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Pre-Impoundment Water Quality Study for the West Divide Project

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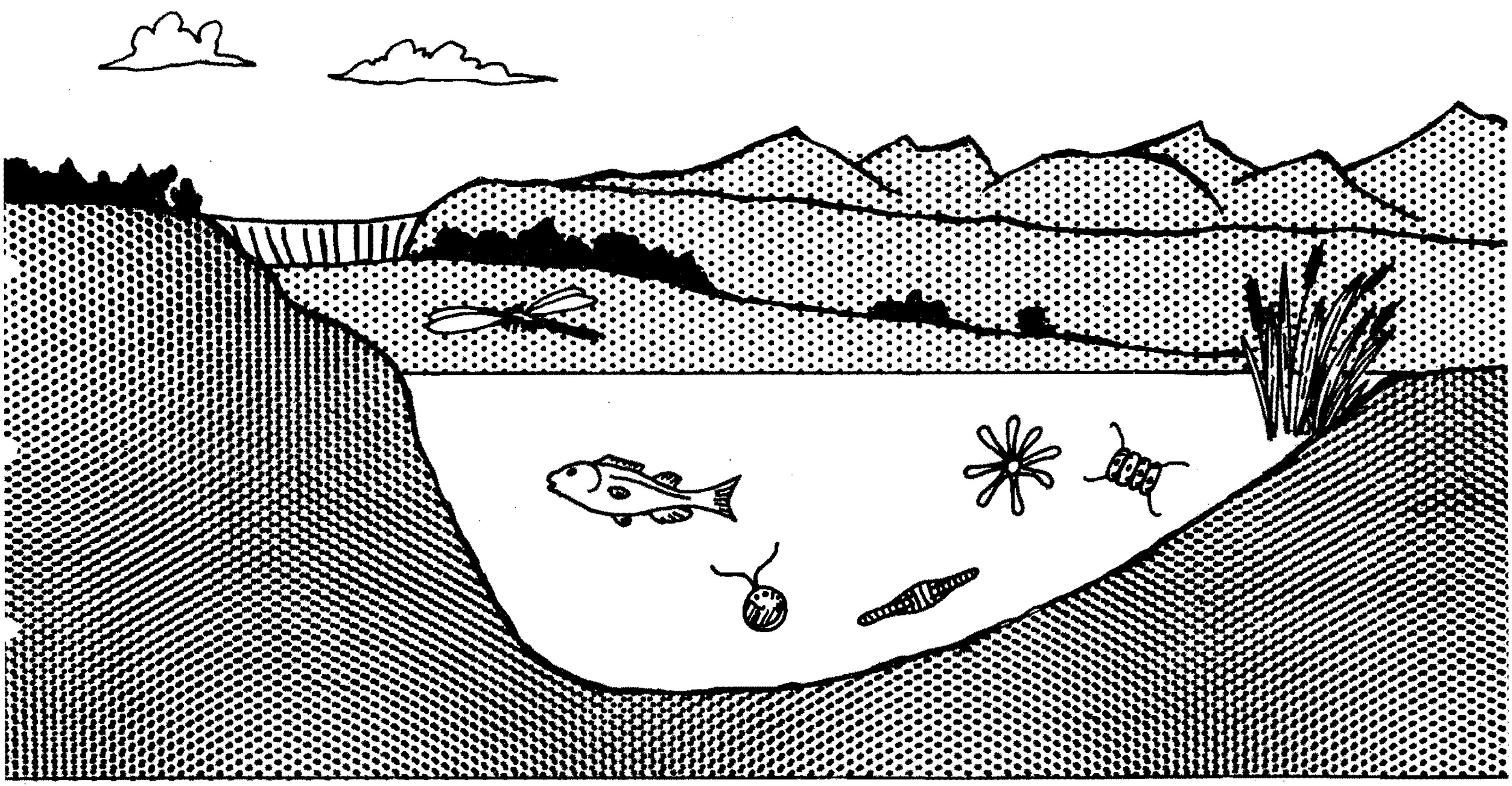

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Introduction

The U.S. Bureau of Reclamation is currently in the process of evaluating a number of water development projects in Southwest Colorado. As a part of the planning process the Bureau has conducted a water quality investigation, in cooperation with the UWRL, of the stream segments that will be affected by each project. The data collected in this study were used to evaluate the water quality of each stream segment with respect to various beneficial uses of water (agriculture, raw municipal water supply, protection of the aquatic biota) and will provide a baseline by which to assess the impact of each project. In addition, these data will be used in the process of site location, design and operation planning for reservoirs and other project features.

