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CHARACTERIZATION OF WATER FROM LaVERKIN SPRINGS, UTAH

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16. ABSTRACT

Analytical water data obtained from two separate test programs at the LaVerkin Springs site, Washington County, southwestern Utah, were evaluated. During the first analyses, from February 11 through November 6, 1972, water samples were obtained weekly from 14 atmospheric springs. During the second analyses, from November 1, 1979 through August 27, 1980, water samples were obtained weekly at aquifer pressure by pumping from a well representative of the 14 springs. Acquired data included characteristics of the water in 1972, and again in 1979-1980, uniformity of the water in the springs tested, variations of these characteristics within the time of year, and the comparison of the water obtained in 1972 with that obtained in 1979-1980.

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CHARACTERIZATION OF WATER FROM LaVERKIN SPRINGS, UTAH

by

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April 1983

Applied Sciences Branch
Division of Research
Engineering and Research Center
Denver, Colorado

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- Engineering and Research Center, Denver, Colorado, Division of Research, Chemistry, Petrography, and Chemical Engineering Section.
- Yuma Desalting Test Facility, Yuma, Arizona, Yuma Project Office.
- Lower Colorado Region, Boulder City, Nevada.

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INTRODUCTION

The LVS (LaVerkin Springs) are a highly saline springs in Washington County of southwestern Utah which discharge into the Virgin River, a tributary of the Colorado River. The high salt content and moderate flow rates of the LVS significantly contribute to the salinity of the Colorado River. Consequently, methods to prevent the salts in the LVS water from entering the Virgin River, which flows into the Colorado River, have been studied since 1971 by the Bureau as one phase of the Colorado River Water Quality Improvement Program. As part of this program, a characterization study of LVS water based on physical tests and on analyses for major dissolved chemical constituents was conducted between February 11 and November 6, 1972. The study included taking water samples about once each week from 14 identified springs which were submitted to an offsite laboratory for complete chemical analysis [1].*

Additional water characterization studies were conducted at the LVS site between November 1, 1979 and August 27, 1980. The reference test water was pumped from a well bored into the aquifer from which the 14 springs emerge. Well water samples were submitted to a remote laboratory for complete analyses each week. The 1979 to 1980 water analyses data were reported and statistically evaluated in another report [2]. These water analyses data were obtained during onsite pretreatment and desalting processes evaluation at LVS [3].

The 1972 and 1979 to 1980 LVS water analyses data were reevaluated and compared to resolve the following:

1. Uniformity of water analyses from each of the 14 springs (1972).

2. Monthly variations in spring water analyses (1972).

3. Comparison between the spring water and the borehole water analyses.

4. Characteristics of the spring water (1979 to 1980).

5. Comparisons between the 1972 and 1979 to 1980 spring water analyses.

CONCLUSIONS

1. The analyses of water taken from 10 of the 14 springs in 1972 strongly supports the hypothesis that the water issuing from each spring comes from the same source.

2. Throughout the 1972 tests, dissolved calcium, magnesium, potassium, and sodium salt concentrations varied less than plus or minus 5 percent from the average values. The average value of TDS (total dissolved solids) was 9770 mg/L and remained constant at 9800 mg/L during January through May. The TDS dropped to a low of 9670 mg/L in June but gradually returned to 9800 mg/L by December.

3. The values from the analyses of water from the springs was averaged and compared to the water (1979-1980) from borehole No. LV102. The difference between the two was less than the variations which would be expected from normal sampling and analytical errors. Apparently, the water from all of the springs and the borehole is from the same source.

4. The average values for the physical and chemical analyses of LVS water (1979-1980) are shown (table 1).

5. The spring water, tested in 1972 and again in 1979-1980, had comparable average values of calcium, magnesium, potassium, and sodium bicarbonate, chloride, and sulfate dissolved salts. The average values of dissolved salts for the two test periods compared within the variations expected from sampling and analytical errors.

CHARACTERIZATION OF THE WATER

About 14 springs emerge at intervals in and along the river (fig. 1) for about 305 m. During the period of low riverflow (June through October) most water from the springs is visible flowing from fissures and joints on both banks, from the riverbed, and from a tunnel in the Toroweap Limestone of Permian age. The springs vary from about 36 to 42 °C, and are heavily mineralized with a strong odor of H_2S (hydrogen sulfide) present. Analyses indicated (table 1) a concentration of 5 mg/L H_2S where the springs emerge. The only direct use of the spring water is for therapeutic baths at the Pah Tempe Hot Springs Resort.

Water quantity (1943-1972).–Because there are many spring outlets, several of which are in the riverbed, it is not practical to directly measure the spring

* Numbers in brackets refer to entries in the bibliography.

water discharges. Total spring water discharge has been determined by measuring the flow of the river above and below the springs. Estimated discharge measurements of the stream were made in this manner from 1943 through 1972 (table 2), and on this basis 0.34 m^3/s is the maximum design flow.

Characteristics of Water (1972).–A characterization study of LVS water was conducted between February 11, 1972, and November 6, 1972, as part of the Colorado River Water Quality Improvement Program. The analytical results and the source and sampling time periods for the analyses (table 3) were included in the Bureau Feasibility Report [1]. Surface emerging springs No. 1 through 13, and 21 are identified by symbol and number (fig. 1), and the two drill holes, LV101 and LV102, are shown. All water used in the 1979 to 1980 site study was pumped from drill hole LV102.

Uniformity of springs.–The 1972 analyses strongly supported the hypothesis that all water from each spring came from the same source. Analyses of samples of water taken from springs No. 1 through 10 on February 2, 1982 (table 4) [1] show physical tests and chemical analyses, including the mean, standard deviation, and percent deviation for each parameter. The mean (μ) equals the average concentration of each parameter, obtained by summing all of the concentrations (X_i) for each parameter and dividing by the number (n) of analyses.

$$\mu = \frac{\Sigma X_i}{n}$$

The standard deviation (δ) for each parameter was then calculated:

$$\delta = \sqrt{\frac{\Sigma (X_i - \mu)^2}{n}}$$

From this percent deviation (%) was then calculated:

$$\%\delta = \frac{\delta \times 100\%}{\mu}$$

The very small "percent standard deviation" values (table 4) for each parameter indicate that the 10 springs are all supplied from the same source. The deviation in analyses due to sampling and analytical errors for 10 samples taken from the same spring could easily be 10 percent. All components except magnesium and bicarbonate show less than 3 percent deviation. The error in the magnesium analysis is normally high because it is determined by subtracting a calcium analysis (meq/L) from a total hardness analysis (meq/L) which are of about the same magnitude and tend to magnify the error. The error in the bicarbonate analysis is also high because some of the bicarbonate concentration is due in part to dissolve carbon dioxide (CO_2). To retain CO_2 in solution water, samples need to be sealed and refrigerated immediately at the test site, a precaution not taken in 1972 because the high CO_2 content of LVS water was not known until 1979.

Variations in water analyses with time of year.–The analyses for water from spring No. 4 for February 2 through November 6, 1972, is given (table 5) and the changes in TDS, spring water temperature, and pH are also shown (fig. 2). The average value of TDS was 9770 mg/L. The TDS remained constant at 9800 mg/L from February through April, but in May, it first increased slightly and then dropped to a low of 9670 mg/L by the end of June, and then gradually increased back to about 9800 mg/L by November.

The changes in concentrations of TDS appear to have some correlation with the temperature of the spring water. The TDS was constant at 9800 mg/L while the temperature was constant at 42 °C throughout February, March, and April. The TDS started to change about a month before a change in temperature was observed. In early June, the temperature rose 1/2 °C, but dropped back again by mid-July; however, it gradually increased to about 43 °C by November at the same time the TDS increased to 9800 mg/L.

The pH of water from spring No. 4 followed approximately the transitions in TDS and temperature, the average of which was 6.7. The pH readings were also erratic in 1972; since the presence of CO_2 was not known, the water samples were not specially handled to prevent the escape of CO_2. The pH was very erratic during February and March with the average at 6.5, but more closely approximated a smooth line during May and June at 6.9, and increased to 7.2 during August and then dropped back to 6.4 by November 6.

The changes in the concentrations of the cations potassium, magnesium, calcium, and sodium (fig. 3) occurred at three stages between February 2 and November 6, the averages of which are summarized (table 6).

The effects of winter, spring, and summer on the concentrations of the anions: bicarbonate, sulfate, and chloride are evident (fig. 4). Bicarbonate, which averaged 20.2 meq/L, remained at 20.25 meq/L during February and March, dropped to 19.85 by June, and reached a high of 20.75 by mid-October. Sulfate, which averaged 39.8 meq/L, remained at 43.0 during February and March, dropped to 37.5 by mid-July, and leveled off to a constant 38.5 during September and October. Chloride averaged

98.0 meq/L between February and November, increased to 99.0 during Feburary and March, and dropped to 96.3 by June, but was back to 99.0 by November.

Comparison of water from spring No. 4 with borehole No. LV102.–The 1972 summarized data (table 4) demonstrate that the spring water all came from the same source. Since water was pumped from borehole No. LV102 for the 1979 to 1980 tests, it becomes important to demonstrate that this water came from the same source as the springs. Borehole No. LV102 is located adjacent to spring No. 4 (fig. 1). The physical and chemical analyses were obtained in 1972 for spring No. 4 and borehole No. LV102 (table 5 and 7) and the average analytical values compared (table 8). The temperature of borehole No. LV104 water was 0.5 °C higher than the springs water. The pH and TDS were essentially the same for both. Comparison of sodium, calcium, bicarbonate, chloride, and sulfate for the two was less than 4 percent difference, or well below normally expected differences due to errors in sampling and analyses. Although the potassium, magnesium, and silica analytical differences are high: 9.3, 7.3, and 5.5 percent, respectively, these values still fall within the normally expected sampling and analytical variation errors. The data support the hypothesis that the spring water and the borehole water are from the same source, and therefore, that the water used for the 1979 to 1980 site study was representative of the spring water.

Characteristics of water (1979-1980).–The quality of LVS water pumped from the aquifer in 1979 and 1980 [2] was tested, and typically contained 750 mg/L of dissolved CO_2 and had a pH of 6.0 (table 1). The water typically contained (in concentrations of mg/L): 820 calcium, 150 magnesium, 180 potassium, 2220 sodium, 1266 bicarbonate, 3350 chloride, and 1860 sulfate. Essentially, 400 mg/L of calcium were associated with the bicarbonate as temporary hardness, and 420 mg/L of calcium were associated with the chloride and sulfate as permanent hardness. The raw water contained significant amounts of silica, boron, strontium, and sulfide in concentrations of 40, 5.0, 10.2, and 4.9 mg/L, respectively. All trace metals in the water were in concentrations of less than 0.1 mg/L. A measurable amount (33 pCi/L) of radium 228 was present in the water.

Because of the CO_2, bicarbonate, and calcium content, the water was prone to precipitate calcium carbonate by the dissolution of CO_2. If water pumped from aquifer pressure is allowed to drop to atmospheric pressure and release CO_2 from solution, calcium carbonate scale will form on the intake pipe and pump wetted surfaces. If the water were to be fed directly into a desalting process, a tenacious, hard coating of calcium carbonate would form on all process-wetted surfaces. Consequently, the water must be sparged with air to purge out CO_2 and to subsequently precipitate about 200 mg/L of calcium carbonate prior to further pretreatment [3].

The LVS water will still contain 620 mg/L of calcium present with an excess amount of sulfate. Calcium sulfate can precipitate and foul RO (reverse osmosis) and ED (electrodialysis) membranes as the brine concentrates in the desalting process. Consequently, before using LVS water for ED or RO desalting, the water must be pretreated to remove more calcium. Lime- and ion-exchange treatment or lime- and soda-ash treatment would be required depending on the desired level of calcium reduction.

Comparison of 1972 water with 1979-1980 water.–During the site test [3] between November 1, 1979, and August 25, 1980, samples of LVS water were taken each week and submitted to an offsite laboratory for analyses, and the weekly raw water analyses were summarized into monthly averages for 20 parameters (table 9). The average values for the 10 months in this period and for the 11-month 1972 period (from table 5) and the differences and percent differences were computed.

Comparison of these data lead to the conclusion that the yearly average water analyses for periods 1972 and 1979 to 1980 were not significantly different. During the 11-month 1972 period, pH of the water taken from atmospheric springs averaged 6.7. During the 10-month 1979-1980 period, water pumped from a well averaged 6.1. Apparently, loss of CO_2 from solution accounts for the 0.3 difference in pH units. Conductivity and TDS differed for the two test periods, by 0.3 and 0.5 percent, respectively. This as well as the calcium, potassium, bicarbonate, sulfate, and chloride fall within variations to be expected from the analytical procedures employed. Silica, magnesium, and sodium, however, do have a higher percent difference than might be expected. The high percent difference for magnesium are probably due to the analytical procedures used to determine magnesium concentrations. Magnesium is calculated by subtracting calcium determined by titration from "total hardness" determined by another titration. Soluble silica analysis is subject to high sampling error, since silica tends to convert to the insoluble forms with elapsed time between sampling and analysis. The 8.2 percent analytical difference for sodium between the 1972 period and 1979 to 1980 is not as readily explained. Since the major cations potassium and calcium and all the major anions are not statistically different for the two

time periods, sodium content of the water probably was at the same levels during both time periods. It is reasonable to conclude that the springs water had essentially the same analyses in both 1972 and 1979 to 1980.

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[3] Eisenhauer, R. J., "Onsite Pretreatment and Desalting Processes Evaluation, LaVerkin Springs, Utah," REC-ERC-83-5, Bureau of Reclamation, Denver, Colorado, July 1983.

Table 1.—*Water analyses (1979-1980)*

Elements	Average values	Elements		Average values
pH	6.1 pH	Lead		0.012
Conductivity at 25 °C	1401 mS/m	Mercury		0.0038
Temperature	36.6 °C	Manganese		0.013
		Selenium		<0.02
Major constituents (mg/L)		Silver		<0.0005
		Aluminum		<0.1
TDS	9620	Copper		0.001
Silica	31	Nickel		0.01
Calcium	813	Zinc		<0.1
Magnesium	151	Sulfide		4.9
Sodium	2309			
Potassium	194	Trace Anions[1] (mg/L)		
Iron	<0.1			
Manganese	0.06	Orthophosphate		2.6
Strontium	11	Nitrate		1.8
Bicarbonate	1286	Fluoride		2.6
Sulfate	1947	Total organic carbon		2.0
Chloride	3405			
T-alkalinity as $CaCO_3$	1045	Radioactivity[1]		
P-alkalinity as $CaCO_3$	0			
Free carbon dioxide	771	Radium 226	pCi/L	33.3
T-phosphorous as PO_4	2.7	Radium 228	pCi/L	0
Sulfides	5.0			
		Desalting—% Water Recovery[1]		
Trace elements[1] (mg/L)				
		Based on $CaSO_4$ solubility at		
Arsenic	0.1			
Barium	0.09	0 °C	%	4.3
Boron	5.0	20 °C	%	23.0
Cadmium	0.004	50 °C	%	28.2
Chromium	0.002	90 °C	%	16.1
Iron	<0.10			

[1] From reference [2] and [3].

