Big Bear Watermaster

Forty-Fifth Annual Report

For Calendar Year 2021

BIG BEAR MUNICIPAL WATER DISTRICT v. NORTH FORK WATER COMPANY, et al.,
Case No. SCV 165493 – County of San Bernardino

Bear Valley Mutual Water Company

Big Bear Municipal Water District
EST. 1964

San Bernardino Valley
Water Conservation District
Helping Nature Store Our Water

Watermaster Members:
Donald E. Evenson
Samuel H. Fuller
Daniel B. Cozad

Mailing Address:
1630 W. Redlands Blvd
Redlands, CA 92373
(909) 793-2503

BIG BEAR WATERMASTER

FOR

BIG BEAR MUNICIPAL WATER DISTRICT v.
NORTH FORK WATER COMPANY, et al.,
CASE NO. 165493---COUNTY OF SAN BERNARDINO

WATERMASTER MEMBERS:
DONALD E. EVENSON
DANIEL B. COZAD
SAMUEL H. FULLER

MAILING ADDRESS
P.O. BOX 1839
REDLANDS, CA 92373
909-793-2503

March 29, 2022

To: Clerk of the Superior Court of San Bernardino County and All Parties

Subject: Watermaster Report for Calendar Year 2021

Gentlemen:

We have the honor of submitting the Forty-Fifth Annual Report of the Big Bear Watermaster for Calendar Year 2021.

Paragraph Twenty (20) of the Judgment requires that the Watermaster Report be submitted to the Court and the Parties before April 1 of each year on all significant Watermaster activities and provide an accounting of water deliveries for the preceding calendar year as set forth in Section VI, Physical Solutions, of the Judgment.

We and each of us here by certify that this is a true and correct report of the Watermaster work performed by us and under our supervision during 2021 pursuant to the requirement of the Judgment.

Respectfully Submitted,

By: Donald E. Evenson
Donald E. Evenson

By:
Daniel B. Cozad

By:
Samuel H. Fuller

FORTY-FIFTH ANNUAL REPORT
BIG BEAR WATERMASTER
CALENDAR YEAR 2021

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I. INTRODUCTION

The Big Bear Watermaster presents the Forty-Fifth Annual Report of its activities for calendar year 2021. The Watermaster's activities ensure that the rights of all parties subject to the Judgment rendered in Case No. 165493 are protected. The Watermaster generally oversees watershed conditions that may affect the Judgment and attempts to improve the conditions to the benefit of all parties.

This report describes the 2021 activities of the Watermaster including the status of accounts and various tabulations as required by the Judgment.

In 2021, the Big Bear Watermaster Committee was composed of Donald E. Evenson, President, representing Big Bear Municipal Water District; Samuel H. Fuller, representing Bear Valley Mutual Water Company; and Daniel B. Cozad, Secretary, representing San Bernardino Valley Water Conservation District.

The Watermaster Committee met four times during 2021. These meetings were held on the following dates:

January 20, 2021
March 23, 2021
July 13, 2021
October 12, 2021

Appendix A contains the minutes of these meetings. Minutes of the meetings are also on file at the office of each of the agencies.

II. SUMMARY

2021 WATERMASTER ACCOUNTS

2021 was an average precipitation year. Annual precipitation at the two gauges in the Big Bear Lake watershed averaged 25.38 inches, which is 103 percent of the 24.61 inches of average annual rainfall since 1977. Precipitation at Bear Valley Dam was 29.63 inches, which is 85 percent of the 112-year (1910-2021) average of 34.95 inches.

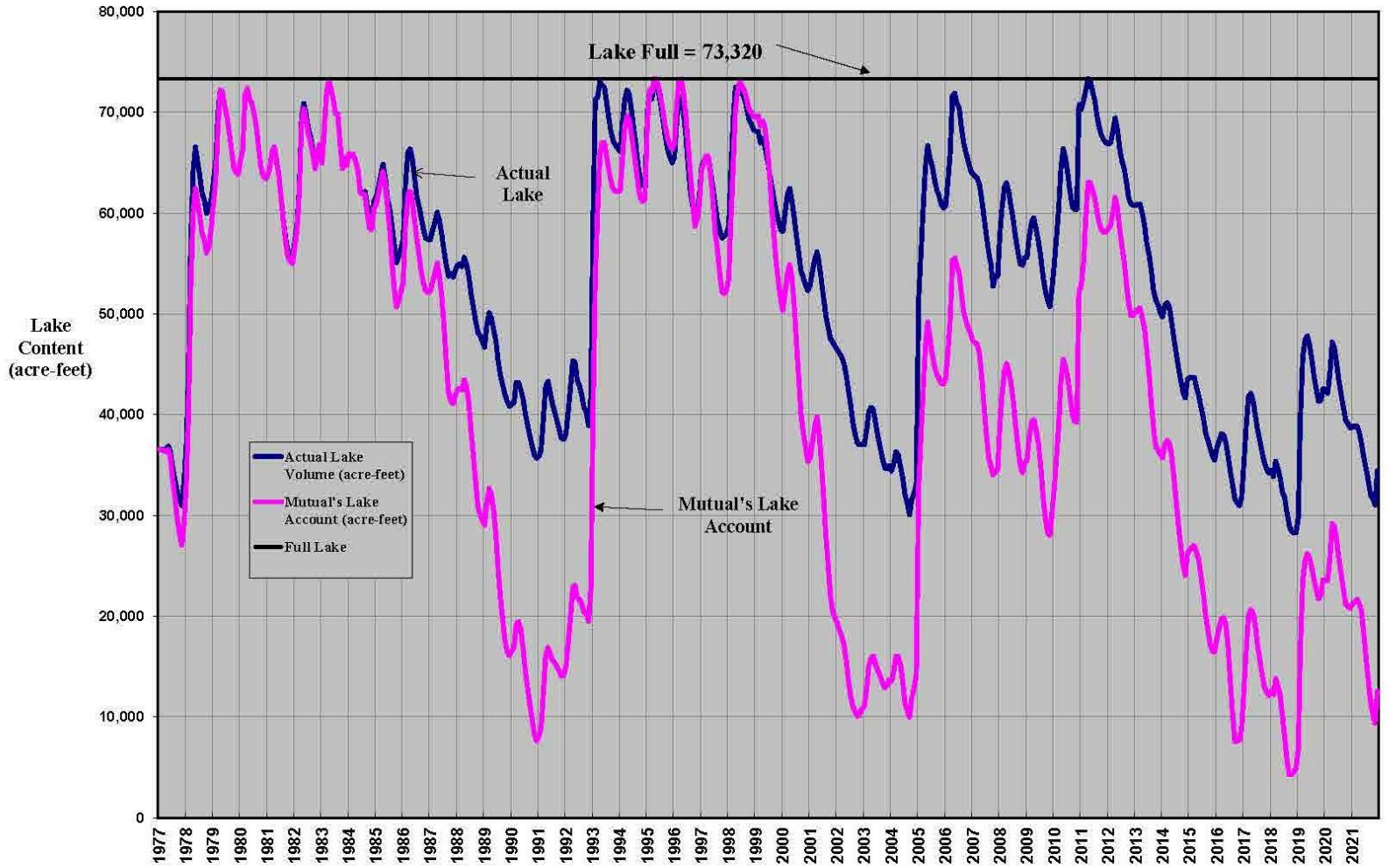
Inflow to Big Bear Lake in 2021 was below average. The 2021 calculated lake inflow was 6,401 acre-feet, which is 43 percent of the average inflow since 1977. The average inflow for the 45 years since the Judgment was rendered is 14,857 acre-feet per year.

Actual lake levels fell 1.92 feet in 2021 and ended the year 15.06 feet below the top of the dam. Accordingly, lake contents decreased by 4,245 acre-feet during the year. On December 31, 2021, the lake contained 34,418 acre-feet of water. When full, the lake level is 72.33 feet and it holds 73,320 acre-feet. **Figure 1** shows the history of the actual lake contents since the Judgment was rendered in 1977.

Mutual's lake account held 12,537 acre-feet at the end of 2021. Their lake account decreased by 8,251 acre-feet during the year. **Figure 1** also shows the history of Mutual's lake account since 1977. Under a "Mutual Operation" lake releases would be made to meet Mutual's water demands and their lake account is credited with the net wastewater exported from the Big Bear Lake watershed. Under these conditions, the lake level would have ended the year at 44.50 feet or 27.83 feet below the top of the dam and 12.77 feet lower than the actual year-end lake level of 57.27 feet. If Mutual had not been credited with the net wastewater exports, their lake account balance would have been 7,818 acre-feet and the lake level would have been 40.50 feet or 31.83 feet below the top of dam and 16.77 feet lower than it actually was.

In 2021, Mutual received 8,981.3 acre-feet of water from Big Bear MWD. Big Bear MWD has the option to provide In Lieu Water supplies or to release water from the lake. In 2021, Mutual received 2,190.4 acre-feet of In Lieu State Water Project (SWP) Water and 6,084.0 acre-feet of In Lieu groundwater from the San Bernardino Groundwater Basin. Also, Mutual was able to use 706.9 acre-feet of water from Big Bear Lake that was required for fish protection purposes as required under SWRCB Order No. 95-4.

FIGURE 1
ACTUAL LAKE CONTENTS AND MUTUAL'S LAKE ACCOUNT 1977 - 2021
Calendar Year 2021 - Big Bear Watermaster



At the beginning of the year, Big Bear MWD had 17,875 acre-feet in their lake account. By the end of the year, their lake account had increased by 4,006 acre-feet to 21,881 acre-feet. Big Bear MWD's lake account is the difference between the actual lake contents and Mutual's lake account as shown on **Figure 1**.

The Basin Make-up Account provides an estimate of the water supply impacts of the operation of Big Bear Lake under the Judgment on the San Bernardino Groundwater Basin. A positive account balance means there has been an increase in groundwater recharge as a result of the Big Bear MWD operation of the lake. If the account becomes negative, Big Bear MWD is required to correct the deficiency by providing additional water for groundwater recharge.

In 2021 the Basin Make-up Account balance decreased by 3,014 acre-feet. The Basin Make-up Account began the year with a balance of 27,046 acre-feet and ended the year with a balance of 24,032 acre-feet. The decrease resulted primarily as a result of the use of In Lieu groundwater from the San Bernardino Groundwater Basin.

OTHER WATERMASTER ACTIVITIES

The Watermaster has the responsibility to undertake studies and investigations, collect and maintain data and records, and monitor related activities necessary to implement the physical solution contained in the Judgment. In 2021, the Watermaster was involved in monitoring and discussing two issues. These issues are:

- Impacts of Seven Oaks Dam,
- Protecting Big Bear Lake from Quagga Mussels,

These issues are discussed in Chapter V.

III. BASIC DATA

BIG BEAR LAKE

Summary

The Watermaster conducts a water balance of Big Bear Lake for each month. This water balance is based on measurements of lake levels, releases, leakages, and air temperature, as well as calculated values of spills, evaporation, and inflows. For 2021, the overall water balance for the lake was:

Initial Storage (1-1-21)	38,663 acre-feet
Inflows	6,401 acre-feet
Evaporation	9,301 acre-feet
Releases for Mutual	-0- acre-feet
Releases for Valley District	-0- acre-feet
Releases & Leakage for SWRCB Order 95-4	811 acre-feet
Spills & Flood Control Releases	-0- acre-feet
Net Snowmaking Withdrawal	535 acre-feet
Ending Storage (12-31-21)	34,418 acre-feet
Change-in-Storage	-4,245 acre-feet

In 2021, the volume of water in Big Bear Lake decreased by 4,245 acre-feet. The following subsections of this chapter describe each of the components in this water balance.

Lake Levels and Storage

Water levels in Big Bear Lake are measured continuously based on a reference mark located on the upstream side of the dam. In July 1998, Big Bear MWD completed installation of a continuous lake level recorder. The lake level recorder is a Global Water Model WL300 and is enclosed in a stilling well, which is attached to the upstream face of the dam. Lake level data is continuously transmitted by a remote telemetry unit (RTU) in the control building at the dam. From there, data is transmitted via radio to a central computer in the administrative offices of Big Bear MWD. The

automatically recorded values have been used since July 1998. The recorder can only record lake levels when the lake is within 15 feet of the top of the dam (i.e. above a gauge height of 57.33 feet). In 2021, the lake was within the top 15 feet until the end of summer. As a result, Big Bear MWD had recorded values for the first nine months of 2021 and relied on manual measurements for the balance of the year.

The lake began the year at a gauge height of 59.19 feet and ended the year at a gauge height of 57.27 feet. Over the year the lake level dropped 1.92 feet. The lowest lake level was 57.57 feet or 16.76 feet below the top of the dam, and it occurred on December 13, 2021. The highest recorded lake level was 59.35 feet, which occurred on seven days in February 2021. The lake is full at a gauge height reading of 72.33 feet (6,743.20 feet above msl) and is empty at a gauge height of zero.

The Watermaster uses an established gauge height-lake capacity table to estimate the volume of water in the lake from the measured gauge heights. At the beginning of the year, the lake contained 38,663 acre-feet of water. At the end of the year, there were 34,418 acre-feet of water in the lake. The lake content decreased by 4,245 acre-feet during 2021. When full, the lake contains 73,320 acre-feet of water.

Lake Evaporation

The Watermaster calculates evaporation from the lake surface using the Blaney Criddle formula to estimate monthly evaporation rates. The 1977 Annual Watermaster report describes the formula as follows:

> "The Blaney Criddle empirical formula, utilizing average temperatures and daylight hours, has been used. The constant K for each month was calculated based on float pan empirical data at Long Valley Reservoir in Mono County, California, which is at elevation 6,796 feet, compared to the elevation of Big Bear Lake which is 6,743 feet."

Monthly lake evaporation is calculated using the estimated evaporation rate and the average surface area of the lake during the month. If a negative value for lake inflow is calculated, the

monthly evaporation rate is increased to achieve a zero lake inflow. Calculated negative lake inflows occurred two times in 2021. They occurred in May, and September. The adjusted monthly evaporation rates totaled 4.381 feet (52.6 inches) for 2021. Total evaporation from the lake for 2021 was calculated to be 9,301 acre-feet.

Precipitation

Precipitation in the Big Bear Lake watershed varies significantly from Bear Valley Dam to Big Bear City at the east end of the watershed. **Table III-1** shows the monthly precipitation at Bear Valley Dam and the Big Bear City Community Services District for 2021. The 2021 precipitation at the two stations was 29.63 and 21.13 inches, respectively. During the months of May, September, and November there was no precipitation. January and December were the wettest months with approximately 66 percent of the annual precipitation.

Table III-1 also compares the 2021 precipitation at the two stations with their corresponding averages for the forty-five years since the Judgment was rendered. At the Bear Valley Dam station, precipitation was 86 percent of its forty-five-year average, and at the Big Bear City Community Services District station, precipitation was 142 percent of its forty-five-year average. For both stations, 2021 precipitation averaged 103 percent of their forty-five-year combined average.

Table III-2 shows the annual precipitation for both stations for the forty-five years since the Judgment was rendered. As shown in **Table III-2**, 2021 was nearly an average year for precipitation. For the Bear Valley Dam station, precipitation was 85 percent of the 112-year (1910–2021) average of 34.95 inches.

TABLE III - 1

MONTHLY PRECIPITATION FOR TWO STATIONS IN BIG BEAR AREA (Inches)

Calendar Year 2021 - Big Bear Watermaster

Month	Bear Valley Dam*	Big Bear City Community Services District**	Average	Percent of Annual Total
January	4.87	3.65	4.26	16.78%
February	0.18	0.14	0.16	0.63%
March	3.53	1.67	2.60	10.24%
April	0.13	0.01	0.07	0.28%
May	0.00	0.00	0.00	0.00%
June	0.24	0.24	0.24	0.95%
July	1.62	4.79	3.21	12.63%
August	0.11	1.06	0.59	2.30%
September	0.00	0.00	0.00	0.00%
October	2.11	1.23	1.67	6.58%
November	0.00	0.00	0.00	0.00%
December	16.84	8.34	12.59	49.61%
2021 Totals	29.63	21.13	25.38	100.00%
1977-2021 45-year Averag	34.38	14.84	24.61	
2021 % of 45-year Averag	86.2%	142.4%	103.1%	

Average of the 45-year Average for both stations	24.61
Average of the 2021 precipitation for both stations	25.38
2021 Average as a percent of the 45-year average	103.1%

Source:
*** Big Bear MWD**
**** Big Bear City Community Services District**

Updated 2/17/22 D.Evenson

Table III-2

FORTY-FIVE YEARS OF PRECIPITATION DATA FOR TWO STATIONS IN BIG BEAR AREA (Inches)

Calendar Year 2021 - Big Bear Watermaster

Year	Bear Valley Dam*	Big Bear City Community Services District**
1977	31.95	13.35
1978	68.43	26.09
1979	34.87	15.84
1980	63.00	29.86
1981	16.67	8.42
1982	49.14	26.53
1983	56.97	24.29
1984	20.19	16.66
1985	22.40	14.11
1986	35.16	15.26
1987	27.49	12.52
1988	24.18	8.15
1989	17.32	6.85
1990	22.20	11.02
1991	38.47	19.81
1992	44.03	16.64
1993	73.81	19.45
1994	31.78	12.24
1995	49.00	15.89
1996	41.04	15.47
1997	27.00	12.92
1998	50.40	12.07
1999	13.22	6.06
2000	24.82	5.21
2001	30.62	9.10
2002	15.02	3.82
2003	32.44	12.70
2004	39.50	13.51
2005	54.74	19.56
2006	37.96	9.98
2007	16.11	4.89
2008	37.87	8.58
2009	30.70	21.13
2010	64.14	33.23
2011	27.25	14.81
2012	23.70	16.41
2013	14.38	14.53
2014	29.61	12.23
2015	19.72	8.17
2016	31.93	15.42
2017	24.55	14.81
2018	27.84	12.74
2019	54.46	24.87
2020	21.50	11.43
2021	29.63	21.13
	---	---
45-Year Average	**34.38**	**14.84**
Percent of 45-year Average	**86.2%**	**142.4%**
112-Year Average	**34.95**	**N/A**
Percent of 112-Year Average	**84.8%**	

Source:
*** Big Bear MWD**
**** Big Bear City Community Services District**

Updated 2/17/22 - D. Evenson

Lake Inflow

Inflows to Big Bear Lake are not measured. Consequently, inflows naturally tributary to Big Bear Lake above Bear Valley Dam are calculated for each month using a water balance on the actual operation of the lake. This calculation, which utilizes observed basic data along with the calculated evaporation losses described previously, creates a water balance for each month to determine the amount of natural flow into the lake. The formula used is:

Inflow = Evaporation + Releases + Spills + Leakage +
Net Withdrawals - Change in Storage

If the calculated monthly inflow is a negative value, it is reset to zero, and the monthly evaporation rate is recalculated to achieve a lake water balance. Calculated negative lake inflows occurred two times in 2021. They occurred in May and September.

Total annual inflow for 2021 into the lake was calculated to be 6,401 acre-feet. The largest monthly inflow was 3,772 acre-feet, and it occurred in December. The average annual lake inflow for the 45 years (1977-2021) since the Judgment was rendered is 14,857 acre-feet. The median annual inflow for this same period is 9,212 acre-feet.

Table III-3 lists the annual lake inflows for the period 1977–2021. This table also ranks the inflows from the lowest (1,717 acre-feet in 2002) to the highest (48,613 acre-feet in 1993). Inflow to the lake for 2021 was well below both the average inflow and the median inflow for the forty-five years since the Judgment was rendered in 1977. Ten years had lower lake inflows, and thirty-four years had higher lake inflows.

Table III - 3
Big Bear Lake Inflows 1977-2021
(acre-feet / year)
Calendar Year 2021 - Big Bear Watermaster

Year	Lake Inflows (AF/year)		Rank	Plotting Position	Year	Lake Inflow (AF/year)
1977	7,103		**Min.**	**1**	**2.2%**	**2002**	**1,717**
1978	40,743			2	**4.3%**	2007	2,841
1979	25,318			3	**6.5%**	2013	3,129
1980	**41,302**			4	**8.7%**	2015	3,677
1981	6,529			5	**10.9%**	1999	3,774
1982	25,310			6	**13.0%**	1988	4,551
1983	**34,492**			7	**15.2%**	2018	4,818
1984	10,569			8	**17.4%**	1990	4,856
1985	9,497			9	**19.6%**	1989	4,967
1986	13,812			10	**21.7%**	2014	5,776
1987	8,005			11	**23.9%**	**2021**	**6,401**
1988	4,551			12	**26.1%**	1981	6,529
1989	4,967			**13**	**28.3%**	2001	6,915
1990	4,856			14	**30.4%**	2000	6,930
1991	11,658			15	**32.6%**	2016	7,027
1992	15,543			16	**34.8%**	1977	7,103
1993	**48,613**	Max.		17	**37.0%**	2020	7,945
1994	11,015			18	**39.1%**	1987	8,005
1995	33,340			19	**41.3%**	2012	8,175
1996	13,119			20	**43.5%**	2003	8,295
1997	8,757			21	**45.7%**	2004	8,404
1998	**34,629**			**22**	**47.8%**	1997	8,757
1999	3,774		**Median**	23	**50.0%**	2009	9,212
2000	6,930			24	**52.2%**	1985	9,497
2001	6,915			25	**54.3%**	1984	10,569
2002	**1,717**	**Min.**		26	**56.5%**	1994	11,015
2003	8,295			27	**58.7%**	1991	11,658
2004	8,404			28	**60.9%**	1996	13,119
2005	39,600			29	**63.0%**	2017	13,213
2006	17,564			30	**65.2%**	1986	13,812
2007	2,841			31	**67.4%**	2008	14,182
2008	14,182			32	**69.6%**	1992	15,543
2009	9,212			33	**71.7%**	2011	16,908
2010	32,959			34	**73.9%**	2006	17,564
2011	16,908			**35**	**76.1%**	1982	25,310
2012	8,175			36	**78.3%**	1979	25,318
2013	3,129			37	**80.4%**	2019	25,381
2014	5,776			38	**82.6%**	2010	32,959
2015	3,677			39	**84.8%**	1995	33,340
2016	7,027			40	**87.0%**	1983	**34,492**
2017	13,213			41	**89.1%**	1998	**34,629**
2018	4,818			**42**	**91.3%**	2005	39,600
2019	25,381			**43**	**93.5%**	1978	40,743
2020	7,945			**44**	**95.7%**	1980	**41,302**
2021	**6,401**		**Max**	**45**	**97.8%**	**1993**	**48,613**

1977 - 2021	
Maximum	**48,613**
Average	**14,857**
Median	**9,212**
Minimum	**1,717**

Notes: 1980 and 1983 values were corrected to delete non-tributary inflows to the Lake
1998 inflows were corrected to reflect actual value in the 1998 Annual Report

SWRCB Order No. 95-4

On February 16, 1995, the State Water Resources Control Board (SWRCB) issued Order No. 95-4. This order directed the Big Bear MWD and Bear Valley Mutual Water Company to release enough water from the lake to maintain a minimum seven-day average flow of 1.2 cfs and a minimum average daily flow of 1.0 cfs in Bear Creek no more than 500 feet downstream of its confluence with West Cub Creek. This location is referred to as Station A. In 1998, Big Bear MWD completed construction of a continuous flow recording device at Station A to measure compliance with SWRCB Order No 95-4.

SWRCB Order No. 95-4 also required sufficient releases to maintain a minimum flow of 0.3 cfs at a location approximately 300 feet downstream from the toe of the dam. This location is referred to as Station B. In 1998, Big Bear MWD also completed construction of a continuous recording device at this location to measure compliance with SWRCB Order No. 95-4

Station B History

Flow at Station B was initially measured by a compound weir with a v-notch section and a rectangular section. It was attached to a reinforced concrete structure in the riverbed. The v-notch section had a flow range of 0 to 0.44 cfs and the rectangular section had a flow range of 0.44 to 5.03 cfs. A water level transmitter is located in a stilling well just upstream of the weir structure. The water level data are transmitted to a remote telemetry unit (RTU) located in the control building at the dam. From there, data are transmitted to a central computer at the administrative offices of Big Bear MWD where average daily flow rates at Station B were calculated based on the rating curve of the weir plate.

In late 2015, vandalism at Station B impaired the reliability and accuracy of the flow measurements at Station B. To confirm compliance with the SWRCB Order No. 95-4, Big Bear MWD used the measured flows from the 6-inch Bypass Pipeline plus the estimated leakage from the sluice gates until Station B was repaired.

In October 2016, the Station B weir plate was replaced to improve the accuracy of the water level measurements and the calculated flow values. The weir plate was changed from the compound

weir to a 90-degree, 12-inch v-notch weir. Big Bear MWD reprogrammed the SCADA/PLC for the new weir and the flow values at Station B showed improved accuracy.