This report includes only the results of the West Divide Project.[1] Data were collected for three water quality stations associated with this project:

Station #13: West Divide Creek

Station #20: Lower Colorado River at Silt, Colorado

Station #21: Upper Colorado River at Newcastle, Colorado

Water quality data were collected during the period May, 1977, through August, 1978. One sample was collected and analyzed during each month, except during June, 1977, when two samples were collected from some sites.

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[1] Other projects included in this study are: the Dolores Project, the Animas La Plata Project, the Mancos Project, the Dominguez Project, the McElmo Creek Project and the San Miguel Project. The results of the water quality study for each project are contained in individual reports.

The concentration of 49 water quality constituents was determined for each sample at the UWRL (Table 1).

Methods

Bottles to be used for sample collection were prepared at the UWRL and sent to Colorado for sample collection via Greyhound bus. Three sample bottles were used for each station. Water to be analyzed for non-metallic constituents (plus calcium and magnesium) were collected in half gallon Nalgene bottles. Two 500 ml polyethylene bottles were used for the collection of samples to be analyzed for metals. One of these was reserved for the analyses of "total" metals and the other reserved for the analyses of "dissolved" metals. All sample bottles were prepared prior to shipment using a rinse with dilute HCl followed by three rinses with high quality distilled water. Prior to shipment, 1.5 ml of 50 percent HNO_3 was added to each sample bottle reserved for the analyses of "total" metals.

In Colorado the staff of the USBR or of the consulting firm of A and S Consultants, Inc. collected samples from each water quality station. Samples were packed in ice for the return trip to the UWRL and shipped via Greyhound bus. Samples usually arrived in Logan the following afternoon and analyses were begun immediately. Occasionally, samples were held in transit longer due to inclement weather.

Upon receipt at the UWRL a portion of the sample reserved for the analyses of non-metallic constituents and the entire sample reserved for the analyses of dissolved metals was filtered through a 0.45 μ "Millipore" filter. Where necessary samples were filtered through a GF/C glass fiber filter prior to filtration through the Millipore filter. Aliquots to be used for the analyses of total Kjeldahl nitrogen, dissolved metals, cyanide and NO_3/NO_2 were preserved as outlined in Table 2.

Immediately following sample coding and pre-treatment (filtration and/or preservation), analyses were performed for total phosphorus, orthophosphate, alkalinity, cyanide, nitrate and nitrite. On some occasions the analyses of nitrate/nitrite and cyanide were postponed until the following day. When this was necessary the samples for NO_3/NO_2 and cyanide were preserved.

The analyses of calcium, total hardness, sulfate, chloride, total dissolved solids, total Kjeldahl nitrogen, hexavalent chromium and fluoride were completed within seven days using the methods listed in Table 1.

The data obtained for each water quality station during this study was subjected to statistical analysis to determine the means, maximum, minimum, range, standard deviation and coefficient of variation for each constituent. In addition the water quality data for each station was compared to the proposed Colorado Water Quality Standards for agricultural use, raw water supply and the protection of the aquatic biota (Appendix A). This analysis was based on the number of times in which the concentration of a constituent exceeded the proposed standard for that constituent with respect to the number of times a detectable concentration of the constituent was analyzed (Appendix D). In Tables 6 and 7 the comparison is made on the basis of the total number of samples analyzed since for most constituents if the concentration is below the detection limit of analyses it is below the proposed standards. For some metals (cadmium, mercury, silver, copper and zinc) the proposed standards for the protection of the

Table 1. Analytical methods used in water quality survey.[1]