Table 2.—*Estimated discharge of springs (1943-72)*

Test date	Estimated discharge (m^3/s)		
	Below springs	Above springs	Discharge of springs
July 12, 1943[1]	0.36	0.03	0.33
July 23, 1943[1]	0.35	0.04	0.31
July 16, 1947[1]	0.32	—	0.32
September 10, 1956[2]	—	—	0.28
August 10, 1960[2]	—	—	0.30
August 1, 1963[2]	—	—	0.29
August 21, 1963[2]	—	—	0.33
—	—	—	0.28
June 21,1972[1]	0.40	0.99	0.31
July 12, 1972 a.m.[1]	0.38	0.04	0.34
July 12, 1972 p.m.[1]	0.34	0.03	0.31
July 13, 1972[1]	0.35	0.02	0.32

[1] Data source, USBR.
[2] Data source, USGS.

Table 3.—*Chemical analyses summarized*

Table [1] [1]	Location	Time through which test was run
A-5	Spring No. 1.	February 11 through November 6, 1972.
A-6	Spring No. 2.	February 11 through November 6, 1972.
A-7	Spring No. 3.	January 31 through November 6, 1972.
A-8	Spring No. 4.	February 2 through November 6, 1972.
A-9	Spring No. 5.	February 11 through May 19, 1972.
A-10	Spring No. 6.	February 11 through May 19, 1972.
A-11	Spring No. 7.	February 11 through June 8, 1972.
A-12	Spring No. 8.	February 11 through November 6, 1972.
A-13	Spring No. 9.	February 11 through May 19, 1972.
A-14	Spring No. 10.	February 11 through November 6, 1972.
A-15	Spring No. 11.	February 11 through November 6, 1972.
A-16	Spring No. 12.	May 12 through June 2, 1972.
A-17	Spring No. 21.	May 8 through November 6, 1972.
A-18	River near USGS Station.	May 17 through July 3, 1972.
A-19	Spring No. 13.	May 19 through November 6, 1972.
A-20	Drill hole LV101	May 26 through October 5, 1972.
A-21	Drill hole LV102.	August 21 through October 5, 1972.

[1] Table identification from referenced report (see table A-5 through A-21 in appendix).

Table 4.—*Deviation of analyses among ten springs (February in 1972)*

Parameter tested		Spring number (see fig. 1)										Mean (μ)[1]	Standard deviation (σ)[2]	Percent standard deviation[3]
		1	2	3	4	5	6	7	8	9	10			
Physical tests														
Temperature	°C	42.0	42.0	39.0	42.0	39.8	42.3	42.0	41.0	40.5	39.0	41.0		
pH	pH	6.3	6.3	6.5	6.3	6.3	6.3	6.5	6.4	6.4	6.4	6.4		
Conductivity	mS/m	1414	1414	1376	1414	1414	1424	1414	1394	1434	1394	1409		
TDS (total dissolved solids)	mg/L	9800	9830	9490	9790	9180	9850	9830	9560	9830	9710	9667	207	2.14
Chemical analyses														
Sodium	meq/L	111.0	110.4	105.3	108.6	111.6	111.0	112.0	107.4	109.8	106.8	109.4	2.2	2.0
Potassium	meq/L	5.22	5.31	5.07	5.13	5.25	5.25	5.25	5.04	5.22	5.07	5.18	0.090	1.7
Calcium	meq/L	40.82	39.92	39.12	40.72	40.32	40.52	39.72	39.22	39.72	42.12	40.22	0.84	2.1
Magnesium	meq/L	10.33	11.33	10.73	10.33	—	10.73	11.23	11.13	11.23	10.94	10.89	0.86	7.1
Carbonate	meq/L	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicarbonate	meq/L	22.20	20.05	19.35	20.25	20.20	20.30	20.30	19.95	20.35	19.50	20.25	0.73	3.6
Chloride	meq/L	100.0	100.5	96.50	99.75	100.5	100.5	100.0	97.75	100.5	100.0	99.6	1.29	1.3
Sulfate	meq/L	42.32	42.82	42.65	41.32	42.65	44.82	42.82	44.98	41.65	41.98	42.80	1.15	2.7
Boron	mq/L	5.1	5.0	5.0	5.2	5.1	5.1	5.2	5.0	5.2	4.8	5.0	0.14	2.8
Fluoride	mg/L	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	0	0
Iron	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	0
Silica	mg/L	31.0	32.5	30.0	31.0	31.0	30.0	32.5	31.0	31.0	31.0	31.1	0.8	2.6

[1] μ = mean = X_i/n

[2] σ = standard deviation = $\sqrt{\frac{(x_i - \mu)^2}{n}}$

[3] Percent diviation = $\frac{\sigma \times 100\%.}{\mu}$

Table 5.—*Chemical analyses, spring No. 4*[1]

Date sampled	Field laboratory °F	pH	Conductivity[2] mS/m	Dissolved solids mg/L	Cations meq/L Na	K	Ca	Mg	Anions meq/L HCO_3	Cl	SO_4	Total Cation meq/L	Anion meq/L	Minor elements mg/L B	F	Fe	SiO_2	PO_4
2-2-72	107.6	6.4	1450	9800	110.7	5.16	40.12	10.93	20.20	100.5	42.16	166.9	162.9	4.9	2.9	<0.1	35	0
2-4-72	107.6	6.6	1450	9800	110.7	5.16	40.22	10.73	20.20	101.5	40.99	166.8	162.7	4.9	2.9	<0.1	35	0
2-11-72	107.6	6.3	1414	9790	108.6	5.13	40.72	10.33	20.25	99.75	41.32	164.8	161.3	5.2	2.7	<0.1	31	–
2-18-72	107.6	6.5	1400	9790	106.2	5.00	41.64	11.10	20.30	96.27	44.94	163.8	161.5	5.0	2.6	<0.1	31	<1.0
2-25-72	107.6	6.5	1432	9760	110.0	5.06	39.39	13.07	20.30	97.20	43.59	167.5	161.1	5.0	2.8	<0.1	31	<1.0
3-2-72	107.2	6.8	1379	9780	105.8	5.13	41.06	11.11	20.10	96.90	43.27	163.1	160.3	5.1	2.8	<0.1	28	3.2
3-10-72	107.6	6.6	1385	9780	105.2	5.13	42.15	10.01	20.35	97.50	42.87	162.5	160.7	5.1	2.7	<0.1	28	3.2
3-17-72	107.6	6.4	1333	9790	109.2	5.13	40.62	11.02	20.15	99.13	44.05	166.0	163.3	5.1	2.7	<0.1	28	3.3
4-19-72	107.6	6.6	1465	9790	105.2	5.04	41.50	8.70	20.15	96.97	39.56	160.4	156.7	5.1	3.0	<0.1	29	3.8
5-1-72	107.6	6.8	1439	9810	105.7	4.86	39.20	11.00	20.05	96.61	39.43	160.8	156.1	5.0	2.5	<0.1	27	2.5
5-8-72	107.6	6.9	1439	9820	105.2	4.86	40.20	10.00	19.95	96.13	37.28	160.3	153.4	5.0	2.5	<0.1	27	2.5
5-11-72	107.6	6.9	1439	9800	104.8	4.86	40.00	10.20	20.05	96.13	40.16	159.9	156.3	5.1	2.5	<0.1	28	2.0
5-19-72	107.6	6.9	1429	9730	102.4	4.68	39.20	11.10	20.00	96.61	36.67	157.4	153.3	5.2	2.6	<0.1	29	2.3
5-26-72	107.6	6.7	1413	9780	102.4	4.77	39.50	10.50	19.95	96.37	36.83	157.2	153.2	5.3	2.6	<0.1	29	2.3
6-2-72	109.0	6.9	1379	9740	102.2	4.68	43.00	8.50	19.75	91.54	39.66	158.4	151.0	5.2	2.4	<0.1	25	2.6
6-8-72	108.1	6.8	1413	9680	103.2	4.77	44.20	7.20	19.85	98.01	38.00	159.4	155.9	4.4	2.8	<0.1	28	3.8
6-16-72	108.5	6.6	1403	9680	103.7	4.77	42.80	8.60	20.00	97.51	37.66	159.9	155.2	4.4	2.7	<0.1	28	3.4
7-13-72	108.0	7.2	1380	9349	103.4	5.60	35.30	7.77	13.21	98.50	37.50	152.1	149.2	4.2	2.19	<0.1	29	–
8-30-72	108.5	7.1	1410	9723	102.7	5.70	43.00	8.66	20.38	97.50	38.50	160.1	156.4	5.0	2.90	<0.1	29	–
10-5-72	105.5	6.6	1377	9712	101.2	5.76	44.60	6.96	20.96	97.02	38.50	158.7	156.5	4.8	2.7	<0.1	29	–
10-6-72	105.5	6.6	1377	9753	101.2	5.76	43.40	7.56	20.64	98.98	38.50	157.9	158.1	4.8	2.7	<0.1	29	–
10-27-72	110.5	6.6	1400	9780	103.5	5.61	41.60	9.25	20.33	99.18	38.50	160.0	158.0	5.0	2.80	<0.1	29	–
11-6-71	110.0	6.4	1417	9795	104.1	5.61	38.70	13.37	20.44	100.3	38.50	161.8	159.2	5.0	2.77	<0.1	29	–
Averages	107.8	6.7	1411	9770	105.1	5.14	40.97	10.28	20.20	97.95	39.80						31.1	

[1] See table A-8 in appendix.
[2] Conductivity at 25 °C.

Table 6.—*Summary of changes in average cation concentrations (1972) for spring No. 4*

meq/L	February-March	April-June	July-November	February-November
Potassium	5.10	4.65	5.66	5.14
Magnesium	10.8	10.2	8.0	10.3
Calcium	41.0	39.8	43.0	41.0
Sodium	108.0	105.0	102.8	105.1

Table 7.—*Chemical analyses, drill hole No. LV102*[3]

Date sampled[1]	Field laboratory °F	pH	Conductivity[2] mS/m	Dissolved solids mg/L	Cations meq/L Na	K	Ca	Mg	Anions meq/L HCO_3	Cl	SO_4	Total Cation meq/L	Anion meq/L	Minor elements mg/L B	F	Fe	SiO_2	PO_4
8-21-72	105.0	6.9	1385	9442	99.80	5.49	38.00	8.20		94.08	41.83	151.5	152.3	4.5	2.02	<0.1	30	–
8-28-72	105.5	7.0	1385	9353	103.3	5.04	34.20			94.08	38.16	148.9	145.0	4.1	1.83	<0.1	28	–
8-30-72	109.0	6.9	1390	9464	99.00	5.49	34.50	12.50		96.40	37.00	151.5	149.4	4.1	1.66	<0.1	36	–
8-30-72	109.0	6.9	1390	9449	99.00	5.49	35.60	11.50	16.45	95.06	36.33	151.6	147.8	4.1	1.62	<0.1	37	–
8-31-72	105.0	7.0	1380	9453	100.9	5.58	39.30	8.42	16.59	96.06	38.50	154.2	150.2	3.5	2.35	<0.1	27	–
9-5-72	114.0	7.1	1409	9640	99.80	5.76	36.50	12.40	18.70	95.80	37.66	154.5	152.2	4.1	1.77	<0.1	35	–
9-6-72	110.0	6.9	1420	9840	99.80	5.58	41.40	12.30	22.25	96.29	36.83	159.1	155.4	4.5	1.81	<0.1	31	–
9-7-72	107.0	6.8	1420	9710	101.1	5.58	42.60	8.50	19.85	96.29	37.16	157.8	153.3	4.5	2.45	<0.1	28	–
9-8-72	109.0	7.0	1402	9679	100.9	5.58	42.60	8.35	20.23	96.04	38.75	157.4	155.0	3.6	2.48	<0.1	28	–
9-9-72	107.0	7.0	1420	9730	101.1	5.58	44.40		20.35	97.29	37.33	157.3	155.0	4.1	2.97	<0.1	28	–
9-12-72	107.0	7.0	1408	9756	99.66	5.58	38.90	12.86	20.96	97.27	38.50	157.0	156.7	3.6	1.77	<0.1		–
9-12-72	107.0	7.0	1427	9937	100.9	5.85	43.50	9.88	20.02	98.49	40.00	160.0	158.5	3.6	2.13	<0.1	25	–
9-15-72	116.2	6.8	1417			5.94	48.20	13.27	16.54	95.06	49.50	163.7	161.1	3.4	2.07	<0.1	25	–
9-20-72	114.8	6.8	1447		97.47		48.00	15.49	19.55	96.29	49.50	167.7	165.3	3.6	1.61	<0.1	31	–
9-21-72	112.1	6.8	1479				45.40	20.52	18.77	95.55		168.3	164.6	2.9	1.55	<0.1	28	–
10-4-72	106.0	6.4	1408	9751	98.80	5.76	43.10	8.76	21.32	96.53	38.00	156.4	155.9	3.9	2.63	<0.1	28	–
10-4-72	106.0	6.4	1408	9627	98.80	5.76	43.00	8.16	20.38	97.51	38.25	155.7	156.1	3.9	2.66	<0.1	28	–
10-5-72	107.6	6.4	1399	9749	99.66	5.76	42.60	8.56	20.85	96.78	38.00	156.6	155.6	3.9	2.67	<0.1	28	–
10-5-72	105.5	6.4	1408	9742	99.56	5.76	42.30	8.86	20.64	96.53	38.25	156.5	155.4	5.5	2.72	<0.1	28	–
Averages	108.5	6.8	1410	9640	101.1	5.62	41.27	9.53	19.59	96.18	39.42						29.4	

[1] Table is a summary of data, see appendix.

[2] Conductivity at 25 °C.

[3] See table A-21 in appendix.

Table 8.—*Comparison of water from spring No. 4 and borehole No. LV102*

Parameter description	Units	Spring[1] No. 4	Bore-hole[2] LV104	Difference	Percent difference
Physical test.					
Temperature	°C	42.0	42.5	-0.5	
pH	pH	6.7	6.8	-0.1	
Conductivity	mS/m	1411	1410	1	0
TDS	mg/L	9770	9640	130	1.3
Chemical analysis					
Sodium	meq/L	105.1	101.1	4.0	3.8
Potassium	meq/L	5.14	5.62	0.48	9.3
Calcium	meq/L	40.97	41.27	-0.30	0.7
Magnesium	meq/L	10.28	9.53	0.75	7.3
Bicarbonate	meq/L	20.20	19.59	0.61	3.0
Chloride	meq/L	97.95	96.18	1.8	1.8
Sulfate	meq/L	39.80	39.42	0.38	1.0
Silica	mg/L	31.1	29.4	1.7	5.5

[1] Average values from table 5.
[2] Average values from table 7.