However, in 2017 measurement problems at Station B continued so Big Bear MWD continued to rely on using releases from the 6-inch Bypass Pipe Line to maintain flows at Station B. Big Bear MWD contracted with XiO, Inc. to install a new transducer probe and cloud SCADA system to record flows through the new weir plate at Station B. The new system was expected to be operational in early 2018 but problems with the data transmission cable delayed implementation. On December 12, 2018, the cable was repaired and the Station B data collection became operational and worked throughout 2021.

Station A History

On December 29, 2004, data transmission from Station A ceased. In January of 2005, major storms hit the Bear Creek watershed with significant snowfall. Consequently, Big Bear MWD staff could not access Station A until May. On their first visit to the site, they found the data transmission facilities destroyed, the stilling basin filled with sediment and the weir plate damaged. The staff estimated the flow in Bear Creek at this time to be in the range of 10 to 15 cfs, well above the 1.20 cfs requirement.

Beginning in June 2005, the staff visited the site every two weeks and made velocity and water depth measurements. From these measurements they used two methods to estimate the flow at Station A. Flow estimates ranged between 2.3 cfs and 11.8 cfs. Consequently, in 2005 Station A was well in compliance with the 1.20 cfs, seven-day flow requirement.

During the summer and fall of 2005, Big Bear MWD repaired the weir plate, cleaned out the stilling basin, and installed a battery operated, pressure transducer to record weir water depth information. Since 2005, when weather conditions permit, Big Bear MWD retrieves the recorded information and calculates the flows at Station A.

In December 2010, major storms again hit the Bear Creek watershed, destroyed the data recording equipment and filled the stilling basin with sediment and rock at Station A. In November 2011, Big Bear MWD cleaned out the stilling basin and downstream creek bed and installed a new battery

operated, pressure transducer to record weir water depth information. However, there was some damage to the weir plate that could not be repaired.

When weather conditions permit, Big Bear MWD staff retrieves the recorded information, which again allows the flow at Station A to be calculated.

To determine if Station A was determining flows accurately, Big Bear MWD retained a consultant, Jericho Systems, Inc., to manually measure the Bear Creek flows above and below Station A on two occasions. The consultant found that the measured flows were 0.5 to 1.0 cfs higher than the flows calculated from water level data applied to the damaged weir plate. In 2017, Big Bear MWD began discussing options for Station A with the State Water Resources Control Board. These discussions will continue in 2022.

Flow Compliance Plans

During 2005, Big Bear MWD, working with State Water Resources Control Board (SWRCB) and the State Department of Fish and Game, developed a proposed plan to keep Station A in compliance with both the 1.0 cfs average daily flow requirement and the 1.2 cfs seven-day average flow requirement. This proposed plan involved increasing the Station B flow requirements to ensure the Station A requirements would be met. The new Station B requirements vary by month and hydrologic year type. The monthly hydrologic year type is based on water year-to-date precipitation at Bear Valley Dam. Water years (October 1 to September 30) are used to determine the hydrologic year type. The adopted plan is referred to as the “Exhibit A Flow Compliance Plan” and is presented in the following table.

Exhibit A Flow Compliance Plan
Table to Determine Minimum Daily Flows at Station B
Based Upon Water Year-to-Date Precipitation at Bear Valley Dam

Date	Enter Water Year-to-date Precipitation at Bear Valley Dam (inches)	Dry Year		Below Normal Year		Above Normal Year		Wet Year	
		If year-to-date precipitation is less than (inches)	Station B Minimum Flow is (cfs)	If year-to-date precipitation is between (inches)	Station B Minimum Flow is (cfs)	If year-to-date precipitation is between (inches)	Station B Minimum Flow is (cfs)	If year-to-date precipitation is more than (inches)	Station B Minimum Flow is (cfs)
October 1		n.a.	0.95	n.a.	0.95	n.a.	0.95	n.a.	0.95
November 1		0.03	0.90	0.03 and 0.56	0.90	0.57 and 1.93	0.70	1.93	0.70
December 1		1.59	0.85	1.59 and 3.04	0.85	3.05 and 5.60	0.80	5.60	0.60
January 1		3.73	0.90	3.73 and 8.14	0.75	8.15 and 12.84	0.75	12.84	0.30
February 1		8.94	1.00	8.94 and 13.84	0.85	13.85 and 20.79	0.50	20.79	0.30
March 1		14.42	0.80	14.42 and 20.05	0.40	20.06 and 31.47	0.40	31.47	0.30
April 1		19.29	0.75	19.29 and 25.84	0.50	25.85 and 40.30	0.40	40.30	0.30
May 1		21.61	0.95	21.61 and 28.65	0.70	28.66 and 41.16	0.55	41.16	0.30
June 1		22.18	1.15	22.18 and 30.01	0.80	30.02 and 41.86	0.75	41.86	0.30
July 1		22.42	1.20	22.42 and 30.01	0.95	30.02 and 41.86	0.95	41.86	0.30
August 1		22.93	1.25	22.93 and 30.69	1.05	30.70 and 42.48	0.95	42.48	0.30
September 1		23.30	1.00	23.30 and 30.86	0.95	30.87 and 43.69	0.95	43.69	0.30

The plan was approved by the SWRCB on January 08, 2009. The amended order also required Big Bear MWD to monitor the flows at Station A for ten years to confirm that the Exhibit A Flow Compliance Plan would satisfy the minimum flow requirements at Station A. Starting in December of 2005, Big Bear MWD followed the Exhibit A Flow Compliance Plan for Station B.

Effective July 1, 2014, Big Bear MWD adopted a "Revised Flow Compliance Plan" that increased the minimum flow requirements at Station B in some months based on their experience over the six years since the SWRCB approved the Exhibit A Flow Compliance Plan. The Revised Flow Compliance Plan is shown on the following table. The Revised Station B flow requirements for 2021 are highlighted in yellow.

2021 Revised Flow Compliance Plan
Table to Determine Minimum Flows at Station B
Based Upon Year-to-Date Precipitation at Bear Valley Dam

Date	Water Year-to-date Precipitation at Bear Valley Dam (inches)	Dry Year		Below Normal Year		Above Normal Year		Wet Year	
		If year-to-date precipitation is less than (inches)	Station B Minimum Flow is (cfs)	If year-to-date precipitation is between (inches)	Station B Minimum Flow is (cfs)	If year-to-date precipitation is between (inches)	Station B Minimum Flow is (cfs)	If year-to-date precipitation is more than (inches)	Station B Minimum Flow is (cfs)
October 1	0.00	n.a.	1.20	n.a.	1.20	n.a.	1.20	n.a.	1.20
November 1	0.00	0.03	1.10	0.03 and 0.56	1.00	0.57 and 1.93	0.95	1.93	0.90
December 1	3.53	1.59	0.90	1.59 and 3.04	0.85	3.05 and 5.60	0.85	5.60	0.85
2021									
January 1	5.46	3.73	0.90	3.73 and 8.14	0.85	8.15 and 12.84	0.85	12.84	0.85
February 1	10.33	8.94	1.00	8.94 and 13.84	0.85	13.85 and 20.79	0.50	20.79	0.30
March 1	10.51	14.42	0.95	14.42 and 20.05	0.85	20.06 and 31.47	0.40	31.47	0.30
April 1	14.04	19.29	0.75	19.29 and 25.84	0.50	25.85 and 40.30	0.40	40.30	0.30
May 1	14.17	21.61	0.95	21.61 and 28.65	0.70	28.66 and 41.16	0.55	41.16	0.30
June 1	14.17	22.18	1.15	22.18 and 30.01	1.00	30.02 and 41.86	0.75	41.86	0.30
July 1	14.41	22.42	1.50	22.42 and 30.01	1.30	30.02 and 41.86	0.95	41.86	0.55
August 1	16.03	22.93	1.50	22.93 and 30.69	1.50	30.70 and 42.48	1.25	42.48	0.55
September 1	16.14	23.30	1.35	23.30 and 30.86	1.20	30.87 and 43.69	1.20	43.69	1.15
October 1	0.00	n.a.	1.20	n.a.	1.20	n.a.	1.20	n.a.	1.20
November 1	2.11	0.03	1.10	0.03 and 0.56	1.00	0.57 and 1.93	0.95	1.93	0.90
December 1	2.11	1.59	0.90	1.59 and 3.04	0.85	3.05 and 5.60	0.85	5.60	0.85

Note 1 — Yellow highlighted values are the Flow Compliance values for CY 2021

Note 2 — Minimum flow values in blue are revised values used effective July 1, 2014

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2021 Revised Flow Compliance Plan.xlsx

Based on the Revised Flow Compliance Plan and the actual water year-to-date precipitation at Bear Valley Dam, the plan for minimum daily average flows at Station B in 2021 were as follows:

Month 2021	Hydrologic Condition WY To-Date	Minimum Daily Average Flow (cfs)	Exhibit A Req.
January	Below Normal	0.85	0.75
February	Below Normal	0.85	0.85
March	Dry	0.95	0.80
April	Dry	0.75	0.75
May	Dry	0.95	0.95
June	Dry	1.15	1.15
July	Dry	1.50	1.20
August	Dry	1.50	1.25
September	Dry	1.35	1.00
October	Start Water Year	1.20	0.95
November	Wet	0.90	0.70
December	Below Normal	0.85	0.85

Flows at Station B normally consist of leakage from the dam and spillway gates, releases, and leakage from the outlet works, spills from the lake, and inflows and consumptive losses between the Dam and Station B.

In December 2018, the XiO cloud SCADA system was installed and began collecting data. There was a testing period between December 2018 and January 2019 to ensure data collection reliability and probe accuracy. In 2019, the XiO data was checked against the original transducer at Station B to ensure accuracy of measurement and system redundancy. With reliable data from Station B, the XiO system will automatically actuate the 6-inch bypass valve based on flow conditions at Station B. If side flows are excessive, the XiO system will slow the flow of the 6-inch bypass valve. On the contrary, if side flows are non-existent, the XiO system will adjust flows through the 6-inch bypass valve to meet the desired downstream flow rate as stated in the Revised Flow Compliance Plan based on cumulative water year rainfall.

2019 was a year of learning how to implement the XiO Cloud SCADA system. The system began operation in December 2018 and on February 17, 2019, a deep freeze damaged the control valve

on the 6-inch Bypass Line, which put the XiO system out of service. The control valve was replaced but there were other operational and equipment issues that required the Big Bear MWD staff to manually oversee the control system to keep Station B in compliance. On December 2, 2019 all problems with XiO SCADA system appeared to be resolved. In October of 2020 XiO was having trouble keeping flows steady at Station B. Big Bear MWD determined that manual setting of the flows in the 6-inch Bypass Line would create a more accurate flow at Station B.

During 2021, the Exhibit A Flow Compliance Plan requirements at Station B were met on all, except 5 days. The Revised Flow Compliance Plan flow requirements at Station B were higher in some months and the number of days of non-compliance in 2021 was 11 days. On these days there were operational issues that resulted in flows that were a little below the requirements. Meeting the Flow Compliance requirements at Station B kept the flows at Station A in compliance with the SWRCB requirements, except for periods in April, May, and June when the measured flows at Station A were just below the requirements.

The next step for Big Bear MWD is to review the flow and release data collected over the past 14 years and recommend a final Flow Compliance Plan for Station B to the SWRCB that will require flows at Station B that will meet the flow needs at Station A and to eliminate the flow measurement facility at Station A. In 2022, Big Bear MWD will be in discussions with the SWRCB to amend SWRCB Order No. 95-4 to make this change.

Watermaster Accounting Procedures

To handle the SWRCB Order No 95-4 lake release and In Lieu delivery conditions, the Watermaster Committee, in 2002, clarified the accounting procedures. In 2003, the Watermaster made further improvements to these procedures. In 2005, they made a further change to better reflect actual lake management. This change was to include leakage with the flows from the outlet works in the accounting for flows to meet SWRCB Order 95-4. For the lake accounts, the accounting procedures are:

1. The outlet works flows and dam leakage will be deducted from both Mutual's and BBMWD's lake accounts in proportion to the amount of water in their respective lake accounts on days when Mutual is not fully utilizing all the flow in the Santa Ana River at the point of diversion to the forebay of SCE Power Plant No. 1.

2. The outlet works flows and dam leakage releases will be deducted entirely from Mutual's lake account on days when:
    a) Mutual is fully utilizing all the flow in the Santa Ana River at the point of diversion to the forebay of SCE Power Plant No. 1,
    b) Mutual is requesting releases from the lake and BBMWD is releasing water from the lake or providing In Lieu supplies, or
    c) Mutual is purchasing SWP Water.

Prior to 2012, the term "fully utilized" was defined as days when the "net amount" of water the SBVWCD diverted from the forebay of SCE Power Plant No. 3 was less than the amount of the fish release. The "net amount" of water diverted from the forebay was defined as the actual amount diverted by SBVWCD for groundwater recharge less the amount of water delivered to the forebay by the Bear Valley Pick-up on the Santa Ana River below Seven Oaks Dam. In prior years, the Committee noticed there were some operational conditions when this definition did not accurately depict if Mutual was "fully utilizing" all the flow in the Santa Ana River at the point of diversion to the forebay of SCE Power Plant No. 1. When this occurred, adjustments were made in the accounting to better reflect actual operating conditions.

In 2012, the Committee reviewed the conditions and adopted a revised definition of the term "fully utilized." The revised definition of when Mutual is "fully utilizing" all the flow in the Santa Ana River is when:

- Mutual's Deliveries of Santa Ana River water are greater than or equal to the SCE Santa Ana River Diversions, and
- The SCE Santa Ana River Diversions are greater than the Outlet Works Flows and Dam Leakage used to meet SWRCB Order No. 95-4.

The daily values of Mutual's Deliveries and the SCE Santa Ana River Diversions will be made using the Daily Flow Reports prepared by the San Bernardino Valley Water Conservation District.

The daily SCE Santa Ana River Diversions will be determined as the sum of the following flows:

- PH#3 Penstock (CALC) (A1) flow,
- BVMWC Highline (B1) flow,
- Greenspot Spill (F1) to PH#3, and
- Deliveries to the Greenspot Pipeline (C1).

Beginning in 2018, the Watermaster Committee decided that Mutual's Deliveries of Santa Ana River Water should be determined as the sum of the following three deliveries:

- BVMWC Highline (B1)* delivery,
- Northfork delivery: Northfork Canal Weir delivery (G2) plus Edwards Canal delivery (H2) plus Northfork Parshall Flume delivery to SBVWCD (K2), and
- Redlands delivery: Redlands Aqueduct Weir (W1) delivery less the Redlands Tunnel (I1) inflow plus the Redlands Sandbox Spills (YI).

The daily Outlet Works Flows and Dam Leakage from Big Bear Lake used to meet SWRCB Order No. 95-4 are determined by the Watermaster Committee using measured releases and leakage estimates provided by Big Bear MWD.

The following paragraph describes the 2020 accounting changes related to the Big Bear Lake outflows for fishery protection required by SWRCB Order 95-4 to reflect the operational change of SCE operations and the impact of related SOD operational procedures in 2020.

2020 was an abnormal operational year that required changes to the accounting procedures used to allocate the daily Outlet Works Flows and Dam Leakage for fishery protection required by SWRCB Order 95-4. Beginning March 3 and throughout the remainder of 2020, SCE was not generating power. The only diversions SCE made at their Bear Creek diversion facility were for delivery to Mutual at the Greenspot Forebay. The diversions during this period were between zero and 11 cfs. This SCE operation limited the amount of SAR water that could be delivered to Mutual. Because of the low diversion rates, the assumption was made that SCE did not divert the full flow of Bear Creek and the Outlet Works Flows and Dam Leakage would continue to flow downstream into Seven Oaks Reservoir. This operating condition continued throughout 2020.

The updated allocation for the 2021 condition when SCE was not operational is to determine if Mutual is "fully utilizing" the releases from Seven Oaks Dam. If they are "fully utilizing" the SOD releases the amount of the Outlet Works Flows and Dam Leakage would be deducted from Mutual's Lake Account. "Fully utilizing" is defined as the condition when Mutual is diverting essentially all of the SOD releases and the amount diverted by SBVWCD and/or flowing past Cuttle Weir is less than the amount of the Outlet Works Flows and Dam Leakage, or if Mutual is also taking delivery of In Lieu Water. In 2021, Mutual was considered to be "fully utilizing" the SOD Releases for 311 days.

*The term in parenthesis refers to the site location used in the Daily Flow Reports (DFR's) of the San Bernardino Valley Water Conservation District.

When the SOD releases are high and the SBVWCD is diverting some of the SOD releases for recharge or there are un-diverted releases flowing past Cuttle Weir, the amount of the Outlet Works Flows and Dam Leakage is deducted from Mutual's and BBMWD's lake accounts in proportion to the amount of water in their accounts. In 2021, this condition occurred on 17 days, and Mutual was considered to be NOT "fully utilizing" the SOD releases. These were days when SBVWCD diverted SAR water at their main diversion structure below SOD.

A second condition when Mutual is not "fully utilizing" the SOD releases and the SCE deliveries of SAR water is when Mutual delivers water to SBVWCD from the Tailrace Pipeline that is more than the Outlet Works Flows and Dam leakage used for fishery protection. The Tailrace Pipeline delivers SAR water from the afterbay of SCE PH3. In 2021, with SCE out of service, except for May and June, the water entering the afterbay comes from Mutual's River Pick-up, which consists of SOD releases and Greenspot spills from Mutual's Highline. In 2021, there were 37 days when these flows exceeded Mutual's needs and Mutual delivered the surplus water to SBVWCD for groundwater recharge. The committee assumed these flows included the Outlet Works Flows and Dam Leakage for fishery protection. The amounts would be deducted from Mutual's and BBMWD's lake accounts in proportion to the amount of water in their accounts.

In 2021 the estimated Outlet Works Flows and Dam Leakage was 810.8 acre-feet and using the update accounting procedures resulted in the following allocation:

1. 103.9 acre-feet was deducted from both Mutual's and BBMWD's lake accounts in proportion to the amount of water in their respective lake accounts on the 54 days when Mutual did not "fully utilize" the Santa Ana River Diversions or the SOD releases when SCE was not operational and did not receive In Lieu deliveries or purchase SWP water when SCE was operational, and
2. 706.9 acre-feet was deducted from Mutual's lake account on the 311 days they "fully utilized" the Santa Ana River Diversions or the SOD releases when SCE was not operational, received In Lieu water deliveries or purchased SWP water when SCE was operational.

The Watermaster Committee will continue to review these accounting methods in 2022 to make sure the determinations of the allocation of the "Outlet Works Flows and Dam Leakage" for fishery protection in Bear Creek accurately reflect actual operations.

The input data and allocation of releases under SWRCB Order No. 95-4 in **Table 2.C** of **Appendix B** reflect the above revised procedures.

For the Basin Make-up Account the accounting procedures are:

1. Under a Big Bear MWD operation, the actual fish releases used by Mutual under Item 2 above will be considered a "release actually made under District Operation (R_d)" and the actual releases under Item 1 above will be treated as "spills which actually occurred under District Operation (S_d)".

2. Under a Mutual operation, the fish releases used by Mutual under Item 2 above will be considered a "release which would have been made under a Mutual Operation (R_m)", and the releases allocated to Mutual under Item 1 above will be considered a "spill which would have occurred under a Mutual Operation (S_m)."

Tables 4.A and **4.B** of **Appendix B** reflect these accounting procedures.

The Watermaster Committee will continue to work on these accounting procedures in 2022 to make sure they will be accurate for all possible river flow and diversion conditions that could occur in future years.

Dam and Spillway Gate Leakage

Leakage through the spillway gates in Bays 1 and 10 can occur when the lake level is above the spillway crest elevation. In addition, minor leakage from pressure relief values in Bays 1 and 10 can occur when the lake level is below the spillway crest and above the elevation of the relief values. The structural reinforcement project completed in 2006 eliminated the dam leakage from cracks in the upper arches of Bays 5, 6 and 8.

In 2021, the lake level was below the spillway crest (Elevation 6,735.25 feet which is 8.00 feet below a full lake) the full year and no spillway gate leakage was observed. The lake level was near the relief valve elevation (6,731.05 feet above MSL) in February 2021 and Big Bear MWD observed relief valve leakage during this period. The 2021 estimated monthly leakages are shown in **Table III-4**. The total estimated leakage from Bays 1 and 10 for 2021 was 0.5 acre-feet.

In late November 2009 during excavation of foundations for the new highway bridge below the Dam, workers noticed water entering the excavation and seeping to the surface below. During meetings with Caltrans engineers and the District's engineer in January 2010, Caltrans indicated they were convinced the new seepage was not related to their blasting efforts but the result of the removal of overburden and bedrock resulting in the opening of new pathways for seepage water to move through the abutment rock. Caltrans promised to prepare a remedial grouting plan and submit it to the District for engineering review and approval.

TABLE III-4
ESTIMATES OF
MONTHLY DAM LEAKAGE
(acre-feet)
Calendar Year 2021
Big Bear Watermaster

Month	Spillway Gate Leakage (AF)	Bay 1 and Bay 10 Relief Valve Leakage (AF)	Additional Foundation Leakage (AF)	Total Estimated Leakage (AF)
January	-0-	-0-	-0-	-0-
February	-0-	0.53	-0-	0.53
March	-0-	-0-	-0-	-0-
April	-0-	-0-	-0-	-0-
May	-0-	-0-	-0-	-0-
June	-0-	-0-	-0-	-0-
July	-0-	-0-	-0-	-0-
August	-0-	-0-	-0-	-0-
September	-0-	-0-	-0-	-0-
October	-0-	-0-	-0-	-0-
November	-0-	-0-	-0-	-0-
December	-0-	-0-	-0-	-0-
Annual Total	**-0-**	**0.53**	**-0-**	**0.53**

In late 2011, Caltrans prepared a remedial grouting program to control seepage at the left abutment of the dam. After review and approval by the Big Bear MWD, the program was submitted for technical review to the Division of Safety of Dams and Caltrans received their approval in concept. The Caltrans proposal included four rows of grout holes. Two parallel rows parallel to the edge of the lake beginning at the left abutment and two rows perpendicular to the first rows beginning at the left abutment. While the intent of Caltrans is to protect their new highway bridge foundation, the project should dramatically reduce seepage at the left abutment of the dam. In mid-2012, Caltrans conducted the left abutment grouting on the roadbed approach (now the parking area) of the old highway bridge. Two rows of holes were drilled and grouted during the process along with three verification holes. After completion of this effort in August 2012 observed downstream seepage at the left dam abutment was significantly reduced. As a result of this observation Caltrans determined that the second set of grout holes would be unnecessary and Caltrans closed the project.

The additional foundation leakage cannot be directly measured and has been estimated from flow measurements at Station B that are in excess of the measured releases and estimated spillway gate leakage from the lake. Beginning in September 2013, no additional foundation leakage has been identified which indicates the grouting program may have reduced or perhaps eliminated the foundation leakage. The Committee will continue to monitor this source of leakage before drawing any conclusions concerning the effectiveness of the grouting program.

The total estimated dam leakage in 2021 was 0.5 acre feet and it contributed to the outflows from the Lake to meet the requirements of SWRCB Order 95-4. The dam leakage was from Bay 1 and Bay 10 of the multi- arch Bear Valley Dam. This "leakage," as shown in column two of **Table III-4,** is not directly from the spillway gates in Bays 1 and 10, but rather from the pressure relief pipes located below the spillway gates in Bays 1 and 10. When the lake level is below the bottom of the spillway gates (<6,735.25 feet above sea level NGVD29) there is still the potential of water leakage through these pressure relief pipes. These pressure relief pipes rarely flow more than one gallon per minute and this leakage amount should be considered separate from spillway gate leakage.

Outlet Works Releases

Water is released from the lake through the outlet works. These releases can be for flood control purposes, for Mutual, or for fishery protection in accordance with SWRCB Order No. 95-4.

Releases are made either through a 36-inch outlet works or a 6-inch bypass pipeline that is connected to the 36-inch outlet works. A 36-inch butterfly valve is the primary control mechanism on the outlet works. Flows in the outlet works are measured by an in-line 36-inch flow meter that was installed on the outlet piping downstream of the butterfly valve in December 1993 to replace an older meter. The meter is an Electromatic Flow Meter Model 655 manufactured by Sparling Instruments, Inc. Downstream of the flow meter, the outlet works splits into a 24-inch pipeline and a 14-inch pipeline. Flows through these two pipelines are controlled by two motorized sluice gates. The two sluice gates are 24-inch by 24-inch and 14-inch by 14-inch. The 36-inch meter was calibrated with an accuracy of ± 0.5 percent between 7.07 and 212 cfs. When the sluice gates were fully opened and the lake was full, the meter measured a flow of 256 cfs, which is the maximum that can be discharged through the outlet works. When the lake is full and only the 14-inch sluice gate is open, the flow from the outlet works is estimated to be 68 cfs. When only the 24-inch sluice gate is open, the maximum discharge from the Outlet Works is estimated to be 195 cfs. The rate of flow and totalized flow are recorded at the flow meter and also at the control building. There is usually a small amount of leakage through the two sluice gates. In 2021, the flow from the sluice gates was estimated to be 37.9 acre-feet.

