction Center (CPC) are used beginning in April.
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, which is 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.

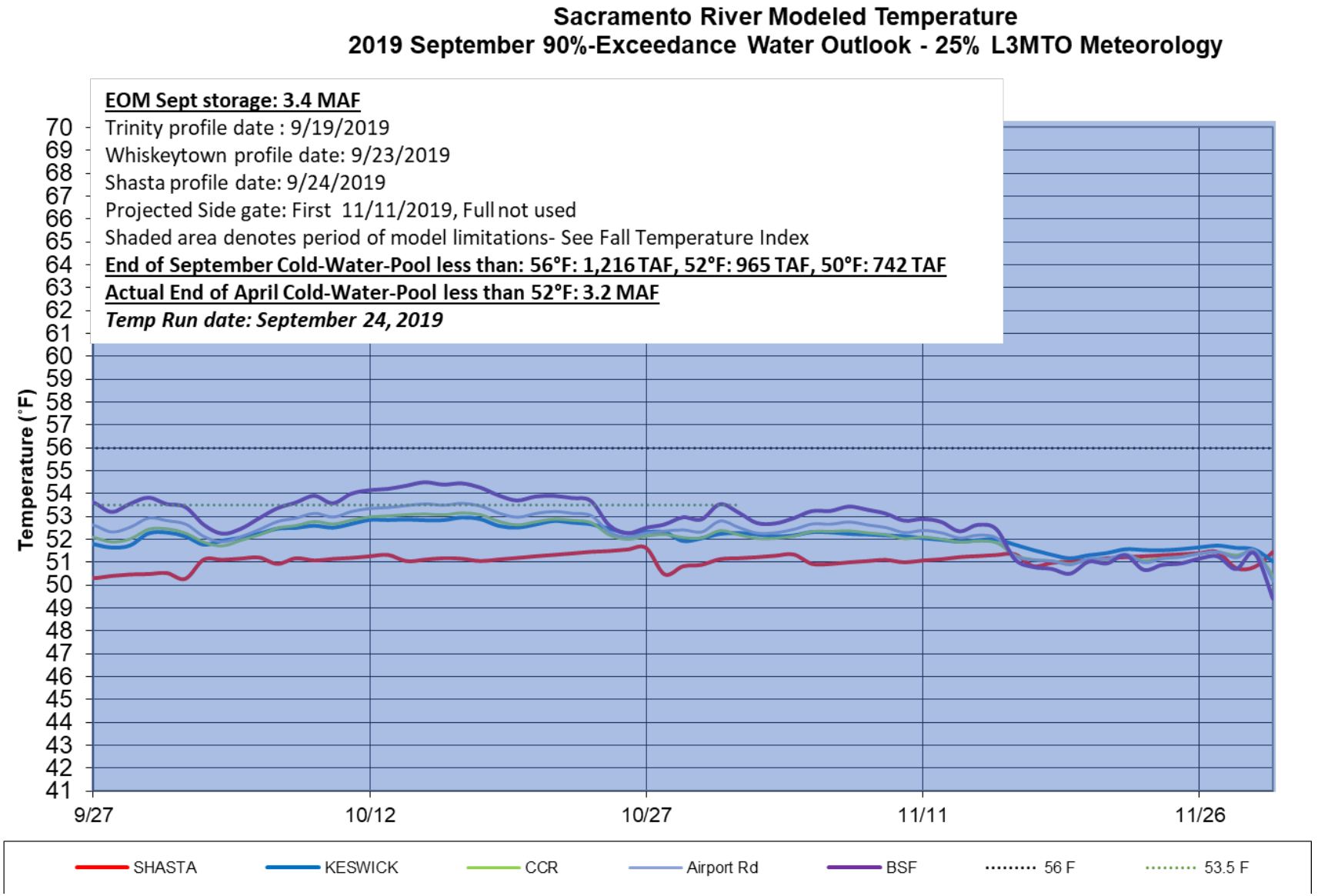


Figure 1. September 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 25% L3MTO meteorology.

