

The Ins and Outs & Ups and Downs of Lake Berryessa

By Peter Kilkus

In & Up

Most of us have heard of the rule of thumb that Lake Berryessa rises 1 foot for every 1 inch of rain. As with most rules of thumb, this is not accurate. Lake level rise depends on many variables like the actual lake level when it rains and how saturated is the ground.

It usually takes about 3 inches of rain on dry hills before there is any appreciable runoff into the lake. That's why the 3-week dry period in January slowed this year's rise and it took an inch or more to start the runoff again.

Also the lake is roughly like a V-shaped bowl, so the higher the level to start, the more rain it takes to make the lake rise even further.

A look at the actual data during the last few years shows that the average increase in 2009 was 3.4" rise per inch of rain. In 2010 the number was 7.5" rise per inch of rain. In 2011, that figure (seven day average) went from 3 inches rise per inch of rainfall in early February to 11 inches per inch in early March to a peak of 13 - 16 inches per inch during the wettest part of late March.

Date	Level (Feet msl)	Rain (Inches)	Cum Rain (Inches)	Daily Level Rise (Inches)	Level Rise (14 day ave) (Inches per inch of rain)	Level Rise (7 day ave) (Inches per inch of rain)
2/14/11	417.85	0.08	13.66	0.00	3.0	3.0
2/15/11	418.08	0.46	14.12	2.76	5.6	5.3
2/16/11	419.07	1.63	15.75	11.88	6.9	6.8
2/17/11	419.93	0.6	16.35	10.32	9.1	9.1
2/18/11	420.45	1.35	17.70	6.24	7.6	7.6
2/19/11	420.84	0.83	18.53	4.68	7.3	7.3
2/20/11	421.05	0.02	18.55	2.52	7.8	7.7
2/21/11	421.21	0	18.55	1.92	8.2	8.2
2/22/11	421.32	0	18.55	1.32	8.4	8.8
2/23/11	421.43	0	18.55	1.32	8.7	10.1
2/24/11	421.53	0	18.55	1.20	8.9	8.7
2/25/11	421.86	1.55	20.10	3.96	7.4	7.1
2/26/11	422.04	0.02	20.12	2.16	7.7	9.1
2/27/11	422.15	0	20.12	1.32	7.9	8.4
2/28/11	422.24	0	20.12	1.08	8.2	7.9
3/1/11	422.24	0	20.12	0.00	8.3	7.0
3/2/11	422.55	0.48	20.60	3.72	8.6	6.6
3/3/11	422.73	0.23	20.83	2.16	7.5	6.3
3/4/11	422.84	0	20.83	1.32	9.2	16.1
3/5/11	422.93	0	20.83	1.08	10.9	15.0
3/6/11	423.15	0.52	21.35	2.64	9.0	9.8
3/7/11	423.3	0.8	22.15	1.80	7.0	6.3
3/8/11	423.4	0	22.15	1.20	6.9	6.9
3/9/11	423.46	0	22.15	0.72	6.8	7.0
3/10/11	423.57	0	22.15	1.32	6.8	7.6
3/11/11	423.64	0	22.15	0.84	10.4	7.3
3/12/11	423.68	0	22.15	0.48	9.7	6.8
3/13/11	423.72	0	22.15	0.48	9.3	8.6

3/14/11	423.96	0.91	23.06	2.88	7.0	8.7
3/15/11	424.24	0	23.06	3.36	8.2	11.1
3/16/11	424.63	0.54	23.60	4.68	8.3	9.7
3/17/11	424.82	0	23.60	2.28	9.1	10.3
3/18/11	425.33	0.17	23.77	6.12	10.2	12.5
3/19/11	426.22	1.22	24.99	10.68	9.5	10.7
3/20/11	428.06	2.89	27.88	22.08	9.0	9.1
3/21/11	428.57	0.14	28.02	6.12	10.8	11.2
3/22/11	428.9	0	28.02	3.96	11.2	11.3
3/23/11	429.52	1.07	29.09	7.44	10.5	10.7
3/24/11	431.03	0.34	29.43	18.12	12.3	12.8
3/25/11	431.83	2.01	31.44	9.60	10.6	10.2
3/26/11	432.67	1	32.44	10.08	10.5	10.4
3/27/11	433.2	0.05	32.49	6.36	11.0	13.4
3/28/11	433.54	0.03	32.52	4.08	12.2	13.3
3/29/11	433.82	0	32.52	3.36	12.2	13.1
3/30/11	434.05	0	32.52	2.76	12.7	15.8
3/31/11	434.19	0	32.52	1.68	12.6	12.3
4/1/11	434.31	0	32.52	1.44		