Analysis	Units/Sensitivity	Method
Non Metallic Constituents		
Total hardness	1 mg/l as $CaCO_3$	EDTA Titrimetric. *S.M.* p. 202
pH		pH electrode. *S.M.* p. 460
Total alkalinity	1 mg/l as $CaCO_3$	Potentiometric. *S.M.* p. 278
Carbonate hardness	1 mg/l as $CaCO_3$	Calculated from $CaCO_3$
Bicarbonate hardness	1 mg/l as $CaCO_3$	Calculated from $CaCO_3$
Total dissolved solids	1 mg/l	Gravimetric. *S.M.* p. 82
Chloride, dissolved	mg/l, 2 place	Titrimetric ($HgNO_3$) *S.M.* p. 304
Sulfate, dissolved	mg/l, 2 place	Turbidimetric ($BaCl_2$) *S.M.* p. 496
Fluoride, dissolved	mg/l, 2 place	Ion selective electrode *S.M.* p. 391
Cyanide, total	mg/l, 2 place	Ion selective electrode *S.M.* p. 372
Phosphorus, total	mg/l, 2 place	Persulfate digestion *S.M.* p. 466
Phosphate, ortho	mg/l, 2 place	Ascorbic acid *S.M.* p. 481
Nitrogen, total organic	mg/l, 2 place	Kjeldahl. *S.M.* p. 437
Nitrate	mg/l, 2 place	Cadmium reduction (automated) *S.M.* p. 620
Metallic Constituents		
Aluminum, total; dissolved	µg/l, 3 place	Atomic absorption (AA) *S.M.* p. 152
Arsenic, total; dissolved	µg/l, 3 place	Atomic Absorption (Vapor generation) *S.M.* p. 159

Table 1. Continued.

Analysis	Units/Sensitivity	Method
Barium, dissolved[2]	μg/l, 2 place	Atomic absorption *S.M.* p. 152
Boron, dissolved	mg/l, 2 place	Carmine. *S.M.* p. 290
Calcium	mg/l, 2 place	Titrimetric (EDTA) *S.M.* p. 189
Cadmium, total; dissolved	μg/l, 3 place	Atomic absorption (Flameless) EPA p. 78
Chromium, dissolved[2]	μg/l, 3 place	Atomic absorption (Flameless) EPA p. 78
Chromium, hexavalent	μg/l, 3 place	Colorimetric, *S.M.* p. 192
Copper, total; dissolved	μg/l, 3 place	Atomic absorption *S.M.* p. 148
Iron, total; dissolved	μg/l, 3 place	Atomic absorption *S.M.* p. 148
Lead, total; dissolved	μg/l, 3 place	Atomic absorption (Flameless) EPA p. 78
Magnesium, dissolved	mg/l, 2 place	Calculated from calcium and total hardness
Manganese, total; dissolved	μg/l, 3 place	Atomic absorption *S.M.* p. 148
Mercury, total; dissolved	μg/l, 3 place	Atomic absorption (Cold vapor) *S.M.*p. 56
Molybdenum, total; dissolved	μg/l, 3 place	Atomic absorption (Flameless) EPA p. 78
Nickel, total; dissolved	μg/l, 3 place	Atomic absorption (Flameless) EPA p. 78
Potassium, dissolved	mg/l, 2 place	Flame photometric, *S.M.* p. 234
Selenium, total; dissolved	μg/l, 2 place	Atomic absorption (Vapor generation) *S.M.* p. 159
Silver, total; dissolved	μg/l, 3 place	Atomic absorption (Flameless) EPA p. 78

Table 1. Continued.

Analysis	Units/Sensitivity	Method
Sodium, dissolved	mg/l, 2 place	Flame photometric, *S.M.* p. 250
Zinc, total; dissolved	μg/l, 3 place	Atomic absorption, *S.M.* p. 148

[1]Sources of analytical methods:

S.M. = *Standard Methods for Examination of Water and Wastewater*. 14th Ed. (1975). APHA.

EPA = USEPA (1976a). *Methods for Chemical Analysis of Water and Wastes*.

[2]These analysis were not included in original contract. Analysis of these constituents began in January, 1978.

Table 2. Methods of storage and preservation of samples used in the water quality survey.