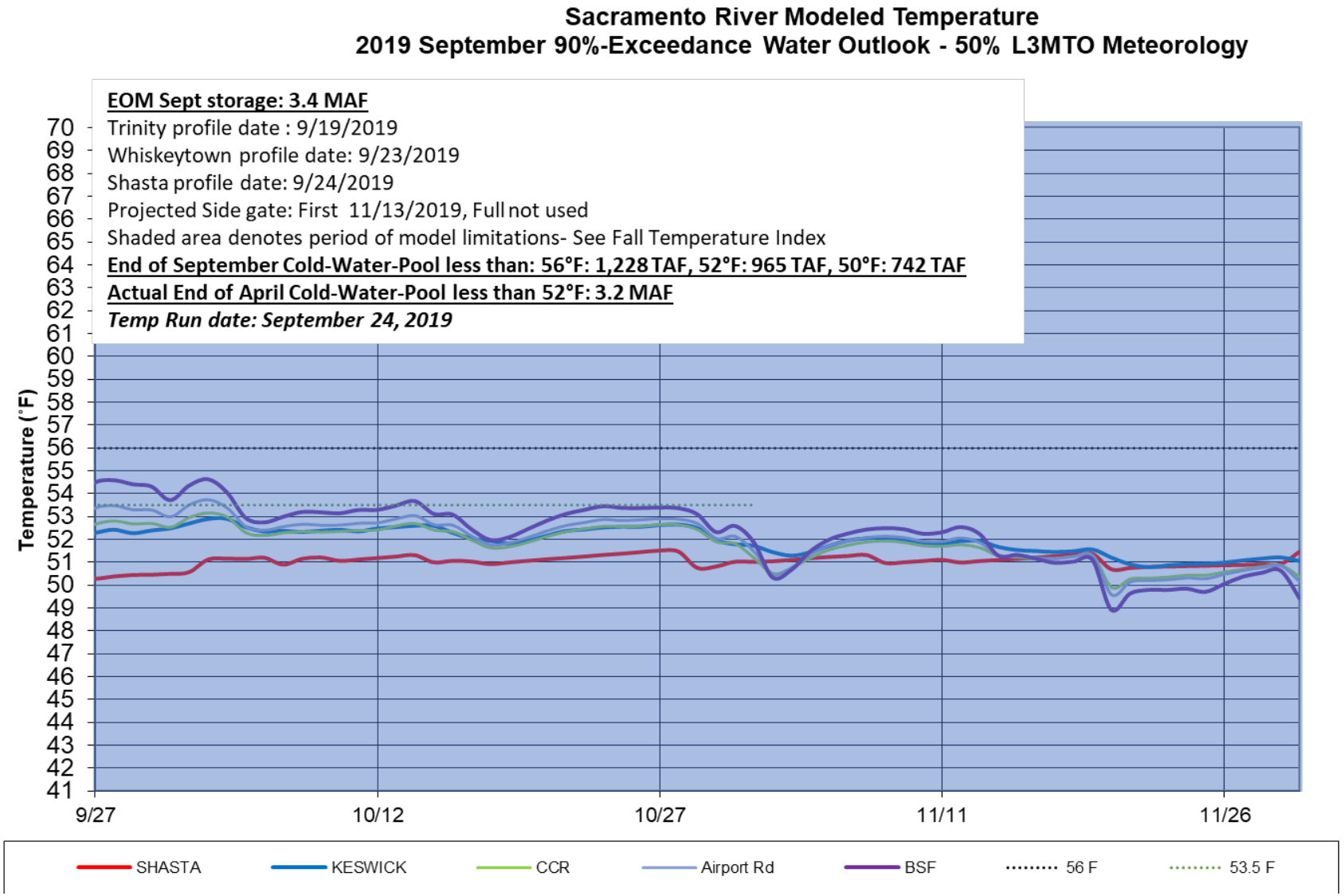


Figure 2. September 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 50% L3MTO meteorology.

Figures 3-5 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.