Table 9.—*Comparison of monthly averages of weekly water analyses for 1972 and 1979 to 1980*

Parameter description	Units	Nov. 1979	Dec. 1979	Jan. 1980	Feb. 1980	Mar. 1980	Apr. 1980	May 1980	June 1980	July 1980	Aug. 1980	1979-80[1]	1972[2]	Difference	Percent difference
pH	pH	6.3	6.5	6.5	6.1	6.1	6.1	6.1	6.2	6.1	6.1	6.1	6.4	0.3	
TDS	mg/L	9660	9560	9590	9730	9680	9830	9570	9460	9540	9620	9620	9667	47	0.5
Conductivity at 25 °C	mS/m	1360	1340	1300	1430	1470	1320	1430	1420	1460	1480	1401	1397	-4	0.3
Temperature	°C	31.0	33.5	30.4	37.0	36.3	37.2	39.0	39.5	41.0	41.0	36.6	41.0	4.5	
Silica	mg/L	29.0	30.0	32.6	30.7	30.0	—	37.3	40.2	40.5	41.0	34.6	31.1	-2.5	7.2
Calcium	mg/L	855	835	785	800	800	829	795	810	815	810	813	804	-9	1.1
Magnesium	mg/L	—	159	153	156	156	—	150	144	144	145	151	132	-19	12.6
Sodium	mg/L	2300	2300	2300	2322	2380	2230	2281	2320	2250	2280	2309	2516	207	8.2
Potassium	mg/L	205	215	205	196	199	206	170	189	184	175	194	203	9	4.6
Iron, total	mg/L	0.09	0.09	0.09	0.08	0.08	—	<0.10	<0.10	<0.10	—	<0.1	<0.1	—	
Manganese, total	mg/L	0.05	0.06	0.04	0.05	0.07	0.05	<0.30	<0.30	<0.30	<0.02	0.06	—	—	
Strontium	mg/L	12.0	11.8	11.8	12.1	11.5	10.5	10.3	11.2	10.9	11.1	11.3	—	—	
Bicarbonate	mg/L	1270	1290	1280	1291	1283	—	1291	1288	1284	1296	1286	1235	-41	3.2
Sulfate	mg/L	2000	1942	2020	1920	1953	1965	1950	1885	1900	1925	1947	2054	7	0.3
Chloride	mg/L	3430	3430	3440	3430	3373	—	3440	3360	3375	3370	3405	3536	131	3.8
T-alkalinity as $CaCO_3$	mg/L	1035	1042	1040	1042	1043	1050	1042	1056	1038	1062	1045	—		
P-alkalinity as $CaCO_3$	mg/L	0	0	0	0	0	0	0	0	0	0	0	—		
Free CO_2	mg/L	757	781	762	765	793	785	756	748	—	—	771	—		
T-phosphorous as PO_4	mg/L	2.7	2.9	—	3.1	2.2	—	—	—	—	—	2.7	—		
Sulfides, total	mg/L	—	—	4.6	5.1	5.2	5.2	4.8	4.6	5.3	5.0	5.0	—		

[1] Average values November 1979 through August 1980 [3].

[2] Average values February through November 1972.

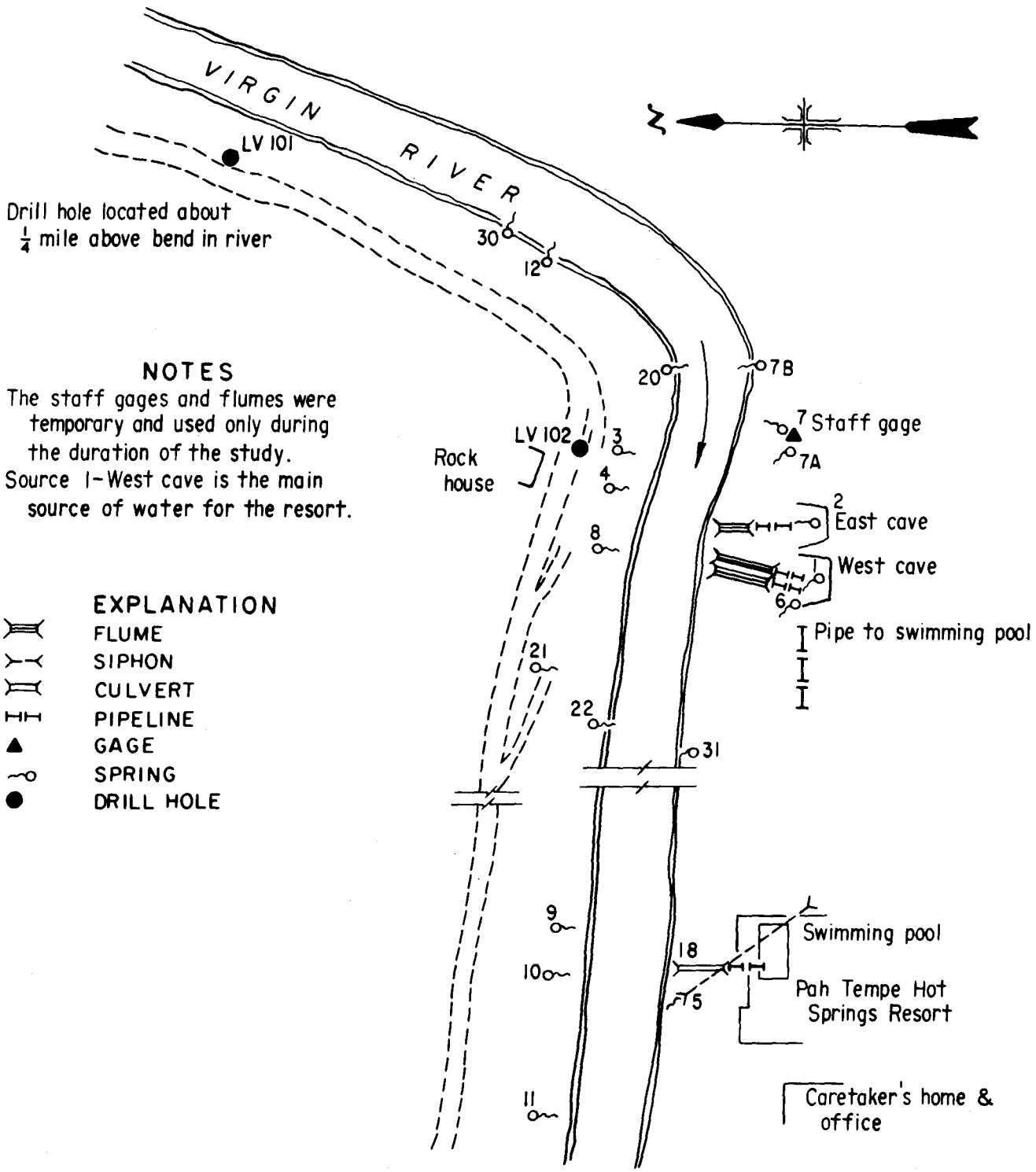

Figure 1.–Approximate locations of surface springs and drill holes.

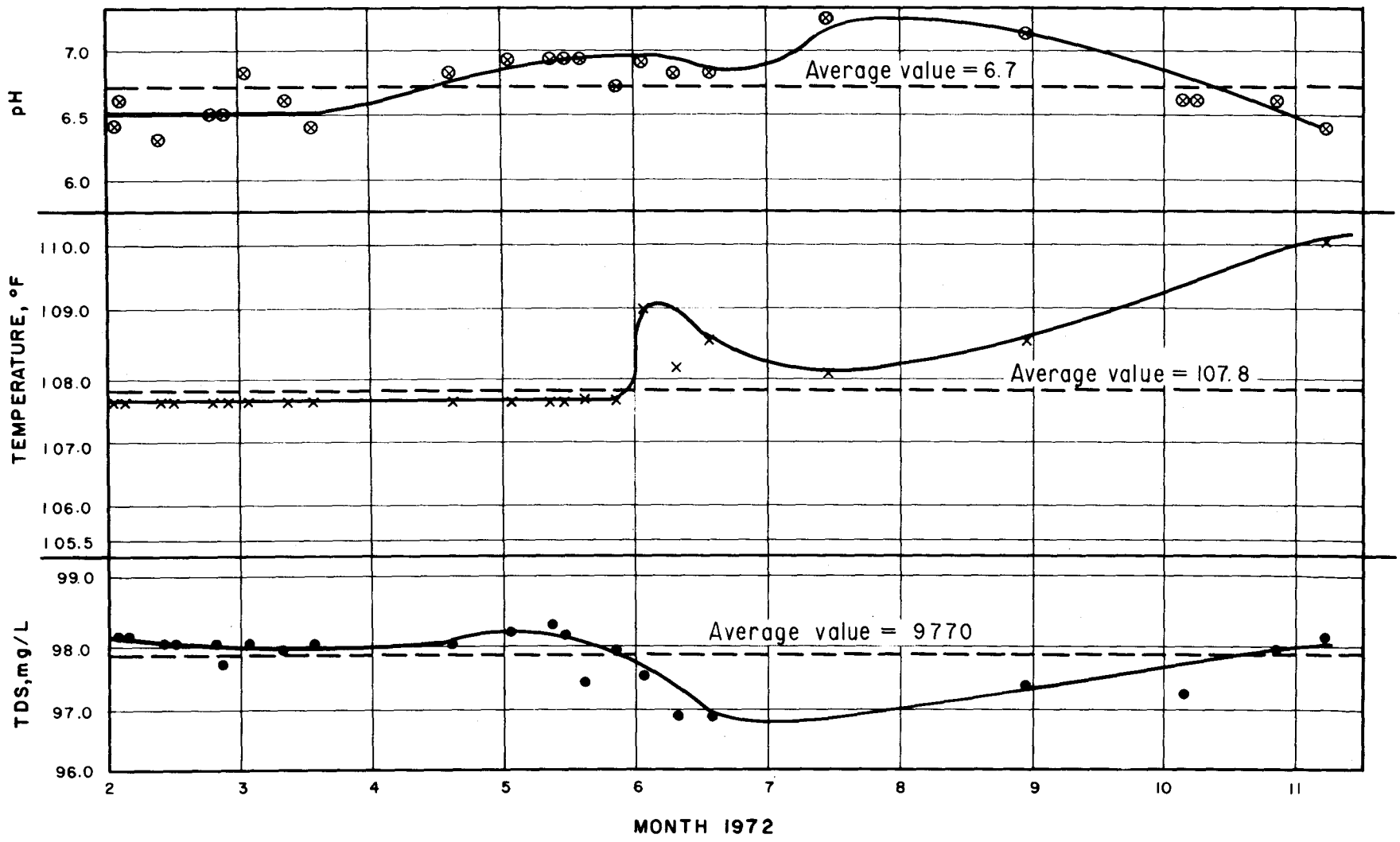

Figure 2.–Comparative changes in pH, temperature, and TDS (10 months in 1972, for spring No. 4).

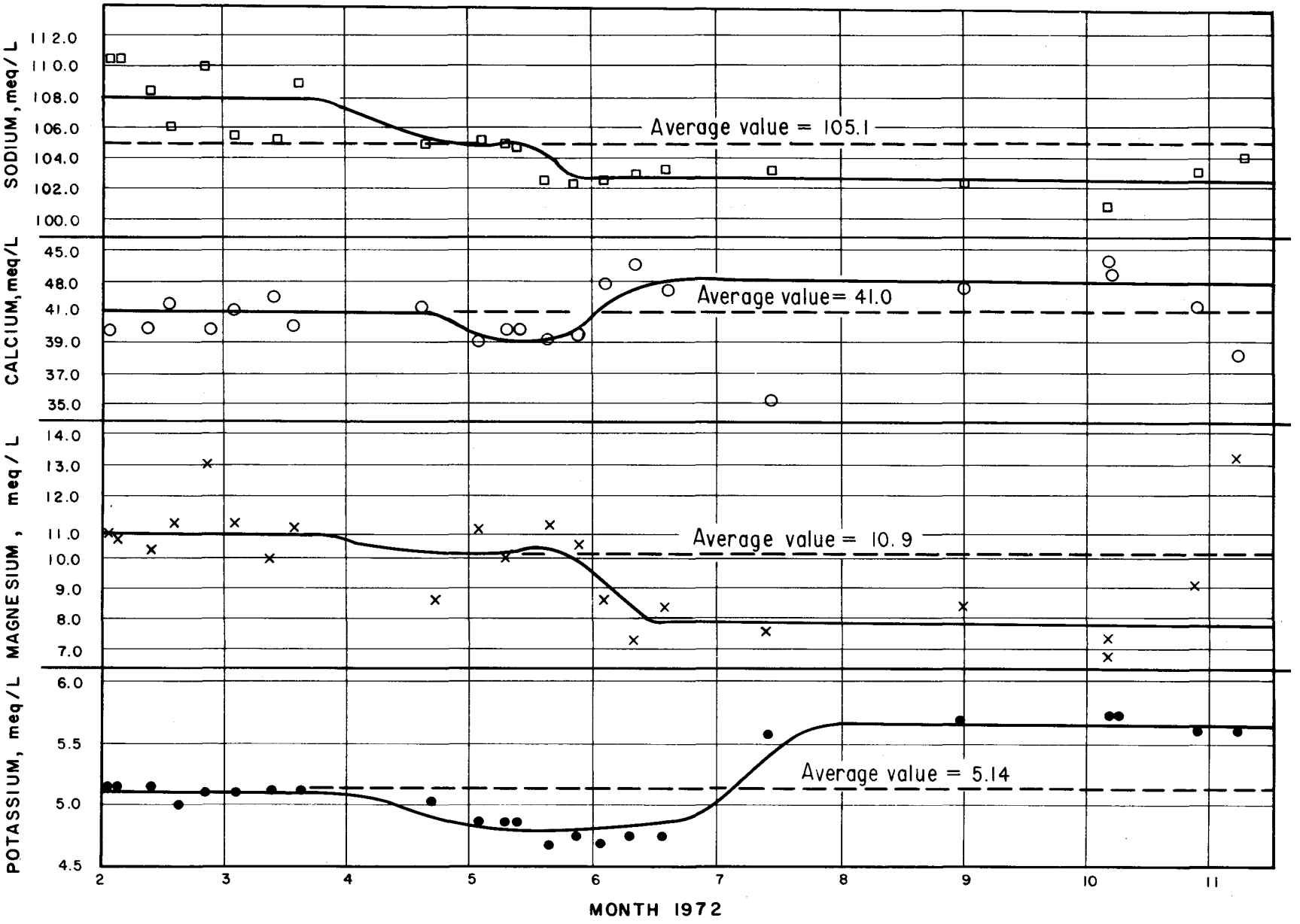

Figure 3.–Comparative changes in dissolved cation concentration (10 months in 1972, for spring No. 4).