Constitutent	Preservative	Storage
Metals[1]	3 ml 50% "mercury free" HNO_3/l	Several months (refrigerated)
TKN	0.8 ml conc. H_2SO_4/l	Max. of 7 days in dark amber glass bottle (refrigerated)
NO_3-NO_2	1 drop chloroform per 12 ml vials	Max. of 2 days in stoppered vials (refrigerated)
CN^-	pH adjusted to 12 with ionic strength adjuster	Up to 24 hours (refrigerated)

[1]Sample bottles (500 ml) for "total metals" contained 1.5 ml HNO_3 when shipped to field.

aquatic biota are below the detection limits of analyses. Since there may have been instances in which the concentration of one of these metals was less than the detection limit of analysis but still greater than the proposed standard for the protection of the aquatic biota, the comparisons for these metals with the proposed standards in Tables 6 and 7 are enclosed in parenthesis.

Results

The water quality data collected during this study are presented in Appendix B. Statistical analyses of these data, including the mean, maximum, minimum, range, standard deviation and coefficient of variance for each constituent are presented in Appendix C.

The sampling period for this study began in May, 1977, and ended during August, 1978 (17 sampling rounds). Forty-four analyses were to be performed on each sample between May, 1977, and December, 1977, and 49 analyses were to be performed on each sample between January, 1978, through August, 1978. Thus, a total of 2,364 analyses were to be performed for the three sampling stations associated with the West Divide Project. During this study one sample (designated for non-metallic constituent analyses) was not received, resulting in the omission of 16 analyses (0.6 percent of the total). In addition to these, 16 analytical tests were omitted throughout the study (0.6 percent of the total). Thus, 98.2 percent of the initially scheduled analyses were completed.

In order to check the reliability of these analyses, ion balances were computed for each sample analyzed. The error in each ion balance was calculated as follows:

$$\%\ \text{error} = \frac{|\Sigma M^{+n} - \Sigma M^{-n}|}{\Sigma M^{+n} - \Sigma M^{-n}} \times 100 \qquad (1)$$

The ion balance calculations for each sampling period are presented in Table 4. A frequency distribution of the errors in the ion balances for each water quality station is presented in Table 5 and Figure 1.

Table 3. West Divide water quality survey - Missing parameter values.[a]

Sampling Round	Station	Analyses not performed	Reason for Omission
1	13,20	Hexavalent chromium	Analysis omitted
2	13	Alkalinity	Analysis omitted
	20	Nitrite	Analysis omitted
3	20	Total cyanide	Analysis omitted
	21	All non-metallic constituents, plus calcium and hex. chromium	Sample not received
4	21	Total nickel	Analysis omitted
5	13,21	Chloride	Analysis omitted
10	13,20,21	Fluoride; hex. chromium	Analysis omitted
	21	TDS	Analysis omitted
14	13,20,21	Arsenic (tot.; diss.); selenium (tot.; diss.)	Analysis omitted

[a]When total hardness was not determined, magnesium concentration could not be calculated. When alkalinity was not determined, inorganic carbon species (HCO_3^-, $CO_3^=$) could not be determined.

Table 4. Ion balance calculations for the West Divide Project(1)

STDS = Sum of the constituents (mg/ℓ)
MTDS = Laboratory measured TDS (mg/ℓ)
SC = Sum of cations (meq/ℓ)
SA = Sum of anions (meq/ℓ)
ADIFF = Absolute difference between SC and SA (meq/ℓ)
ERR(%) = (ADIFF)/(SC + SA) x 100
* = Indicated date where one or more constituents have not been recorded.
– = Indicates that the concentration was below detection limit.