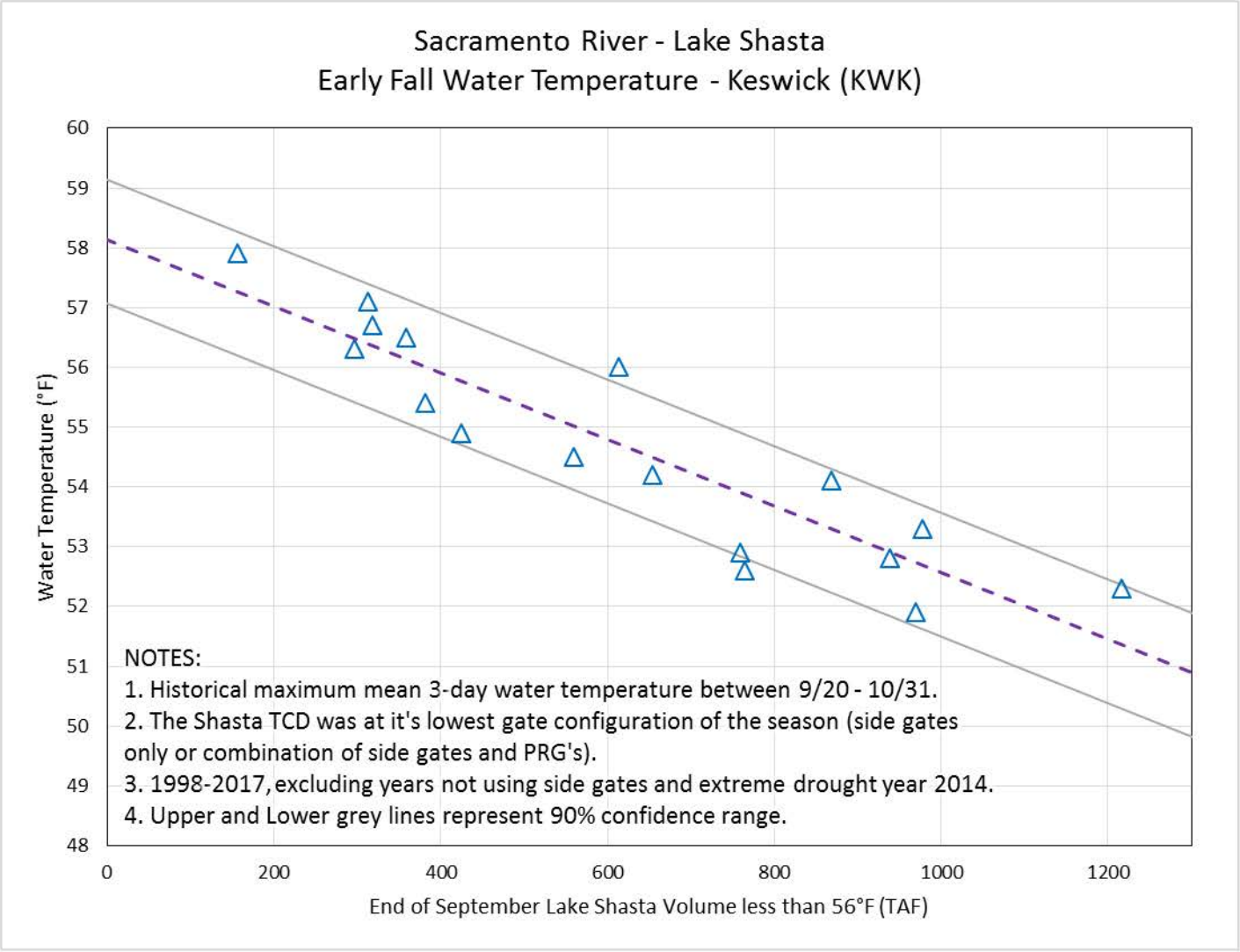


Figure 3. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Keswick water temperature.