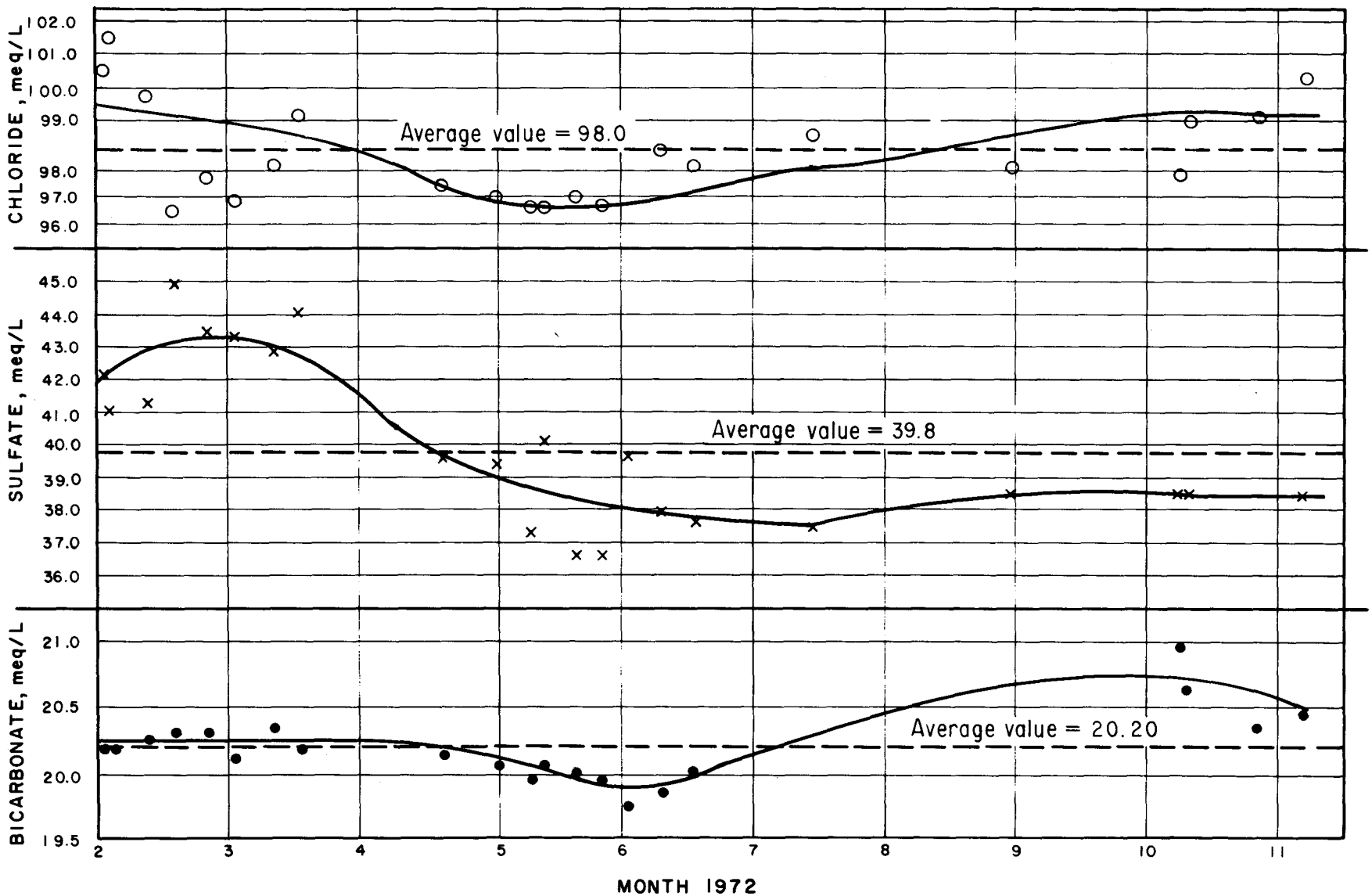

Figure 4.–Comparative changes in dissolved anion concentration (10 months in 1972, for spring No. 4).

APPENDIX

Table A-5
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Station No. Source #1 Description of Sampling Site Southside of River - West Spring LaVerkin Springs Analysis by

Date Sampled	Lab. No.	Field Lab Temp. °C/F	Field Lab pH	ECx10⁶ at 25°C.	Dissolved Solids 2/ ppm mg/l	Dissolved Solids 2/ Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/l	Total Anion meq/l	Minor Elements (ppm) B	F	Fe	SiO_2	PO_4	3/ Qty. cfs	By
		42	-						Meq/l	111.0	5.22	40.92	10.33	0	22.20	100.0	42.38	-									
2-11-72	W38.2	107.6	6.3	14,140	9,800	13.33	66	22	Mg/l	-	-	-	-	-	-	-	-	-	167.4	164.5	5.1	2.7	<.1	31.0	-	-	ASD
		42	-						Meq/l	107.0	5.05	41.84	10.72	0	20.65	96.76	44.45	-									
2-18-72	W51.2	107.6	6.5	14,000	9,850	13.40	65	20.9	Mg/l	-	-	-	-	-	-	-	-	-	164.6	161.9	5.0	2.6	<.1	31	< 1.0	-	JWD
		-	-						Meq/l	106.6	5.13	42.35	10.14	0	20.40	97.80	42.87	-									
3-3-72	W12.2	-	6.8	13,890	9,850	13.40	65.9	21.7	Mg/l	-	-	-	-	-	-	-	-	-	164.2	161.1	5.1	2.8	<.1	28	3.2	-	JWD
		42	-						Meq/l	106.7	5.13	41.84	9.50	0	19.35	97.60	43.27	-									
3-10-72	W30.2	107.6	6.5	13,850	9,840	13.38	66.2	21.9	Mg/l	-	-	-	-	-	-	-	-	-	163.5	160.4	5.1	2.7	<.1	28	3.2	-	JWD
		42	-						Meq/l	106.6	5.13	41.04	9.70	0	20.20	99.74	42.48	-									
3-17-72	W34.2	107.6	6.5	13,330	9,830	13.37	66.2	21.9	Mg/l	-	-	-	-	-	-	-	-	-	163.4	162.4	5.1	2.7	<.1	28	3.3	-	JWD
		42	-						Meq/l	105.2	5.13	42.99	7.50	0	20.30	98.19	40.23	-									
4-19-72	W90.2	107.6	6.6	14,650	9,840	13.40	66	21.0	Mg/l	-	-	-	-	-	-	-	-	1.3	160.6	158.7	5.1	2.9	<.1	29	3.8	-	KER
		41.75	-						Meq/l	105.7	4.86	40.60	10.10	0	20.20	97.09	36.51	-									
5-1-72	W23.2	107.2	6.9	14,500	9,870	13.40	65.5	21.0	Mg/l	-	-	-	-	-	-	-	-	2.1	161.3	153.8	5.0	2.5	<.1	27	2.5	0.763	JWD
		41.75	-						Meq/l	105.7	4.86	40.00	10.50	0	19.95	96.85	37.18	-									
5-11-72	W36.2	107.2	7.0	14,500	9,860	13.4	65.7	21	Mg/l	-	-	-	-	-	-	-	-	1.8	161.0	154.0	5.0	2.5	<.1	28	2.0	0.763	JWD
		41.75	-						Meq/l	102.4	4.77	39.60	10.30	0	20.00	97.09	36.33	-									
5-19-72	W65.2	107.2	6.9	14,390	9,840	13.4	64.9	20.4	Mg/l	-	-	-	-	-	-	-	-	< .5	157.7	153.4	5.3	2.6	<.1	29	2.3	0.745	EB
		42.0	-						Meq/l	103.8	4.77	39.00	11.20	0	19.05	96.85	36.50	-									
5-26-72	W80.2	107.6	6.7	14,130	9,840	13.4	65.4	20.7	Mg/l	-	-	-	-	-	-	-	-	< .5	158.8	152.4	5.4	2.6	<.1	29	2.3	0.747	EB
		42.75	-						Meq/l	102.6	4.68	42.60	9.40	0	20.10	96.85	40.16	0.03									
6-2-72	W90.2	100	6.9	14,680	9,760	13.27	64.4	20.1	Mg/l	-	-	-	-	-	-	-	-	1.6	159.3	157.1	5.2	2.4	<.1	25	2.6	0.762	EB
		42.75	-						Meq/l	103.7	4.77	41.70	9.70	0	20.05	99.00	39.00	-									
6-8-72	W08.2	109	6.8	14,230	9,748	13.26	64.9	19.7	Mg/l	-	-	-	-	-	-	-	-	<1.0	159.9	158.1	4.4	2.6	<1.	28	3.8	0.763	EB
		42.5	-						Meq/l	104.1	4.86	43.30	8.58	0	20.00	99.25	38.16	-									
6-16-72	W21.2	108.5	6.5	14,130	9,709	13.20	64.7	20.5	Mg/l	-	-	-	-	-	-	-	-	<1.0	160.8	157.4	4.4	2.7	<1	28	3.4	0.780	DLB
		42.5	-						Meq/l	102.2	5.70	38.60	5.88	0	13.73	99.00	39.00	-									
7-13-72	W94.2	108.5	7.2	13,800	9,428	12.81	67.1	-	Mg/l	-	-	-	-	-	-	-	-	-	152.4	151.7	3.4	2.19	<1	29	-	0.751	KER
		42.5	-						Meq/l	103.9	5.70	42.20	9.16	0	20.64	100.9	38.50	-									
8-30-72	W20.2	108.5	7.2	14,400	9,825	13.36	64.5	-	Mg/l	-	-	-	-	-	-	-	-	-	161.0	160.0	5.1	2.81	<1	29	-	0.687	LRP

1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated at 180° C
Remarks:
3/ Combination of the flow through Weirs 1a and 1b

Table A-5
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Sheet 2 of 2

Station No. Source #1 Description of Sampling Site Southside of River - West Spring LaVerkin Springs Analysis by ____

	Date Sampled	Lab. No.	Field/Lab Temp. C/F	Field/Lab pH	ECx10^6 at 25°C.	Dissolved Solids 2/ 1/ ppm-mg/l	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO3	Anions HCO3	Anions Cl	Anions SO4	Anions NO3	Total Cation meq/l	Total Anion meq/l	Minor Elements (ppm) B	F	Fe	SiO2	PO4	7/ Qty. cfs	By
			41.1	-						Meq/l	101.7	5.70	42.10	9.66	0	20.49	97.00	38.50	-									
3/	10-5-72	W605.2	106.2	6.5	14,040	9,730	13.23	63.9	-	Mg/l	-	-	-	-	-	-	-	-	-	159.2	156.0	5.2	2.87	<.1	29	-	0.196	DLJ
			41.1	-						Meq/l	101.0	5.70	42.20	8.87	0	20.64	96.00	38.50	-									
4/	10-5-72	W606.2	106.0	6.5	14,040	9,731	13.23	64.0	-	Mg/l	-	-	-	-	-	-	-	-	--	157.8	155.1	5.2	2.90	<.1	29	-	0.302	DLJ
			41.4	-						Meq/l	101.2	5.76	43.60	8.26	0	20.75	98.98	38.50	-									
5/	10-6-72	W607.2	106.5	6.5	13,970	9,878	13.43	63.7	-	Mg/l	-	-	-	-	-	-	-	-	-	158.8	158.2	4.9	2.70	<.1	29	-	0.514	KEE
			43.9 6/	-						Meq/l	104.1	5.50	42.20	10.57	0	20.49	99.18	38.75	-									
	10-27-72	W690.2	111.0	6.3	14,200	9,796	13.32	64.1	-	Mg/l	-	-	-	-	-	-	-	-	-	162.4	158.4	5.0	2.82	<.1	29	-	0.657	JWH
			43.9	-						Meq/l	103.5	5.61	39.80	12.77	0	20.44	99.18	38.50	-									
	11-6-72	W696.2	111.0	6.3	14,170	9,794	13.32	64.0	-	Mg/l	-	-	-	-	-	-	-	-	-	161.7	158.1	5.0	2.84	<.1	29	-	0.641	MH
										Meq/l / Mg/l																		
										Meq/l / Mg/l																		
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										Meq/l / Mg/l																		
										Meq/l / Mg/l																		

Remarks:

1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated at 180°C
3/ Sample taken after 47 hours and 30 minutes of pumping--Pump Test #4
4/ Sample taken 1 hour and 20 minutes after Pump Test #4 was stopped
5/ Sample taken 16 hours after Pump Test #4 was stopped
6/ New thermometer
7/ Combination of flow through Weirs 1a and 1b

Table A-6

CHEMICAL ANALYSES

Colorado River Water Quality Improvement Program

Point Source Division, LaVerkin Springs Unit, Utah

Station No. Source #2 Description of Sampling Site Southside of River - East Springs LaVerkin Springs Analysis by

Date Sampled	Lab. No.	Field Lab Temp. °C/F	Field Lab pH	EC x 10^6 at 25°C.	Dissolved Solids 2/ ppm/1 mg/l	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/l	Total Anion meq/l	Minor Elements (ppm) B	F	Fe	SiO_2	PO_4	3/ Qty. cfs	By
2-11-72	W40.2	42 / 107.6	- / 6.3	14,140	9,830	13.37	66	22	Meq/l	110.4	5.31	39.92	11.33	0	20.05	100.5	42.82	-									
									Mg/l	-	-	-	-	-	-	-	-	-	167.0	161.4	5.0	2.7	<.1	32.5	-	-	ASD
2-18-72	W52.2	42 / 107.6	- / 6.5	14,000	9,840	13.38	65.1	20.9	Meq/l	107.3	5.06	42.66	9.90	0	20.25	97.00	44.79	-									
									Mg/l	-	-	-	-	-	-	-	-	-	164.9	162.0	5.0	2.6	<.1	31	<1.0	-	JWD
2-25-72	W96.2	42 / 107.6	- / 6.8	14,420	9,800	13.33	65.7	22	Meq/l	110.0	5.06	36.78	13.68	0	20.50	97.80	44.12	-									
									Mg/l	-	-	-	-	-	-	-	-	-	167.5	162.4	5.0	2.8	<.1	31	<1.0	-	JWD
3-3-72	W113.2	- / -	- / 6.9	13,890	9,850	13.40	65.9	21.7	Meq/l	106.6	5.13	42.15	10.34	0	20.10	97.80	43.24	-									
									Mg/l	-	-	-	-	-	-	-	-	-	164.2	162.1	5.1	2.8	<.1	28	3.2	-	JWD
3-10-72	W131.2	42 / 107.6	- / 6.5	13,940	9,840	13.38	66.5	22.2	Meq/l	107.8	5.13	42.45	9.19	0	20.40	97.80	43.27	-									
									Mg/l	-	-	-	-	-	-	-	-	-	164.6	161.5	5.1	2.7	<.1	28	3.2	-	JWD
3-17-72	W135.2	42 / 107.6	- / 6.5	13,330	9,830	13.37	66.2	21.9	Meq/l	106.6	5.13	41.53	10.11	0	20.40	99.43	44.05	-									
									Mg/l	-	-	-	-	-	-	-	-	-	163.4	163.5	5.1	2.7	<.1	28	3.3	-	JWD
4-19-72	W191.2	42 / 107.6	- / 6.7	14,650	9,840	13.4	66	21.0	Meq/l	105.2	5.13	42.90	8.40	0	19.90	97.94	40.23	-									
									Mg/l	-	-	-	-	-	-	-	-	1.3	160.6	158.1	5.1	3.0	<.1	29	3.8	-	EER
5-1-72	W224.2	41.75 / 107.2	- / 6.9	14,500	9,850	13.4	65.5	21.0	Meq/l	105.2	4.86	40.00	10.40	0	20.00	97.09	39.34	-									
									Mg/l	-	-	-	-	-	-	-	-	2.1	160.5	156.4	5.0	2.5	<.1	27	2.5	0.160	JWD
5-19-72	W266.2	41.75 / 107.2	- / 6.9	14,390	9,830	13.4	65.4	20.8	Meq/l	104.8	4.77	40.20	10.40	0	19.60	97.09	37.33	-									
									Mg/l	-	-	-	-	-	-	-	-	<.5	160.2	154.2	5.2	2.6	<.1	29	2.3	0.173	EB
5-26-72	W281.2	41.75 / 107.2	- / 6.8	14,230	9,840	13.4	65.4	20.7	Meq/l	103.8	4.77	39.70	10.50	0	20.15	97.33	36.83	-									
									Mg/l	-	-	-	-	-	-	-	-	<.5	158.8	154.3	5.4	2.6	<.1	29	2.3	0.160	EB
6-2-72	W291.2	42.75 / 109	- / 7.0	14,680	9,770	13.29	64.4	20.1	Meq/l	102.6	4.68	43.20	8.70	0	19.80	96.85	40.00	0.02									
									Mg/l	-	-	-	-	-	-	-	-	1.6	159.2	156.2	2.4	<.1	25	2.6	0.160	EB
6-8-72	W309.2	42.75 / 109	- / 6.8	14,130	9,764	13.28	65.4	19.6	Meq/l	103.2	4.77	43.20	6.69	0	20.00	98.75	38.50	-									
									Mg/l	-	-	-	-	-	-	-	-	<1.0	159.7	157.4	4.4	2.8	<.1	28	3.8	0.160	EB
6-16-72	W322.2	42.75 / 109	- / 6.6	14,130	9,740	13.25	64.7	20.4	Meq/l	104.0	4.77	43.00	8.99	0	20.00	98.49	37.50	-									
									Mg/l	-	-	-	-	-	-	-	-	<1.0	160.7	156.0	4.4	2.7	<.1	28	3.4	0.173	DLB
7-13-72	W395.2	42.5 / 108.5	- / 7.1	13,900	9,458	12.86	67.3	-	Meq/l	103.5	5.70	36.60	8.09	0	14.09	98.00	38.50	-									
									Mg/l	-	-	-	-	-	-	-	-	-	153.9	150.6	3.4	2.23	<.1	29	-	0.180	EER
8-30-72	W521.2	42.5 / 108.5	- / 7.3	14,400	9,832	13.37	64.5	-	Meq/l	103.9	5.70	42.50	9.16	0	20.80	99.00	38.50	-									
									Mg/l	-	-	-	-	-	-	-	-	-	161.3	158.3	5.0	2.88	<.1	29	-	0.135	LRP

1/ Ppm equals mg/l up to 7,000 ppm.