WEST DIVIDE PROJECT

STATION 13: WEST DIVIDE CREEK

	5/25/77	6/16 *	6/30	7/19	8/24 *	9/21	10/19	11/15	12/13	1/18/78	2/15	3/21	4/18	5/16	6/16 *	7/19	8/24
CA	48.0	49.0	80.0	114.0	64.0	87.0	79.0	106.0	83.0	94.0	82.0	51.0	45.0	29.0	0.0	42.0	54.0
MG	44.0	5.0	23.0	28.0	10.0	34.0	31.0	50.0	45.0	43.0	42.0	14.0	3.0	2.0	0.0	6.0	32.0
NA	36.0	34.0	97.0	192.0	65.0	77.0	141.0	196.0	151.0	176.0	147.0	71.0	25.0	5.0	15.0	24.0	114.0
K	2.0	2.0	5.0	5.0	8.0	11.0	5.5	2.6	6.1	2.4	2.9	3.1	1.7	3.8	4.0	3.0	5.0
HCO3	177.0	0.0	210.0	516.0	285.0	379.0	429.0	429.0	452.0	417.0	424.0	263.0	136.0	106.0	100.0	148.0	314.0
CO3	12.0	0.0	0.0	15.0	0.0	6.0	14.0	34.0	0.0	0.0	12.0	0.0	0.0	0.0	10.0	0.0	22.0
CL	20.0	5.0	3.0	-1.0	0.0	23.0	-1.0	35.0	36.0	-1.0	32.0	21.0	55.0	-2.0	4.0	6.0	0.0
SO4	62.0	46.0	164.0	303.0	83.0	166.0	139.0	199.0	177.0	148.0	171.0	58.0	24.0	7.0	43.0	26.0	131.0
STDS	401.0	135.0	582.0	1173.0	515.0	763.0	838.5	1031.6	950.1	880.4	912.9	481.1	291.7	152.8	176.0	257.0	672.0
MTDS	198.0	262.0	596.0	946.0	400.0	646.0	750.0	791.0	763.0	734.0	711.0	436.0	171.0	112.0	168.0	211.0	576.0
SC	7.632	4.387	10.231	16.472	7.048	10.769	12.766	16.350	14.568	15.945	14.015	6.804	3.023	1.926	0.755	3.710	10.414
SA	5.635	0.974	7.699	16.928	7.428	11.805	11.754	14.391	13.741	11.421	13.183	7.000	4.611	2.266	3.208	3.712	9.447
ADIFF	1.997	3.413	2.532	0.457	0.380	1.036	1.012	1.959	0.827	4.524	0.832	0.196	1.188	0.339	2.453	0.002	0.966
ERR(%)	15.051	63.665	14.122	1.367	2.624	4.590	4.128	6.373	2.922	16.530	3.061	1.405	14.085	6.098	61.906	0.029	4.866

WEST DIVIDE PROJECT

STATION 20: LOWER COLORADO AT SILT

	5/25/77	6/16	6/30	7/19	8/24	9/21	10/19	11/15	12/13	1/18/78	2/15	3/21	4/18	5/16	6/16	7/19	8/24
CA	67.0	63.0	70.0	69.0	77.0	79.0	90.0	108.0	81.0	72.0	64.0	84.0	62.0	44.0	33.0	50.0	60.0
MG	9.0	14.0	10.0	12.0	10.0	12.0	16.0	8.0	20.0	18.0	13.0	11.0	0.0	2.0	3.0	5.0	10.0
NA	102.0	73.0	124.0	129.0	69.0	86.0	151.0	218.0	162.0	210.0	171.0	144.0	66.0	9.0	9.0	38.0	94.0
K	4.0	3.0	5.0	4.0	5.0	5.0	4.5	3.0	7.0	3.1	3.0	3.5	2.0	5.1	3.0	3.0	4.0
HCO3	116.0	111.0	130.0	119.0	122.0	117.0	141.0	147.0	131.0	126.0	128.0	127.0	114.0	172.0	78.0	116.0	139.0
CO3	2.0	0.0	0.0	1.0	0.0	16.0	6.0	21.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0
CL	140.0	115.0	108.0	178.0	14.0	186.0	161.0	206.0	236.0	215.0	211.0	213.0	216.0	23.0	12.0	60.0	154.0
SO4	73.0	92.0	136.0	91.0	105.0	99.0	130.0	172.0	138.0	134.0	130.0	126.0	68.0	43.0	67.0	62.0	107.0
STDS	513.0	471.0	645.0	603.0	422.0	600.0	699.5	963.0	775.0	764.1	740.0	708.5	566.0	296.1	205.0	334.0	603.0
MTDS	452.0	550.0	696.0	572.0	518.0	563.0	746.0	626.0	661.0	716.0	637.0	681.0	396.0	213.0	162.0	284.0	562.0
SC	8.623	7.548	9.637	10.144	8.064	8.798	12.491	15.607	12.913	14.587	12.776	11.450	6.701	2.862	2.362	4.636	9.223
SA	7.829	7.380	10.212	9.316	5.021	9.968	10.188	15.009	12.151	11.375	11.219	11.172	10.262	4.964	3.293	5.303	9.552
ADIFF	0.794	0.168	0.375	0.828	3.043	1.170	2.302	0.598	0.762	3.212	1.557	0.278	3.561	2.102	0.932	0.667	0.329
ERR(%)	4.824	1.125	1.870	4.255	26.621	6.235	10.152	1.953	3.042	12.372	6.490	1.226	20.566	26.723	16.476	6.715	1.751