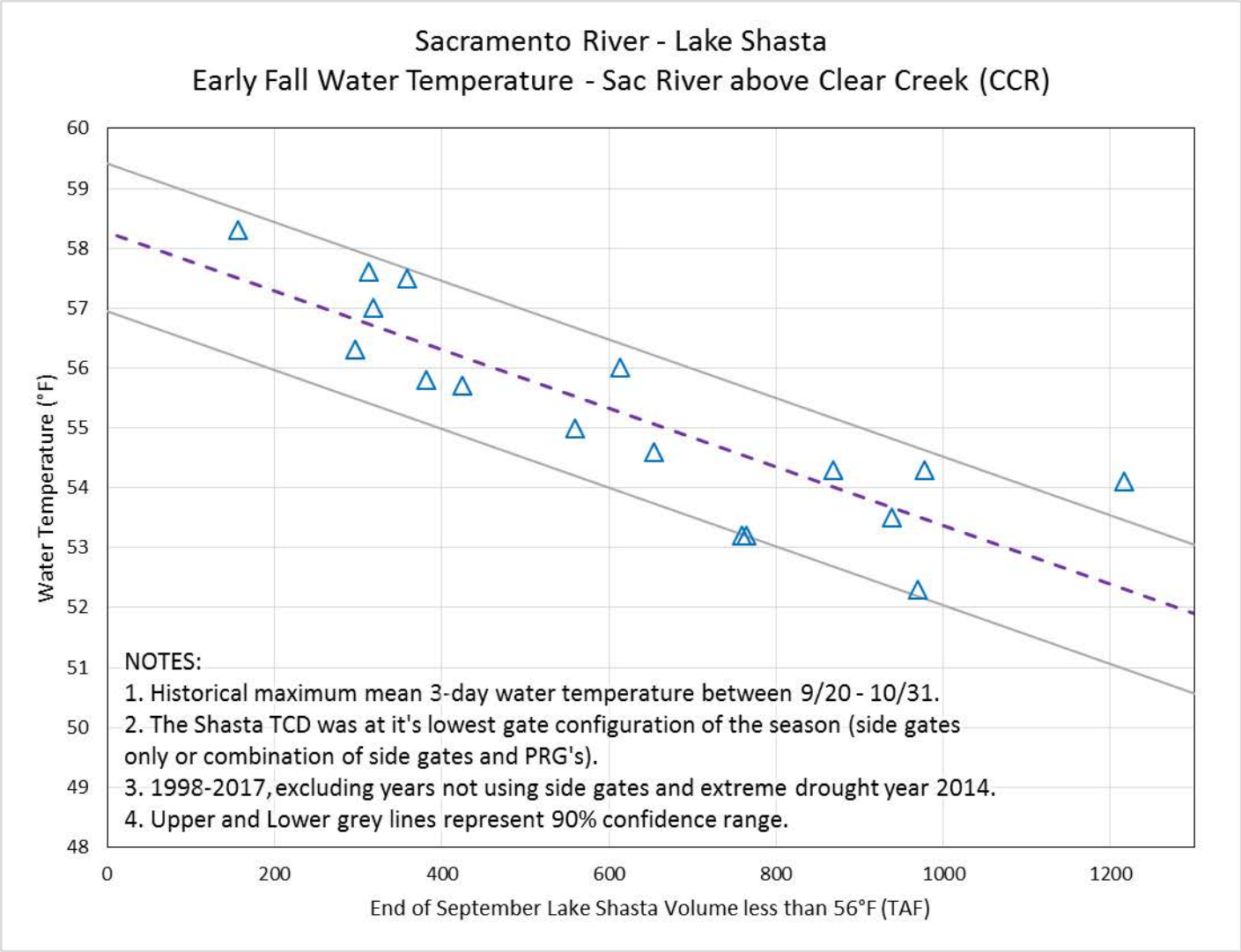


Figure 4. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Sacramento River above Clear Creek confluence water temperature.