2/ Evaporated at 180°C

Remarks:

3/ The discharge at Weir #2

Table A- 6
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Sheet 2 of 2

Station No. Source #2 Description of Sampling Site Southside of River - East Springs LaVerkin Springs Analysis by

	Date Sampled	Lab. No.	Field / Lab Temp. °C/°F	Field / Lab pH	$ECx10^6$ at 25°C.	Dissolved Solids 2/ 1/ ppm- mg/l	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/l	Total Anion meq/l	Minor Elements B	Minor Elements F	Minor Elements Fe	Minor Elements SiO_2	Minor Elements PO_4	Qty. cfs	By
			42.5	-						Meq/l	101.6	5.76	43.30	7.40	0	20.15	97.51	37.00	-									
3/	9-9-72	537.2	108.5	6.9	14,200	9,780	13.30	64.3	-	Mg/l	-	-	-	-	-	-	-	-	-	158.1	154.7	4.5	2.70	<.1	28	-	0.032	RR
			40.6	-						Meq/l	101.2	5.76	44.60	7.16	0	20.49	97.02	38.25	-									
4/	10-5-72	608.2	105.0	6.6	13,950	9,713	13.07	63.7	-	Mg/l	-	--	-	-	-	-	-	-	-	158.7	155.8	4.8	2.7	<.1	29	-	6/	EER
			40.8	-						Meq/l	101.6	5.76	44.00	7.36	0	20.90	98.00	38.75	-									
5/	10-6-72	609.2	105.5	6.5	13,950	9,760	13.27	63.7	-	Mg/l	-	-	-	-	-	-	-	-	-	158.7	157.7	4.8	2.7	<.1	29	-	0.004	EER
			43.9	-						Meq/l	104.1	5.50	42.20	9.36	0	20.12	99.18	38.75	-									
	10-27-72	691.2	111.0	6.5	14,200	9,795	13.32	64.6	-	Mg/l	-	-	-	-	-	-	-	-	-	161.2	158.1	5.0	2.82	<.1	29	-	0.129	JWI
			43.9	-						Meq/l	103.5	5.61	37.20	14.06	0	20.23	100.3	38.50	-									
	11-6-72	697.2	111.0	6.3	14,170	9,804	13.33	64.5	-	Mg/l	-	-	-	-	-	-	-	-	-	160.4	159.0	5.0	2.85	<.1	29	-	0.106	MH
										Meq/l																		
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										Mg/l																		

1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated at 180°C

6/ There was no flow over the weir

Remarks:

3/ Sample taken after 11 hours of pumping--Pump Test #1
4/ Sample taken after 47 hours and 40 minutes of pumping--Pump Test #4
5/ Sample taken 16 hours after Pump Test #4 was stopped

Table A-7
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Station No. Source #3 Description of Sampling Site Northside of River - East of Rock House LaVerkin Springs Analysis by

Date Sampled	Lab. No.	Field Temp. °C/F	Lab pH	ECx10⁶ at 25°C.	Dissolved Solids 2/1 ppm mg/l	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/l	Total Anion meq/l	Minor Elements (ppm) B	F	Fe	SiO_2	PO_4	3/ Qty. cfs	By
1-31-72	W24.2	39 102.2	- 6.4	14,000	9,470	12.88	66	21.3	Meq/1	106.2	5.04	39.72	9.93	0	19.75	96.50	41.32	-									
									Mg/1	-	-	-	-	-	-	-	-	-	160.9	157.6	4.9	2.8	<.1	35	0	-	JWD
2-4-72	W27.2	39 102.2	- 6.6	14,000	9,460	12.87	65.9	21.3	Meq/1	106.2	5.04	39.62	10.23	0	19.50	96.75	41.32	-									
									Mg/1	-	-	-	-	-	-	-	-	-	161.1	157.6	4.9	2.8	<.1	35	0	-	JWD
2-11-72	W46.2	39 102.2	- 6.5	13,700	9,360	12.81	66	21	Meq/1	105.3	5.07	39.12	10.73	0	19.35	96.50	42.65	-									
									Mg/1	-	-	-	-	-	-	-	-	-	160.2	158.5	5.0	2.7	<.1	30	-	-	ASD
2-18-72	W50.2	39 102.2	- 6.5	13,500	9,510	12.93	64.7	20.4	Meq/1	103.4	4.86	41.23	10.21	0	19.50	92.88	43.13	-									
									Mg/1	-	-	-	-	-	-	-	-	-	159.7	156.5	5.0	2.5	<.1	31	< 1.0	-	JWD
3-2-72	W111.2	39 102.2	- 6.9	13,520	9,500	12.92	65.6	21.1	Meq/1	102.4	4.95	40.31	10.84	0	19.50	97.50	41.69	-									
									Mg/1	-	-	-	-	-	-	-	-	-	158.5	159.0	5.1	2.8	<.1	28	3.2	-	JWD
3-10-72	W129.2	39 102.2	- 6.5	13,660	9,460	12.87	65.9	21.3	Meq/1	102.4	4.95	40.31	10.10	0	19.65	93.90	42.87	-									
									Mg/1	-	-	-	-	-	-	-	-	-	157.8	156.4	5.1	2.7	<.1	28	3.2	-	JWD
3-17-72	W133.2	39.25 102.7	- 6.5	13,160	9,480	12.89	66.1	21.5	Meq/1	103.5	4.95	40.62	9.79	0	19.70	94.66	42.08	-									
									Mg/1	-	-	-	-	-	-	-	-	-	158.9	156.6	5.1	2.7	<.1	28	3.3	-	JWD
4-19-72	W189.2	39.5 103.1	- 6.7	14,250	9,440	12.8	65	20.4	Meq/1	100.4	4.86	40.20	8.80	0	19.10	93.33	38.53	-									
									Mg/1	-	-	-	-	-	-	-	-	1.3	153.7	150.7	5.1	3.0	<.1	28	3.5	-	KER
5-1-72	W222.2	39.5 103.1	- 7.0	14,000	9,370	12.7	65.2	20	Meq/1	101.0	4.68	38.90	10.30	0	19.10	92.99	38.91	-									
									Mg/1	-	-	-	-	-	-	-	-	2.1	154.9	150.1	5.0	2.5	<.1	27	2.5	0.788	JWD
5-11-72	W235.2	39.5 103.1	- 6.8	13,900	9,500	12.9	65.2	20	Meq/1	101.0	4.68	39.50	9.70	0	19.60	92.75	35.86	-									
									Mg/1	-	-	-	-	-	-	-	-	1.8	154.9	148.2	5.0	2.5	<.1	28	2.0	0.750	JWD
5-19-72	W64.2	39.5 103.1	- 6.9	13,720	9,480	12.9	64.7	19.6	Meq/1	98.26	4.50	38.10	11.10	0	19.10	92.75	36.33	-									
									Mg/1	-	-	-	-	-	-	-	-	<.5	152.0	148.2	5.2	2.6	<.1	29	2.3	0.788	KES
5-26-72	W279.2	39.75 103.6	- 6.8	13,660	9,870	13.4	65	20.1	Meq/1	99.72	4.50	40.20	8.50	0	19.75	92.50	36.00	-									
									Mg/1	-	-	-	-	-	-	-	-	<.5	153.3	148.3	5.4	2.6	<.1	28	2.3	0.750	EB
6-2-72	W292.2	40.75 105.4	- 6.9	14,470	9,390	12.77	64.2	19.7	Meq/1	96.55	4.50	42.00	8.30	0	19.20	92.75	32.83	0.03									
									Mg/1	-	-	-	-	-	-	-	-	1.6	153.4	150.8	5.2	2.4	<.1	25	2.6	0.750	EB
6-8-72	W310.2	42.5 108.5	- 6.8	13,740	9,388	12.77	64.3	19.7	Meq/1	98.56	4.50	42.20	8.00	0	19.45	94.55	37.33	-									
									Mg/1	-	-	-	-	-	-	-	-	<1.0	153.3	151.3	4.4	2.8	<.1	28	3.8	0.788	EB
6-16-72	W323.2	40.75 105.4	- 6.6	13,650	9,356	12.72	63.5	19.0	Meq/1	95.60	4.59	42.00	8.10	0	19.40	93.50	36.83	-									
									Mg/1	-	-	-	-	-	-	-	-	<1.0	150.6	149.8	4.4	2.7	<.1	28	3.4	0.750	DLB

1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated at 180°C.
Remarks:
3/ Combined flow @ Weir Nos. 3 and 4.

Sheet 2 of 2

Station No. Source #3 Description of Sampling Site Northside of River - East of Rock House LaVerkin Springs Analysis by

Date Sampled	Lab. No.	Field Lab Temp. °C/F	Field Lab pH	ECx10[6] at 25°C.	Dissolved Solids ppm mg/l [2/][1/]	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/l	Total Anion meq/l	Minor Elements B	Minor Elements F	Minor Elements Fe	Minor Elements SiO_2	Minor Elements PO_4	Qty. cfs	By
		40.75	-						Meq/l	99.78	5.50	35.70	7.98	0	13.68	94.10	37.25	-									
7-13-72	W396.2	105.4	7.2	13,600	9,095	12.37	67	-	Mg/l	-	-	-	-	-	-	-	-	-	149.0	145.0	3.3	2.20	<.1	29	-	0.675	EE
		41.0	-						Meq/l	100.3	5.50	43.60	7.25	0	20.28	94.10	37.50	-									
8-30-72	W522.2	105.8	7.1	13,700	9,440	12.84	64	-	Mg/l	-	-	-	-	-	-	-	-	-	156.7	151.9	5.0	2.74	<.1	29	-	0.826	EE
3/		39.2	-						Meq/l	98.62	5.58	45.20	5.05	0	20.12	95.06	37.75	-									
4/ 10-6-72	W610.2	102.5	6.6	13,620	9,464	12.87	63.8	-	Mg/l	-	-	-	-	-	-	-	-	-	154.5	152.9	4.8	2.7	<.1	29	-	0.500	EE
		42.5	-						Meq/l	99.81	5.39	40.60	11.47	0	19.86	95.40	37.50	-									
10-27-73	692.2	108.5	6.6	13,700	9,506	12.93	63.5	-	Mg/l	-	-	-	-	-	-	-	-	-	157.3	152.8	5.0	2.76	<.1	29	-	0.569	JW
		42.5	-						Meq/l	99.81	5.39	36.40	13.36	0	19.92	95.94	37.00	-									
11-6-72	W698.2	108.5	6.4	13,690	9,484	12.90	63.6	-	Mg/l	-	-	-	-	-	-	-	-	-	157.0	152.9	5.0	2.77	<.1	29	-	0.534	MH

1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated at 180°C.

Remarks:
3/ Sample taken 16 hours after Pump Test #4 stopped.
4/ Flood sediments covered site so exact location could not be recognized.

Table A-8
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Station No. Source #4 Description of Sampling Site Northside of River - Larger Issue South of Rock House and West of Source #3 - LaVerkin Springs Analysis by

Date Sampled	Lab. No.	Field Lab Temp. C°/F.	Field Lab pH	EC x 10^6 at 25°C.	Dissolved Solids 2/ ppm mg/l	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/l	Total Anion meq/l	Minor Elements (ppm) B	F	Fe	SiO_2	PO_4	3/ Qty. cfs	By
2-2-72 W	25.2	42/107.6	- 6.4	14,500	9,800	13.33	66.3	21.9	Meq/l	110.7	5.16	40.12	10.93	0	80.20	100.5	42.16	-									
									Mg/l	-	-	-	-	-	-	-	-	-	166.9	162.9	4.9	2.9	< .1	35	0	-	JWD
2-4-72 W	26.2	42/107.6	- 6.6	14,500	9,800	13.33	66.4	21.9	Meq/l	110.7	5.16	40.22	10.73	0	80.20	101.5	40.99	-									
									Mg/l	-	-	-	-	-	-	-	-	-	166.8	162.7	4.9	2.9	< .1	35	0	-	JWD
2-11-72W	47.2	42/107.6	- 6.3	14,140	9,790	13.31	66	21	Meq/l	108.6	5.13	40.72	10.33	0	80.25	99.75	41.32	-									
									Mg/l	-	-	-	-	-	-	-	-	-	164.8	161.3	5.2	2.7	< .1	31	-	-	ASD
2-18-72W	49.2	42/107.6	- 6.5	14,000	9,790	13.31	64.8	20.7	Meq/l	106.2	5.00	41.64	11.10	0	80.30	96.27	44.94	-									
									Mg/l	-	-	-	-	-	-	-	-	-	163.8	161.5	5.0	2.6	< .1	31	< 1.0	-	JWD
2-25-72W	93.2	42/107.6	- 6.5	14,320	9,760	13.27	65.7	22	Meq/l	110.0	5.06	39.39	13.07	0	80.30	97.20	43.59	-									
									Mg/l	-	-	-	-	-	-	-	-	-	167.5	161.1	5.0	2.8	< .1	31	< 1.0	-	JWD
3-2-72 W	110.2	42/107.6	- 6.8	13,790	9,780	13.30	65.8	21.6	Meq/l	105.8	5.13	41.06	11.11	0	80.10	96.99	43.27	-									
									Mg/l	-	-	-	-	-	-	-	-	-	163.1	160.3	5.1	2.8	< .1	28	3.2	-	JWD
3-10-72W	128.2	42/107.6	- 6.6	13,850	9,780	13.30	65.7	21.5	Meq/l	105.2	5.13	42.15	10.01	0	80.35	97.50	42.87	-									
									Mg/l	-	-	-	-	-	-	-	-	-	162.5	160.7	5.1	2.7	< .1	28	3.2	-	JWD
3-17-72W	132.2	42/107.6	- 6.4	13,330	9,790	13.31	66.7	22.4	Meq/l	109.2	5.13	40.62	11.02	0	80.15	99.13	44.05	-									
									Mg/l	-	-	-	-	-	-	-	-	-	166.0	163.3	5.1	2.7	< .1	28	3.3	-	JWD
4-19-72W	188.2	42/107.6	- 6.6	14,650	9,790	13.3	66	21.0	Meq/l	105.2	5.04	41.50	8.70	0	80.15	96.97	39.56	-									
									Mg/l	-	-	-	-	-	-	-	-	1.3	160.4	156.7	5.1	3.0	< .1	29	3.8	-	EER
5-1-72 W	221.2	42/107.6	- 6.8	14,390	9,810	13.3	65.7	21.0	Meq/l	105.7	4.86	39.20	11.00	0	80.05	96.61	39.43	-									
									Mg/l	-	-	-	-	-	-	-	-	2.1	160.8	156.1	5.0	2.5	< .1	27	2.5	0.788	JWD
5-8-72 W	232.2	42/107.6	- 6.9	14,390	9,820	13.4	65.6	21	Meq/l	105.2	4.86	40.20	10.00	0	19.95	96.13	37.28	-									
									Mg/l	-	-	-	-	-	-	-	-	2.1	160.3	153.4	5.0	2.5	< .1	27	2.5	0.750	JWD
5-11-72W	234.2	42/107.6	- 6.9	14,390	9,800	13.3	65.5	21	Meq/l	104.8	4.86	40.00	10.20	0	80.05	96.13	40.16	-									
									Mg/l	-	-	-	-	-	-	-	-	1.8	159.9	156.3	5.1	2.5	< .1	28	2.0	0.750	EB
5-19-72W	263.2	42/107.6	- 6.9	14,290	9,730	13.2	65.1	20.4	Meq/l	102.4	4.68	39.20	11.10	0	80.00	96.61	36.67	-									
									Mg/l	-	-	-	-	-	-	-	-	< .5	157.4	153.3	5.2	2.6	< .1	29	2.3	0.788	EB
5-26-72W	278.2	42/107.6	- 6.7	14,130	9,780	13.3	65.1	20.5	Meq/l	102.4	4.77	39.50	10.50	0	19.95	96.37	36.83	-									
									Mg/l	-	-	-	-	-	-	-	-	< .5	157.2	153.2	5.3	2.6	< .1	29	2.3	0.750	EB
6-2-72 W	293.2	42.75/109	- 6.9	13,790	9,740	13.25	64.5	20.1	Meq/l	102.2	4.68	43.00	8.50	0	19.75	91.54	39.66	0.03									
									Mg/l	-	-	-	-	-	-	-	-	1.6	158.4	151.0	5.2	2.4	< .1	25	2.6	0.750	EB

1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated at 180°C.
Remarks:

3/ Combined flow @ Weir Nos. 3 and 4.