The lake did go up 61 feet in one year in 94-95 but that was due to an unusually wet season with two significant storms - a January flood event and a March flood event. A state report said heavy rains began during the second week of January, 1995 with the Coast Range north of San Francisco and the upper Sacramento Valley hardest hit. The Russian River jumped from low flow levels to near record levels (set in February 1986) in just three days. Levels on the Napa and Eel rivers, although not as high as in 1986, were well above flood stage.

A series of early March storms dropped significant precipitation. The March storms produced a new record stage on the Salinas River near Spreckles and exceeded the 1986 peak on the Napa River by 0.3 feet.

This Old House was doing a Napa restoration and described the weather on their web site: The Napa Valley House - The renovation of Dennis Duffy's 1906 Victorian farmhouse in the vineyards of northern California.

“The stunning vistas and rich agricultural and cultural history of Napa Valley proved irresistible to us back in the winter of 1994-95. If only we'd known about the rain. And then the skies opened. The rain came down 22 days in a row that February; 52 inches fell in one month; the nearby Napa River leapt its banks. Contractor Nolan and crew persevered, however, working in the mud to pour new foundation walls, frame up the new kitchen and make the structure weather tight. Scene after scene was shot with cast and crew increasingly sodden. And then, a week before our wrap, the skies turned blue, the sun reappeared and the mustard bloomed in all its glory.”

From the Napa Valley Vintners Harvest updates for 1995:

“A year of weather extremes marked the 1995 vintage, which saw winter floods, spring rains and a June hailstorm. The dramatic weather events got the growing season off to a late start, and although summer heat pushed grapes to maturity, harvest was late and yields were down. Moderate Indian Summer temperatures permitted extended hang time for red varieties, important to the development of rich flavors and deep color. Overall, vintners characterized the year as late, light and luscious.”

Out & Down

During an unusually wet 2011 season, conspiracy theory rumors still circulated. One was that the lake would have risen faster if the Solano Irrigation District (SID) and the Solano County Water Agency (SCWA) were not letting out water so fast. Several years ago some people claimed that the dam managers were letting out water faster than necessary because electricity prices were so high that they were trying to make a profit from the power generated by Lake Berryessa.

The actual Lake Berryessa output is controlled by the water allocations established when the dam was built, as well as certain Bureau of Reclamation flow specifications. SID cannot exceed specific annual allocations and water is not simply flushed for power generation exclusively. Power is an added bonus as water is sent to consumers.

During February and March of 2011, the power plant was shut down completely for its annual maintenance. There was zero power generation for that period. What can be a little misleading is that if someone looks over the edge of the dam they will typically see the very visible release spouting out through the outlet pipe as it was originally designed.



This is not water passing through the powerhouse. The total power generated also remains relatively constant from year to year...peaking during the summer months when agriculture demands also peak.

Winter (Oct 15 through mid March...depending on temperatures) is the time for filling Lake Berryessa - except for a base amount of release required to maintain stream flows and dam safety. The Bureau of Reclamation requires a minimum of 45 cubic feet per second (CFS) to be released through Monticello at all times. This supports the Lower Putah Creek fishery and keeps Lake Solano "charged".

There are many variables when it comes to stream flows and runoff from the watershed. Soil saturation, ground water levels, sun exposure, air temps, wind speed and direction plus the downstream demands and how soon those deliveries begin in the season. So how do we measure input and output and how does it affect lake levels.

Let's start with some simple arithmetic.

- 1 Cubic Foot per Second equals 1.98 Acre-Foot per day
- 1 AF of water equals 1 foot of water on 1 acre
- The required minimum output of 45 CFS equates to 89.1 AF per day.
- Lake Berryessa has a surface level of about 19,500 acres when full but decreases as it empties.
- At the minimum output it would take 219 days for the lake to drop 1 foot when full.