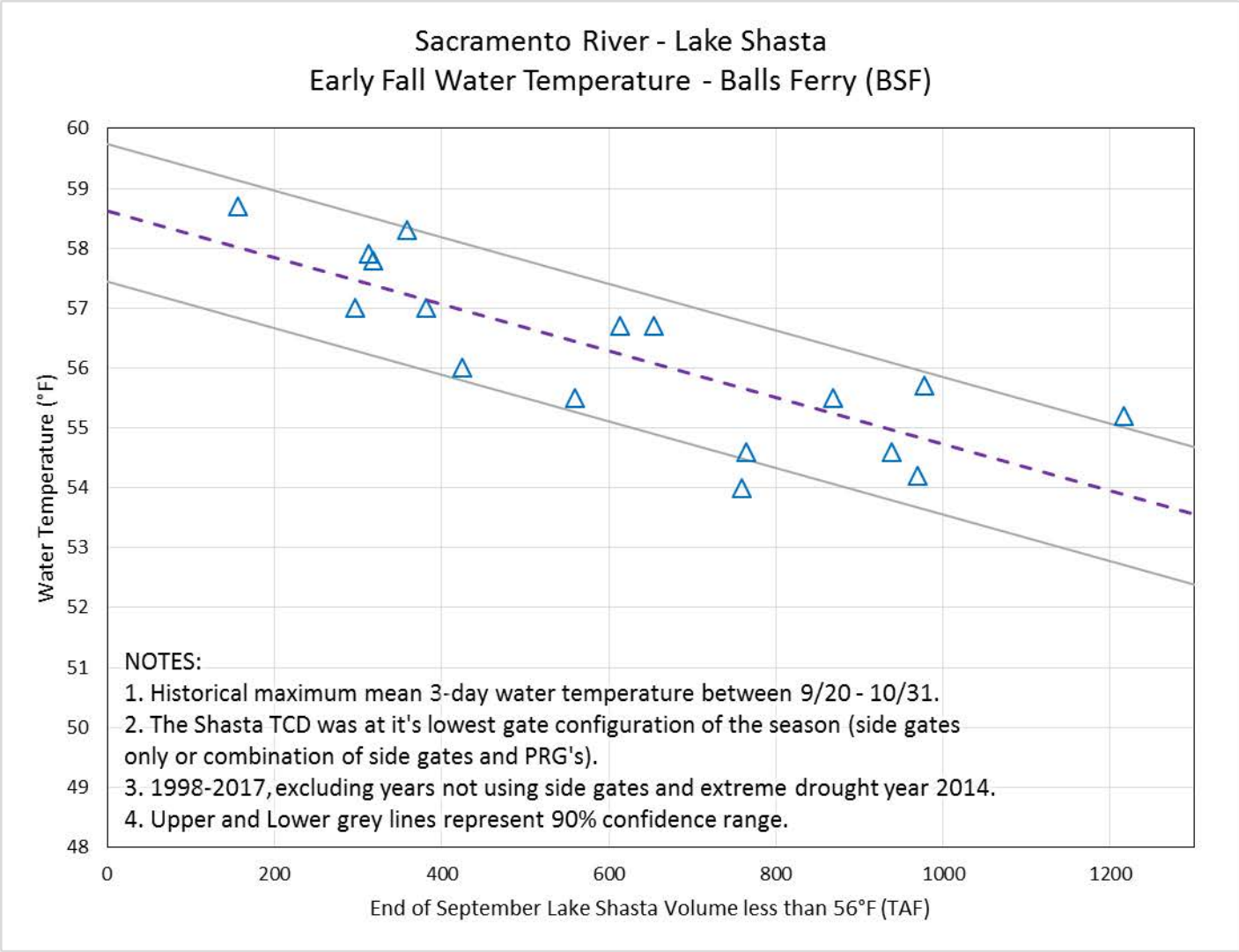
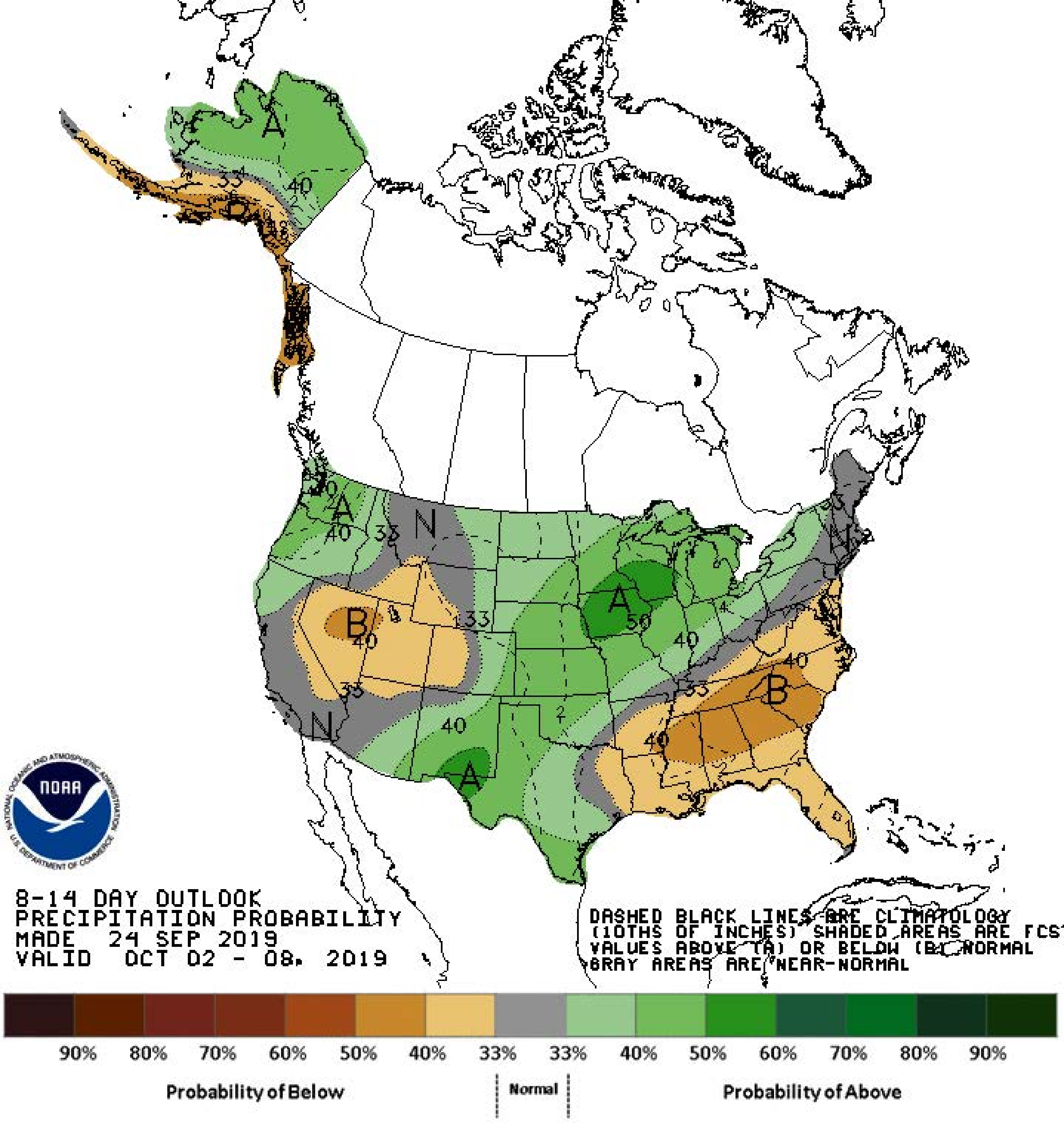
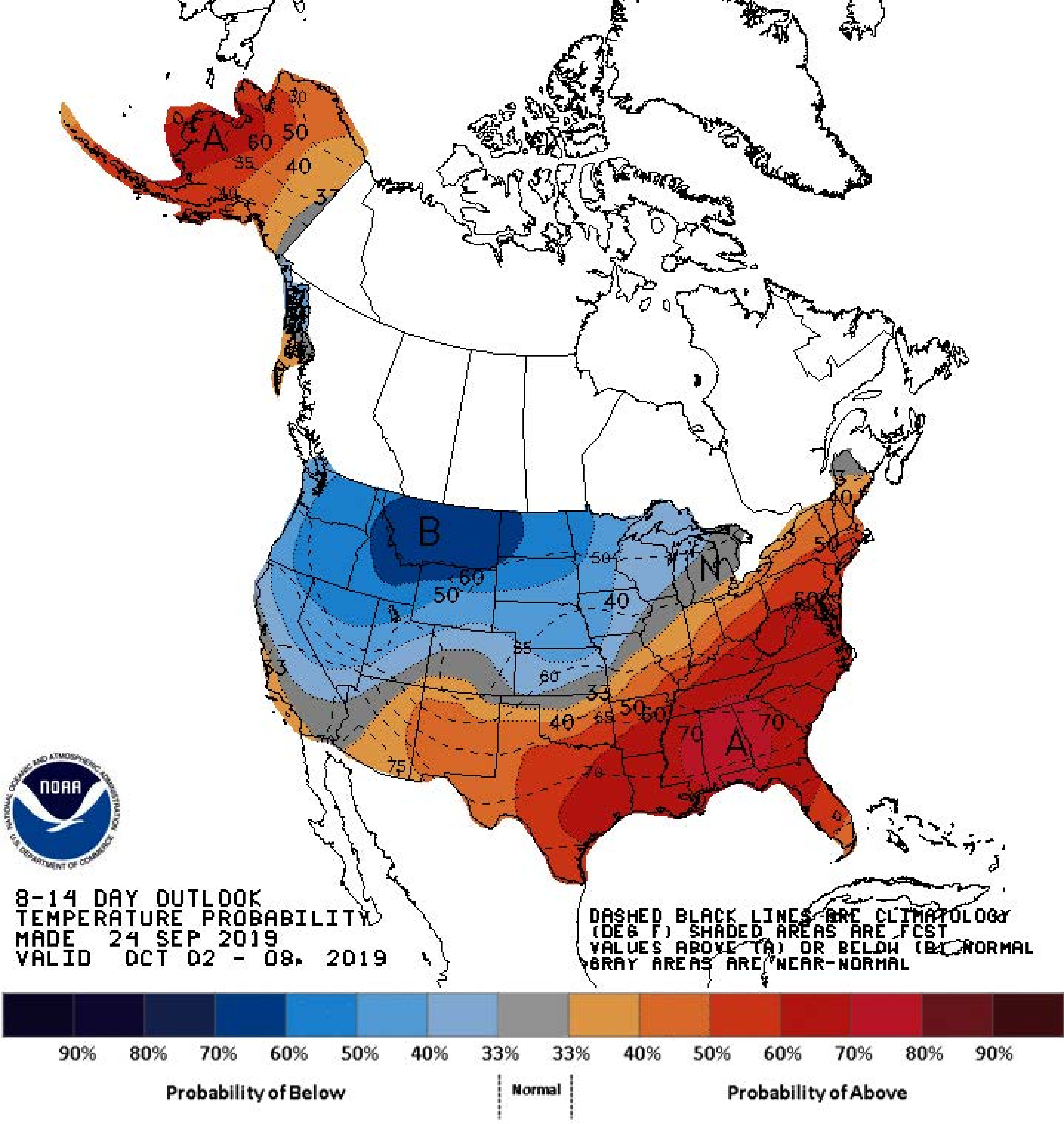


Figure 5. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Balls Ferry water temperature.


8-14 DAY OUTLOOK
PRECIPITATION PROBABILITY
MADE 24 SEP 2019
VALID OCT 02 - 08, 2019
DASHED BLACK LINES ARE CLIMATOLOGY
(10THS OF INCHES) SHADED AREAS ARE FCS
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


8-14 DAY OUTLOOK
TEMPERATURE PROBABILITY
MADE 24 SEP 2019
VALID OCT 02 - 08, 2019
DASHED BLACK LINES ARE CLIMATOLOGY
(DEG F) SHADED AREAS ARE FCST
VALUES ABOVE (A) OR BELOW (B) NORMAL
GRAY AREAS ARE NEAR-NORMAL
NOAA
A
B
N
A
90% 80% 70% 60% 50% 40% 33% 33% 40% 50% 60% 70% 80% 90%
Probability of Below
Normal
Probability of Above