Table A-3
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Sheet 2 of 2

Station No. Source #4   Description of Sampling Site Northside of River - Larger Issue South of Rock House and West of Source #3 - LaVerkin Springs   Analysis by ______

Date Sampled	Lab. No.	Field / Lab Temp. °C/°F	Field / Lab pH	ECx10⁶ at 25°C.	Dissolved Solids 2/ 1/ ppm mg/l	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO3	Anions HCO3	Anions Cl	Anions SO4	Anions NO3	Total Cation meq/l	Total Anion meq/l	Minor Elements B	Minor Elements F	Minor Elements Fe	Minor Elements SiO2	Minor Elements PO4	3/ Qty. cfs	By
6-8-72	W311.2	42.25	-	14,130	9,680	13.16	64.7	20.4	Meq/1	103.2	4.77	44.20	7.20	0	19.85	98.01	38.00	-	159.4	155.9	4.4	2.8	< .1	28	3.8	0.788	EE
		108.1	6.8						Mg/1	-	-	-	-	-	-	-	-	< 1.0									
6-16-72	W324.2	42.5	-	14,030	9,680	13.16	64.9	20.5	Meq/1	103.7	4.77	42.80	8.60	0	20.00	97.51	37.66	-	159.9	155.2	4.4	2.7	< .1	28	3.4	0.750	DL
		108.5	6.6						Mg/1	-	-	-	-	-	-	-	-	< 1.0									
7-13-72	W397.2	42.2	-	13,800	9,349	12.71	68.0	-	Meq/1	103.4	5.60	35.30	7.77	0	13.21	98.50	37.50	-	152.1	149.2	4.2	2.19	< .1	29	-	0.675	EE
		108	7.2						Mg/1	-	-	-	-	-	-	-	-	-									
8-30-72	W523.2	42.5	-	14,100	9,723	13.22	64.1	-	Meq/1	102.7	5.70	43.00	8.66	0	20.38	97.50	38.50	-	160.1	156.4	5.0	2.90	< .1	29	-	0.826	LR
		108.5	7.1						Mg/1	-	-	-	-	-	-	-	-	-									
4/ 10-5-72	W611.2	40.8	-	13,770	9,712	13.21	63.7	-	Meq/1	101.2	5.75	44.60	6.96	0	20.96	97.02	38.50		158.7	156.5	4.8	2.7	< .1	29	-	0.403	EE
		105.5	6.6						Mg/1	-	-	-	-	-	--	-	-	-									
5/ 10-6-72	W612.2	40.8	-	13,770	9,753	13.26	64.1	-	Meq/1	101.2	5.76	43.40	7.56	0	20.64	98.98	38.50	-	157.9	158.1	4.3	2.7	< .1	29	-	0.500	EE
		105.5	6.6						Mg/1	-	-	-	-	-	-	-	-	-									
10-27-72	W693.2	43.6 6/	-	14,000	9,780	13.30	64.7	-	Meq/1	103.5	5.61	41.60	9.25	0	20.33	99.18	38.50	-	160.0	158.0	5.0	2.80	< .1	29	-	0.569	JW
		110.5 6/	6.6						Mg/1	-	-	-	-	-	-	-	-	-									
11-6-72	W699.2	43.3	-	14,170	9,795	13.32	64.3	-	Meq/1	104.1	5.61	35.70	13.37	0	20.44	100.3	38.50	-	161.8	159.2	5.0	2.77	< .1	29	-	0.534	MH
		110	6.4						Mg/1	-	-	-	-	-	-	-	-	-									
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1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated @ 180°C

6/ New thermometer used.

Remarks:

3/ Combined flow of Sources Nos. 3 and 4.
4/ Sample taken after 44 hours and 15 minutes of pumping - Pump Test #4.
5/ Sample taken 16 hours after Pump Test #4 was stopped.

Table A-9
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

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Station No. Source #5 Description of Sampling Site Discharge from 1½" Pipe Near Baths - Southside of River - LaVerkin Springs Analysis by __________

	Date Sampled	Lab. No.	Field/Lab Temp. °C/°F	Field/Lab pH	$ECx10^6$ at 25°C	Dissolved Solids 2/ 1/ ppm-mg/1	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/1	Total Anion meq/1	Minor Elements (ppm) B	F	Fe	SiO_2	PO_4	By
	2-11-72	W 39.2	39.75	-	14,140	9,180	13.34	67	23	Meq/1	111.6	5.25	40.32	8.73	0	20.20	100.5	42.65	-	165.9	163.4	5.1	2.7	< .1	31.0	-	ASD
			103.6	6.3						Mg/1	-	-	-	-	-	-	-	-	-								
3/	5-1-72	W225.2	36.0	-	14,500	9,840	13.4	65.5	21	Meq/1	105.2	4.86	39.70	10.70	0	20.25	97.09	38.86	-	160.5	156.2	5.0	2.5	< .1	27.0	2.5	JWD
			96.8	7.1						Mg/1	-	-	-	-	-	-	-	-	2.1								
	5-19-72	W267.2	-	-	14,390	9,840	13.4	65.4	20.8	Meq/1	104.8	4.77	39.60	11.00	0	20.10	97.33	37.33	-	160.2	154.0	5.2	2.6	< .1	29	2.3	EB
			-	6.9						Mg/1	-	-	-	-	-	-	-	-	< .5								
										Meq/1																	
										Mg/1																	
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1/ Ppm equals mg/1 up to 7,000 ppm.
2/ Evaporated at 180°C.
Remarks:
3/ Temperature on 4-29-72 35.20°C.

Table A-10
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Sheet ______ of ______

Station No. Source #6 Description of Sampling Site West side issue of West Spring (Source #1) south side river--LaVerkin Springs Analysis by ____________

Date Sampled	Lab. No.	Field/Lab Temp. °C/F	Field/Lab pH	ECx10[6] at 25°C.	Dissolved Solids ppm[1/] mg/l	Dissolved Solids [2/] Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/l	Total Anion meq/l	Minor Elements ppm B	F	Fe	SiO_2	PO_4	Mn	By
2-11-72	W41.2	42.25	-						Meq/l	111.0	5.25	40.52	10.73	0	20.30	100.5	44.82	-									
		108.1	6.3	14,240	9,850	13,40	66	22	Mg/l	-	-	-	-	-	-	-	-	-	167.5	165.6	5.1	2.7	<.1	30.0	0.4	0.03	ASI
5-1-72	W226.2	42	-						Meq/l	105.2	4.95	41.00	9.40	0	19.90	97.09	38.77	-									
		107.6	7.0	14,500	9,560	13.4	65.5	21	Mg/l	-	-	-	-	-	-	-	-	2.1	160.6	155.8	5.0	2.5	<.1	27	2.5		JWE
5-19-72	W268.2	42	-						Meq/l	105.2	4.77	39.50	10.60	0	19.80	97.58	36.83	-									
		107.6	6.8	14,390	9,860	13.4	65.6	21.0	Mg/l	-	-	-	-	-	-	-	-	<4.5	160.4	154.2	5.2	2.6	<.1	29	2.3		EB

1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated at 180°C.
Remarks:

Table A-11
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

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Station No. Source #7 Description of Sampling Site Southside of River -- Issue East of Masonary Wall--LaVerkin Springs Analysis by ----

Date Sampled	Lab. No.	Field/Lab Temp. °C/F	Field/Lab pH	ECx10[6] at 25°C.	Dissolved Solids [2/] ppm[1/] mg/1	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/1	Total Anion meq/1	Minor Elements (PPM) B	F	Fe	SiO_2	PO_4	By cfs
2-11-72	W 37.2	42.0 / 107.6	-- / 6.5	14,140	9,830	13.37	71	24	Meq/1 / Mg/1	112.0 / --	5.25 / --	39.72 / --	11.23 / --	0 / --	20.30 / --	100.0 / --	42.82 / --	-- / --	168.2	163.1	5.2	2.7	<.1	32.5	--	ASD
5-1-72	W227.2	42.0 / 107.6	-- / 7.1	14,500	9,860	13.4	65.5	21	Meq/1 / Mg/1	105.2 / --	4.86 / --	40.20 / --	10.30 / --	0 / --	20.15 / --	96.85 / --	37.18 / --	-- / 2.1	160.6	154.2	5.0	2.5	<.1	27	2.5	JWD
5-19-72	W269.2	42.0 / 107.6	-- / 6.8	14,390	9,840	13.4	65.6	21.0	Meq/1 / Mg/1	105.2 / --	4.77 / --	39.60 / --	10.80 / --	0 / --	20.00 / --	97.09 / --	36.50 / --	-- / <.5	160.4	153.6	5.4	2.6	<.1	28	2.3	EB
5-26-72	W282.2	42.0 / 107.6	-- / 7.1	14,680	9,780	13.30	64.5	20.2	Meq/1 / Mg/1	103.1 / --	4.77 / --	41.20 / --	10.70 / --	0 / --	20.10 / --	96.85 / --	39.50 / --	0.035 / 2.1	159.8	156.5	4.7	2.4	<.1	25	2.8	EB
6-8-72	W312.2	42.5 / 108.5	-- / 6.9	14,130	9,756	13.27	64.7	20.3	Meq/1 / Mg/1	103.2 / --	4.77 / --	43.40 / --	8.20 / --	0 / --	20.15 / --	99.00 / --	38.00 / --	-- / <1.0	159.6	157.2	4.4	2.8	<.1	28	3.8	EB
									Meq/1 / Mg/1																	
									Meq/1 / Mg/1																	
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									Meq/1 / Mg/1																	

1/ Ppm equals mg/1 up to 7,000 ppm.
2/ Evaporated at 180°C.
Remarks:

Table A-12
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Sheet ______ of ______

Station No. Source #8 Description of Sampling Site Northside of River--Most Westerly of the Two Ponds--"V"-Notched Weir Located Here--Southwest of Rock House--LaVerkin Springs Analysis by ----

Date Sampled	Lab. No.	Field/Lab Temp. °C/F	Field/Lab pH	ECx10[6] at 25°C.	Dissolved Solids ppm[1] mg/l [2]	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/l	Total Anion meq/l	Minor Elements (ppm) B	F	Fe	SiO_2	PO_4	Qty. cfs	By
		41.0	--						Meq/l	107.4	5.04	39.22	11.13	0	19.95	97.75	44.98	--									
2-11-72	W 43.2	105.8	6.4	13,940	9,560	13.00	66	21	Mg/l	--	--	--	--	--	--	--	--	--	162.8	162.3	5.0	2.7	<.1	31.0	--	--	ASD
		39.5	--						Meq/l	102.0	4.68	39.10	10.40	0	19.50	92.99	36.28	--									
5-1-72	W228.2	103.1	7.1	14,100	9,560	13.0	65.3	21	Mg/l	--	--	--	--	--	--	--	--	2.1	156.2	148.8	5.0	2.5	<.1	27	2.5	0.171	JWD
		39.25	--						Meq/l	101.0	4.59	39.70	9.60	0	19.40	93.47	35.33	--									
5-19-72	W270.2	102.7	6.8	14,000	9,540	13.0	65.2	20.3	Mg/l	--	--	--	--	--	--	--	--	<.5	154.9	148.2	5.2	2.6	<.1	29	2.3	0.184	EB
		41.5	--						Meq/l	100.5	5.50	34.50	8.16	0	12.90	94.60	37.00	--									
7-13-72	W398.2	106.7	7.3	13,600	9,105	12.39	67.6	--	Mg/l	--	--	--	--	--	--	--	--	--	148.7	144.5	4.2	2.12	<.1	28	--	0.159	EER
		38.9	--						Meq/l	101.6	5.58	43.00	7.10	0	19.95	95.55	36.33	--									
3/ 9-9-72	W538.2	102.0	7.1	14,160	9,610	13.07	64.6	--	Mg/l	--	--	--	--	--	--	--	--	--	157.3	151.8	4.5	2.72	<.1	28	--	0.096	RR
		38.1	--						Meq/l	98.62	5.58	41.60	7.53	0	20.33	94.08	38.00	--									
4/ 10-5-72	W613.2	100.5	6.8	13,500	9,418	12.81	64.3	--	Mg/l	--	--	--	--	--	--	--	--	--	153.3	152.5	4.6	2.7	<.1	29	--	0.088	EER
		38.3	--						Meq/l	98.62	5.58	42.20	7.54	0	20.28	95.06	37.50	--									
5/ 10-6-72	W614.2	101.0	6.7	13,590	9,470	12.88	64.3	--	Mg/l	--	--	--	--	--	--	--	--	--	153.9	152.8	4.6	2.7	<.1	29	--	0.120	EER
		43.6[6]	--						Meq/l	99.81	5.39	38.40	14.78	0	20.18	97.02	38.00	--									
10-27-72	W694.2	110.5	6.4	13,700	9,594	13.05	63.0	--	Mg/l	--	--	--	--	--	--	--	--	--	158.4	155.2	5.0	2.77	<.1	29	--	0.088	JWD
		43.3[6]	--						Meq/l	100.9	5.39	41.80	8.75	0	19.71	97.02	38.00	--									
11-6-72	W700.2	110.0	6.3	13,880	9,587	13.04	64.3	--	Mg/l	--	--	--	--	--	--	--	--	--	156.8	154.7	5.0	2.78	<.1	29	--	0.115	MH
									Meq/l																		
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1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated at 180°C.
Remarks:
3/ Sample taken after 11 hours of pumping--Pump Test #1.
4/ Sample taken after 47 hours and 50 minutes of pumping--Pump Test #4.
5/ Sample taken 16 hours after Pump Test #4 was stopped.
6/ A new thermometer was used for these two readings.