Lake Level: Acre-Feet of Storage per Foot of Level Increase

440' – 445': 19,500

430' – 440': 18,500

400' – 430': 17,050

390' – 400': 14,820

380' – 390': 13,270

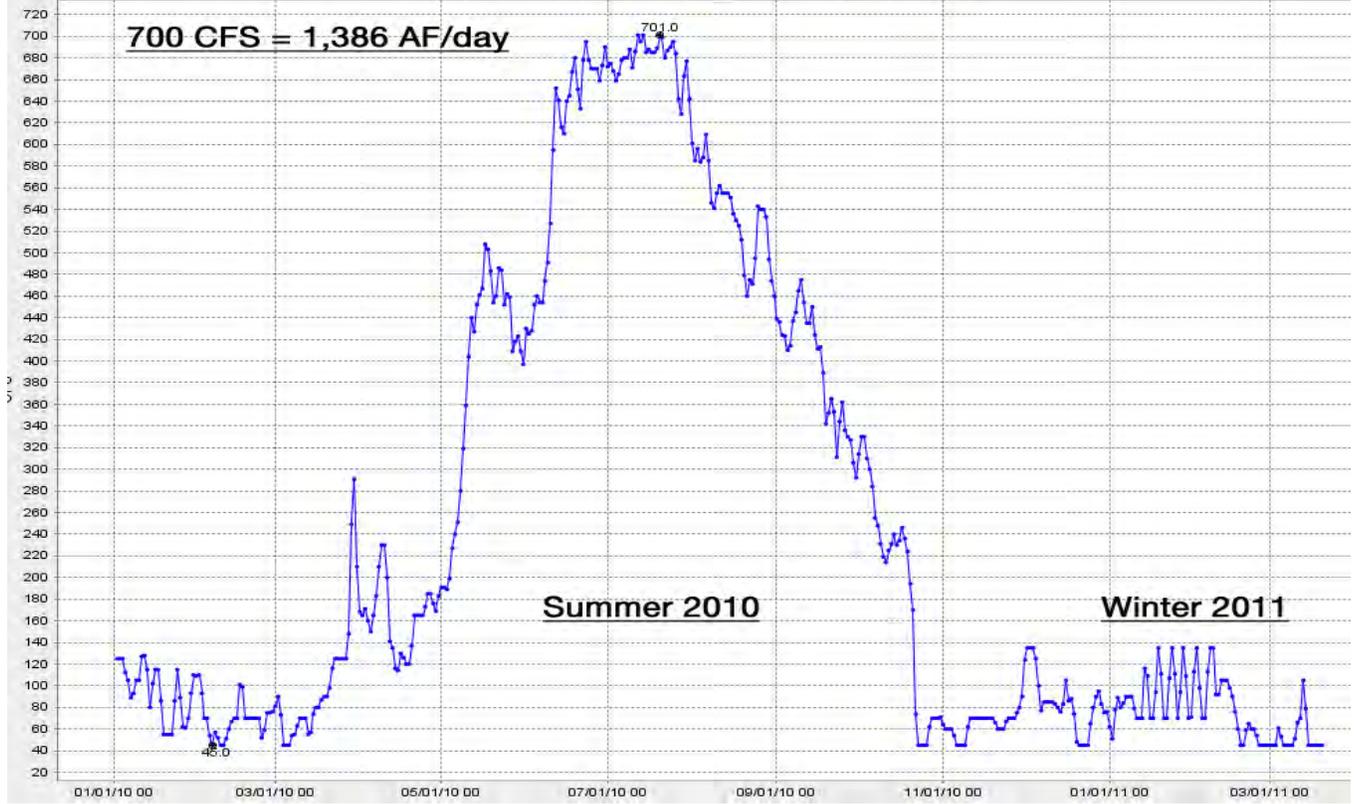
350' – 380': 11,500

From December 31, 2005 until January 31, 2006 the lake remained above 440 feet. It hit 443.5 feet maximum level on Jan 2 and didn't get back down to 440 feet until May 19. Its maximum outflow was 5,363 cfs (10,600 AF/day) on April 14. The average outflow for April, 2005 was 2,000 cfs or 3,960 AF/day. This would equate to about a foot drop every 5 days. It rained 6.7 inches during that same April time frame.

The maximum outflow obviously occurs during the summer. The dam was originally built to supply irrigation water to Solano County. That is still its main purpose, although it also provides drinking water to about 500,000 people in Solano County. The Budweiser brewery in Fairfield has a contract that requires the use of Lake Berryessa water only. Thus the old joke we've heard so many times... No Lake Berryessa water is used in the Napa Valley, but some does go to the residential communities around the lake.