Table 4. (cont'd). Ion balance calculations for the West Divide Project[1]

WEST DIVIDE PROJECT

STATION 21: UPPER COLORADO AT NEW CASTLE

	5/25/77	6/16	6/30 *	7/19	8/24 *	9/21	10/19	11/15	12/13
CA	67.0	62.0	0.0	61.0	73.0	82.0	103.0	101.0	87.0
MG	13.0	9.0	0.0	14.0	7.0	14.0	6.0	12.0	12.0
NA	94.0	77.0	122.0	128.0	87.0	84.0	151.0	240.0	166.0
K	4.0	3.0	5.0	4.0	6.0	5.0	4.8	2.9	7.0
HCO3	116.0	107.0	0.0	118.0	120.0	129.0	143.0	149.0	139.0
CO3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0
CL	135.0	111.0	0.0	174.0	0.0	193.0	167.0	283.0	288.0
SO4	75.0	92.0	0.0	88.0	111.0	110.0	127.0	174.0	135.0
STDS	504.0	461.0	127.0	587.0	404.0	617.0	701.8	967.9	834.0
MTDS	480.0	438.0	0.0	594.0	500.0	502.0	752.0	818.0	696.0
SC	8.604	7.260	5.435	9.866	8.156	9.025	12.324	16.541	12.728
SA	7.690	7.187	0.000	9.101	4.711	10.315	10.215	14.706	13.715
ADIFF	0.914	0.074	5.435	0.765	3.445	1.289	2.109	1.835	0.987
ERR(%)	5.610	0.509	100.000	4.034	26.776	6.667	9.358	5.873	3.732

	1/18/78	2/15	3/21	4/18	5/18	6/16	7/19	6/24
CA	79.0	80.0	86.0	68.0	43.0	35.0	48.0	76.0
MG	14.0	74.0	8.0	2.0	6.0	2.0	6.0	11.0
NA	212.0	172.0	139.0	71.0	11.0	9.0	38.0	97.0
K	3.5	2.9	3.3	2.2	4.7	3.0	3.0	4.0
HCO3	127.0	128.0	125.0	112.0	158.0	77.0	108.0	130.0
CO3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CL	226.0	220.0	213.0	213.0	25.0	13.0	71.0	154.0
SO4	117.0	109.0	123.0	87.0	43.0	49.0	66.0	101.0
STDS	778.5	785.9	697.3	555.2	290.7	188.0	340.0	573.0
MTDS	0.0	665.0	705.0	374.0	223.0	170.0	273.0	552.0
SC	14.405	17.635	11.080	6.702	3.238	2.379	4.618	9.019
SA	11.351	11.036	11.070	10.060	4.761	2.927	5.537	9.047
ADIFF	3.054	6.600	0.011	3.358	1.523	0.548	0.919	0.028
ERR(%)	11.856	23.019	0.049	20.030	19.036	10.322	9.045	0.156

STDS = Sum of the constituents (mg/ℓ)
MTDS = Laboratory measured TDS (mg/ℓ)
SC = Sum of cations (meq/ℓ)
SA = Sum of anions (meq/ℓ)
ADIFF = Absolute difference between SC and SA (meq/ℓ)
ERR(%) = (ADIFF)/(SC + SA) x 100
***** = Indicated date where one or more constituents have not been recorded.
– = Indicates that the concentration was below detection limit.