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CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

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Station No. Source #9 Description of Sampling Site 40 feet upstream from black boulder in river. Analysis by ____________

Date Sampled	Lab. No.	Temp. °C. (Field / Lab)	pH (Field / Lab)	ECx10[6] at 25°C.	Dissolved Solids ppm[1] mg/l	Dissolved Solids [2] Tons acre-foot	% Na	SAR	Units	Na	K	Ca	Mg	CO3	HCO3	Cl	SO4	NO3	Total Cation meq/l	Total Anion meq/l	B	F	Fe	SiO2	PO4	By
2-11-72	W45.2	[illegible]	-	[illegible]	9,830	13.37	66	22	Meq/1	100.8	5.22	39.72	11.23	0	20.35	100.5	[illegible]	-	166.0	162.5	5.2	2.7	<.1	31.0	-	ASD
		104.[illegible]	[illegible]						Mg/1	-	-	-	-	-	-	-	-	-								
5-1-72	W229.2	40.25	-	14,500	9,920	13.5	65.8	21	Meq/1	106.6	4.95	40.70	9.70	0	20.[illegible]	97.33	35.17	-	162.0	155.5	5.0	2.5	<.1	27	2.5	JWD
		104.5	7.0						Mg/1	-	-	-	-	-	-	-	-	2.1								
5-19-72	W271.2	40.75	-	[illegible]	9,890	13.5	65.6	21.0	Meq/1	105.2	4.77	39.30	11.10	0	20.10	97.58	35.17	-	160.4	153.9	5.2	2.6	<.1	29	2.3	EB
		105.[illegible]	[illegible]						Mg/1	-	-	-	-	-	-	-	-	<.5								

1/ Ppm equals mg/1 up to 7,000 ppm.
2/ Evaporated at 180°C.
Remarks:

Table A-14
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Sheet ______ of ______

Station No. Source #10 Description of Sampling Site Opposite spa outlet on northside of river-- LaVerkin Springs Analysis by ____________

Date Sampled	Lab. No.	Field/Lab Temp. °C/°F	Field/Lab pH	ECx10^6 at 25°C.	Dissolved Solids ppm[1] mg/l[2]	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/l	Total Anion meq/l	Minor Elements ppm B	F	Fe	SiO_2	PO_4	By
2-11-72	W42.2	39 / 102.2	- / 6.4	13,940	9,710	13.21	65	21	Meq/l	106.8	5.07	42.12	10.94	0	19.50	100.0	41.98	-	164.9	161.5	4.8	2.7	<.1	31.0	-	ASD
									Mg/l	-	-	-	-	-	-	-	-	-								
5-1-72	W230.2	39 / 102.2	- / 7.0	14,290	9,770	13.3	64.3	20	Meq/l	102.4	4.68	41.90	10.20	0	19.40	93.23	37.67	-	159.2	150.3	5.0	2.5	<.1	27	2.5	JWD
									Mg/l	-	-	-	-	-	-	-	-	2.1								
5-19-72	W272.2	39 / 102.2	- / 5.7	14,100	9,740	13.2	64.0	20.0	Meq/l	101.0	4.68	42.30	9.60	0	19.40	93.[illegible]	37.67	-	157.8	150.8	5.2	2.6	<.1	29	2.3	EB
									Mg/l	-	-	-	-	-	-	-	-	<.5								
11-6-72	W701.2	40.6 / 105	- / 6.3	13,780	9,678	13.17	63.3	-	Meq/l	100.0	5.39	43.00	9.67	0	19.71	[illegible]	40.00	-	158.4	156.7	5.0	2.74	<.1	29	-	MH
									Mg/l	-	-	-	-	-	-	-	-	-								
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1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated at 180°C.
Remarks:

Table A-15
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Sheet ______ of ______

Station No. Source #11 | Description of Sampling Site Northside of river-north of spa office LaVerkin Springs | Analysis by ______

Date Sampled	Lab. No.	Field / Lab Temp. °C/F	Field / Lab pH	ECx10^6 at 25°C.	Dissolved Solids ppm[1] mg/1	Dissolved Solids[2] Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/1	Total Anion meq/1	Minor Elements ppm B	Minor Elements ppm F	Minor Elements ppm Fe	Minor Elements ppm SiO_2	Minor Elements ppm PO_4	By
2-11-72	44.2	37 98.6	- 6.4	13,390	9,380	12.76	64	20	Meq/1 Mg/1	101.1 -	[illegible] -	[illegible] -	10.74 -	0 -	18.85 -	92.00 -	43.15 -	- -	158.7	154.0	4.8	2.6	<.1	28.0	-	ASD
5-1-72 W	231.2	36.25 97.3	- 6.9	13,540	9,380	12.8	63.1	18.9	Meq/1 Mg/1	96.48 -	4.41 -	41.70 -	10.40 -	0 -	19.15 -	87.67 -	39.36 -	- 2.1	153.0	146.2	5.0	2.5	<.1	27	2.5	JWD
5-19-72	273.2	36.5 97.7	- 6.7	13,540	9,720	13.2	62.6	18.5	Meq/1 Mg/1	94.23 -	4.32 -	41.00 -	10.90 -	0 -	19.20 -	87.92 -	38.33 -	- <.5	150.5	145.5	5.2	2.6	<.1	29	2.3	EB
11-6-72	702.2	38.3 101	- 6.3	13,420	9,423	12.82	62.0	-	Meq/1 Mg/1	[illegible] -	[illegible] -	[illegible] -	9.38 -	0 -	19.71 -	92.17 -	40.00 -	- -	154.3	151.9	5.0	2.67	<.1	29	-	JWD
									Meq/1 Mg/1																	
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1/ Ppm equals mg/1 up to 7,000 ppm.
2/ Evaporated at 180°C.
Remarks:

Table A-16
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Sheet ____ of ____

Station No. Source #12   Description of Sampling Site About 600 feet downstream from drill hole LV101 and on right bank   Analysis by ____________

Date Sampled	Lab. No.	Field/Lab Temp. °	Field/Lab pH	ECx10[6] at 25°C.	Dissolved Solids ppm[1/] mg/l	Dissolved Solids [2/] Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO3	Anions HCO3	Anions Cl	Anions SO4	Anions NO3	Total Cation meq/l	Total Anion meq/l	Minor Elements ppm B	F	Fe	SiO2	PO4	BY
5-12-72	W239.2	42.75	-	13,720	9,360	12.7	65.0	20	Meq/l	100.1	4.95	39.00	9.80	0	19.70	90.81	35.98	-	153.9	146.5	5.0	2.4	<.1	27	2.0	EB
		109.0	6.9						Mg/l	-	-	-	-	-	-	-	-	1.7								
5-19-72	W274.2	39.75	-	13,720	9,360	12.7	64.8	19.9	Meq/l	98.25	4.50	39.70	9.10	0	19.50	91.05	36.17	-	151.6	146.7	5.2	2.7	<.1	29	2.3	EB
		103.6	6.7						Mg/l	-	-	-	-	-	-	-	-	<.5								
5-26-72	W283.2	38.75	-	14,070	9,280	12.62	63.9	19.3	Meq/l	96.75	4.32	41.40	8.80	0	18.85	91.30	39.16	0.03	151.3	149.3	4.7	2.4	<.1	25	2.8	EB
		101.8	6.9						Mg/l	-	-	-	-	-	-	-	-	2.1								
6-2-72	W294.2	39.75	-	13,700	9,290	12.63	64.2	19.5	Meq/l	97.65	4.32	41.60	8.40	0	19.40	91.05	38.16	0.03	152.0	148.6	4.7	2.4	<.1	24	2.5	EB
		103.6	7.0						Mg/l	-	-	-	-	-	-	-	-	1.7								
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1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated at 180°C.
Remarks:

Table A-17
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Sheet ______ of ______

Station No. Source #21 Description of Sampling Site Northside of river, about 100 feet west of Source #8 Analysis by ______

Date Sampled	Lab. No.	Field / Lab Temp. °C/°F	Field / Lab pH	ECx10[6] at 25°C.	Dissolved Solids ppm[1/] mg/1[2/]	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/1	Total Anion meq/1	Minor Elements ppm B	F	Fe	SiO_2	PO_4	Qty. cfs	By
5-8-72	W233.2	41.75 / 107.2	- / 6.9	14,500	9,880	13.4	65.7	21	Meq/1 / Mg/1	105.7 / -	4.86 / -	39.70 / -	10.70 / -	0 / -	20.30 / -	97.33 / -	37.67 / -	- / 2.0	161.0	155.3	5.1	2.5	<.1	28	2.3	-	JWI
5-11-72	W237.2	41.75 / 107.2	- / 7.0	14,500	9,920	13.5	65.8	21	Meq/1 / Mg/1	106.6 / -	4.95 / -	40.40 / -	10.00 / -	0 / -	20.25 / -	97.33 / -	37.28 / -	- / 1.8	162.0	154.9	5.0	2.5	<.1	28	2.0	0.08	EB
5-19-72	W277.2	42.0 / 107.6	- / 6.9	14,390	9,830	13.4	65.3	20.7	Meq/1 / Mg/1	103.8 / -	4.77 / -	39.20 / -	11.20 / -	0 / -	20.30 / -	97.58 / -	36.67 / -	- / < .5	159.0	154.6	5.4	2.6	<.1	29	2.3	0.05	EB
5-26-72	W288.2	42.0 / 107.6	- / 6.9	16,180	9,780	13.30	64.5	20.3	Meq/1 / Mg/1	103.1 / -	4.36 / -	42.00 / -	9.80 / -	0 / -	19.20 / -	97.58 / -	40.00 / -	0.03 / 1.7	159.8	156.8	5.0	2.3	<.1	28	3.0	0.05	EB
6-12-72	W299.2	42.5 / 108.5	- / 7.0	14,570	9,810	13.34	64.6	20.3	Meq/1 / Mg/1	103.1 / -	4.68 / -	41.60 / -	10.20 / -	0 / -	20.20 / -	97.58 / -	39.16 / -	0.01 / 1.1	159.6	157.0	5.0	2.4	<.1	24	2.5	0.05	EB
6-8-72	W317.2	42.5 / 108.5	- / 6.8	14,130	9,764	13.28	64.6	20.3	Meq/1 / Mg/1	103.2 / -	4.77 / -	44.60 / -	7.20 / -	0 / -	20.20 / -	99.50 / -	37.50 / -	- / <1.0	159.8	157.2	4.5	2.7	<.1	28	3.2	0.06	EB
6-16-72	W329.2	42.25 / 108.1	- / 6.7	14,250	9,752	13.26	65.1	20.7	Meq/1 / Mg/1	105.0 / -	4.56 / -	43.00 / -	8.40 / -	0 / -	20.45 / -	98.49 / -	37.66 / -	- / <1.0	161.3	156.6	4.6	2.7	<.1	28	2.9	0.05	DLE
10-27-72	W695.2	43.6 / 110.5	- / 6.7	14,300	9,958	13.54	64.7	-	Meq/1 / Mg/1	104.8 / -	5.61 / -	42.60 / -	9.06 / -	0 / -	20.23 / -	100.3 / -	38.50 / -	- / -	162.1	159.0	5.0	2.84	<.1	29	-	-	JWI
11-6-72	W705.2	43.3 / 110	- / 6.6	14,200	9,831	13.37	64.4	-	Meq/1 / Mg/1	103.5 / -	5.72 / -	37.80 / -	13.56 / -	0 / -	20.49 / -	100.3 / -	38.50 / -	- / -	160.6	159.3	5.0	2.81	<.1	29	-	-	MH
									Meq/1 / Mg/1																		
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1/ Ppm equals mg/1 up to 7,000 ppm.
2/ Evaporated at 180°C.
Remarks:

Table A-18
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Sheet ____ **of** ____

Station No. Source #16 **Description of Sampling Site** USGS Gaging Station 9-4060 (discontinued) (Virgin River at Virgin) **Analysis by** ________

Date Sampled	Lab. No.	Field / Lab Temp. °C/F	Field / Lab pH	ECx10^6 at 25°C.	Dissolved Solids ppm[1] mg/l	Dissolved Solids Tons[2] acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/l	Total Anion meq/l	Minor Elements B	Minor Elements F	Minor Elements Fe	Minor Elements SiO_2	Minor Elements PO_4	G.H. / Qty. cfs	By
5-17-72	W241.2	17.2	-						Meq/l	2.48	0.09	3.60	2.06	0	3.10	1.79	3.48	-	8.23	8.37	0.2	0.26	<.1	9.0	0.4	0.65	EER
		63.0	8.1	820	524	0.7	30.1	1.5	Mg/l	-	-	-	-	-	-	-	-	1.5								-	
5-26-72	W287.2	20.0	-						Meq/l	2.43	0.10	4.00	2.02	0	3.10	1.88	3.25	0.03	8.55	8.26	<.1	0.4	<.1	10	0.6	0.78	EB
		68.0	7.9	850	550	0.75	28.4	1.4	Mg/l	-	-	-	-	-	-	-	-	1.7								-	
6-2-72	W298.2	24.5	-						Meq/l	2.50	0.10	3.98	1.92	0	2.80	1.84	3.60	0.03	8.50	8.27	<.1	0.4	<.1	12	0.9	0.60	EB
		76.1	8.0	850	530	0.72	29.4	1.5	Mg/l	-	-	-	-	-	-	-	-	1.7								-	
6-8-72	W316.2	23.5	-						Meq/l	2.35	0.11	4.86	1.28	0	3.15	1.60	3.80	-	8.60	8.55	<.1	0.35	<.1	11	0.35	0.93	EB
		74.3	7.7	840	548	0.75	27.3	1.3	Mg/l	-	-	-	-	-	-	-	-	1.3								-	
6-16-72	W328.2	22.5	-						Meq/l	2.05	0.12	4.50	1.18	0	2.63	1.52	3.60	-	7.85	7.75	<.1	0.73	<.1	10	0.7	0.75	DLB
		72.5	7.5	770	496	0.67	26.1	1.2	Mg/l	-	-	-	-	-	-	-	-	<1.0								-	
7-18-73	W399.2	20.0	-						Meq/l	2.46	0.14	4.45	1.58	0	2.96	1.86	3.75	-	8.63	8.57	<.1	0.33	<.1	11	-	0.72	EER
		68.0	7.[illegible]	830	536	0.73	28.5	-	Mg/l	-	-	-	-	-	-	-	-	-								-	
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1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated at 180°C.
Remarks:

Table A-19
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Sheet ______ of ______

Station No. Source #13 Description of Sampling Site Northside of river near Masonary Pier, about 500 feet downstream from Old Highway Bridge Analysis by ____________