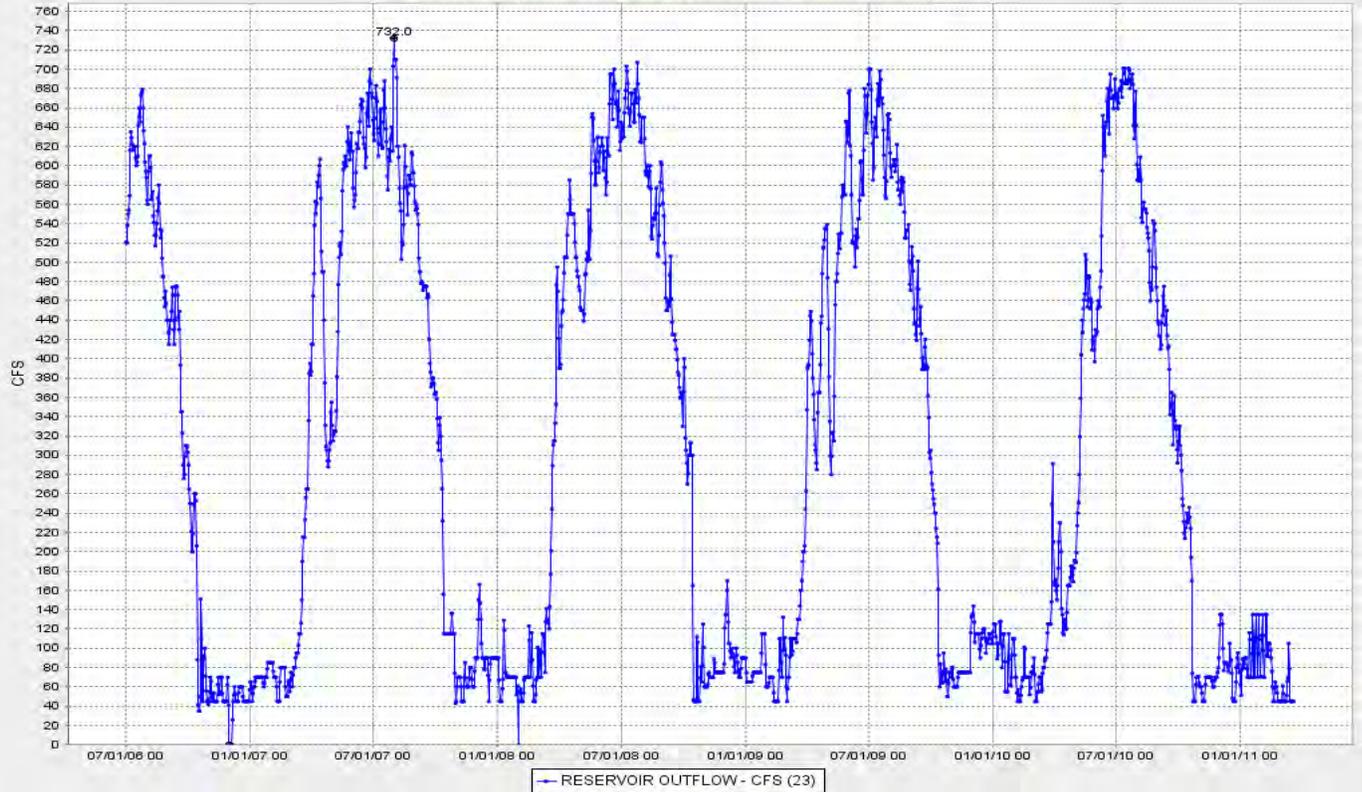
The majority of Lake Berryessa water is released during May-September – the growing season. Peak outflow is about 700 cfs or 1,400 AF/day.