There is also a 3-inch Relief Line meter and valve on the 36-inch outlet pipeline. During the winter months this valve is usually opened to allow a small amount of flow (minimum of 30 gpm) to pass through the 36-inch pipeline and prevent water in the pipeline from freezing. The 3-inch Relief Line had been used to provide water for the construction of the new highway bridge downstream of the Dam that replaced the bridge that was on the top of Bear Valley Dam. The bridge construction was completed in November 2011, and Big Bear MWD is no longer releasing any water for the bridge construction project. The releases through the 3-inch Relief Line were 75.8 acre-feet in 2021, and they flowed down Bear Creek and were measured as part of the flow at Station B. These releases are considered as part of the releases to comply with SWRCB Order No. 95-4.

Flow through the 6-inch Bypass Pipeline was metered beginning in August 2006 when Big Bear MWD replaced a 4-inch Bypass Pipeline with a 6-inch Bypass Pipeline, valve and a Krohne IFS 400 flow meter. Releases to comply with SWCRB Order No. 95-4 are normally made through the 6-inch Bypass Pipeline. The total amount released through the 6-inch Bypass Pipeline in 2021 was 696.6 acre-feet.

In 2021, Big Bear MWD released water from the lake through the Outlet Works to comply with SWRCB Order No. 95-4. **Table III-5** summarizes the monthly amounts of water discharged from the Outlet Works in 2021. The total from the Outlet Works in 2021 was estimated to be 810.8 acre-feet.

TABLE III-5

MONTHLY DISCHARGES FROM LEAKAGE AND THE OUTLET WORKS OF BEAR VALLEY DAM
(acre-feet)
Calendar Year 2021
Big Bear Watermaster

Month	Flood Control Releases (AF)	Mutual Releases (AF)	SBVMWD Releases (AF)	SWRCB Discharges (AF)	Total Outlet Works Discharges (AF)
January	-0-	-0-	-0-	57.1*	57.1
February	-0-	-0-	-0-	49.2*	49.2
March	-0-	-0-	-0-	60.3*	60.3
April	-0-	-0-	-0-	48.3*	48.3
May	-0-	-0-	-0-	59.7*	59.7
June	-0-	-0-	-0-	69.9*	69.9
July	-0-	-0-	-0-	94.1*	94.1
August	-0-	-0-	-0-	98.6*	98.6
September	-0-	-0-	-0-	84.7*	84.7
October	-0-	-0-	-0-	76.7*	76.7
November	-0-	-0-	-0-	59.7*	59.7
December	-0-	-0-	-0-	52.6*	52.6
Total	**-0-**	**-0-**	**-0-**	**810.8**	**810.8**

* These releases were also used to partially or wholly meet Mutual's needs for lake water.

Mutual Releases

There were no lake releases for Mutual in 2021.

San Bernardino Valley MWD Releases

In 2021 San Bernardino Valley MWD did not request any lake releases from their storage account in Big Bear Lake for delivery of Lake In Lieu Water to Mutual.

Flood Control Releases

There were no flood control releases in 2021.

Spills

Spills are flows that leave the lake over the spillway of the dam. They are calculated from lake gauge height readings and spillway gate settings at the dam during the time of the spill. In 2021, there were no spills from the lake

Station B Flows

Leakage estimates and outlet works flows are confirmed by comparing the sum of dam leakage plus the amount released from the lake through the outlet works with the flow measured at Station B, which is 300 feet downstream of the dam. The differences can be either gains or losses. Although small, these differences can illustrate the impacts of rainfall/snowfall and plant evapotranspiration between the dam and Station B. **Table III-6** shows this comparison.

TABLE III-6

COMPARISON OF FLOWS AT STATION B WITH ESTIMATED LEAKAGE AND FLOWS FROM OUTLET WORKS

Calendar Year 2021 - Big Bear Watermaster

Month	Flows from Outlet Works (AF)	Dam Leakage (AF)	Spillway Gate Release (AF)	Total Flows From Lake (AF)	Flow at Station B (AF)	Gains/ (Losses) (AF)
January	57.1	-	-	57.1	51.6	(5.5)
February	48.7	0.5	-	49.2	49.5	0.2
March	60.3	-	-	60.3	62.1	1.8
April	48.3	-	-	48.3	49.4	1.1
May	59.7	-	-	59.7	59.8	0.1
June	69.9	-	-	69.9	70.9	1.0
July	94.1	-	-	94.1	94.0	(0.1)
August	98.6	-	-	98.6	96.1	(2.5)
September	84.7	-	-	84.7	83.6	(1.1)
October	76.7	-	-	76.7	76.4	(0.3)
November	59.7	-	-	59.7	58.6	(1.1)
December	52.6	-	-	52.6	60.9	8.3
Total	810.3	0.5	-	810.8	812.7	1.9

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2021 Leakage etc. vers 5E3.xlsx

In 2021, the measured and estimated flow at Station B was 1.9 acre-feet more than the estimated amount leaving Big Bear Lake from releases, leakage and spills. In 2021 these differences reflect the side flows that enter Bear Creek between the Dam and Station B during the winter months. In the summer and fall months, the differences were small and reflect the improved measurements at Station B. In October 2016, Big Bear MWD replaced the weir plate at Station B with a 12-inch v-notch weir to improve the accuracy of the measurements and replaced the communication line between the transducer and the SCADA system. These changes improved the accuracy of the Station B measurements. Big Bear MWD is continuing their efforts to improve the reliability and accuracy of the Station B measurements by installing an additional transducer probe and XiO cloud SCADA system. The Big Bear MWD is taking physical measurements as well to ensure that Station B measurements are in line. The Watermaster Committee will continue to monitor this condition in 2022.

Lake Withdrawals for Snowmaking

Big Bear MWD sells water from Big Bear Lake for use in snowmaking and active fire fighting for ski areas within the watershed. In 2021, 928.15 acre-feet of water was withdrawn from the lake for these purposes. The withdrawals for snowmaking occurred in seven winter months (January, February, March, April, October, November, and December). The withdrawals for other puposes occurred in five summer and fall months (May, June, July, August, and September).

Big Bear MWD began selling water from the lake for snowmaking purposes in 1980 and the Watermaster accounting assumed 50 percent would return to the lake as snowmelt. In 1989, Big Bear MWD retained James M. Montgomery, Consulting Engineers to evaluate this assumption. Their report was completed in May 1989 and concluded the return flow factors would range between 0.48 and 0.52 depending on the air temperature during snowmaking. The report recommended the Watermaster continue using a return flow factor of 0.50. The Watermaster Committee adopted the recommendation in 1989.

Based on this report, Watermaster estimates that half of the monthly amount pumped from the lake for snowmaking in the winter months returns to the lake in the form of snowmelt during the same month. In 2021, the withdrawal from the lake for snowmaking was 786.49 acre-feet and 393.25

acre-feet returned to the lake. In the summer and fall months, 141.66 acre-feet of water was used and none was returned to the lake. The "net withdrawal" for all purposes was 534.91 acre-feet.

Net Wastewater Exports

The Watermaster Committee calculates "net" wastewater exports as the difference between the wastewater that leaves the Big Bear Lake Watershed and the water supply that is imported into the Big Bear Lake Watershed from the Baldwin Lake Watershed. The methodology used to make these calculations is documented in a report entitled "Development of a Methodology for Estimating Gross Sewage Export from Upper Bear Creek Watershed", prepared by James M. Montgomery, Consulting Engineers, Inc., in September 1989 for Big Bear Municipal Water District.

Wastewater is exported from the Big Bear Lake watershed to the Baldwin Lake watershed from the following three areas:

- City of Big Bear Lake
- San Bernardino County Service Area 53B
- Airport area served by Big Bear City CSD

Wastewater flows from the first two areas are measured by the Big Bear Area Regional Wastewater Authority (BBARWA). Wastewater flows from the airport area within the Big Bear Lake watershed are estimated based upon the number of sewer connections in the area.

Water is imported into the Big Bear Lake watershed from the Baldwin Lake watershed by the following three activities:

- City of Big Bear Lake imports groundwater from the Baldwin Lake watershed.
- Big Bear City CSD provides water to the airport area from the Baldwin Lake watershed
- Big Bear City CSD occasionally provides emergency water to the City of Big Bear Lake

The City of Big Bear Lake imported supplies and emergency supplies are both metered, while the airport area supplies are estimated based on the number of water service connections.

In 2021, the "net" wastewater exported from the Big Bear Lake Watershed was 881.3 acre-feet. **Table III-7** contains the 2021 monthly net exports. The “net” wastewater exported in 2021 was lower than normal due to the dry winter conditions, which contributed to lower inflow/ infiltration into the sewerage collection systems from rainfall and snowmelt.

TABLE III-7

NET WASTEWATER EXPORTS
(acre-feet**)**
Calendar Year 2021
Big Bear Watermaster

Month	**Net Wastewater Exports (acre-feet)**
January	90.3
February	99.7
March	96.5
April	70.5
May	60.1
June	60.9
July	76.6
August	59.5
September	48.7
October	52.0
November	54.7
December	111.8
Total	**881.3**

SANTA ANA RIVER

Bear Valley Mutual Water Company Water Needs

Mutual meets the water needs of its shareholders primarily by diverting water from the Santa Ana River. When river flow is inadequate to meet their needs Mutual can call upon water stored in Big Bear Lake, pump groundwater from the San Bernardino groundwater basin, buy State Water Project (SWP) water from San Bernardino Valley MWD, or reduce the delivery rate to its shareholders.

In 2021, Mutual reported they may need more than 6,500 acre-feet of water from Big Bear MWD including the portion of the SWRCB 95-4 Lake outflows they could beneficially use. 2021 was a difficult year for Mutual because SCE was out of service and was only able to deliver Santa Ana River water to Mutual to the Greenspot forebay during this period. Fortunately, Mutual was able to use the releases from Seven Oaks Dam to help meet their needs. Mutual met their overall 2021 water needs by releases from SOD, In Lieu Water supplies from Big Bear MWD, diversions from the Santa Ana River, SWP water purchases from Valley District, and local groundwater. Mutual also got some water from the lake releases and dam leakage for fish protection in Bear Creek.

Summary of Flows and Diversions at Mouth of the Santa Ana River Canyon

Exhibit D, Section 1(f) of the Judgment calls for data to be included in each Watermaster annual report summarizing the river flows at the mouth of the Santa Ana River Canyon and diversions at the mouth of the Santa Ana River Canyon. Specifically, it requests quantities of water diverted into the following facilities:

1. Bear Valley High Line
2. Redlands Canal
3. North Fork Canal
4. Edwards Canal
5. San Bernardino Valley Water Conservation District Spreading Grounds

Exhibit D also requires the annual report to estimate the amount of Santa Ana River flow not diverted for beneficial use. **Table III-8** contains this information for 2021.

TABLE III-8

SUMMARY OF DIVERTED FLOW AT MOUTH OF SANTA ANA RIVER CANYON
(ACRE-FEET)
Calendar Year 2021
Big Bear Watermaster

Flow Component	Amount (AF)
FLOW OF SANTA ANA RIVER AT MOUTH OF CANYON	
Flow Reported for U.S.G.S. Gauge 11051501-provisional	16,427
less BVMWC Canyon Well No. 1 Production	-0-
Estimated Santa Ana River Flow Below Seven Oaks Dam	**16,427**
Annual Storage Change in Seven Oaks Reservoir	2,523
Estimated Santa Ana River Flow at Mouth of Canyon	**18,950**
DIVERSIONS BY BEAR VALLEY MUTUAL WATER COMPANY	
Diversions:	
Greenspot Metering Station	-0-
Edwards Line	335
North Fork Canal	1,710
Bear Valley Highline	3,302
Redlands Aqueduct (includes Redlands Tunnel)	5,647
SBVMWD Morton Canyon Connector Deliveries	-0-
Redlands Sandbox Spreading (observed)	79
	11,073
Adjustments:	
Water pumped from BVMWC Canyon Well No. 1	-0-
Redlands Tunnel Diversion	-256
Total MUTUAL Diversions	**10,817**
DIVERSIONS BY SBVWCD	
Diversion by San Bernardino Valley Water Conservation District	4,743
SBVMWD Morton Canyon Connector Deliveries to SBVWCD	0
Total SBVWCD Diversions	**4,743**
TOTAL DIVERSIONS FROM THE SANTA ANA RIVER	
Total Diversions by Mutual and SBVWCD	**15,560**
AMOUNT NOT DIVERTED	
Santa Ana River Flow at Mouth of Canyon	**18,950**
Mutual and SBVWCD Diversions	**- 15,560**
Amount Released from Storage Behind Seven Oaks Dam	**-2,523**
Estimated Not Diverted	**867**
Estimated Flow Downstream of Diversions*	**38**
Estimated Losses and Measurement Errors **	**+829 or 4.4%**

* This value equals the amount observed at the Cuttle Weir (-0- AF) plus spills from PH #3 (38 AF)
** See written text for explanation

Flow of Santa Ana River at Mouth of Canyon

The United States Geological Survey (USGS) reports flow in the Santa Ana River at the mouth of the Santa Ana Canyon under Station No. 11051501. This station is the combination of flow records from three gauges (USGS Station No. 11049500, 11051499, and 11051502). Flow in the flume between the afterbay of SCE Power House No. 1 (SCE Power House No. 2 was removed due to the construction of Seven Oaks Dam) and the forebay of SCE Power House No. 3 is estimated by the USGS using a meter installed by SCE and reported as Station No.11049500. Note that this metered flow includes the overflow from the old SCE Powerhouse No.3 forebay as reported on the Daily Flow Report as the Greenspot Spill. In addition, the USGS maintains two gauging stations near the mouth of the Santa Ana River Canyon below Seven Oaks Dam. Station No. 11051499 measures the flow in the main river channel while Station No. 11051502 measures river flow diverted into the afterbay of SCE Power House No. 3 through the Bear Valley River Pick-up. The measured flows at this gauge also includes the over-flow from the old SCE Powerhouse No. 3 forebay. The records from these three sources are summarized, adjusted for the overflow from the old SCE Powerhouse No. 3 forebay, and reported as the total flow in the Santa Ana River, USGS Station No. 11051501.

During 2021, the total river flow reported by the USGS, currently provisional, was 16,427 acre-feet. However, measurements at Station No. 11049500 include the amount of groundwater pumped by Mutual and discharged into the flume above the gauge. Thus, to get the actual Santa Ana River Flow the Canyon Well production must be deducted from the reported flows. In 2021, the Canyon Well production was zero acre-feet. Thus, the resulting estimated Santa Ana River flow was 16,427 acre-feet in 2021. However, this value does not reflect the storage change in the reservoir behind Seven Oaks Dam. In 2021, an estimated 2,523 acre-feet of water was stored behind the Dam. Thus, the estimated flow of the Santa Ana River at the mouth of the canyon above Seven Oaks Dam was 18,950 acre-feet in 2021.

Diversions by Bear Valley Mutual Water Company

Amounts diverted by Mutual and associated prior right companies are reported to the State Water Resources Control Board under Recordation Numbers 36-00021, 36-00022, and 36-00028. In 2021, Mutual's diversions were estimated to be 10,817 acre-feet based on the Daily Flow Reports

prepared by the San Bernardino Valley Water Conservation District (SBVWCD). A little over half, 5,816 acre-feet, was water released from the Seven Oaks Dam. Beginning in 2020, Mutual's diversions include the water they deliver to North Fork Water Company and North Fork delivers the water to SBVWCD via the North Fork Parshall Flume. Mutual did not pump groundwater from their Canyon Well No.1 located in the Santa Ana Canyon above the major points of diversion and they produced 256 acre-feet of water from the Redlands Tunnel.

Diversions by San Bernardino Valley Water Conservation District

Water diverted by the San Bernardino Valley Water Conservation District for groundwater recharge is by virtue of licenses, pre-1914 rights and diversion rights of San Bernardino Valley MWD and Western MWD; all diversions are reported to the State Water Resources Control Board. In 2021, the diversions were estimated to be 4,743 acre-feet of Santa Ana River water for ground water recharge based on the Daily Flow Reports prepared by the SBVWCD. As mentioned above, the SAR water SBVWCD received from the North Fork Parshall Flume was not included in Table III-8 as a SBVWCD diversion.

Amount Not Diverted

The sum of the diversions mentioned above are subtracted from the total river flow as reported by USGS Gauge 11051501 plus the annual storage change in Seven Oaks Reservoir to determine the "Amount Not Diverted". The "Amount Not Diverted" represents the amount of water that flows past the mouth of the Santa Ana River Canyon without being diverted for beneficial use.

Losses and Measurement Errors

During preparation of the 1996 report the Watermaster Committee discovered significant discrepancies between the value for "Amount Not Diverted", as calculated by the method contained in previous Watermaster Reports and observed flows in the Santa Ana River just downstream from the last diversion point. Since 1994, San Bernardino Valley Water Conservation District staff have been estimating the amount of water flowing past the Greenspot Road Bridge at the Cuttle Weir, which is just downstream from the mouth of the Santa Ana River Canyon, on a daily basis. In past years the difference between the estimated flows at the Greenspot Road Bridge and the "Amount Not Diverted" were significantly different. The Watermaster has

conducted extensive research with regards to the discrepancy and provided the following eight explanations:

1. Leakage Losses between Inflows and Outflows. The first explanation was unmeasured losses between the points where inflows and outflows are measured. These include:

    1. Leakage in the tailrace from SCE Power House No. 3 afterbay,
    2. Leakage in the Redlands Aqueduct between SCE Power House No. 3 afterbay and the Redlands Sandbox which may have been partially remedied by the replacement of a portion of a steel pipe segment of the Aqueduct in 2021, and
    3. Leakage around the Redlands Sandbox weir.

2. Unmeasured Diversions. The second explanation was that Mutual can divert water for spreading at the Redlands Sandbox without it being measured. San Bernardino Valley Water Conservation District staff now observes and reports this diversion on a daily basis. These estimates are based on known flows delivered to the Redlands Sandbox and are fairly accurate. This possible source of error has been corrected and the amount diverted for spreading is included in Table III-8.

3. USGS Gauge Accuracy. The third possible explanation for the disparity is the accuracy of the USGS flow records. The USGS reports that this combined flow measurement of the three gaging stations is considered to have an accuracy rating of "fair". A "fair" rating means that 95 percent of the daily discharge measurements are within 15 percent of the true value. According to Jeffrey Agajanian of the USGS, this means the error band for the entire year should be within approximately 15 percent of the total measured flow. This value is a conservative estimate of the possible measurement errors and the flow is likely to be well within this error band, especially during the summer months when flows are generally constant and lower.

4. Water Delivery Flow Measuring Device Accuracy. A fourth reason for the difference could be inaccuracies in the diversion measuring devices, which should be less than +/- 10 percent at any given time. Most of these measurements are obtained through the use of stable, long-term weirs and Parshall flumes, but small, though not insignificant, errors are possible. Some of the measurement devices provide daily readings and are equipped with totalizer equipment providing monthly data. The San Bernardino Valley Water Conservation District (SBVWCD) will continue to update totalizer equipment on any of the measurement devices that are not equipped with totalizer equipment.

5. Observed Flow at the Cuttle Weir. A fifth possible explanation was the accuracy of the flow estimates at the Cuttle Weir. These estimates are based on daily flow observations. Total flow quantities are difficult to determine because of the high degree of short-term variability in the river flows during storm events. For 2021, no flow over the Cuttle Weir was observed.

The construction of the Seven Oaks Dam required the reconstruction of the SCE flume between the old Power House No. 2 and No. 3. This eliminated any losses in the flume from the old Power House No. 2 and No. 3 and required the USGS to move Station No. 11049500 to the old forebay of Power House No. 3. Flow at this station was initially estimated by using the Daily Flow Report provided by the San Bernardino Valley Water Conservation District and is reported as Station No. 11049500. As of August 2001, SCE has installed a new meter in their aqueduct above the forebay of Power House No. 3 and data from this flow meter is provided to the USGS. In addition, improved efforts were taken to monitor diverted water at the Redlands Sandbox for ground water recharge and observed flows at the Cuttle Weir. The Watermaster has concluded that these efforts have reduced the losses and measurement inaccuracies such that the large errors that occurred in the past should no longer occur.

6. Storage behind Seven Oaks Dam. There is, however, an additional factor that must be considered when the Watermaster Committee estimates the "amount not diverted". This factor is the amount of water that has been stored behind Seven Oaks Dam (SOD) and not released by year-end. This stored water is Santa Ana River flow that has not yet been measured by the two USGS stream gauges below the dam. In addition, water stored behind the dam from inflow in the previous year and released in the current year must also be taken into account. The amount stored behind SOD at the end of 2020 was 668.6 acre-feet (water surface elevation of 2,160.0 feet). The amount stored behind SOD at the end of 2021 was 3,191.2 acre-feet (water surface elevation of 2,200.8 feet). In other words, water was behind from the dam from inflow in 2021. This amount was 2,522.7 acre-feet and was not included in the USGS provisional value of 16,427 acre-feet. Adding the amount of SAR water stored behind SOD in 2021 and deducting the amount of groundwater pumped from BVMWC Canyon Well (-0- acre-feet) from the USGS provisional value increases the estimate of Santa Ana River flow to 18,950 acre-feet for 2021.

7. Spills from SCE PH No. 3. In 2012, the Committee identified an additional location where Santa Ana River water that is not diverted is measured by the San Bernardino Valley Water Conservation District. This location is the afterbay of SCE Power House No. 3. On occasion, all

of the water delivered to the afterbay is not diverted and some of it is spilled to a small channel that discharges to the Santa Ana River below Cuttle Weir. The Committee agreed that these spills should be added to the observed flows at Cuttle Weir to estimate the "Estimated Flow Downstream of Diversions" as reported in **Table III-8**. In 2021, there were 38 acre-feet of spills from SCE PH No. 3.

8. Differences in Measurements. The USGS estimates of the Santa Ana River flow are based on stream gauges that record data at 15-minute intervals throughout the day. The estimates of diversions are based on the Daily Flow Reports prepared by the SBVWCD and these reports contain only a single value (usually in the morning) for each working day for each diversion point. Thus, the diversion estimates are not as accurate as the USGS flow estimates and this could lead to significant errors in the "Estimated Not Diverted" value (829 acre-feet) as shown in Table III-8. The Watermaster Committee will review this item in 2022 to determine if Table III-8 should be revised to provide a better estimate of the amount of Santa Ana River water that is not diverted.

2021 Estimate of Amount Not Diverted

In 2021, San Bernardino Valley Water Conservation District did not observe any river flow past the Cuttle Weir at the Greenspot Road Bridge and reported 38 acre-feet of spills from the Santa Ana River from the afterbay of SCE Power House No. 3. Their estimate of these flows, which represents the amount not diverted, was 38 acre-feet.

In 2021, the estimated Santa Ana River flow at the mouth of the canyon was 18,950 acre-feet. The total estimated diversions of Santa Ana River flow by Mutual and San Bernardino Valley Water Conservation District was 15,560 acre-feet. Adding the 2,523 acre-feet of water stored behind Seven Oaks Dam in 2021, this left an estimated 867 acre-feet of Santa Ana River water not diverted in 2021. Comparing this difference with the observed flows past the Cuttle Weir at Greenspot Road Bridge (-0- acre-feet) and the spills from the afterbay of SCE PH No. 3 (38 acre-feet), results in unmeasured leakage losses and measurement errors of 829 acre-feet. These losses and errors represent 4.4 percent of the estimated Santa Ana River flow (acre-feet), which is about normal.

The main problem appears to be the estimates of flow at the Main River Gauge. The USGS annual flow estimate is 2,828 acre-feet, while the estimate from the DFR values is 1,917 acre-feet, a 911

acre-foot difference. The differences are mainly in April and December when there were high releases from SOD. The Watermaster Committee will review this difference in 2022 to determine if any adjustments in diversions should be made to decrease the Amount Not Diverted.

Lake Releases/In Lieu Water Deliveries

Santa Ana River flows are often insufficient to meet Mutual's water needs; as a result, they frequently request lake releases from Big Bear MWD to meet their needs. Big Bear MWD has the choice of releasing water from the lake or providing an In Lieu supply. At their meeting on May 1, 1987, the Board of Directors of the Big Bear MWD voted unanimously to approve the following policy for providing In Lieu Water supplies.