Date Sampled	Lab. No.	Field Lab Temp. °C/F	Field Lab pH	ECx10^6 at 25°C.	Dissolved Solids ppm 1/ mg/1	Dissolved Solids 2/ Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/1	Total Anion meq/1	Minor Elements ppm B	Minor Elements ppm F	Minor Elements ppm Fe	Minor Elements ppm SiO_2	Minor Elements ppm PO_4	Qty. By cfs	
		19	-						Meq/1	22.16	0.90	10.40	3.40	0	6.10	18.26	9.50	-									
5-19-72	W275.2	66.2	7.5	3,630	2,180	2.96	60.1	8.4	Mg/1	-	-	-	-	-	-	-	-	1.3	36.86	33.84	0.8	0.7	0.8	14	0.4	-	EB
		24.25	-						Meq/1	30.36	1.35	15.20	3.80	0	9.85	27.92	13.70	0.03									
5-26-72	W284.2	75.7	7.6	4,780	3,080	4.19	59.9	9.8	Mg/1	-	-	-	-	-	-	-	-	1.8	50.71	51.50	1.6	1.1	<.1	15	1.35	-	EB
		27.75	-						Meq/1	26.43	1.17	15.30	2.50	0	6.90	24.54	13.80	0.02									
6-2-72	W295.2	82.0	7.5	4,470	2,800	3.81	58.2	8.9	Mg/1	-	-	-	-	-	-	-	-	1.2	45.40	45.2[illegible]	1.4	1.1	<.1	15	1.4	-	EB
		25.0	-						Meq/1	19.36	0.84	14.40	2.00	0	5.80	17.37	12.70	0.04									
6-8-72	W313.2	77.0	7.1	3,470	2,272	3.09	52.9	6.8	Mg/1	-	-	-	-	-	-	-	-	2.3	36.60	35.91	0.5	0.8	<.1	14	0.75	-	EB
		27.0	-						Meq/1	29.25	1.32	15.92	2.30	0	7.00	26.75	13.50	-									
6-16-72	W325.2	80.6	7.1	4,660	2,980	4.05	59.3	9.6	Mg/1	-	-	-	-	-	-	-	-	<1.0	49.29	47.25	1.0	1.0	<.1	14	0.80	-	DLB
		37.8	-						Meq/1	89.73	4.80	29.80	7.61	0	9.31	83.80	34.25	-									
7-11-72	W400.2	100.0	7.2	12,000	8,025	10.91	68.0	-	Mg/1	-	-	-	-	-	-	-	-	-	131.9	127.4	3.7	1.88	<.1	25	-	3/	EER
		38.9	-						Meq/1	96.13	5.30	31.70	5.74	0	9.78	90.70	36.00	-									
7-13-72	W401.2	102.0	7.4	13,100	8,622	11.73	67.7	-	Mg/1	-	-	-	-	-	-	-	-	-	141.9	136.5	4.7	2.80	<.1	25	-	12.2	EER
		13.9	-						Meq/1	10.80	0.59	7.60	2.91	0	4.95	10.09	6.70	-									
11-6-72	W703.2	57.0	7.2	2,130	1,357	1.85	49.3	-	Mg/1	-	-	-	-	-	-	-	-	-	21.90	21.74	0.65	0.52	<.1	12	-	-	MH
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1/ Ppm equals mg/1 up to 7,000 ppm.
2/ Evaporated at 180°C.
Remarks:
3/ Four discharge measurements were made on 7-12-72 and they averaged 12.6 cfs.

Table A- 20
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Sheet ______ of ______

Drill Hole No. LV-101 Description of Sampling Site ______ Analysis by ______

	Date Sampled	Lab. No.	Field / Lab Temp. °C/°F	Field / Lab pH	ECx10[6] at 25°C.	Dissolved Solids 2/ ppm 1/ mg/l	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO3	Anions HCO3	Anions Cl	Anions SO4	Anions NO3	Total Cation meq/l	Total Anion meq/l	Minor Elements ppm B	Minor Elements ppm F	Minor Elements ppm Fe	Minor Elements ppm SiO2	Minor Elements ppm PO4	Water Level (ft) / Hole Depth (ft)
			21.5	--						Meq/l	20.55	0.61	22.40	4.20	0	9.60	18.17	19.40	0.02								30.5
	5-26-72	W289.2	70.7	7.0	4,240	2,930	3.98	42.8	5.6	Mg/l	--	--	--	--	--	--	--	--	1.4	47.96	47.18	1.0	0.7	<.1	14	1.3	60
			23.0	--						Meq/l	19.12	0.54	14.60	4.00	0	10.10	9.70	17.10	0.10								31.0
	6-8-72	W318.2	73.4	6.9	3,300	2,356	3.20	50.0	6.3	Mg/l	--	--	--	--	--	--	--	--	6.0	38.26	37.00	<.1	1.2	<.1	15	0.9	70
			--	--						Meq/l	52.34	2.40	32.00	7.50	0	15.95	48.02	27.30	--								--
	6-19-72	W367.2	--	6.8	8,310	5,696	7.75	52.8	11.8	Mg/l	--	--	--	--	--	--	--	--	<1.0	94.24	91.27	2.7	1.5	<.1	22	1.5	92.5
			22.2	--						Meq/l	53.30	2.40	32.80	8.00	0	17.45	49.00	27.30	--								--
	6-20-72	W368.2	72	6.8	8,460	5,788	7.87	55.2	11.8	Mg/l	--	--	--	--	--	--	--	--	<1.0	96.50	93.75	2.7	1.5	<.1	22	1.5	96
			23.3	--						Meq/l	56.79	2.60	33.80	8.60	0	17.60	52.68	28.40	--								--
	6-21-72	W369.2	74	6.7	8,910	6,112	8.31	55.7	12.3	Mg/l	--	--	--	--	--	--	--	--	<1.0	101.8	98.68	2.7	1.5	<.1	22	1.5	114
			26.1	--						Meq/l	49.71	2.25	33.60	5.30	0	17.00	45.33	25.60	--								--
	6-23-72	W370.2	79	6.7	7,920	5,444	7.40	54.7	11.3	Mg/l	--	--	--	--	--	--	--	--	<1.0	90.86	87.93	2.7	1.5	<.1	22	1.5	118
			36.0	--						Meq/l	91.65	4.59	32.[illegible]	7.72	0	19.55	78.40	34.30	--								38.5
3/	9-28-72	W586.2	96.8	6.8	11,930	8,290	11.27	61.0	--	Mg/l	--	--	--	--	--	--	--	--	--	133.8	132.5	2.9	2.31	<.1	25	--	522
			35.3	--						Meq/l	82.51	[illegible]	[illegible]	8.02	0	19.56	79.35	35.00	--								40.5
4/	10-4-72	W602.2	95.5	6.5	12,000	8,375	11.39	61.1	--	Mg/l	--	--	--	--	--	--	--	--	--	135.1	133.9	[illegible]	2.33	<.1	25	--	522
			37.0	--						Meq/l	83.53	4.36	[illegible]1.00	7.33	0	19.45	81.10	35.00	--								--
5/	10-5-72	W603.2	98.6	6.5	12,130	8,521	11.59	61.1	--	Mg/l	--	--	--	--	--	--	--	--	--	136.7	135.6	4.4	2.37	<.1	25	--	522
			34.7	--						Meq/l	83.96	4.36	40.80	7.73	0	19.71	80.61	35.25	--								--
6/	10-5-72	W604.2	94.5	6.5	12,280	8,539	11.61	61.0	--	Mg/l	--	--	--	--	--	--	--	--	--	137.6	135.6	4.4	2.37	<.1	25	--	522
										Meq/l																	
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										Meq/l																	
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1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated @ 180°C.
Remarks: 3/ Sample taken 11 hours and 30 minutes after start of Pump Test #2.
4/ Sample taken 25 hours after start of Pump Test #4.
5/ Sample taken 43 hours after start of Pump Test #4.
6/ Sample taken 47 hours after start of Pump Test #4.
7/ Depth from natural ground service.

Table A- 21

CHEMICAL ANALYSES

Colorado River Water Quality Improvement Program

Point Source Division, LaVerkin Springs Unit, Utah

Drill Hole No. LV-102 Description of Sampling Site Adjacent to Block House Analysis by -----

Date Sampled	Lab. No.	Field Lab Temp. °C/F	Field Lab pH	ECx10⁶ at 25°C.	Dissolved Solids 2/ ppm 1/ mg/l	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/l	Total Anion meq/l	Minor Elements B	Minor Elements F	Minor Elements Fe	Minor Elements SiO_2	Minor Elements PO_4	Depth (ft)	By
		40.6	--						Meq/l	99.80	5.49	38.00	8.20	0	16.40	94.08	41.83	--									
8-21-72	W515.2	105	6.9	13,850	9,442	12.84	65.9	--	Mg/l	--	--	--	--	--	--	--	--	--	151.5	152.3	4.5	2.02	<.1	30	--	25	GB
		40.8	--						Meq/l	103.3	5.04	34.20	6.40	0	12.80	94.08	38.16	--									
8-28-72	W516.2	105.5	7.0	13,850	9,353	12.72	69.4	--	Mg/l	--	--	--	--	--	--	--	--	--	148.9	145.0	4.1	1.83	<.1	28	--	50	GB
		42.8	--						Meq/l	99.00	5.49	34.50	12.50	0	16.00	96.40	37.00	--									
8-30-72	W517.2	109	6.9	13,900	9,464	12.87	65.8	--	Mg/l	--	--	--	--	--	--	--	--	--	151.5	149.4	4.1	1.66	<.1	36	--	72A	RR
		42.8	--						Meq/l	99.00	5.49	35.60	11.50	0	16.45	95.06	36.33	--									
8-30-72	W518.2	109	6.9	13,900	9,449	12.85	65.3	--	Mg/l	--	--	--	--	--	--	--	--	--	151.6	147.8	4.1	1.62	<.1	37	--	72B	RR
		40.6	--						Meq/l	100.9	5.58	39.30	8.42	0	16.52	96.06	38.50	--									
8-31-72	W519.2	105	7.0	13,800	9,453	12.86	65.4	--	Mg/l	--	--	--	--	--	--	--	--	--	154.2	150.2	3.5	2.35	<.1	27	--	77	GB
		45.6	--						Meq/l	99.80	5.76	36.50	12.40	0	18.70	95.80	37.66	--									
9-5-72	W533.2	114	7.1	14,090	9,640	13.11	64.6	--	Mg/l	--	--	--	--	--	--	--	--	--	154.5	152.2	4.1	1.77	<.1	35	--	100	LW
		43.3	--						Meq/l	99.80	5.58	41.40	12.30	0	22.25	96.23	36.83	--									
9-6-72	W534.2	110	6.9	14,200	9,840	13.38	62.6	--	Mg/l	--	--	--	--	--	--	--	--	--	159.1	155.4	4.5	1.81	<.1	31	--	125	RR
		41.7	--						Meq/l	101.1	5.58	42.60	8.50	0	19.85	96.23	37.16	--									
9-7-72	W535.2	107	6.8	14,200	9,710	13.20	64.1	--	Mg/l	--	--	--	--	--	--	--	--	--	157.8	153.3	4.5	2.45	<.1	28	--	150	LW
		42.8	--						Meq/l	100.9	5.58	42.60	8.35	0	20.23	96.04	38.73	--									
3/ 9-8-72	W579.2	109	7.0	14,020	9,674	13.16	64.1	--	Mg/l	--	--	--	--	--	--	--	--	--	157.4	155.0	3.6	2.48	<.1	28	--	160	--
		41.7	--						Meq/l	101.1	5.58	44.40	6.20	0	20.35	97.29	37.33	--									
4/ 9-9-72	W536.2	107	7.0	14,200	9,730	13.23	64.1	--	Mg/l	--	--	--	--	--	--	--	--	--	157.3	155.0	4.1	2.97	<.1	28	--	160	RR
		41.7	--						Meq/l	99.66	5.58	38.90	12.86	0	20.96	97.27	38.50	--								165	
9-12-72	W581.2	107	7.0	14,020	9,754	13.27	63.1	--	Mg/l	--	--	--	--	--	--	--	--	--	157.0	156.7	3.6	1.77	<.1	23	--	170	GB
		41.7	--						Meq/l	100.9	5.85	43.50	9.88	0	20.02	98.49	40.00	--									
9-12-72	W582.2	107	7.0	14,270	9,937	13.51	63.1	--	Mg/l	--	--	--	--	--	--	--	--	--	160.0	158.5	3.6	2.13	<.1	25	--	175	GB
		46.73	--						Meq/l	96.24	5.94	48.20	13.27	0	16.54	95.08	49.50	--									
9-15-72	W583.2	116.2	6.8	14,170	10321	14.04	58.8	--	Mg/l	--	--	--	--	--	--	--	--	--	163.7	161.1	3.4	2.07	<.1	25	--	200	LW
		46.0	--						Meq/l	97.47	6.75	48.00	15.49	0	19.55	96.29	49.50	--									
9-20-72	W584.2	114.8	6.8	14,470	10526	14.32	58.1	--	Mg/l	--	--	--	--	--	--	--	--	--	167.7	165.3	3.6	1.61	<.1	31	--	225	RR
		44.5	--						Meq/l	94.91	7.47	45.40	20.52	0	18.77	95.55	50.25	--									
9-21-72	W585.2	112.1	6.8	14,470	10,568	14.37	56.4	--	Mg/l	--	--	--	--	--	--	--	--	--	168.3	164.6	2.9	1.55	<.1	28	--	230	LW

1/ Ppm equals mg/l up to 7,000 ppm.

2/ Evaporated at 180°C.

Remarks:

3/ Sample taken 23 minutes after Pump Test #1 began.

4/ Sample taken after 11 hours of pumping - Pump Test #1.

Table A-21
CHEMICAL ANALYSES
Colorado River Water Quality Improvement Program
Point Source Division, LaVerkin Springs Unit, Utah

Drill Hole No. LV-102 **Description of Sampling Site** Adjacent to Block House **Analysis by** ----

	Date Sampled	Lab. No.	Field Lab Temp. °C/F	Field Lab pH	ECx10[6] at 25°C.	Dissolved Solids 2/ ppm 1/ mg/l	Dissolved Solids Tons acre-foot	% Na	SAR	Units	Cations Na	Cations K	Cations Ca	Cations Mg	Anions CO_3	Anions HCO_3	Anions Cl	Anions SO_4	Anions NO_3	Total Cation meq/l	Total Anion meq/l	Minor Elements B	Minor Elements F	Minor Elements Fe	Minor Elements SiO_2	Minor Elements PO_4	Depth (ft)	By
			41.1	--						Meq/l	98.80	5.76	43.10	8.76	0	21.32	96.53	38.00	--									
3/	10-4-72	W598.2	106	6.4	14,080	9,751	13.26	63.2	--	Mg/l	--	--	--	--	--	--	--	--	--	156.4	155.9	3.9	2.63	< .1	28	--	230	DLA
			41.1	--						Meq/l	98.80	5.76	43.00	8.16	0	20.38	97.51	38.25	--									
4/	10-4-72	W599.2	106	6.4	14,080	9,627	13.23	63.5	--	Mg/l	--	--	--	--	--	--	--	--	--	155.7	156.1	3.9	2.66	< .1	28	--	230	GS
			42.0	--						Meq/l	99.65	5.76	42.60	8.56	0	20.85	96.78	38.00	--									
5/	10-5-72	W600.2	107.6	6.4	13,990	9,749	13.26	63.6	--	Mg/l	--	--	--	--	--	--	--	--	--	156.6	155.6	3.9	2.67	< .1	28	--	230	GS
			40.8	--						Meq/l	99.56	5.76	42.30	8.86	0	20.64	96.53	38.25	--									
6/	10-5-72	W601.2	105.5	6.4	14,080	9,742	13.25	63.6	--	Mg/l	--	--	--	--	--	--	--	--	--	156.5	155.4	5.5	2.72	< .1	28	--	230	[illegible]

Remarks:
1/ Ppm equals mg/l up to 7,000 ppm.
2/ Evaporated at 180°C.
3/ Sample taken 12 hours after Pump Test #4 began.
4/ Sample taken 24 hours after Pump Test #4 began.
5/ Sample taken 43 hours after Pump Test #4 began.
6/ Sample taken 48 hours after Pump Test #4 began.