Date from 01/01/2010 13:48 through 03/23/2011 13:48 Duration : 445 days
Max of period : (07/20/2010 00:00, 701.0) Min of period : (02/06/2010 00:00, 45.0)



BERRYESSA (BER)

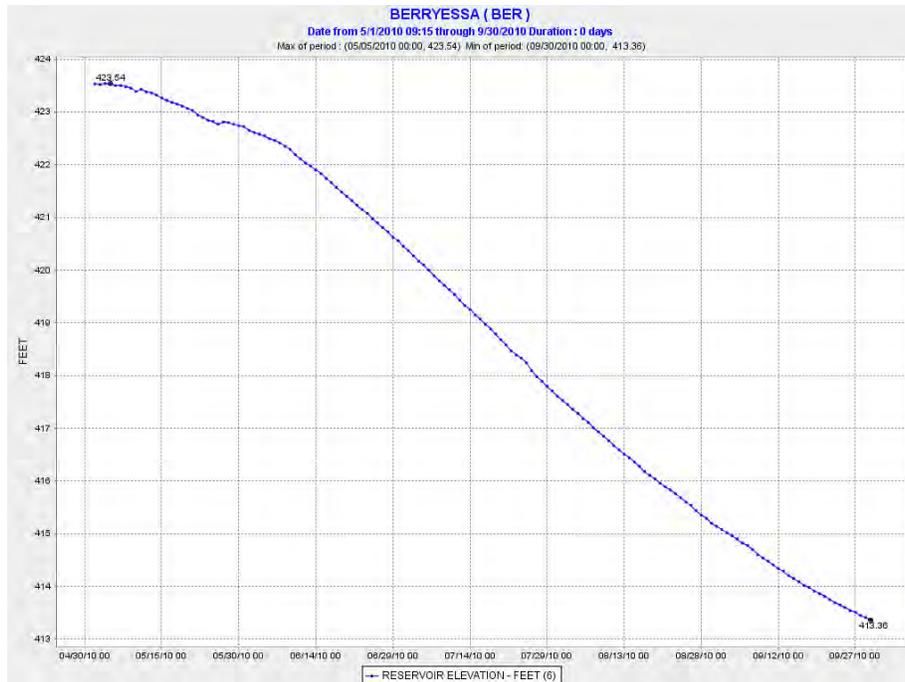
Date from 07/01/2006 13:48 through 03/23/2011 13:48 Duration : 1726 days
Max of period : (06/01/2007 00:00, 732.0) Min of period : (12/01/2006 00:00, 0.0)



Total outflow in 2010 was 202,825 AF. Total outflow from May 1 – Sept. 30 was 156,588 AF. Only about 46,000 AF were released during the winter. To put that in perspective, evaporation in 2010 total was 4.7 feet. From May to September it was 3.06 feet.

A 3.06 foot decrease when the lake is nearly full equates to about 56,600 AF. **As incredible as it may seem, more Lake Berryessa water is lost to evaporation during the summer than is actually released from the lake during the winter.** Evaporation is measured in inches using actual evaporation measurements. An evaporation pan, 48" in diameter 10" deep, is located at Markley Cove.

Actual 2010 figures show the lake dropped from 423.55' on 5/1 to 413.38' on 9/30 - a 10.17' decrease



At the 423 foot level the lake has a surface area of about 17,050 AF so the loss in AF was 173,399 AF (10.17' x 17,050 AF/foot). And evaporation accounted for an actual loss of approximately 52,173 AF (3.06' x 17,050).

At 700 cfs (1,400 AF/day) summer outflow with a surface area of 17,050 AF at the 430 foot level the lake experiences a one-foot drop every 12 days – which matches observation.

Once again the conclusions are that rumors are only rumors and all conspiracy theories about Lake Berryessa water are false. Numbers don't lie, but do take some thought to unravel.

Some fun facts about water use from the Montana Department of Natural Resources:

- 1 human family (up to 5 people) uses 1 AF/Yr
- 1 dairy cow or horse uses .038 AF/Yr
- Therefore 1 human family = 26 cows or 26 horses
- 300 chickens or 3 pigs use .017 AF/yr
- 1 human family = 17,648 chickens or 176 pigs
- 100 turkeys or rabbits or 125 prairie dogs use .017 AF/yr
- 1 human family = 5,882 turkeys or rabbits or 7,353 prairie dogs!

- 1 CFS equals 1.98 AF per day
- 1 family (up to 5 people) uses 1 AF/YR
- 1 Cubic foot of water equals 7.48 Gallons
- 1 AF of water equals 1 foot of water on 1 acre
- 1 AF of water equals 325,851 Gallons
- 1 AF of water equals 43,560 Cubic feet
- 1 CFS equals 448.8 GPM
- 1 GPM equals 1,440 Gallons per 24 hour day
- 1 GPM equals 1.61 AF per year