1. Adopt the following 1987 In Lieu policy:

A. When the lake is in the top 4 feet, the irrigation demands from the lake will be met by releasing water from Big Bear Lake.

B. When the lake is between 4 feet and 6 feet down, the District intends to purchase In Lieu Water between the months of May 1st and October 31st from either wells or the State Water Project; between November 1st and April 30, water required would be released from Big Bear Lake.

C. When the lake is between 6 and 7 feet down, the Board shall determine whether to release from the lake.

D. In the unlikely event that the lake is more than 7 feet down, the District intends to buy In Lieu water throughout the year.

E. The General Manager shall inform the Board each time water is released.

On November 16, 2006, the Board of Directors of Big Bear MWD modified their Lake Release Policy to eliminate items C, D and E and to use In Lieu Water whenever the lake is more than 6 feet below full. The revised Lake Release Policy is:

1. When the Lake is within the top 4 feet, the water demands from Bear Valley Mutual will be met with Lake releases;

2. *When the Lake is between 4 and 6 feet below full, the District intends to obtain In Lieu water between the months of May 1 and October 31. Between November 1 and April 30, water required would be released from Big Bear Lake;*

3. *When the Lake is more than 6 feet below full, the District intends to obtain In Lieu water throughout the year.*

In 2021, the lake level was more than 6 feet below full for the entire year. The lake ended the year 15.06 feet below full.

2012 In Lieu Lake Release Agreement

In July 2012, Big Bear MWD and San Bernardino Valley MWD (Valley District) entered into a Memorandum of Understanding that allowed Valley District to deliver In Lieu Water to Mutual when the Lake Release Policy would normally call for lake releases, and, in return, Valley District would get credit for an equal amount of water stored in Big Bear Lake. The amount of water in their storage account would be reduced monthly by the amount of additional evaporation resulting from the increased surface area of the lake. This In Lieu Lake Release program began on July 1, 2012 and was scheduled to run through December 31, 2015. In 2015, the two agencies modified the existing In Lieu Agreement to extend the time Valley District could make In Lieu Lake Water deliveries to Mutual and provide Valley District with the opportunity to reduce their In Lieu SWP Water deliveries to Mutual during emergency years when their State Water Project (SWP) deliveries are significantly reduced. At the end of 2020, Valley District had stored 655 acre-feet of water in Big Bear Lake. In 2021, Valley District did not request any In Lieu Lake Releases. The additional evaporation losses in 2021 were 85 acre-feet. Valley District ended the year with 570 acre-feet in their sub-account and the Lake was 0.33 feet higher than it would have been without the Memorandum of Understanding. **Table III-9** shows the account details of Valley District's portion of Big Bear MWD's lake account.

TABLE III-9

ALLOCATION OF BIG BEAR MWD LAKE ACCOUNT

Calendar Year 2021

Big Bear Watermaster

LAKE ACCOUNTS (acre-feet)	Big Bear WM Account	Valley District Subaccount	Big Bear Subaccount
Initial Storage	17,875.1	655.2	17,219.9
Lake Inflows	-	-	-
In Lieu Water Supplies to Mutual	(8,274.4)	-	-
Lake Releases (Mutual & BBMWD)	-	-	-
Releases & Leakage (SWRCB 95-4)	(55.4)	-	(55.4)
Net Snowmaking Withdrawals	(534.9)	-	(534.9)
Lake Spills & Flood Control Releases	-	-	-
Evaporation from Lake	(2,796.6)	(85.1)	(2,796.6)
Net Wastewater Exports	(881.3)	-	(881.3)
Advances and Repayment of Advances	-	-	-
Ending Storage	21,881.2	570.1	21,311.1

Water Deliveries to Mutual by Big Bear MWD

Mutual received 8,981.3 acre-feet of water from Big Bear MWD in 2021. This year Mutual's needs for water from BBMWD were met by SWP In Lieu Water, In Lieu Groundwater, and water discharged from the lake for fishery protection under SWRCB Order No. 95-4. **Table III-10** shows Big Bear MWD monthly water deliveries to Mutual during 2021.

TABLE III-10
WATER DELIVERIES TO MUTUAL BY
BIG BEAR MUNICIPAL WATER DISTRICT
(Acre-feet)
Calendar Year 2021
Big Bear Watermaster

Month	Releases from Big Bear Lake for Mutual	Mutual's Use of Fish Releases*	"In Lieu" State Water Project	"In Lieu" Lake Releases	"In Lieu" Groundwater	Total Deliveries to Mutual
January	-0-	57.1	-0-	-0-	-0-	57.1
February	-0-	44.1	-0-	-0-	-0-	44.1
March	-0-	58.3	-0-	-0-	-0-	58.3
April	-0-	18.2	-0-	-0-	-0-	18.2
May	-0-	40.5	-0-	-0-	-0-	40.5
June	-0-	69.9	320.5	-0-	981.7	1,322.1
July	-0-	94.1	428.9	-0-	1,376.1	1,899.1
August	-0-	86.0	435.1	-0-	1,097.2	1,618.3
September	-0-	84.7	329.8	-0-	873.5	1,288.0
October	-0-	64.1	446.6	-0-	749.3	1,260.0
November	-0-	55.3	201.7	-0-	487.6	744.6
December	-0-	34.6	27.8	-0-	518.6	581.6
Total	**-0-**	**706.9**	**2,190.4**	**-0-**	**6,084.0**	**8,981.3**

* Also required to comply with SWRCB Order No. 95-4

The amount of water delivered to Mutual consisted of 2,190.4 acre-feet of SWP In Lieu Water, 6,084 acre-feet of In Lieu groundwater, and 706.9 acre-feet of lake water they were able to use from the releases and leakage for fish protection.

In 2019, Mutual used In Lieu Water for groundwater recharge for the second time. They did not use any In Lieu Water for groundwater recharge in 2021. These deliveries could have an impact on the Basin Make-up Account. The Watermaster committee will look into this issue in 2022.

The amount of water Big Bear MWD is obligated to deliver to Mutual is limited by the Judgment. According to the Physical Solution Agreement, Article III.A.1.(b), Mutual has the right to:

> *"divert water, or cause water to be diverted, at such rate as may be reasonably necessary to meet the requirements of Mutual's stockholders, not exceeding 65,000 acre-feet in any ten (10) year period, as determined by the Board of Directors of Mutual in its sole discretion."*

Table III-11 summarizes the deliveries to Mutual since the agreement went into effect. For the ten-year period ending with calendar year 2021, the amount of water delivered to Mutual by Big Bear MWD was 61,721 acre-feet. For the 45-year period the Judgment has been in effect, the average annual deliveries by Big Bear MWD to Mutual has been 4,620 acre-feet.

In 2022 Mutual can request up to 8,616 acre-feet of water from Big Bear MWD. This value is the amount that they are below the 65,000 acre-feet limitation at the end of 2021 (which is 3,279 acre-feet), plus the deliveries made in 2012 (which was 5,337 acre-feet), that will be dropped from the ten-year period ending in 2022. The 8,616 acre-feet total includes In Lieu deliveries, lake releases, and fishery outflows that Mutual is able to divert.

TABLE III-11
SUMMARY OF WATER DELIVERIES TO MUTUAL 1977 - 2021

(acre-feet)

Calendar Year 2021 Big Bear Watermaster

Calendar Year	Mutual Lake Releases	SWRCB Outflows to Mutual	In Lieu Well Water	In Lieu SWP Water	In Lieu EVWD or /D Lake Rel	In- Lieu BV Stock Water	Total In Lieu & Releases	10-year Total
1977	868.0	-	4,412.0	-	-	-	5,280.0	**n.a.**
1978	-	-	-	-	-	-	-	**n.a.**
1979	-	-	-	-	-	-	-	**n.a.**
1980	-	-	-	-	-	-	-	**n.a.**
1981	2,250.0	-	-	672.0	-	-	2,922.0	**n.a.**
1982	657.0	-	-	56.0	-	-	713.0	**n.a.**
1983	-	-	-	-	-	-	-	**n.a.**
1984	1,700.0	-	-	993.0	-	-	2,693.0	**n.a.**
1985	2,463.0	-	842.0	2,994.0	-	-	6,299.0	**n.a.**
1986	1,358.0	-	1,139.0	190.0	-	-	2,687.0	**20,594.0**
1987	-	-	3,301.0	4,762.0	-	84.0	8,147.0	**23,461.0**
1988	-	-	1,864.0	5,432.0	-	63.0	7,359.0	**30,820.0**
1989	-	-	1,593.0	8,555.0	-	-	10,148.0	**40,968.0**
1990	-	-	562.0	7,722.0	-	-	8,284.0	**49,252.0**
1991	78.6	-	-	-	151.0	-	229.6	**46,559.6**
1992	-	-	-	-	-	-	-	**45,846.6**
1993	-	-	-	-	-	-	-	**45,846.6**
1994	1,140.8	-	-	-	-	-	1,140.8	**44,294.4**
1995	88.3	-	-	-	-	-	88.3	**38,083.7**
1996	3,460.7	-	-	4,027.5	-	-	7,488.2	**42,884.9**
1997	364.0	-	-	6,780.1	-	-	7,144.1	**41,882.0**
1998	-	-	-	-	-	-	**-**	**34,523.0**
1999	124.2	146.5	-	10,435.8	-	-	**10,706.5**	**35,081.5**
2000	-	510.4	-	12,877.5	-	-	**13,387.9**	**40,185.4**
2001	46.3	492.7	48.1	14,212.4	-	-	**14,799.5**	**54,755.3**
2002	-	614.1	-	5,000.0	-	-	**5,614.1**	**60,369.4**
2003	-	484.3	-	-	-	-	**484.3**	**60,853.7**
2004	-	512.3	-	2,500.0	-	-	**3,012.3**	**62,725.2**
2005	-	146.3	-	2,218.0	-	-	**2,364.3**	**65,001.2**
2006	-	467.2	-	2,070.3	-	-	**2,537.5**	**60,050.5**
2007	-	486.0	-	6,500.0	-	-	**6,986.0**	**59,892.4**
2008	-	474.6	-	4,633.6	-	-	**5,108.2**	**65,000.7**
2009	-	509.8	-	5,990.2	-	-	**6,500.0**	**60,794.2**
2010	123.1	276.2	-	2,478.8	-	-	**2,878.1**	**50,284.3**
2011	-	384.5	-	789.2	-	-	**1,173.7**	**36,658.5**
2012	-	640.8	-	4,695.9	-	-	**5,336.7**	**36,381.1**
2013	-	653.1	-	6,454.4	-	-	**7,107.5**	**43,004.3**
2014	-	892.9	4,691.9	1,716.0	-	-	**7,300.8**	**47,292.8**
2015	-	661.9	648.0	5,170.9	484.8	-	**6,965.6**	**51,894.1**
2016	-	766.5	-	8,500.0	-	-	**9,266.5**	**58,623.1**
2017	-	506.3	-	4,146.8	-	-	**4,653.1**	**56,290.2**
2018	-	824.6	447.9	6,618.4	-	-	**7,890.9**	**59,072.9**
2019	**-**	251.2	**-**	299.7	**-**	**-**	**550.9**	**53,123.8**
2020	**-**	**587.8**	**-**	**3,079.7**	**-**	**-**	**3,667.5**	**53,913.2**
2021	**-**	**706.9**	**6,084.0**	**2,190.4**	**-**	**-**	**8,981.3**	**61,720.8**
1977-2021 Average	**327.2**	**266.6**	**569.6**	**3,439.1**	**14.1**	**3.3**	**4,619.9**	

2019 value for SWRCB Outflows to Mutual was corrected to 251.2 AF

Table III-11 was updated December 27, 2018 to correct minor rounding problems

Mutual's Equivalent Water Diversions

Table III-12 shows the amount of water that Mutual would have diverted from the Santa Ana River if the Judgment had not been rendered. This figure is determined by adding the In Lieu State Water Project water and In Lieu groundwater deliveries as reported in **Table III-10** to the River diversions by Mutual and Mutual's groundwater production from their Canyon Well No. 1, as shown in **Table III-8**. Mutual's Canyon Well No. 2 was destroyed as part of the construction of the Seven Oaks Dam between 1994 and 1998. The value for Santa Ana River diversions includes the supply from the Redlands Tunnel. This Equivalent Water Diversion is the amount of Santa Ana River water Mutual would have to divert if their demands for water from Big Bear MWD had been met by lake releases rather than In Lieu Water deliveries. The 2021 Equivalent Water Diversions were 19,347 acre-feet.

TABLE III-12
EQUIVALENT WATER DIVERSIONS BY MUTUAL 1977-2021
(acre-feet)
Calendar Year 2021, Big Bear Watermaster

Calendar Year	Net Santa Ana River Diversion by BVMWC*	Groundwater Production From Wells No. 1 & 2	Big Bear MWD In Lieu Water Deliveries	Equivalent Total Water Diversions
1977	14,420	1,546	4,412	20,378
1978	16,809	282	-	17,373
1979	19,470	114	-	19,584
1980	20,479	188	-	20,667
1981	20,449	1,130	672	22,251
1982	18,565	246	56	18,867
1983	19,209	53	-	19,262
1984	23,392	739	993	25,124
1985	19,837	872	3,836	24,545
1986	23,160	894	1,9	25,383
1987	16,373	947	8,147	25,467
1988	14,170	612	7,359	21,141
1989	11,449	672	10,148	22,269
1990	11,242	1,576	8,283	21,101
1991	13,715	368	151	14,234
1992	16,840	97	-	16,937
1993	26,591	-	-	26,591
1994	23,819	594	-	24,413
1995	30,794	60	-	30,853
1996	19,529	1,131	4,027	24,687
1997	19,490	1,559	6,780	27,829
1998	26,625	105	-	26,730
1999	21,336	484	10,436	32,256
2000	17,171	2	12,878	30,371
2001	12,355	140	14,260	26,755
2002	8,007	58	5,000	13,065
2003	13,301	114	-	13,415
2004	11,815	67	2,500	14,382
2005	13,615	-	2,218	15,833
2006	18,733	-	2,070	20,803
2007	12,445	182	6,500	19,127
2008	14,144	182	4,634	18,960
2009	11,022	-	5,990	17,012
2010	18,153	-	2,479	20,632.
2011	17,601	-	789	18,390
2012	15,560	-	4,696	20,250
2013	11,310	-	6,454	17,764
2014	9,572	-	6,408	15,980
2015	11,345	-	5,819	17,164
2016	9,453	-	8,500	17,953
2017	16,521	-	4,147	20,668
2018	11,608	-	7,066	18,674
2019	18,205	15	300	18,520
2020	20,789	131	3,080	24,090
2021	11,073	-	8,274	19,347

* Includes Redlands Tunnel Diversions

IV. DETERMINATIONS AND ACCOUNTS

ACCOUNTING REQUIREMENTS

In accordance with Article 29 of the Judgment, "Watermaster shall maintain three basic accounts, in accordance with Watermaster Operating Criteria, as follows:

(a) District's Lake Water Operation. A detailed account to reflect actual operation of the Lake by District shall be maintained.

(b) Mutual's Lake Water Operations. In addition, a corollary account shall be maintained to simulate the effect of Mutual's operations with regard to Lake water under the In Lieu Water operations.

(c) Basin Make-up Account. An account of District's annual and cumulative obligation for Basin Make-up Water shall also be maintained."

In 1986, the Watermaster Committee developed a computer program for keeping these accounts. This program was designed to operate on an IBM (or IBM compatible) personal computer using Lotus 1-2-3. To standardize all years of operations under the Judgment, all past accounts were re-calculated using the program and were included in the 1986 Annual Report.

In 1990, the Watermaster Committee decided how to account for wastewater exports from the Big Bear Lake watershed and delivery of water on Mutual stock owned by Big Bear MWD. Only the Basin Make-up Account was affected by these decisions. Consequently, the 1990 Watermaster Report contained revised tables for the Basin Make-up Accounts for calendar years 1986, 1987, 1988, and 1989, as well as the status of all the 1990 accounts.

For the 1994 report, the Watermaster Committee updated the accounting procedures to reflect 1994 Watermaster decisions and to clarify the reports.

In 1995, the Watermaster made several additional revisions to the accounting procedures. However, in preparing the 1996 accounts, the Watermaster Committee discovered some errors in

the changes made in 1995. These errors were corrected and, as a result, the 1995 accounts were recomputed and were included in the 1996 Annual Watermaster Report.

2021 ACCOUNT BALANCES

Appendix B contains the 2021 accounts. The first four pages of the appendix present the input data used to calculate the various accounts. The fifth page summarizes the status of the various accounts. The remaining pages of **Appendix B** are the detailed monthly tables of the accounts.

Actual Lake Account

Figure 2 illustrates the water balance for the actual operation of Big Bear Lake in 2021. **Table 1** of **Appendix B** provides additional detail. This information shows that:

1) The lake level dropped 1.92 feet, from a gauge height of 59.19 feet to 57.27 feet; 72.33 feet is full;

2) Lake storage decreased by 4,245 acre-feet, it began the year with 38,663 acre-feet and ended the year with 34,418 acre-feet; when the lake is full, it contains 73,320 acre-feet of water;

3) Lake surface area varied between 1,979 and 2,260 acres;

4) Evaporation was 9,301 acre-feet;

5) Lake inflow was 6,401 acre-feet,

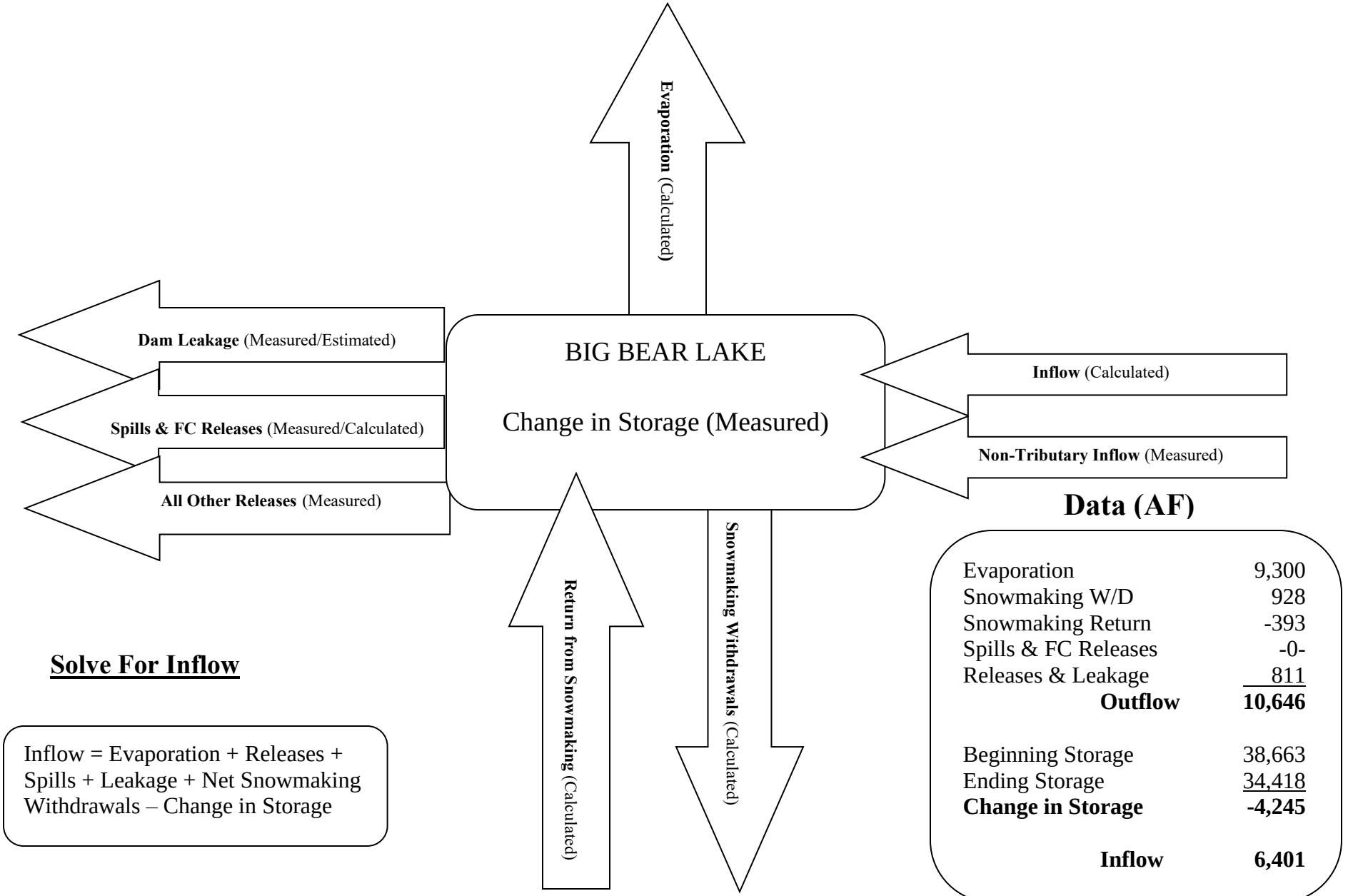
6) The total of spills, releases, leakage, and net lake withdrawals was 1,346 acre-feet.

Tables 1A through **1D** provide additional details to support **Table 1**.

Mutual's Lake Account

Figure 3 illustrates the water balance for Mutual's synthesized operation of Big Bear Lake in 2021. Mutual's operation shows what would have happened if:

Figure 2
Water Balance for 2021 Actual Lake Operations



Solve For Inflow

Inflow = Evaporation + Releases + Spills + Leakage + Net Snowmaking Withdrawals – Change in Storage

Data (AF)

Evaporation	9,300
Snowmaking W/D	928
Snowmaking Return	-393
Spills & FC Releases	-0-
Releases & Leakage	811
Outflow	**10,646**
Beginning Storage	38,663
Ending Storage	34,418
Change in Storage	**-4,245**
Inflow	**6,401**

1) Mutual had owned the lake,

2) The In Lieu program was not in place, and

3) The net wastewater exported from Big Bear Lake watershed entered the lake as supplemental inflow.

In this synthesized case, Mutual's demands for lake water would have been met entirely from lake releases.

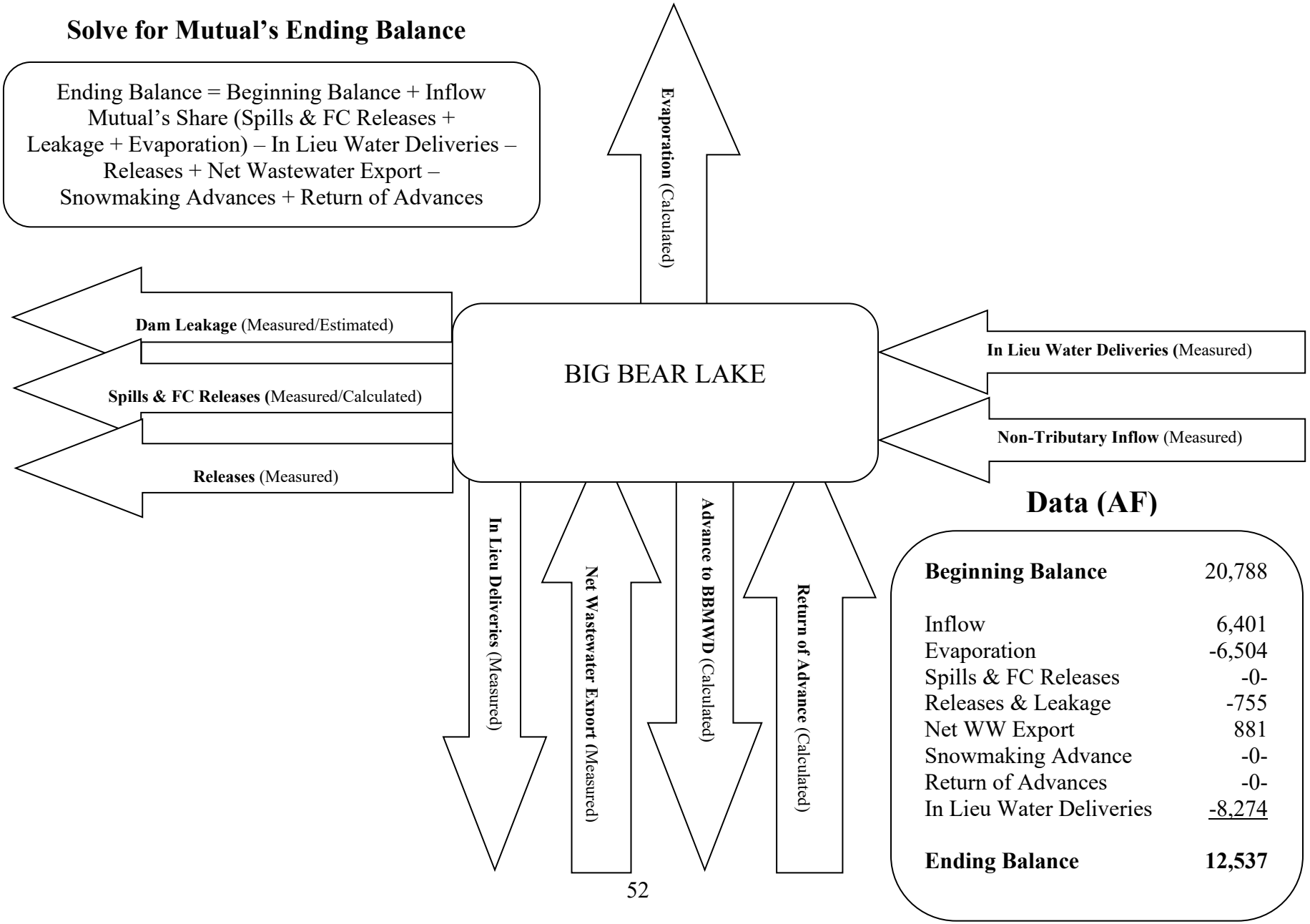
Figure 3 and **Table 2** of **Appendix B** show that Mutual had 12,537 acre-feet in its lake account at the end of 2021. This account balance is 8,251 acre-feet less than was in their lake account at the end of 2020. **Table 2** also shows that in 2021 Mutual's lake account was credited with all the lake inflow (6,401 acre-feet), the total of their releases, spills, and leakage was 755 acre-feet and their In Lieu Water deliveries were 8,274 acre-feet. In 2021, supplemental inflow of 881 acre-feet was added to Mutual's Lake Account for net wastewater exported from the basin. In 2021, there were no advances to Big Bear MWD for snowmaking within the watershed. Evaporation that would have taken place under a Mutual operation was 6,504 acre-feet.