Table 5. Frequency distribution of errors in the ion balances for the West Divide Project[1]

Station 13: West Divide Creek

Err(%)	Number	% of total
0 - 5	9	60.0
5 - 10	2	14.3
10 - 15	2	14.3
15 - 20	2	14.3
>20	0	0
Missing Data	2	
Total	17	

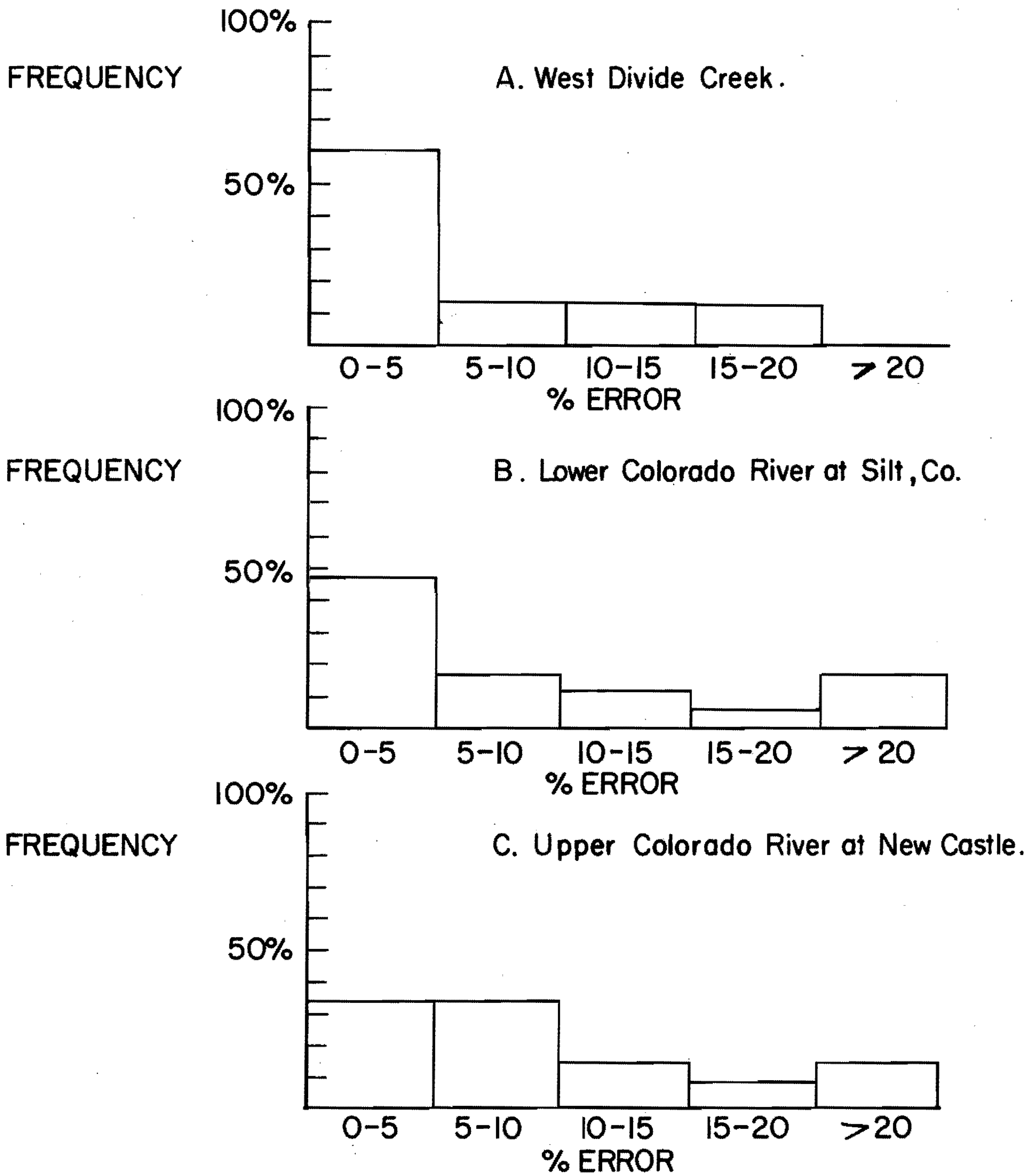
Station 20: Lower Colorado at Silt

Err(%)	Number	% of total
0 - 5	8	47.1
5 - 10	3	17.6
10 - 15	2	11.8
15 - 20	1	5.9
>20	3	17.6
Missing Data	0	
Total	17	

Station 21: Upper Colorado at New Castle

Err(%)	Number	% of total
0 - 5	5	33.3
5 - 10	5	33.3
10 - 15	2	13.3
15 - 20	1	6.7
>20	2	13.3
Missing Data	2	
Total	17	

Figure 1. Frequency distribution of errors in the ion balances for the West Divide Project.