The cumulative effect of changes in lake releases and supplemental inflows that would have taken place since 1977 under a "Mutual Operation" would be a lake level that would have been 44.50 feet at the end of 2021 or 27.83 feet below the top of the dam. This synthesized lake level is 12.77 feet lower than it actually was. This lower lake level reflects the impact of what Mutual's lake withdrawals would have been without the In Lieu Water program and with the credits they receive from the net wastewater exports. **Tables 2A** through **2C** of **Appendix B** provide additional details to support **Table 2**.

Article 4.(b) of the Watermaster Operating Criteria (Exhibit "D" of the Judgment discusses how to handle the export of wastewater from and the import of water to the Upper Bear Creek Watershed. Specifically, it says:

> *In the event gross export from Upper Bear Creek Watershed to any area not tributary to the Santa Ana River Watershed within Upper Bear Creek Watershed, calculated inflow to the Lake shall be increased each year, beginning with the calendar year 1986 by the amount by which such gross export exceeds imports. If gross import exceeds gross export, said excess shall be credited against District's Basin Make-up Water obligation.*

Figure 3
Water Balance for 2021 Mutual's Lake Operation
(Synthesized Conditions)



In 1986, the Watermaster Committee decided to handle the net wastewater exports (gross exports-gross imports) entirely in the District's Basin Make-up water obligations. This decision was contingent upon implementation of a wastewater reclamation project in the Upper Bear Creek Watershed by December 31, 1994. A reclamation project was not implemented by that date so the Watermaster Committee, in 1994, decided to add the net wastewater credits to the calculated lake inflows effective January 1990. This decision adds the net wastewater credits to Mutual's lake account. Essentially, it transfers the amount of the credit from Big Bear MWD's lake account to Mutual's lake account.

Table IV-1 shows the impacts of crediting Mutual's lake account (and debiting Big Bear MWD's lake account) with the net wastewater exports. Since 1990, Mutual has been credited with 40,155 acre-feet of net wastewater exports. After 32 years of getting these credits, Mutual's lake account has 4,719 acre-feet more water than it would have had if it hadn't received the credits. This additional increase raised their simulated lake level by 4.00 feet. In other words, without the credits, Mutual's lake account would have been 7,818 acre-feet and their lake level would have ended the year at 40.50 or 31.83 feet down. In other words, it would have been 16.77 feet below the actual lake level of 57.27 feet and 4.00 feet lower than reported in Mutual's lake account tables (44.50 feet).

There are two primary reasons why the increase in their lake account (4,719 acre-feet) is less than the cumulative credits they have received (40,155 acre-feet). The first reason is spills. When the lake fills, Big Bear MWD's water spills first, and then Mutual's water spills. The Wastewater export credits they receive will spill during very wet years, like 1998. The second reason is evaporation. Mutual's lake level increases with the credits. With higher lake levels, their share of the evaporation losses increases. The end result is that at the end of 2021 Mutual's lake account had 4,719 acre-feet more and Big Bear MWD's lake account had 4,719 acre-feet less as a consequence of the net wastewater export credits.

TABLE IV-1
EFFECT OF WASTEWATER EXPORT CREDITS
ON MUTUAL'S LAKE ACCOUNT
Calendar Year 2021
Big Bear Watermaster

End of Calendar Year	Net Wastewater Export Credit (AF)	w/Wastewater Credits		w/o Wastewater Credits		Differences	
		Storage Account (AF)	Lake Level (Feet)	Storage Account (AF)	Lake Level (Feet)	Storage Account (AF)	Lake Level (Feet)
1989	-	16,905	47.00	16,905	47.00	-	-
1990	857	7,627	40.30	6,864	39.50	763	
1991	940	14,226	45.75	12,772	44.65	1,454	1.10
1992	723	22,787	51.15	20,886	50.05	1,901	1.10
1993	2,223	62,165	68.40	58,271	67.00	3,894	1.40
1994	1,397	61,407	68.15	56,451	66.35	4,956	1.80
1995	2,012	66,308	69.90	65,019	69.45	1,289	0.45
1996	1,540	60,875	67.95	58,229	67.00	2,646	0.95
1997	1,427	52,407	64.80	48,663	63.35	3,744	1.45
1998	2,427	69,566	71.00	68,282	70.60	1,284	0.40
1999	1,339	51,390	64.40	48,922	63.45	2,468	0.95
2000	1,337	35,335	57.65	31,900	56.00	3,435	1.65
2001	1,317	19,898	49.45	15,732	46.75	4,166	2.70
2002	889	10,856	43.15	6,897	39.55	3,959	3.60
2003	1,044	13,718	45.35	9,695	42.20	4,023	3.15
2004	1,024	14,200	45.70	10,233	42.65	3,967	3.05
2005	1,750	43,041	61.05	37,900	58.85	5,141	2.20
2006	1,462	48,034	63.10	42,067	60.65	5,967	2.46
2007	997	34,655	57.35	28,588	54.30	6,067	3.05
2008	1,207	35,251	57.60	28,855	54.45	6,396	3.15
2009	1,074	30,034	55.05	23,496	51.55	6,538	3.50
2010	1,715	52,208	64.75	44,898	61.85	7,310	2.90
2011	1,781	58,121	66.95	49683	63.75	8,438	3.20
2012	1,175	49,881	63.85	41,167	60.25	8,714	3.60
2013	883	36,058	58.00	27,657	53.80	8,402	4.20
2014	732	26,252	53.05	18,292	48.45	7,960	4.60
2015	846	16,437	47.25	8,968	41.55	7,469	5.70
2016	848	8,977	41.55	3,021	33.65	5,956	7.90
2017	1,279	12,122	44.20	6,290	38.90	5,832	5.30
2018	727	4,935	37.25	799	26.00	4,136	11.25
2019	1,264	23,611	51.60	18,920	48.85	4,691	2.75
2020	1,038	20,788	49.95	15,775	46.80	5,013	3.15
2021	881	12,537	44.50	7,818	40.50	4,719	4.00
TOTAL	**40,155**						

*The lake is empty at a gauge height of 23.0

** The 2018 Storage Account and Lake Level Values were incorrectly reported in the 2018 Watermaster Report; the corrected values are shown above

Big Bear MWD's Lake Account

Section 3(b), District's Water in Storage, of the Watermaster Operating Criteria of the Judgment describes the procedure to determine Big Bear MWD's storage account as follows:

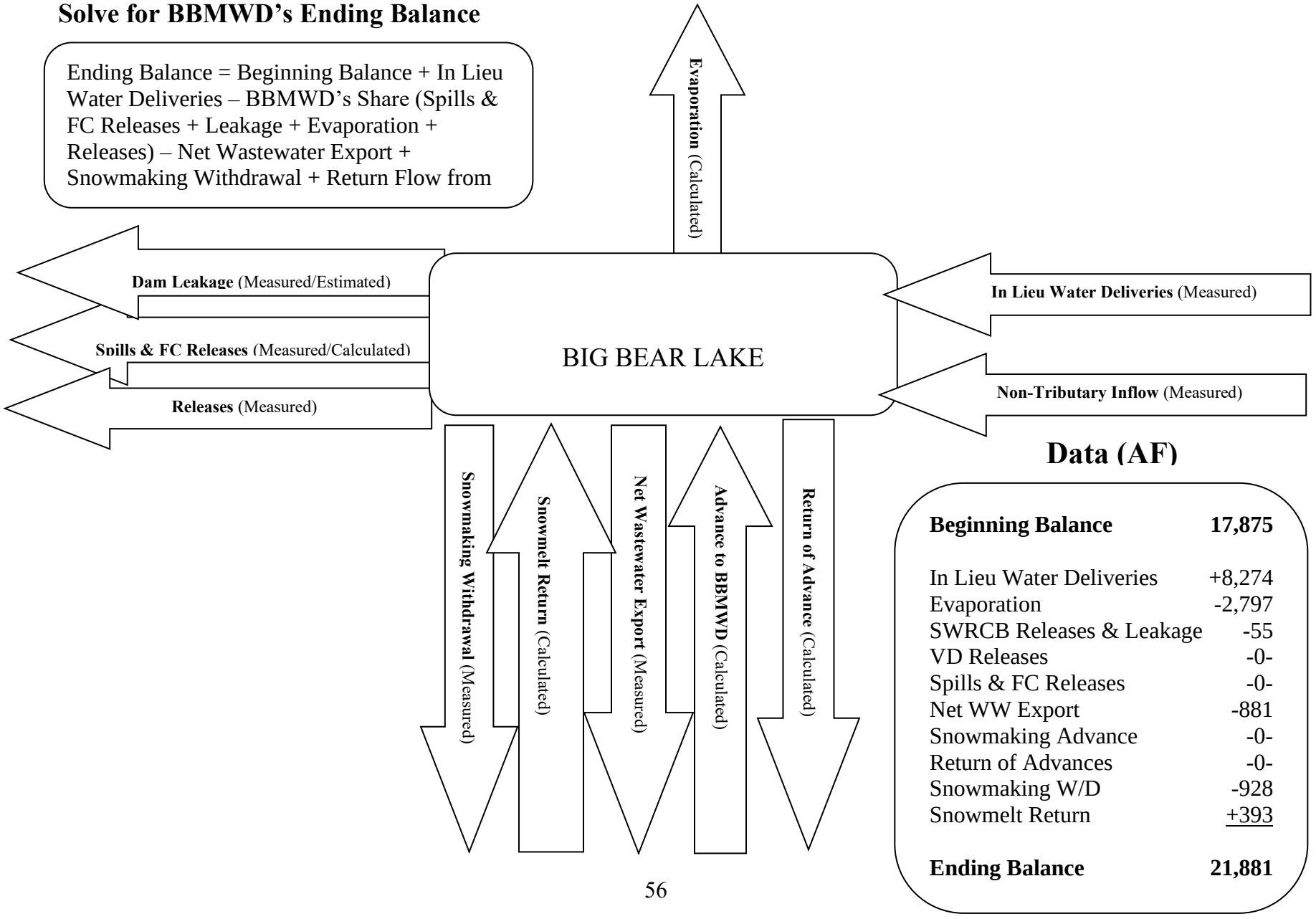
> *"Any water actually in storage in excess of Mutual's water in Storage, as calculated above, shall be for the account of District. So long as District has water in storage, all spills from the Lake shall be deemed District Water."*

Figure 4 illustrates the water balance for Big Bear MWD's lake account in 2021. Table 3 of **Appendix B** summarizes the results. This information shows the water actually in storage (from **Table 1** of **Appendix B**), Mutual's water in storage (from **Table 2** of **Appendix B**), and the difference between the two, which is the amount in Big Bear MWD's account. In 2021, Big Bear MWD's account balance began with 17,875 acre-feet and ended the year with 21,881 acre-feet. The increase in their account was 4,006 acre-feet. This increase was because the In Lieu Water deliveries to Mutual during the year were more than the evaporation losses, SWRCB releases, net snowmaking withdrawals, and net wastewater exports.

Table 3 of **Appendix B** also shows the status of Big Bear MWD's "Advance Account". This account represents the net amount of water Big Bear MWD has "borrowed" from Mutual for snowmaking in the Big Bear Lake watershed. In 2021, Big Bear MWD's advance account was zero throughout the year.

Tables 3.A and **3.B** of **Appendix B** provide supporting information to Table 3.

Figure 4
Water Balance for 2021 BBMWD's Lake Operation
(Synthesized Conditions)



Basin Make-up Account

Exhibit D of the Judgment contains a formula to be used for determination of the amount of Basin Make-up Water, if any, that is needed to offset deficiencies in the recharge supply to the San Bernardino Groundwater Basin. **Tables 4, 4A, 4B** and **4C** in **Appendix B** follow the formula presented in the Judgment for calculating the credit or deficiency in the Basin Compensation Account. The formula contained in the Judgment is:

Deficiency or Credit =

$$[(.50)(R_d) + (.51)(S_d) + (.50)(P_d)] - [(.50)(R_m) + (.51)(S_m)]$$

wherein:

R_d = Releases actually made under District Operation.

S_d = Spills which actually occurred under District Operation.

P_d = In lieu water purchased by District from San Bernardino Valley MWD or the Management Committee of the Mill Creek Exchange and delivered under District Operation to Mutual for service area requirements.

R_m = Releases which would have been made under a Mutual Operation.

S_m = Spills which would have occurred under a Mutual Operation.

The first three terms in the equation represent the recharge that occurs under Big Bear MWD's lake operation. These are referred to as the "Big Bear's Basin Additions" in **Table 4**. **Table 4.A** shows the details of the calculations for these three terms.

The last two terms in the equation represent the recharge that would have occurred if Mutual had owned and operated the lake and met its supplemental water needs from lake releases. Collectively these terms are referred to as "Mutual's Basin Additions" in **Table 4**. **Table 4.B** shows the detailed calculations for these two terms.

The monthly net credit or deficiency in recharge to the San Bernardino Basin is shown in Column 5 of **Table 4**. These calculations are in accordance with the formula in the Judgment.

The Judgment also requires Big Bear MWD to make-up for deficiencies in recharge that would occur as a result of their lake operations. Column 7 of **Table 4** shows the amount of water recharged by Big Bear MWD in the San Bernardino Basin to correct (or prevent) deficiencies in recharge. **Table 4.C** presents details of the sources of water used to replenish the Basin Compensation Account.

Table 4 of **Appendix B** presents the status of the Basin Make-up Account for 2021. The account balance began the year with a balance of 27,046 acre-feet and ended the year with 24,032 acre-feet. There was a 3,014 acre-foot decrease in the Basin Make-Up Account in 2021. The reason for the decrease was the use of 6,084 acre-feet of In Lieu groundwater deliveries, which reduced the amount of groundwater recharge from the In Lieu Program.

In 2019, Mutual delivered In Lieu Water for groundwater recharge for the second time. Mutual did not deliver any In Lieu Water for groundwater recharge in 2021. The Watermaster Committee has agreed to review the impact of this new use of In Lieu Water on the Basin Make-up Account. The 1977 Judgment did not anticipate this use of In Lieu Water and the formulas used to determine the Basin Make-up Account balances may have to be revised to reflect this new use. The Watermaster Committee will continue to address this issue in 2022.

V. OTHER WATERMASTER ACTIVITIES

IMPACTS OF SEVEN OAKS DAM

History and Background

Construction of the 550-foot high Seven Oaks Dam (SOD) by the U.S. Army Corps of Engineers (Corps) began in 1990 and was completed in 1998. The plunge pool by-pass pipeline was completed in 2001, which routes low flows, for beneficial use by either Mutual through its "River Pick-up" or by SBVWCD at its main river diversion, through the Dam, around the plunge pool, and back to the river channel.

Two features of SOD can affect Watermaster activities. First, the SOD prevents the natural subsurface flow of groundwater from leaving the Santa Ana River Canyon and causes all groundwater coming from upstream of the Dam to rise to the surface and pass through the dam outlet structure. The plunge pool by-pass line helps to overcome the loss of these subsurface flows. Second, when the SOD impounds storm flows behind the Dam for extended periods, it causes water quality degradation.

In 1993, San Bernardino Valley Municipal Water District (SBVMWD) and Western Municipal Water District (WMWD) of Riverside County provided funding to the Corps for a water conservation study to evaluate SOD as a dual-use structure for flood control and water conservation. The possible impoundment of waters of the Santa Ana River for uses other than flood control raised some water rights issues. Several diversion points for SBVWCD, North Fork Water Company, Mutual, and Redlands Water Company ("Below the Dam Diverters") are downstream of SOD, and the Dam altered the operation of these historical diversion points. It was the intent of the "below the dam diverters" to have releases from SOD approximately average annual natural flows, recognizing that flood control release flows were expected to have less silt at low release rates than previous flows and maybe more evenly distributed. Their request was to have the amount of water to be impounded behind SOD for uses other than flood control determined after the combined needs have been met for (1) the water supply agencies to provide

direct delivery water and (2) the integrity of the groundwater basin is stabilized by assuring groundwater levels are maintained within an appropriate operating range.

Water Rights

In 1995, SBVMWD and WMWD filed a petition to revise the Declaration that the Santa Ana River Stream System is Fully Appropriated and an application to Appropriate Water By Permit with the State Water Resources Control Board (SWRCB). The petition and application were to give the two local agencies the right to impound water behind SOD, subject to the operational directions of the Dam for flood control. In 2000, the SWRCB adopted Order WR2000-12 to process the application filed by SBVMWD and WMWD and for the processing of a water right application filed by Orange County Water District (OCWD). In 2001 the water rights application (AO31165) was filed by SBVMWD and WMWD, and the water rights application (AO31174) filed by OCWD were accepted.

In 2001, SBVMWD filed a second application, and SBVWCD applied for the right to use Santa Ana River water that would initially be impounded behind SOD, then released for downstream use. In 2002, the SWRCB noticed the water rights applications filed by SBVMWD, WMWD, and OCWD, and a Pre-Hearing Conference and Public Hearing were noticed for the water rights applications filed by the Chino Basin Watermaster, SBVMWD/WMWD, SBVWCD, and the City of Riverside. During the Pre-Hearing Conference, all parties agreed to accept the evidence, which resulted in Order WR 2000-12 revising the fully appropriated stream designation for the Santa Ana River. Consequently, the SWRCB adopted WR 2002-6 during its Public Hearing on July 2, 2002. Following the hearing on July 2, the protest period for Applications 31165 and 31174 was closed on July 17. Several protests were submitted and responses provided, but no further action occurred.

In 2008, the SBVWCD and SBVMWD conducted a study of the water spreading capacity of facilities downstream of SOD. Major conclusions of the study were that the area is ideal for recharge and not inhibited by clay or silt, faulting may interfere with the recharge in the eastern end and very high flow years will saturate the spreading grounds. Additionally, structural capacities limit regular use to 300 cfs, and further to the west, the stable flows are limited to about 150 cfs. This study gave rise to the Enhanced Recharge Project, which would be permitted under SBVWCD Wash Plan HCP and SBVMWD River HCP. Construction of Phase 1A of the Enhanced

Recharge Project, which includes a sedimentation basin to improve the water quality of spreading flows was completed in 2019. Phase 1B and 1C are currently in the final design and permitting process to allow construction and operations. This will then allow the water rights decisions to be perfected to a license.

Initial Operations and Water Quality

The Corps and the Local Sponsors (San Bernardino and Orange County Flood Control Districts) initially operated the Dam under the Interim Water Control Plan and in 2004 the Dam began operation under the Water Control Manual for the Seven Oaks Dam & Reservoir. The Manual required that during the storm season (October to May) a debris pool (water surface elevation of 2,200 feet) be formed to protect the intake tower from sediment intrusion. After the storm season, the Corp begins releasing water from the debris pool to start their maintenance activities.

The Watermaster Committee was concerned that the current operations of Seven Oaks Dam could restrict the operations of Big Bear Dam and the in-lieu program as described in the 1977 Judgment. These restrictions could include, at a minimum, reduced releases and increased in-lieu requirements when:

- SCE facilities are out of service, and the quality of water behind Seven Oaks Dam is unacceptable to Mutual.
- SCE facilities are operating at capacity, and the quality of water behind Seven Oaks Dam is unacceptable to Mutual.
- SCE facilities are out of service or operating at capacity in the fall and winter months when the Debris Pool is being filled and there are no releases from Seven Oaks Dam.

In addition, any reduction in releases from the Lake would increase lake evaporation and decrease the long-term average deliveries to Mutual. These restrictions could also constrain Big Bear MWD's opportunities to beneficially use the flood control releases they would make from Big Bear Lake in the late fall and winter months.

It was quickly observed that the raw water discharged from SOD was of poor quality and adversely impacted the ability of the two downstream water treatment plants, one owned by East Valley

Water District (EVWD) and the other owned by the City of Redlands (COR), ability to treat the water. If the upstream flow is diverted around the debris pool, such as when the Edison Facility is operational, there were significantly lower adverse impacts at their respective plants. A 2004 study showed turbidity increasing from 2 NTU to between 5 to 80 NTU when released from the debris pool with similar effects noted with increased color units, iron, manganese, and TOC. These readings indicate poorer quality water than historical Santa Ana River water quality conditions when water is passed through the debris pool.

In 2005, representatives from the Basin met with Congressman Jerry Lewis to describe the situation and seek Federal assistance to solve the problem and Congress appropriated $1,000,000 to study the issue. This report identified that water quality impacts included longer durations and elevated levels of turbidity, total organic carbon, color, iron, manganese, algae, and taste and odor-causing compounds, as well as water supply impacts, including less supply in dry hydrologic years, reduced stores in Fall through Winter as the debris pool behind the Dam is filled, and extended periods the SCE facilities are out of service after flood events. During these extended periods, the SCE facilities cannot divert high-quality Santa Ana River (and Bear Creek) water around SOD. The report recommended long-term comprehensive alternatives, including pretreatment of the water delivered from SOD to achieve the water quality levels that existed before the Dam was constructed and hardening of the SCE facilities to be more reliable and remain in-service for longer periods. The recommended interim solution was to purchase imported SWP water from SBVMWD to replace the water that could not be used because of water quality problems or that was not available due to dam operations and SCE facilities' unavailability.

The COE undertook a two-year $3.5 million study of these issues and completed its draft study of the steps taken to address the water quality degradation in 2008. The report verified the original methodology used in calculating the effects of placing a dam that interrupted the natural flow of the Santa Ana River for purposes of flood control and water retention to maintain a predictable daily controlled water flow for downstream users. The report noted through modeling techniques based on field record data that there appeared to be no negative effect on the Santa Ana River water quality. The downstream users contend otherwise that the very nature of the water being retained behind the Dam for lengthy periods caused algae and bacterial growth, caused water to become stale and stagnant, and tended to plug up the pervious rock and soil layers of the downstream spreading basins.

At Congressman Lewis's urging, the Corps resumed bi-monthly talks with interested downstream prior rights and permitted water users. The Corps was willing to change the method of its operation if the downstream users agreed to accept responsibility for downstream water quality. The Corps and local sponsors began design efforts for a drained debris basin to reduce water held by the Dam in low water conditions. This change would improve water quality but slightly reduce the water conserved. The Corps and local sponsors of the SOD project were unable to complete the documentation and environmental clearance for water quality improvements to the reservoir.

Testing Operations and Edison Facilities

The 2004-2005 water year began with higher rainfall. Late rains in 2004 had started to fill the debris pool behind the Dam. Heavy rains in 2004 and 2005 more than filled the debris pool, and there was approximately 40,000 acre-feet of water stored behind the Dam at an elevation of roughly 2,390. The Corps decided to test the operating valves for flood releases, and when high-velocity releases were taking place, a portion of the outlet tunnel failed, and the tests were terminated. The repairs to the tunnel were not completed until November 2005.

Operations in 2007 began with a release of approximately three (3) cfs from Seven Oaks Dam. The Corps slowly raised the reservoir elevation. During the last two weeks in April, the Corps and local sponsors had hoped to accumulate enough water to test the Seven Oaks Dam tunnel repairs, which were completed in early 2006 but never subjected to test flows. Unfortunately, there was insufficient water behind the Dam and the "high flow" testing lasted only approximately six (6) hours.

In December 2010, heavy rains began and the increased Santa Ana River flows were stored in the reservoir behind SOD. In mid-February 2011, the Corps operators utilized the stored flows to complete testing of the high flow capability of the Dam, ultimately releasing approximately 7,000 cfs in March 2011 from the dual main gates at the outlet works. The flow was reduced shortly thereafter and flows of 1,000 cfs were maintained for several days, almost emptying the reservoir. At this time, the flows were reduced further to facilitate water conservation and Santa Ana Sucker spawning. At the conclusion of successful testing, the facility was considered complete, and the operation was transferred to the local sponsors.

Local Sponsor Operations

In contrast to 2011, precipitation in 2012-2015 was about 50% of normal and this reduction in rainfall was seen in the watershed for Seven Oaks Dam. Little water was stored behind SOD and most outflows were clean and useable by surface diverters. Most water entering the Dam flowed out at the same rate for use by surface diverters and conservation. State Project Water was available in limited quantities and significant basin groundwater had to be used to make up water needed or guaranteed to local uses. Water levels behind SOD were at nearly historic lows due to drought.

In 2016, flow rates remained at historic lows for most of the year with on average ten (10) cfs or less from the Santa Ana River for the period of May through October. SOD remained 50 feet below the debris pool elevation for much of the year, which meant surface water users could use the water for most of the year with minor disruptions. Fortunately, the availability of State Project Water had greatly improved and was used not only to make up for the lack of local surface water supply but was also recharged into the groundwater basin. In 2016, a lawsuit was filed by the Endangered Habitats League and the Center for Biological Diversity related to the construction and operation of SOD effects on the San Bernardino Kangaroo Rat and Santa Ana Sucker.

2017 brought some decent rainfall with moderate and sustained outflows from the Seven Oaks dam between 50-250 cfs through April. Dam operators worked with the spreading operators to keep discharges from the Dam from exceeding 250 cfs. Water quality was not an issue in 2017 as the water was not allowed to sit behind the Dam for extended periods. Edison was also able to generate electricity for the entire summer, which allowed for higher quality water. Northern California had historic rainfall levels meaning State Project Water was widely available and flows helped to relieve some pressure in the groundwater basin that has been caused by several years of drought.

Operations in 2018 saw a return to less than average rainfall. There were only 16 days in April where greater than ten (10) cubic feet per second was released from the Dam for downstream users. Southern California Edison had to cease generating operations in mid-August due to limited flow rates and was only able to begin generating again in December.

A new management entity, the San Bernardino Basin Groundwater Council, was formed in 2018. The goals of the Council were to prepare for and coordinate the management of groundwater supply resources throughout the Basin and to coordinate maintenance of conveyance and recharge facilities to expedite such management.

Operations in 2019 brought above-average rainfall, including one particularly warm storm on February 14, which caused debris that damaged the Edison intake. Edison was unable to generate for 186 days during 2019 due to damages at their intake and high-water levels behind SOD, which rose above 2,300 ft with releases of approximately 700 cubic feet per second occurring in May. Water quality was an issue for downstream users because water was not available from the Edison facilities until August.

In 2019 the Exchange Plan members began to meet for the first time since 2003 to update the plan and address issues that were not included in the original plan. These issues were highlighted by the poor water quality supplies behind the SOD. A new possible exchange would be to swap Santa Ana River water from behind SOD for imported water for direct use by Mutual, leaving the more turbid water for groundwater recharge.

Below average rainfall, with limited availability of State Project Water, characterized 2020 operations. SOD water elevation reached the debris pool level and water was released in April at flows between 100-200 cfs. Water quality was not an issue as no water was stored behind SOD for significant periods. Edison ceased generation at both its powerhouses in March of 2020 due to the COVID-19 Pandemic and electrical generation is not anticipated to resume until the Pandemic has ended. Flows were still diverted at Powerhouse #1 to the Mutual Highline and the Greenspot Spill, but in lower quantities than previously diverted when Powerhouse #3 was in operation. Constant use of the Greenspot Spill has caused degradation of the facility and its use has been limited to eight (8) cfs.

Work on both the Exchange Plan and the design plans for the Enhanced Recharge Phase 1B and 1C continued in 2020. The downstream water rights holders formed a consortium to approach Edison about purchase of the powerhouses on both the Santa Ana River and its tributaries. When Edison's facilities are damaged or down for maintenance, high-quality water flows into the inlet pool of SOD or flows past water-rights holders on the tributaries. Edison's water rights are non-

consumptive for the generation of electricity. The limited value of the electricity from small hydro facilities influences their O&M decisions and restoration after damage.

Current Period Operations

Less than average rainfall, with limited availability of State Project Water, characterized 2021 operations. SOD water elevations barely reached the debris pool level and water was released in April at flows below 100 cfs for a limited number of days. Water quality was not an issue as no water was stored behind SOD for significant periods. Edison operated with limited generation at both of its powerhouses in May and June of 2021. Flows were still diverted at Powerhouse #1 to the Mutual Highline and the Greenspot spill.

Work on both the Exchange Plan and the design plans for the Enhanced Recharge Phase 1B continued in 2021. Enhanced Recharge Phase 1B has been split into two separate phases, Phase 1B-1 is anticipated to begin construction in 2022. The consortium approached Edison about purchasing the powerhouses on both the Santa Ana River and its tributaries and continued to evaluate and analyze alternatives. When Edison's facilities are damaged or down for maintenance, high-quality water flows into the inlet pool of SOD or flows past water-rights holders on the tributaries. Edison's water rights are non-consumptive for the generation of electricity.

QUAGGA MUSSEL PROTECTION PROGRAM

The invasive Quagga Mussel became a significant threat to Big Bear Lake in 2008. Big Bear Municipal Water district launched a ground-breaking program at the beginning of the boating season to prevent the mussel from getting into the Lake. While once only a problem east of the 100th Meridian, the mussel reached western lakes, and most significantly, Lake Mead, in January 2007. By the fall of 2008, the mussel was pervasive in Lake Mojave and Lake Havasu. Boaters traveling to and from the lakes were transporting microscopic larvae in bilges and outdrives, creating a threat to Big Bear Lake. The California mussel population expanded via the Colorado River aqueduct turnout at Parker Dam into receiving reservoirs in San Diego County. Other southern California lakes became infested when infected boats transported the microscopic mussel larvae.

The Quagga Mussel is a prolific reproducer and colonizes every solid object it encounters. This leads to clogged pipes, damage to vessels, and out-competition of the native species. Also, because each mature mussel can filter feed about one liter of water daily, huge mussel masses significantly reduce concentrations of plankton, which are an essential food supply for lake and reservoir fisheries.

In our situation the potential impact of an infestation is exponential because Big Bear Lake is at the top of the Santa Ana River watershed. Every water body and stream below the Bear Valley Dam could become infected, and the resulting impacts to Bear Creek fisheries could suffer, the impoundment behind Seven Oaks Dam, the Edison power generating station, and the Santa Ana River all the way to the ocean.

In response to the threat the District imposed new rules on launching, installed traffic control structures to prevent unauthorized launching, and strictly regulated the launch ramp hours to provide constant staffing at the start of the 2008 boating season. All boats entering in the Lake at public launch ramps were required to complete a questionnaire to determine if and when they might have been in an infected lake. They were also checked for standing water in bilges, lockers, bait wells, live wells, ballast tanks, etc. All vessels deemed suspicious by District inspectors were decontaminated at no charge to the boat owner with pressurized hot water (140°). Some limited training was also provided to commercial ramp operators who were responsible for sending suspicious vessels to a District facility for decontamination.

Both the City of Big Bear Lake and Snow Summit Resort contributed one-time funds at $5,000 to help defray the costs associated with the unexpected burden on the financial resources of the District. Nearly $100,000 was spent during the summer of 2008 for educational materials, signs, additional summer staffing, and capital improvements to the Quagga Prevention Program.

Sampling at the end of the 2008 boating season revealed that Big Bear Lake was free of visible mussels. Beginning in 2009, sampling for the microscopic mussel larvae began as soon as the Lake warmed to 53°F, the minimum temperature at which the mussels can reproduce.

In 2009, a Quagga Prevention Program surcharge was added to boat permits to offset the costs associated with the program. The surcharge will remain in place as long as a threat exists or as

grant money becomes available from the State. With the number of Quagga Mussel infested lakes in southern California increasing and the proximity of recreational boating opportunities such as the Colorado River, the threat of infestation becomes greater. New, more stringent protective measures were implemented at the start of the 2009 boating season. These include training the entire public and private marina work force operating on the Lake, requirements for commercial marinas to staff launch ramps with certified Quagga Mussel inspectors, significant limitations on the use of private launch ramps, and an expanded program of boat decontamination with pressurized hot water at both public launch ramps and the District main office.

Starting in 2009, the BBMWD began offering Watercraft Inspection/Decontamination Training (WIT) certification to all of the private marina workers, allowing all participating marinas to inspect vessels before launching them. The BBMWD also adopted strict standards for the usage of private launch ramps (launch ramps on single family properties), requiring them to be able to be locked closed to prevent unauthorized access. Additionally, these private owners were required to meet personally with District personnel to receive Quagga Mussel education. In 2011, the BBMWD had a total of four WIT III certified staff, allowing them to teach the WIT I and II provided to the BBMWD seasonal staff and marina workers. By 2012, the BBMWD had three decontamination stations, one at the East Public Launch Ramp, one at the West Public Launch Ramp, and one at the BBMWD main office (used only for special events and full decontaminations). The station at the main office got usage in 2014, as inspectors found ten Quagga infested boats. Four of these vessels went to the main office for full decontamination and six were decontaminated at the East Public Launch Ramp.

In 2016, using Department of Boating and Waterways funding, an additional decontamination station and improved decontamination machines were installed at the East Public Launch Ramp. Following the decontamination upgrades, the BBMWD was able to purchase a Flow-Cam in 2017, using Department of Boating and Waterways funding, which allowed for in-house Quagga Mussel monitoring. In 2018, an enclosure for the decontamination units at the East Public Launch Ramp was constructed, protecting them from theft and the elements. The District continued to monitor for potential Quagga Mussel infestation through substrate monitoring at various points around the Lake and by sending plankton tow samples to the California Department of Fish and Wildlife Bodega Bay Shellfish Laboratory for cross-polarized light

microscopy analysis and DNA testing. In 2019, the Watercraft Inspection and Decontamination data collection system (WID) was implemented at the Public Launch Ramps. Protocols for plankton tow sampling to be sent off to the California Department of Fish and Wildlife Bodega Bay Shellfish Laboratory were changed for more accurate results. Finally, after reports of New Zealand Mud Snails being found in Bear Creek (several miles below the Bear Valley Dam), the District performed an informal survey looking for New Zealand Mud Snails in Bear Creek, as well as formal surveys and setting traps in Big Bear Lake to search for a snail infestation. No New Zealand Mud Snails were found in either location.

The 2020 season was the busiest in BBMWD history. Despite a slow start caused by the onset of the COVID-19 pandemic, Big Bear Lake saw the highest number of visitors ever to Big Bear Lake. To help cope with the increased number of visitors and problems finding seasonal staff, the BBMWD implemented a fee for decontaminations. This helped to encourage boaters to take Clean, Drained, and Dry into their own hands. A quarantine banding program was implemented before the 2020 season, giving boaters another option to be ready for the boating season.

2021 Activities

2021 was a step back toward normal at Big Bear Lake. The COVID-19 pandemic continued, and the BBMWD adjusted with changing mandates and guidelines. Visitors to the Valley decreased relative to 2020 and boating saw a similar decline.

Over the summer of 2021, the District employed seven seasonal ramp attendants to inspect and decontaminate vessels as they arrived at the Public Launch Ramps. In total, the District launched 6,514 vessels in the 2021 boating season. Of these, 3,390 were inspected at the Public Launch Ramps. Of the 3,390 inspections, 2,706 were clean and no decontamination was necessary, 576 boats were decontaminated, and 108 boats were turned away. A total of 4,401 boats were banded with a tamper-proof wire to be certain that the boat had not left the trailer after leaving our Lake.

The District monitored water for the presence of Quagga Mussels in Big Bear Lake, similar to years past. Ten of the ten plankton tow water samples made it to the California Department of Fish and Wildlife Bodega Bay Shellfish Laboratory. All viable samples came back negative for Quagga Mussel Veligers. (See Tables V-1 to V-6)

Additionally, the District checked the Quagga substrate at various points around the Lake to confirm that there were no Quagga growing. After being checked all season, no indication of Quagga Mussels were found. Table V-7 shows that Quagga Mussels were “absent” in all Lake samples taken in 2021.

Table V-1: Plankton Tow Sample Sheet May 12, 2021

Results Summary

No	Sample descriptions Big Bear Lake locations	CPLM (veligers)	Preservation QC Check	Lake-equivalent volume examined
1	5/12/21 Dam	not detected	pass	1300 liters
2	5/12/21 Gilner Point	not detected	pass	1300 liters
3	5/12/21 Mid Lake / Middle	not detected	pass	1300 liters
4	5/12/21 Stanfield	not detected	pass	1300 liters

Table V-2: Plankton Tow Sample Sheet May 27, 2021

Results Summary

No	Sample descriptions Big Bear Lake locations	CPLM (veligers)	Preservation QC Check	Lake-equivalent volume examined
1	5/27/21 Dam	not detected	pass	1300 liters
2	5/27/21 Gilner Point	not detected	pass	1300 liters
3	5/27/21 Mid Lake / Middle	not detected	pass	1300 liters
4	5/27/21 Stanfield	not detected	pass	1300 liters

Table V-3: Plankton Tow Sample Sheet August 17, 2021

Results Summary

No	Sample descriptions Big Bear Lake locations	CPLM (veligers)	Preservation QC Check	Lake-equivalent volume examined
1	8/17/21 Gilner Point	not detected	pass	1300 liters
2	8/17/21 Mid Lake / Middle	not detected	pass	1300 liters
3	8/17/21 Stanfield	not detected	pass	1300 liters

Table V-4: Plankton Tow Sample Sheet August 26, 2021

Results Summary

No	Sample descriptions Big Bear Lake locations	CPLM (veligers)	Preservation QC Check	Lake-equivalent volume examined
1	8/26/21 Dam	not detected	pass	1300 liters
2	8/26/21 Gilner Point	not detected	pass	1300 liters
3	8/26/21 Mid Lake / Middle	not detected	pass	1300 liters
4	8/26/21 Stanfield	not detected	pass	1300 liters

Table V-5: Plankton Tow Sample Sheet September 9, 2021

Results Summary

No	Sample descriptions Big Bear Lake locations	CPLM (veligers)	Preservation QC Check	Lake-equivalent volume examined
1	9/9/21 Dam	not detected	pass	1300 liters
2	9/9/21 Gilner Point	not detected	pass	1300 liters
3	9/9/21 Mid Lake / Middle	not detected	pass	1300 liters
4	9/9/21 Stanfield	not detected	pass	1300 liters

Table V-6: Plankton Tow Sample Sheet October 7, 2021

Results Summary

No	Sample descriptions Big Bear Lake locations	CPLM (veligers)	Preservation QC Check	Lake-equivalent volume examined
1	10/7/21 Dam	not detected	pass	1300 liters
2	10/7/21 Gilner Point	not detected	pass	1300 liters
3	10/7/21 Mid Lake / Middle	not detected	pass	1300 liters
4	10/7/21 Stanfield	not detected	pass	1300 liters

Table V-7: Quagga Mussel Substrate Data 2021

2021 Artificial Substrate Monitoring Data

DATE	SUBSTRATE LOCATION	SUBSTRATE DEPTH	EMPLOYEE #	SUBSTRATE	CONDITION	COMMENTS	MUSSELS	SPECIES	PLATE SURFACE	PLATE EDGE	SPACERS	ROPE (DEPTH)	OTHER	OTHER ORGANISMS PRESENT	COMMENTS
5/17/2021	MAIN OFFICE RAMP	5FT	321	PRESENT	INTACT	MUD, ALGAE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
5/17/2021	ER	5FT	321	PRESENT	INTACT	MUD, ALGAE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
5/24/2021	MAIN OFFICE RAMP	5FT	321	PRESENT	INTACT	MUD, ALGAE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
5/24/2021	ER	5FT	321	PRESENT	INTACT	MUD, ALGAE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
6/1/2021	MAIN OFFICE RAMP	5FT	321	PRESENT	INTACT	MUD, ALGAE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
6/1/2021	ER	5FT	321	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
6/7/2021	WR	5FT	305/351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	UNKNOWN EGGS
6/7/2021	ER	3FT	305/351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	UNKNOWN EGGS
6/7/2021	MAIN OFFICE RAMP	5FT	305/351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	UNKOWN EGGS
6/14/2021	MAIN OFFICE RAMP	4FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
6/14/2021	ER	3FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE

2021 Artificial Substrate Monitoring Data

DATE	SUBSTRATE LOCATION	SUBSTRATE DEPTH	EMPLOYEE #	SUBSTRATE	CONDITION	COMMENTS	MUSSELS	SPECIES	PLATE SURFACE	PLATE EDGE	SPACERS	ROPE (DEPTH)	OTHER	OTHER ORGANISMS PRESENT	COMMENTS
6/14/2021	WR	5FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
6/21/2021	MAIN OFFICE RAMP	4FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
6/21/2021	ER	3FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
6/21/2021	WR	5FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
6/28/2021	MAIN OFFICE RAMP	4FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
6/28/2021	ER	3FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
6/28/2021	WR	5FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
7/6/2021	MAIN OFFICE RAMP	4FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
7/6/2021	ER	3FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
7/6/2021	WR	5FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE

2021 Artificial Substrate Monitoring Data

DATE	SUBSTRATE LOCATION	SUBSTRATE DEPTH	EMPLOYEE #	SUBSTRATE	CONDITION	COMMENTS	MUSSELS	SPECIES	PLATE SURFACE	PLATE EDGE	SPACERS	ROPE (DEPTH)	OTHER	OTHER ORGANISMS PRESENT	COMMENTS
7/12/2021	MAIN OFFICE RAMP	3FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
7/12/2021	ER	2FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
7/12/2021	WR	5FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
7/19/2021	MAIN OFFICE RAMP	3FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
7/19/2021	ER	2FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
7/19/2021	WR	5FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
7/26/2021	MAIN OFFICE RAMP	3FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
7/26/2021	WR	5FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
7/26/2021	ER	2FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
8/2/2021	MAIN OFFICE RAMP	3FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE

2021 Artificial Substrate Monitoring Data

DATE	SUBSTRATE LOCATION	SUBSTRATE DEPTH	EMPLOYEE #	SUBSTRATE	CONDITION	COMMENTS	MUSSELS	SPECIES	PLATE SURFACE	PLATE EDGE	SPACERS	ROPE (DEPTH)	OTHER	OTHER ORGANISMS PRESENT	COMMENTS
8/2/2021	WR	5FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
8/2/2021	ER	2FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
8/9/2021	MAIN OFFICE RAMP	3FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
8/9/2021	WR	5FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
8/9/2021	ER	PULLED DUE TO RELOCATION OF DOCK													
8/16/2021	MAIN OFFICE RAMP	3FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
8/16/2021	WR	5FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
8/23/2021	MAIN OFFICE RAMP	3FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
8/23/2021	WR	5FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
8/23/2021	MAIN OFFICE RAMP	3FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
8/23/2021	WR	5FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE

2021 Artificial Substrate Monitoring Data

DATE	SUBSTRATE LOCATION	SUBSTRATE DEPTH	EMPLOYEE #	SUBSTRATE	CONDITION	COMMENTS	MUSSELS	SPECIES	PLATE SURFACE	PLATE EDGE	SPACERS	ROPE (DEPTH)	OTHER	OTHER ORGANISMS PRESENT	COMMENTS
9/8/2021	MAIN OFFICE RAMP	3FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
9/8/2021	WR	5FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
9/8/2021	MAIN OFFICE RAMP	3FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
9/8/2021	WR	5FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
9/13/2021	MAIN OFFICE RAMP	3FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
9/13/2021	WR	5FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
9/20/2021	MAIN OFFICE RAMP	3FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
9/20/2021	WR	5FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
9/27/2021	MAIN OFFICE RAMP	3FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
9/27/2021	WR	5FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE

2021 Artificial Substrate Monitoring Data

DATE	SUBSTRATE LOCATION	SUBSTRATE DEPTH	EMPLOYEE #	SUBSTRATE	CONDITION	COMMENTS	MUSSELS	SPECIES	PLATE SURFACE	PLATE EDGE	SPACERS	ROPE (DEPTH)	OTHER	OTHER ORGANISMS PRESENT	COMMENTS
10/6/2021	MAIN OFFICE RAMP	3FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
10/6/2021	WR	5FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
10/12/2021	MAIN OFFICE RAMP	3FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
10/12/2021	WR	5FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
10/19/2021	MAIN OFFICE RAMP	3FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
10/19/2021	WR	5FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
10/26/2021	MAIN OFFICE RAMP	3FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
10/26/2021	WR	5FT	351	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
11/1/2021	MAIN OFFICE RAMP	2FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
11/1/2021	WR	5FT	305	PRESENT	INTACT	MUD, ALGAE, PLANT LIFE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	NONE	NONE
11/8/2021	WR	5FT	351	PRESENT	INTACT	NONE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	ALGAE	NONE

2021 Artificial Substrate Monitoring Data

DATE	SUBSTRATE LOCATION	SUBSTRATE DEPTH	EMPLOYEE #	SUBSTRATE	CONDITION	COMMENTS	MUSSELS	SPECIES	PLATE SURFACE	PLATE EDGE	SPACERS	ROPE (DEPTH)	OTHER	OTHER ORGANISMS PRESENT	COMMENTS
11/8/2021	MAIN OFFICE RAMP	3FT	351	PRESENT	INTACT	NONE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	ALGAE	NONE
11/15/2021	WR	5FT	109	PRESENT	INTACT	NONE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	ALGAE	NONE
11/15/2021	MAIN OFFICE RAMP	3FT	351	PRESENT	INTACT	NONE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	ALGAE	NONE
11/22/2021	WR	5FT	109	PRESENT	INTACT	NONE	ABSENT	N/A	NONE	NONE	NONE	NONE	NONE	ALGAE	NONE

APPENDIX A

MINUTES OF WATERMASTER MEETINGS

Dates

January 20, 2021

March 23, 2021

July 13, 2021

October 12, 2021

BIG BEAR WATERMASTER
MINUTES OF THE MEETING OF JANUARY 20, 2021

PLACE: San Bernardino Valley Water Conservation District
1630 W. Redlands Blvd., Ste. A
Redlands, California

PRESENT:	Watermaster Committee	Representing
	Don Evenson	Big Bear MWD, Chair
	Daniel Cozad	SBV Water Conservation District
	Sam Fuller	Bear Valley Mutual Water Company
	Others	
	Mike Stephenson	Big Bear MWD
	Bob Ludecke	Big Bear MWD
	John Eminger	Big Bear MWD
	Brittney Lamson	Big Bear MWD
	David E. Raley	SBV Water Conservation District
	Athena Lokelani	SBV Water Conservation District
	Katelyn Scholte	SBV Water Conservation District
	Robert Stewart	SBV Water Conservation District
	T. Milford Harrison	SBV Municipal Water District

1. WELCOME AND CALL TO ORDER

The Big Bear Watermaster meeting was called to order by Don Evenson at 1:30 p.m.

2. APPROVAL OF MINUTES

The minutes of the October 13, 2020, meeting were approved.

3. LAKE AND BEAR CREEK STATUS

Mike Stephenson reported that the current lake level is 59.12, 13.21 is drawn down. The current lake releases are 0.85 CFS. The flow rate is 0.91 CFS at Station B.

Mr. Stephenson also provided an update on the Replenish Big Bear recycled water project. Mr. Stephenson said that they have a draft water quality analysis based on the percentage of RO. We will be presenting it to the Regional Board next week. BBMWD will need 70% RO to discharge water of equal or better quality into the lake. We are preparing a cost estimate of 70% RO for O&M and capital. Mr. Stephenson said it would probably be 70%-100% RO based on water quality. The TDS is the biggest problem; the 175 MG TDS objective for the basin plan. The Regional Board said that if there is no degradation to water quality, then it would be permitted.

4. SANTA ANA RIVER STATUS AND FLOW REPORT/EDISON FACILITIES

Mr. Cozad said that Southern California Edison (SCE) had been out. There has been 28 CFS flow in SAR from snow and rain. Mill Creek has 15 CFS; the District is recharging approximately 3 CFS between Santa Ana River (SAR) and Mill Creek. SCE has no intent to work on its facilities until the pandemic is over. Ms. Scholte indicated that SCE was working on the Mill Creek side but not the SAR side. The negotiations for purchasing the SCE facility are still ongoing. So far,

Mr. Cozad said that legal counsel is working on a draft agreement for the Exchange Plan. The Conservation District should have a draft by March.

5. MUTUAL'S PROJECTION OF NEEDS FOR LAKE RELEASES/IN-LIEU WATER

Sam Fuller said that Mutual's projection of need is at 6,500 AF.

6. ANNUAL WATERMASTER ACCOUNTING, REPORT, TASKS, AND DEADLINES

Mr. Evenson provided handouts to the Committee and reviewed them in detail. He reviewed preliminary data, the 2020 Lake Level, which ended the year at 13.2 feet from full. He discussed the summary of the preliminary lake accounts for 2020. The lake account ending balance for 2020 is 27,034 AF. Mr. Evenson said that he is currently working on the allocation of releases and leakage. He indicated that he could get a draft report out by March 12 for review and comment. Mr. Cozad said that next year the Conservation District would reduce the historical information to a historical summary. Mr. Evenson noted that we need to obtain the data from SCE on how much they are diverting from Powerhouse #1 to Bear Creek. Mr. Fuller indicated that the data should be in their FERC license records.

7. DATE FOR NEXT MEETING

The next meeting will be on Wednesday, March 23, 2021, at 1:30 p.m. at the Water Conservation District.

8. ADJOURN

There being no further business, the meeting was adjourned by acclamation.

Donald E. Evenson | Sam Fuller | Daniel B. Cozad

BIG BEAR WATERMASTER
MINUTES OF THE MEETING OF MARCH 23, 2021

PLACE: Zoom/Teleconference

PRESENT:	Watermaster Committee	Representing
	Don Evenson	Big Bear MWD, Chair
	Daniel Cozad	SBV Water Conservation District
	Sam Fuller	Bear Valley Mutual Water Company
	Others	
	Mike Stephenson	Big Bear MWD
	Bob Ludecke	Big Bear MWD
	Brittney Lamson	Big Bear MWD
	David E. Raley	SBV Water Conservation District
	Athena Lokelani	SBV Water Conservation District
	Katelyn Scholte	SBV Water Conservation District
	Robert Stewart	SBV Water Conservation District
	T. Milford Harrison	SBV Municipal Water District

1. WELCOME AND CALL TO ORDER

The Big Bear Watermaster meeting was called to order by Don Evenson at 1:33 p.m.

2. APPROVAL OF MINUTES

The minutes of the January 20, 2021, meeting were approved.

3. LAKE AND BEAR CREEK STATUS

Mike Stephenson reported that the current lake level is 59.33, 13 feet down. The current Station B flow rate is 1 CFS.

Mr. Stephenson also provided an update on the Replenish Big Bear recycled water project. Mr. Stephenson said that it is a costly project, about $5,000/AF for water. The project is between $64-$96 million in capital costs with an estimated $5.5 million/year for O&M. The Regional Board has found a pathway to permit it. The next step is for the project committee to make a recommendation to the BBMWD Board. There is a 75%-85% RO need to meet the basin water quality objectives depending on the effluent that would be treated. The Groundwater Management Program was discussed in brief.

4. SANTA ANA RIVER STATUS AND FLOW REPORT/EDISON FACILITIES

Mr. Cozad said that it had been a relatively dry year, and there has not been a lot of import water or native river flows. He said that there were some storms that the Conservation District received. However, those were predominantly used by other entities. The construction of Plunge Creek has been completed as of last fall, and we were able to increase recharge and develop new habitat. Plunge Creek was partially grant-funded. Ms. Scholte said that SCE is unable to bring Powerhouse #1 online due to Valley Municipal issues; it has been inoperable all year. Powerhouse #3 has been intermittent.

Mr. Cozad provided a brief update on the Exchange Plan. He indicated that District Counsel is reviewing the consultant's work. There are minor revisions to be discussed with the Exchange Plan Task Force. A Task Force meeting will be scheduled once feedback is received and comments have been incorporated. Mr. Evenson asked if the new agreement will cover the conditions when the water quality behind SOD is unusable. Mr. Cozad indicated a section is included in the draft agreement, and it is also covered under the Valley Municipal and Bear Valley MOU. Mr. Evenson asked if water has been delivered to Mutual by SCE. Ms. Scholte indicated that 5 CFS was coming across the Highline last week, but currently, maintenance is being performed. Mr. Fuller said that Mentone Reservoir is down and being repaired. Mutual is taking only enough to keep the treatment plant operational.

5. MUTUAL'S PROJECTION OF NEEDS FOR LAKE RELEASES/IN-LIEU WATER

Sam Fuller said that Mutual's projection of need is between 6,500-12,000 AF. Mr. Evenson asked what the projection is for SWP. Mr. Fuller indicated that last he heard, it was 10%. Mutual has notified BBMWD that it may need to call on them. Mr. Fuller said that he is hoping to see an increase in allocation of SWP; if not, wells may have to be utilized.

6. ANNUAL WATERMASTER ACCOUNTING, REPORT, TASKS, AND DEADLINES

Mr. Evenson stated that the Watermaster Report had been sent out for review and comment. There were some changes made to the accounting. He indicated that the main one was handling the release from the lake for fishery protection when SCE is inoperable. He said that during periods when SCE was not in operation and SOD was not releasing enough water to meet Mutual's needs, Mutual could not use In Lieu lake water and would have to purchase SWP Water from Valley Municipal. Under these conditions, the Fishery releases would not be deducted from Mutual's account, it would be shared between Mutual and BBMWD. This condition occurred between March 3 and March 23 in 2020. Table III-8 Summary of Diverted Flow at the Mouth of SAR Canyon (Calendar Year 2020) was discussed. He said that there were some flows not included in the USGS data; staff is still in the process of resolving these differences. Ms. Scholte noted that there had been days when the website would indicate zero and field staff would see visual flow. She stated that it would be checked more by USGS and updated by them. Conservation District staff will also update USGS more frequently when there are issues. Mr. Evenson said that this issue should be explained within the report. The Committee approved a revision to include the NF Parshall Flume diversions as a Mutual Diversion in Table III-8 by consensus. This revision would also change Table III-12, which should include the NF Parshall Flume in the column Net SAR Diversions by BVMWC in this table.

7. DATE FOR NEXT MEETING

The next meeting will be on Tuesday, July 13, 2021, at 1:30 p.m. via Zoom.

8. ADJOURN

There being no further business, the meeting was adjourned by acclamation at 2:15 p.m.

Donald E. Evenson | Sam Fuller | Daniel B. Cozad

BIG BEAR WATERMASTER
MINUTES OF THE MEETING OF JULY 13, 2021

PLACE: Zoom/Teleconference

PRESENT:	Watermaster Committee	Representing
	Don Evenson	Big Bear MWD, Chair
	Daniel Cozad	SBV Water Conservation District
	Sam Fuller	Bear Valley Mutual Water Company
	Others	
	Mike Stephenson	Big Bear MWD
	Bob Ludecke	Big Bear MWD
	Brittney Lamson	Big Bear MWD
	Bob Rehfuss	Big Bear MWD
	David E. Raley	SBV Water Conservation District
	Athena Lokelani	SBV Water Conservation District
	Katelyn Scholte	SBV Water Conservation District
	Robert Stewart	SBV Water Conservation District
	T. Milford Harrison	SBV Municipal Water District
	Robert Martin	Bear Valley Mutual Water Company
	George Hanson	Bear Valley Mutual Water Company

1. WELCOME AND CALL TO ORDER

The Big Bear Watermaster meeting was called to order by Don Evenson at 1:35 p.m.

2. APPROVAL OF MINUTES

The minutes of the March 23, 2021, meeting were approved.

3. LAKE AND BEAR CREEK STATUS

Mike Stephenson reported that the current lake level is at elevation 57.62, 14.71 feet down. The current Station B flow rate is 1.50 CFS. There is 616 GPM (1.37 CFS) coming out of the six inch line and a small amount of leakage from the sluice gates.

Mr. Stephenson also provided an update on the Replenish Big Bear recycled water project. Mr. Stephenson said that it is a costly project, revised project costs estimates indicated between $2,200-$2,500/AF for water depending on what type of grants they are obtained. The Regional Board decided that 100% RO of effluent water is needed to meet the basin water quality objectives. The Regional Board decided this is needed after taking drought conditions, degradation and other conditions into consideration. Mr. Stephenson discussed this in brief. Big Bear MWD obtained a $4.5 million grant through SAWPA and possibly an additional $1 million through WIFIA funding. Mr. Cozad indicated that he will share salinity source information with Mr. Stephenson.

4. SANTA ANA RIVER STATUS AND FLOW REPORT/EDISON FACILITIES

Mr. Cozad said that it had been a dry year and we are pretty much out of storred water as of the end of April. Ms. Scholte said that Powerhouse #3 was generating but now but is down to 8 CFS in SAR. They are no longer generating as of today.

Mr. Cozad provided a brief update on the Exchange Plan update. A draft agreement with approximately 10-12 items flagged by legal counsel in the discussion draft put together by the contractor, WSC. There will be another meeting of the Exchange Plan Committee committee to review the draft agreement.

5. MUTUAL'S PROJECTION OF NEEDS FOR LAKE RELEASES/IN-LIEU WATER

Sam Fuller said that Mutual's projection of need is 6,500 AF, but may need more. Valley Municipal is short on water this year; they are working with Mutual to identify alternate sources to meet their demand. SAR water is being diverting to the south, the demands by North Fork are being met by SWP water sources. The SAR has been receiving water through some pumping and minimal flows. There is 5 CFS coming down the highline coming out of the headbreaker valve. Mr. Fuller discussed possible maintenance needed on this system and alternative methods of delivery. The treatment plant will likely be offline while headbreaker valve maintenance is performed, Mutual will use wells to meet their demand. Mr. Evenson asked if Valley Municipal is utilizing wells to meet in-lieu needs. Mr. Fuller indicated that Valley Municipal has agreed to let Mutual operate wells from North Fork, Bear Valley and Redlands to meet in-lieu Mutual demands and reimburse those agencies the cost of operating those wells. SWP water will primarily be used on the north side of the river. Valley Municipal has been allocated 5,130 AF of SWP water for calendar year 2021.

6. ANNUAL WATERMASTER ACCOUNTING, REPORT, TASKS, AND DEADLINES

Mr. Evenson reviewed the 2021 Lake Levels; the highest point for this year was in February when it was 12.98 down and in the end of June it was 14.44 feet down. This is not the lowest it has ever been. He reviewed the grah for Lake Outflow vs. Station B Req., nothing that lake releases are only being made to meet fisheries requirements downstream. There has been 344.4 AF released from lake for fisheries requirements for the six month period. The Preliminary Lake Account Status was reviewed. The beginning storage was 38,663 AF and ended at 35,797 AF. The lake releases were utilized except for April and most of June.

7. DATE FOR NEXT MEETING

The next meeting will be on Tuesday, October 12, 2021, at 10:00 a.m. via Zoom.

8. ADJOURN

There being no further business, the meeting was adjourned by acclamation at 2:09 p.m.

Donald E. Evenson

Sam Fuller

Daniel B. Cozad

BIG BEAR WATERMASTER
MINUTES OF THE MEETING OF OCTOBER 12, 2021

PLACE: Zoom/Teleconference

PRESENT:	Watermaster Committee	Representing
	Don Evenson	Big Bear MWD, Chair
	Daniel Cozad	SBV Water Conservation District
	Sam Fuller	Bear Valley Mutual Water Company
	Others	
	Mike Stephenson	Big Bear MWD
	Bob Ludecke	Big Bear MWD
	Brittney Lamson	Big Bear MWD
	Bob Rehfuss	Big Bear MWD
	Mike Schermer	Big Bear MWD
	David E. Raley	SBV Water Conservation District
	Athena Lokelani	SBV Water Conservation District
	Katelyn Scholte	SBV Water Conservation District
	Robert Stewart	SBV Water Conservation District
	T. Milford Harrison	SBV Municipal Water District
	Robert Martin	Bear Valley Mutual Water Company
	George Hanson	Bear Valley Mutual Water Company

1. WELCOME AND CALL TO ORDER

The Big Bear Watermaster meeting was called to order by Don Evenson at 1:35 p.m.

2. APPROVAL OF MINUTES

The minutes of the July 13, 2021, meeting were approved with minor revisions.

3. LAKE AND BEAR CREEK STATUS

Mike Stephenson reported that the current lake level is at elevation 56.12, 16.21 feet down. The current Station B flow rate is 1.26 CFS.

Mr. Stephenson also provided an update on the Replenish Big Bear recycled water project. He said approved change order number 5, but there has not been much progress since the last meeting. The Committee has recommended that BBMWD review this last change. BBMWD has to anlayze well within 500 feet of the lake, and have to have a solution for wells within 100 ft. as required by DDW.

4. SANTA ANA RIVER STATUS AND FLOW REPORT/EDISON FACILITIES

Mr.Cozad said that the water year ended with a total recharge of 4661 AF in Santa Ana and 2692 AF in Mill Creek; total of 7353 AF. Ms. Scholte said that there was 16 AF in Santa Ana this morning and another 13.7 AF in Mill Creek. The District has only received minor rains, nothing significant for recharge.

Mr. Cozad stated that a meeting was held on September 23 with the Exchange Plan Committee. The Committee provided feedback to legal counsel on the draft agreement. The agreement will go from something that is managed by the Committee, to one that is managed by exchanging parties. It opens up for additional flexibility, with various exchange options. The project manager will not decide when an exchange happens, it will function as more administrative and we will keep track of exchanges.

Mr. Cozad said that a conference call was held with SCE to discuss their facilities. SCE must consult with local tribes before divesting. Mr. Cozad believes that the timeline on this will extend significantly. Mr. Martin said that Valley Municipal is reviewing PUC requirements and how they will be implemented. He said that it is complicated. He said that the lower powerhouse is operable, but rarely turned in. The facilities from upper powerhouse to lower powerhouse are functional, but were told by SCE that there is damage to upper facilities. We are not aware of when that issue will be fixed.

5. MUTUAL'S PROJECTION OF NEEDS FOR LAKE RELEASES/IN-LIEU WATER

Sam Fuller said that in 2021 Mutual has received approximately 6200 AF of in-lieu water through September. He said that 1500 AF is from the SWP, and another 4700 AF has come from wells in the valley including North Fork, Crafton, Redlands, Valley Municipal and Crafton. He said that Mutual may need an additional 1900-2000 AF, totaling nearing 8000 AF for the calendar year. Valley Municipal will provide in-lieu water. The well production will be a credit in a prepaid account, accrue to an account to allow agencies in the future to take back water. Mr. Fuller discussed the need to redefine in-lieu water and requested guidance from the Committee. The water that would typically go to Mutual is held behind SOD creating the requirement for Mutual to purchase water. Mr. Evenson said that we need to come up with a way that allows for more flexibility. Mr. Fuller said that Mutual will draft a proposal to identify a way that allows for more flexibility when dealing with in-lieu water needs and definition. Mr. Evenson said that the assumptions have changed since the judgment was put in to place. Mr. Fuller will draft some ideas and circulate to the Committee for review and consideration. Mr. Cozad asked for other committee members to identify other areas of flexibility or changes that might be needed. He said that any revisions should contain pros, cons and impacts.

6. ANNUAL WATERMASTER ACCOUNTING, REPORT, TASKS, AND DEADLINES

Mr. Evenson reviewed the 2021 Lake Levels. In 2021, the lake has dropped 3.2 feet at the end of September. The Preliminary Lake Account Status was reviewed. The beginning lake storage was 38,663 AF and ended September at 31,847 AF. At the end of September, Mutual's Lake Account had 11,234 AF and BBMWD's Lake Account had 20,613 AF.

7. DATE FOR NEXT MEETING

The next meeting will be on Tuesday, January 18, 2022, at 10:00 a.m. via Zoom and in-person.

8. ADJOURN

There being no further business, the meeting was adjourned by acclamation at 10:39 a.m.

Donald E. Evenson Sam Fuller Daniel B. Cozad

APPENDIX B

TABLE OF
ACCOUNTS OF OPERATION OF BIG BEAR LAKE

ACCOUNTS FOR
CALENDAR YEAR 2021

INPUT DATA
BIG BEAR WATERMASTER REPORT
CALENDAR YEAR
2021

Calandar Year		**2021**		
Mutual's Lake Account Balance on Jan.1	=	**20,787.9**	acre-feet	
Basin Make-Up Account Balance on Jan. 1	=	**27,046**	acre-feet	See Note 1
Account Balance for Mutual's Advances to BBMWD	=	**-**	acre-feet	
Repayment Premium for Mutual's Advances to BBMWD	=	**0%**		
Recharge Factor for Lake Deliveries to Mutual	=	0.500		
Recharge Factor for Imported Water Deliveries to Mutual	=	0.500		
Recharge Factor for Lake Spills	=	0.510		
Snowmelt Return Factor	=	0.500	Jan,Feb, Mar,Apr,Oct,Nov,Dec	
Snowmelt Return Factor	=	0.000	May, June,July,Aug,Sept	

Monthly Evaporation Rate Calculation Factors	C1	C2	C3
January	7.09	0.42	1,200
February	6.90	0.50	1,200
March	8.36	0.74	1,200
April	8.82	0.87	1,200
May	9.73	1.02	1,200
June	9.72	1.10	1,200
July	9.90	1.13	1,200
August	9.34	1.22	1,200
September	8.36	1.25	1,200
October	7.89	1.22	1,200
November	7.01	1.07	1,200
December	6.91	0.50	1,200

Evaporation rate (feet/month) = Average air temperature x C1 x C2 / C3

INPUT DATA
BIG BEAR WATERMASTER REPORT
CALENDAR YEAR
2021
(continued)

Month	Gage* Height 1st of Month (feet)	Actual Mutual Shareholder Releases (acre-feet)	Mutual Other Releases (acre-feet)	Actual Spillway Flood Control Releases (acre-feet)	Actual Outlet Works & Flood Control Releases (acre-feet)	Big Bear's Spreading Releases (acre-feet)	Big Bear's Other Releases (acre-feet)	Leakage (Not used, included in Fish Releases) (acre-feet)
	59.19							
January	59.32	-	-	-	-	-	-	-
February	59.24	-	-	-	-	-	-	-
March	59.30	-	-	-	-	-	-	-
April	59.02	-	-	-	-	-	-	-
May	58.49	-	-	-	-	-	-	-
June	57.88	-	-	-	-	-	-	-
July	57.33	-	-	-	-	-	-	-
August	56.74	-	-	-	-	-	-	-
September	56.09	-	-	-	-	-	-	-
October	55.89	-	-	-	-	-	-	-
November	55.62	-	-	-	-	-	-	-
December	57.27	-	-	-	-	-	-	-
Change	-1.92							

* Gage at Bear Valley Dam

INPUT DATA
BIG BEAR WATERMASTER REPORT
CALENDAR YEAR
2021
(continued)

Month	**Big Bear's Withdrawals for Snowmaking (acre-feet)**	**Big Bear's Releases for SBVMWD (acre-feet)**	Mutual Spills of Wastewater Exports (acre-feet)	**In-Lieu Imported Supplies (SBVMWD) (acre-feet)**	In Lieu Supplies from SBVMWD's Contract Wells (acre-feet)	In Lieu Supplies from Mutual's Wells (acre-feet)	VD In Lieu Supplies from BB Lake acre-feet
January	215.48	-	-	-	-	-	-
February	89.80	-	-	-	-	-	-
March	25.84	-	-	-	-	-	-
April	21.98	-	-	-	-	-	-
May	10.27	-	-	-	-	-	-
June	44.83	-	-	320.50	632.70	349.04	-
July	34.72	-	-	428.90	1,132.30	243.74	-
August	24.94	-	-	435.10	940.00	157.22	-
September	26.90	-	-	329.80	873.50	-	-
October	17.82	-	-	446.60	749.30	-	-
November	123.11	-	-	201.70	487.60	-	-
December	292.46	-	-	27.80	518.60	-	-
Totals	**928.15**	**-**		**2,190.4**	**5,334.0**	**750.0**	**-**

INPUT DATA
BIG BEAR WATERMASTER REPORT
CALENDAR YEAR
2021
(continued)

Month	SWRCB Order 95-4 Releases & Leakage (acre-feet)	Mutual's Direct Use of Order 95-4 Lake Outflows (acre-feet)	Basin Replenishment from SBVMWD (acre-feet)	Basin Replenishment from Others (acre-feet)	2021 Net Wastewater Exports (acre-feet)	**Average Air Temperature (degrees F)**
January	**57.09**	**57.09**	-	-	**90.34**	**35.8**
February	**49.23**	**44.11**	-	-	**99.69**	**38.6**
March	**60.26**	**58.34**	-	-	**96.54**	**37.4**
April	**48.30**	**18.19**	-	-	**70.45**	**47.5**
May	**59.68**	**40.47**	-	-	**60.11**	**53.0**
June	**69.87**	**69.87**	-	-	**60.93**	**64.6**
July	**94.11**	**94.11**	-	-	**76.57**	**68.7**
August	**98.62**	**86.03**	-	-	**59.48**	**66.3**
September	**84.71**	**84.71**	-	-	**48.70**	**60.9**
October	**76.68**	**64.05**	-	-	**52.01**	**47.5**
November	**59.71**	**55.35**	-	-	**54.70**	**46.9**
December	**52.55**	**34.58**	-	-	**111.81**	**36.1**
Totals	**810.81**	706.90			**881.33**	

SUMMARY RESULTS - Preliminary
CALENDAR YEAR
2021

LAKE ACCOUNTS (acre-feet)	**Big Bear**	**Mutual**	**Actual**
Initial Storage	**17,875.1**	**20,787.9**	**38,663.0**
Lake Inflows	0.0	6,401.4	6,401.4
In-Lieu Supplies to Mutual	8,274.4	(8,274.4)	0.0
Lake Releases (Mutual & BBMWD)	0.0	0.0	0.0
Releases & Leakage (SWRCB 95-4)	(55.4)	(755.4)	(810.8)
Net Snowmaking Withdrawals from Lake	(534.9)	0.0	(534.9)
Lake Spills & Flood Control Releases	0.0	0.0	0.0
Leakage from Dam	0.0	0.0	0.0
Evaporation from Lake	(2,796.6)	(6,504.1)	(9,300.7)
Net Wastewater Exports	(881.3)	881.3	0.0
Advances & Repayment of Advances	0.0	0.0	0.0
Ending Storage	**21,881.2**	**12,536.8**	**34,418.0**
Storage Change	**4,006.1**	**(8,251.1)**	**(4,245.0)**
BASIN MAKE UP ACCOUNT (acre-feet)			
Beginning Balance	n.a.	n.a.	**27,046**
Recharge From Releases of Lake Water Used by Mutual	353	4,491	(4,137)
Recharge From In-lieu SWP Water Delivered to Mutual	1,095	n.a.	1,095
Recharge from Spills & Other Lake Releases	53	25	28
Account Credit (Debit)	**1,502**	**4,515**	**(3,014)**
Amount Replenished	0	n.a.	0
Ending Balance			**24,032**

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 1
ACTUAL OPERATION OF BIG BEAR LAKE

Month	1 Gage Height 1st of Month (Input Data) (feet)	2 Volume in Storage (ac-ft)	3 Change in Storage (ac-ft)	4 Lake Surface Area (acres)	5 Spills Releases Leakage Withdrawals (see Table 1.A) (feet)	6 Estimated Lake Evaporation (see Table 1.D) (ac-ft)	7 Calc. Total Inflow (ac-ft)	8 Adjusted Lake Inflow * (ac-ft)	9 Adjusted Lake Evap * (ac-ft)	10 Adjusted Evap Rate * (feet/month)
	59.19	**38,663**		2,252						
January			228		165	200	593	593.2	200	0.089
	59.32	38,891		2,260						
February			(114)		94	251	231	230.7	251	0.111
	59.24	38,777		2,256						
March			114		73	435	623	622.5	435	0.193
	59.30	38,891		2,260						
April			(683)		59	683	59	59.2	683	0.304
	59.02	38,208		2,237						
May			(1,099)		70	972	(57)	0.0	1,029	0.464
	58.49	37,109		2,200						
June			(1,312)		115	1,253	56	55.8	1,253	0.576
	57.88	35,797		2,154						
July			(1,168)		129	1,365	326	326.0	1,365	0.640
	57.33	34,629		2,109						
August			(1,252)		124	1,313	184	184.2	1,313	0.630
	56.74	33,377		2,061						
September			(1,326)		112	1,079	(135)	0.0	1,214	0.597
	56.09	32,051		2,008						
October			(402)		86	763	446	446.2	763	0.381
	55.89	31,649		1,995						
November			(592)		121	582	112	111.8	582	0.293
	55.62	31,057		1,979						
December			3,361		199	212	3,772	3,771.8	212	0.104
	57.27	**34,418**	_____	2,101	_____	_____	_____	_____	_____	_____
TOTALS			**(4,245.0)**		**1,345.7**	**9,109**	**6,209**	**6,401.4**	**9,300.7**	**4.381**

* NOTE: Evaporation adjusted to eliminate negative inflow

9 month totals								2,071.7	7,743.6	

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 1.A
ACTUAL OPERATION OF BIG BEAR LAKE
Summary Details

Month	1	2 Actual Spillway Flood Control Releases (Input Data) (ac-ft)	3 Actual Outlet Works Flood Control Releases (Input Data) (ac-ft)	4 Actual Lake Releases (Non-FC) (see Table 1.B) (ac-ft)	5 Actual Estimated Leakage (not used) (Input Data) (ac-ft)	6 Estimated Net Lake Withdrawal (see Table 1.C) (ac-ft)	7	8	9 Total Spills Releases Leakage Withdrawals (ac-ft)
January		-	-	57.1	-	107.7			164.8
February		-	-	49.2	-	44.9			94.1
March		-	-	60.3	-	12.9			73.2
April		-	-	48.3	-	11.0			59.3
May		-	-	59.7	-	10.3			70.0
June		-	-	69.9	-	44.8			114.7
July		-	-	94.1	-	34.7			128.8
August		-	-	98.6	-	24.9			123.6
September		-	-	84.7	-	26.9			111.6
October		-	-	76.7	-	8.9			85.6
November		-	-	59.7	-	61.6			121.3
December		-	-	52.6	-	146.2			198.8
TOTALS		**-**	**-**	**810.8**	**-**	**534.9**			**1,345.7**

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 1.B
ACTUAL OPERATION OF BIG BEAR LAKE
Release Details

Month	1 Mutual's Shareholder Releases (Input Data) (ac-ft)	2 Mutual's Other Releases (Input Data) (ac-ft)	3 Mutual's Total Releases (Col.1 + Col.2) (ac-ft)	4 Big Bear's Releases for SBVMWD (Input Data) (ac-ft)	5 Big Bear's Spreading Releases (Input Data) (ac-ft)	6 Big Bear's Other Releases (Input Data) (ac-ft)	7 Big Bear's Total Releases (Col.4+Col.5+Col.6) (ac-ft)	8 SWRCB Order NO. 95-4 Lake Outflows (Input Data) (ac-ft)	9 Total Actual Releases (Cols.3+ 7+ 8) (ac-ft)
January	-	-	-	-	-	-	-	57.1	57.1
February	-	-	-	-	-	-	-	49.2	49.2
March	-	-	-	-	-	-	-	60.3	60.3
April	-	-	-	-	-	-	-	48.3	48.3
May	-	-	-	-	-	-	-	59.7	59.7
June	-	-	-	-	-	-	-	69.9	69.9
July	-	-	-	-	-	-	-	94.1	94.1
August	-	-	-	-	-	-	-	98.6	98.6
September	-	-	-	-	-	-	-	84.7	84.7
October	-	-	-	-	-	-	-	76.7	76.7
November	-	-	-	-	-	-	-	59.7	59.7
December	-	-	-	-	-	-	-	52.6	52.6
TOTALS	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**810.81**	**810.8**

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 1.C
ACTUAL OPERATION OF BIG BEAR LAKE
Lake Withdrawal Details

Month	1	2 Snowmaking Withdrawals (Input Data) (ac-ft)	3	4	5 Total Lake Withdrawals (ac-ft)	6	7 Return from Snow melt @ 50.0% (ac-ft)	8	9 Estimated Net Lake Withdrawals (ac-ft)
January		215.48			215.48		107.74		107.74
February		89.80			89.80		44.90		44.90
March		25.84			25.84		12.92		12.92
April		21.98			21.98		10.99		10.99
May		10.27			10.27		-		10.27
June		44.83			44.83		-		44.83
July		34.72			34.72		-		34.72
August		24.94			24.94		-		24.94
September		26.90			26.90		-		26.90
October		17.82			17.82		8.91		8.91
November		123.11			123.11		61.56		61.55
December		292.46			292.46		146.23		146.23
TOTALS		**928.15**			**928.15**		**393.25**		**534.90**

CALENDAR YEAR
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BIG BEAR WATERMASTER

TABLE 1.D
ACTUAL OPERATION OF BIG BEAR LAKE
Evaporation Details

Month	1	2	3 Lake Surface Area (acres)	4 Average Lake Area (acres)	5 Average Air Temperature (Input Data) (deg F)	6 Calculated Evaporation Rate (feet/month)	7	8	9 Estimated Lake Evaporation (ac-ft)
			2,252						
January				2,256	35.80	0.089			200.4
			2,260						
February				2,258	38.60	0.111			250.6
			2,256						
March				2,258	37.40	0.193			435.4
			2,260						
April				2,249	47.50	0.304			683.0
			2,237						
May				2,219	53.00	0.438			972.4
			2,200						
June				2,177	64.60	0.576			1,253.1
			2,154						
July				2,132	68.70	0.640			1,365.1
			2,109						
August				2,085	66.30	0.630			1,312.6
			2,061						
September				2,035	60.90	0.530			1,079.0
			2,008						
October				2,002	47.50	0.381			762.6
			1,995						
November				1,987	46.90	0.293			582.5
			1,979						
December				2,040	36.10	0.104			212.0
			2,101						
						---			---
TOTALS						**4.269**			**9,108.7**

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 2
SYNTHESIZED MUTUAL OPERATION OF BIG BEAR LAKE

Month	1 Gauge Height 1st of Month (feet)	2 Mutual's Lake Account (ac-ft)	3 Change in Storage (*) (ac-ft)	4 Lake Surface Area (acres)	5 Mutual's Lake Inflow (see Table 1) (feet)	6 Mutual's Net Wastewater Export Credit (see Table 2.A) (ac-ft)	7 Mutual's Lake Evap. (see Table 2.B) (ac-ft)	8 Mutual's Snowmaking Advances to Big Bear (see Table 3) (ac-ft)	9 Mutual's Credit for Return of Advances (see Table 3) (ac-ft)	10 Mutual's Releases Leakage Spills & In-lieu Del. (see Table 2.A) (ac-ft)
	49.95	**20,788**		1,681						
January			476		593.2	90.3	150.0	-	-	57.1
	50.25	21,264		1,697						
February			95		230.7	99.7	188.4	-	-	46.9
	50.30	21,359		1,699						
March			331		622.5	96.5	328.6	-	-	59.4
	50.50	21,691		1,710						
April			(423)		59.2	70.5	517.4	-	-	35.0
	50.25	21,268		1,697						
May			(772)		-	60.1	781.4	-	-	51.2
	49.80	20,495		1,672						
June			(2,194)		55.8	60.9	938.5	-	-	1,372.1
	48.45	18,302		1,589						
July			(2,479)		326.0	76.6	982.8	-	-	1,899.1
	46.85	15,822		1,483						
August			(2,278)		184.2	59.5	897.4	-	-	1,624.1
	45.25	13,544		1,372						
September			(2,025)		-	48.7	785.8	-	-	1,288.0
	43.70	11,519.3		1,261						
October			(1,233)		446.2	52.0	466.6	-	-	1,264.5
	42.70	10,286		1,188						
November			(920)		111.8	54.7	339.9	-	-	746.1
	41.90	9,367		1,131						
December			3,170		3,771.8	111.8	127.3	-	-	586.4
	44.50	**12,596.8**		1,319						
TOTALS			**(8,251)**		**6,401.4**	**881.3**	**6,504.1**	**-**	**-**	**9,029.8**
					2,072	663	5,570			

(*) Col. 3 = Col. 5 + Col. 6 - Col. 7 - Col. 8 + Col. 9 - Col. 10

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 2.A
SYNTHESIZED MUTUAL OPERATION OF BIG BEAR LAKE
Lake Outflow Details

Month	1 Mutual's Spills & FC Releases from Table 2.C (ac-ft)	2 Mutual's Lake Releases from Table 1.B (ac-ft)	3 Mutual's Leakage from Table 2.C (ac-ft)	4 Mutual's Order No. 95-4 Releases from Table 2.C (ac-ft)	5 Big Bear's In-lieu Supply Delveries (see Table 3.B) (ac-ft)	6 Mutual's Releases Leakage Spills & In-lieu Del. (to Table 2) (ac-ft)	7	8 Net Credit for Wastewater Exports (Input Data) (ac-ft)	9 Spilled from Mutual's Lake Acct. (Input Data) (ac-ft)	10 Net Wastewater Export Credit (to Table 2) (ac-ft)
January	-	-	-	57.1	-	57.1		90.3	-	90.3
February	-	-	-	46.9	-	46.9		99.7	-	99.7
March	-	-	-	59.4	-	59.4		96.5	-	96.5
April	-	-	-	35.0	-	35.0		70.5	-	70.5
May	-	-	-	51.2	-	51.2		60.1	-	60.1
June	-	-	-	69.9	1,302.2	1,372.1		60.9	-	60.9
July	-	-	-	94.1	1,804.9	1,899.1		76.6	-	76.6
August	-	-	-	91.8	1,532.3	1,624.1		59.5	-	59.5
September	-	-	-	84.7	1,203.3	1,288.0		48.7	-	48.7
October	-	-	-	68.6	1,195.9	1,264.5		52.0	-	52.0
November	-	-	-	56.8	689.3	746.1		54.7	-	54.7
December	-	-	-	40.0	546.4	586.4		111.8	-	111.8
TOTALS	**-**	**-**	**-**	**755.4**	**8,274.4**	**9,029.8**		**881.3**	**-**	**881.3**

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 2.B
SYNTHESIZED MUTUAL OPERATION OF BIG BEAR LAKE
Synthesized Evaporation Calculation

Month	1 Starting Volume (ac-ft)	2 Starting Area (acres)	3 Assumed Evap (ac-ft)	4 Estimated Ending Volume (ac-ft)	5 Estimated Ending Area (acres)	6 Average Area (acres)	7 Mutuals Lake Evap. (to Table 2) (ac-ft)	8 Big Bear's Lake Evap. (to Table 3.A) (ac-ft)	9 Revised Ending Volume Estimate (ac-ft)	10
January	20,787.9	1,681.0	149.3	21,265.1	1,697.0	1,689.0	150.0	50.4	21,264.4	
February	21,264.4	1,697.0	188.3	21,359.6	1,699.0	1,698.0	188.4	62.2	21,359.5	
March	21,359.5	1,699.0	327.6	21,691.6	1,710.0	1,704.5	328.6	106.8	21,690.6	
April	21,690.6	1,710.0	519.4	21,265.9	1,697.0	1,703.5	517.4	165.6	21,267.9	
May	21,267.9	1,697.0	787.2	20,489.7	1,672.0	1,684.5	781.4	247.7	20,495.4	
June	20,495.4	1,672.0	962.4	18,277.6	1,589.0	1,630.5	938.5	314.6	18,301.5	
July	18,301.5	1,589.0	1,017.7	15,787.3	1,480.0	1,534.5	982.8	382.3	15,822.2	
August	15,822.2	1,483.0	933.6	13,508.1	1,368.0	1,425.5	897.4	415.2	13,544.4	
September	13,544.4	1,372.0	818.9	11,486.1	1,261.0	1,316.5	785.8	428.6	11,519.3	
October	11,519.3	1,261.0	480.5	10,272.5	1,188.0	1,224.5	466.6	296.0	10,286.4	
November	10,286.4	1,188.0	348.3	9,358.5	1,131.0	1,159.5	339.9	242.6	9,366.9	
December	9,366.9	1,131.0	117.6	12,546.5	1,319.0	1,225.0	127.3	84.7	12,536.8	
TOTALS							**6,504.1**	**2,796.6**		
							5570.3			

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 2.C
SYNTHESIZED MUTUAL OPERATION OF BIG BEAR LAKE
Mutual's Leakage, Spills & FC Releases, and SWRCB Releases

Month	1 Total Leakage from Input Data (ac-ft)	2 Mutual's Leakage to Table 2.A (ac-ft)	3 Big Bear's Leakage to Table 3.B (ac-ft)	4 Actual Spills & FC Releases from Input Data (ac-ft)	5 Big Bear's Spills & FC Releases to Table 3.B (ac-ft)	6 Mutual's Spills & FC Releases to Table 2.A (ac-ft)	7 SWRCB Order 95-4 Releases from Input Data (ac-ft)	8 Mutual's Order 95-4 Direct Use from Input Data (ac-ft)	9 Mutual's Order 95-4 Releases to Table 2.A (ac-ft)	10 Big Bear's Order 95-4 Releases to Table 3.B (ac-ft)
January	-	-	-	-	-	-	57.1	57.1	57.1	-
February	-	-	-	-	-	-	49.2	44.11	46.9	2.3
March	-	-	-	-	-	-	60.3	58.34	59.4	0.9
April	-	-	-	-	-	-	48.3	18.19	35.0	13.3
May	-	-	-	-	-	-	59.7	40.47	51.2	8.5
June	-	-	-	-	-	-	69.9	69.87	69.9	-
July	-	-	-	-	-	-	94.1	94.11	94.1	-
August	-	-	-	-	-	-	98.6	86.03	91.8	6.8
September	-	-	-	-	-	-	84.7	84.71	84.7	-
October	-	-	-	-	-	-	76.7	64.05	68.6	8.1
November	-	-	-	-	-	-	59.7	55.35	56.8	2.9
December	-	-	-	-	-	-	52.6	34.58	40.0	12.6
TOTALS	**-**	**-**	**-**	**-**	**-**	**-**	**810.81**	**706.90**	**755.37**	**55.44**

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 3
DETERMINATION OF BIG BEAR'S LAKE ACCOUNT STATUS
Lake Account and Advance Account

Month	1 Actual Lake Account (see Table 1) (ac-ft)	2 Mutual's Lake Account (see Table 2) (ac-ft)	3 Big Bear's Lake Account (calc.) (ac-ft)	4 Change in Big Bear's Lake Account (calc.) (ac-ft)	5	6 Big Bear's Advances From Mutual (calc.) (ac-ft)	7 Big Bear's Payments Against Advances (calc.) (ac-ft)	8 Big Bear's Advance Account Balance (calc.) (ac-ft)	9 Big Bear's 0% Repayment Premium (calc.) (ac-ft)	10 Mutual's Credit for Return of Advances (to Table 2) (ac-ft)
	38,663	20,788	**17,875.1**					-		
January	38,891	21,264	**17,627**	(248.5)		-	-	-	-	-
February	38,777	21,359	**17,418**	(209.1)		-	-	-	-	-
March	38,891	21,691	**17,200**	(217.1)		-	-	-	-	-
April	38,208	21,268	**16,940**	(260.3)		-	-	-	-	-
May	37,109	20,495	**16,614**	(326.5)		-	-	-	-	-
June	35,797	18,302	**17,495**	881.9		-	-	-	-	-
July	34,629	15,822	**18,807**	1,311.3		-	-	-	-	-
August	33,377	13,544	**19,833**	1,025.8		-	-	-	-	-
September	32,051	11,519	**20,531.7**	699.1		-	-	-	-	-
October	31,649	10,286	**21,363**	830.9		-	-	-	-	-
November	31,057	9,367	**21,690**	327.5		-	-	-	-	-
December	34,418	12,537	**21,881.2**	191.1		-	-	-	-	-
TOTALS				**4,006.1**		-	-		-	-

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 3.A
DETERMINATION OF BIG BEAR'S LAKE ACCOUNT STATUS
Lake Inflow Details

Month	1 In-lieu SWP Water from SBVMWD (Input Data) (ac-ft)	2 In-lieu Water from Other's Wells (Input Data) (ac-ft)	3 In-lieu Supplies from Mutual's Wells (Input Data) (ac-ft)	4	5 Valley District In Lieu Lake Supplies (Input Data) (ac-ft)	6 Big Bear's In-lieu Deliveries to Mutual (calc.) (ac-ft)	7	8 Big Bear's Advances From Mutual (from Table 3) (ac-ft)	9	10 Big Bear's Total Lake Inflows (calc.) (ac-ft)
January	-	-	-		-	-		-		-
February	-	-	-		-	-		-		-
March	-	-	-		-	-		-		-
April	-	-	-		-	-		-		-
May	-	-	-		-	-		-		-
June	320.5	632.7	349.0		-	**1,302.2**		-		**1,302.2**
July	428.9	1,132.3	243.7		-	**1,804.9**		-		**1,804.9**
August	435.1	940.0	157.2		-	**1,532.3**		-		**1,532.3**
September	329.8	873.5	-		-	**1,203.3**		-		**1,203.3**
October	446.6	749.3	-		-	**1,195.9**		-		**1,195.9**
November	201.7	487.6	-		-	**689.3**		-		**689.3**
December	27.8	518.6	-		-	**546.4**		-		**546.4**
TOTALS	**2,190.4**	**5,334.0**	**750.0**		**-**	**8,274.4**		**-**		**8,274.4**
6 month total						1302.24				

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 3.B
DETERMINATION OF BIG BEAR'S LAKE ACCOUNT STATUS
Lake Outflow Details

Month	1 Big Bear's Snowmaking Withdrawals (Input Data) (ac-ft)	2 Big Bear's Total Releases Table 1.B (ac-ft)	3 Return Flow from Snowmelt 50.0% (Table 1.C) (ac-ft)	4 Big Bear's Net Lake Withdrawal (calc.) (ac-ft)	5 Big Bear's Payments Against Advances (see Table 3) (ac-ft)	6 Big Bear's Spills & FC Releases from Table 2.C (ac-ft)	7 Big Bear's Leakage + SWRCB Rel. from Table 2.C (ac-ft)	8 Big Bear's Lake Evaporation from Table 2.B (ac-ft)	9 Net Wastewater Export Credit (from Table 2.A) (ac-ft)	10 Big Bear's Total Lake Outflows (calc.) (ac-ft)
January	215.5	-	107.7	107.7	-	-	-	50.4	90.3	**248.5**
February	89.8	-	44.9	44.9	-	-	2.3	62.2	99.7	**209.1**
March	25.8	-	12.9	12.9	-	-	0.9	106.8	96.5	**217.1**
April	22.0	-	11.0	11.0	-	-	13.3	165.6	70.5	**260.3**
May	10.3	-	-	10.3	-	-	8.5	247.7	60.1	**326.5**
June	44.8	-	-	44.8	-	-	-	314.6	60.9	**420.3**
July	34.7	-	-	34.7	-	-	-	382.3	76.6	**493.6**
August	24.9	-	-	24.9	-	-	6.8	415.2	59.5	**506.5**
September	26.9	-	-	26.9	-	-	-	428.6	48.7	**504.2**
October	17.8	-	8.9	8.9	-	-	8.1	296.0	52.0	**365.0**
November	123.1	-	61.6	61.6	-	-	2.9	242.6	54.7	**361.8**
December	292.5	-	146.2	146.2	-	-	12.6	84.7	111.8	**355.3**
TOTALS	**928.2**	**-**	**393.3**	**534.9**	**-**	**-**	**55.4**	**2,796.6**	**881.3**	**4,268.3**

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 4
BASIN MAKE-UP ACCOUNT

Month	1 Big Bear's Basin Additions (see Table 4.A) (ac-ft)	2	3 Mutual's Basin Additions (see Table 4.B) (ac-ft)	4	**5** **Net Credit (Debit)** **(ac-ft)**	6	7 Total Basin Replenishment (see Table 4.C) (ac-ft)	8	9 Basin Comp. Account Balance (ac-ft)
									27,046
January	28.5		28.5		-		-		27,046
February	24.7		23.5		**1.2**		-		27,047
March	30.1		29.7		**0.4**		-		27,048
April	24.5		17.7		**6.8**		-		27,054
May	30.0		25.7		**4.3**		-		27,059
June	195.2		686.1		**(490.9)**		-		26,568
July	261.5		949.5		**(688.0)**		-		25,880
August	267.0		812.1		**(545.1)**		-		25,335
September	207.3		644.0		**(436.8)**		-		24,898
October	261.8		632.3		**(370.5)**		-		24,527
November	130.7		373.0		**(242.3)**		-		24,285
December	40.4		293.3		**(252.9)**		-		**24,032**
TOTALS	**1,501.6**		**4,515.4**		**-3,013.7**		**0.0**		

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 4.A
BIG BEAR'S BASIN ADDITIONS

Month	SPILLS			LAKE RELEASES				IN LIEU SUPPLIES		
	1 Actual Spills & FC Releases (ac-ft)	2 Actual SWRCB 95-4 Releases (ac-ft)	3 Basin Addition @ 51.0% (ac-ft)	4 Lake Release for Mutual (ac-ft)	5 SWRCB 95-4 Releases for Mutual (ac-ft)	6 Big Bear's Total Releases Table 1.B (ac-ft)	7 Basin Addition @ 50.0% (ac-ft)	8 Imported In Lieu Deliveries (ac-ft)	9 Basin Addition @ 50.0% (ac-ft)	10 Big Bear's Basin Additions (ac-ft)
January	-	-	-	-	57.1	-	28.5	-	-	28.5
February	-	5.1	2.6	-	44.1	-	22.1	-	-	24.7
March	-	1.9	1.0	-	58.3	-	29.2	-	-	30.1
April	-	30.1	15.4	-	18.2	-	9.1	-	-	24.5
May	-	19.2	9.8	-	40.5	-	20.2	-	-	30.0
June	-	-	-	-	69.9	-	34.9	320.5	160.3	195.2
July	-	-	-	-	94.1	-	47.1	428.9	214.5	261.5
August	-	12.6	6.4	-	86.0	-	43.0	435.1	217.6	267.0
September	-	-	-	-	84.7	-	42.4	329.8	164.9	207.3
October	-	12.6	6.4	-	64.1	-	32.0	446.6	223.3	261.8
November	-	4.4	2.2	-	55.4	-	27.7	201.7	100.9	130.7
December	-	18.0	9.2	-	34.6	-	17.3	27.8	13.9	40.4
TOTALS	**0.0**	**103.9**	**53.0**	**0.0**	**706.9**	**0.0**	**353.5**	**2,190.4**	**1,095.2**	**1,501.6**

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 4.B
MUTUAL'S BASIN ADDITIONS

Month	SPILLS & FISH RELEASES			LAKE RELEASES			
	1 Mutual's Spills (ac-ft)	2 Mutual's SWRCB 95-4 Shared Releases (ac-ft)	3 Basin Addition @ 51.0% (ac-ft)	4 Mutual's Lake Demands (ac-ft)	5 SWRCB 95-4 Lake Outflows Used by Mutual (ac-ft)	6 Basin Addition @ 50.0% (ac-ft)	7 Total Basin Additions (ac-ft)
January	-	-	-	-	57.1	28.5	28.5
February	-	2.8	1.4	-	44.1	22.1	23.5
March	-	1.1	0.5	-	58.3	29.2	29.7
April	-	16.8	8.6	-	18.2	9.1	17.7
May	-	10.7	5.5	-	40.5	20.2	25.7
June	-	-	-	1,302.2	69.9	686.1	686.1
July	-	-	-	1,804.9	94.1	949.5	949.5
August	-	5.8	2.9	1,532.3	86.0	809.2	812.1
September	-	-	-	1,203.3	84.7	644.0	644.0
October	-	4.5	2.3	1,195.9	64.1	630.0	632.3
November	-	1.4	0.7	689.3	55.4	372.3	373.0
December	-	5.4	2.8	546.4	34.6	290.5	293.3
TOTALS	**0.0**	**48.5**	**24.7**	**8,274.4**	**706.9**	**4,490.7**	**4,515.4**

CALENDAR YEAR
2021
BIG BEAR WATERMASTER

TABLE 4.C
BASIN REPLENISHMENTS

Month	1	2 Amount Replenished From SBVMWD Releases (ac-ft)	3	4	5 Amount Replenished From Releases (ac-ft)	6 Amount Replenished From Others (ac-ft)	7	8 Total Amount Replenished (ac-ft)	9
January		-			-	-		-	
February		-			-	-		-	
March		-			-	-		-	
April		-			-	-		-	
May		-			-	-		-	
June		-			-	-		-	
July		-			-	-		-	
August		-			-	-		-	
September		-			-	-		-	
October		-			-	-		-	
November		-			-	-		-	
December		-			-	-		-	
		0.0			**0.0**	**0.0**		**0.0**	