Discussion

The waters from the two water quality stations on the Colorado River are very similar to one another with respect to the concentrations of major ions (Ca, Mg, K, Na, SO_4, Cl) and the total concentration of dissolved solids (See Tables C-2 and C-3). At both sites the mean TDS concentration was just over 500 mg/l. The TDS did not exceed 1,000 mg/l at either station at any time during this study.

The composition of water from West Divide Creek was similar to that of the Colorado River at New Castle and Silt with respect to the concentrations of major ions and TDS, although the levels of some metallic constituents were somewhat different in West Divide Creek than in the main stem of the Colorado River (compare Tables 7 and 8 with Table 9).

For the two water quality stations on the Colorado the most frequently exceeded of the proposed standards for raw water supply was that for total cadmium. The total cadmium standard was exceeded during 41 percent of the sampling periods at Silt and during 29 percent of the sampling periods at New Castle. The concentrations of several other metals exceeded the proposed standards for raw water supply (Tables 7 and 8) but none except cadmium exceeded the standards during more than two sampling rounds. The water from West Divide Creek exceeded the proposed raw water supply for total cadmium during 35 percent of the sampling periods. The most notable difference between the main stem of the Colorado River and West Divide Creek with respect to the proposed water supply standards is the number of occasions on which the dissolved manganese standard was exceeded. In the Colorado River the dissolved manganese standard was exceeded only once

Table 6. Constituents that exceeded the proposed Colorado Water Quality Standards at West Divide Creek.[1]

Parameter (All metals "total" unless specified)	Water Use: Class II Water Supply N/T[2]	Class II Water Supply %	Agriculture N/T[2]	Agriculture %	Aquatic Biota N/T[2]	Aquatic Biota %
Aluminum (dissolved)	-	-	-	-	13/17	76
Barium	1/10	10	-	-	-	-
Cadmium[3]	6/17	35	6/17	35	(11/17)	(65)
Copper[3]	0/17	0	0/17	0	(7/17)	(41)
Iron (total)	-	-	-	-	11/17	65
Lead	0/10	0	0/10	0	2/10	20
Manganese (dissolved)	8/17	47	-	-	-	-
Manganese (total)	-	-	5/17	29	0/17	0
Mercury[3]	3/17	18	-	-	(16/17)	(94)
Silver[3]	0/17	0	-	-	(3/17)	(18)
Zinc[3]	0/17	0	0/17	0	(10/17)	(59)
Total Cyanide	0/17	0	0/17	0	11/17	65
Nitrogen (nitrite)	0/17	0	0/17	0	1/17	6
Sulfate	1/17	6	-	-	-	-

(1) Proposed Colorado Water Quality Standards in Appendix A.

(2) N/T = number of samples exceeding standard compared with total number of samples analyzed.

(3) Parenthesis indicate that the proposed standard was below the detection limit of analyses.

Table 7. Constituents that exceeded the proposed Colorado Water Quality Standards in the Lower Colorado at Silt.(1)

Parameter (All metals "total" unless specified)	Water Use: Class II Water Supply N/T(2)	%	Agriculture N/T(2)	%	Aquatic Biota N/T(2)	%
Aluminum (dissolved)	-	-	-	-	14/17	82
Barium	1/10	0	-	-	-	-
Cadmium(3)	7/17	41	7/17	41	(8/17)	(47)
Copper(3)	0/17	0	0/17	0	(8/17)	(47)
Iron (total)	-	-	-	-	4/17	23
Lead	0/10	0	0/10	0	1/10	10
Manganese (dissolved)	2/17	12	-	-	-	-
Mercury(3)	1/17	6	-	-	(15/17)	(88)
Selenium	1/17	6	1/17	6	0/17	0
Silver(3)	0/17	0	-	-	(3/17)	(18)
Zinc(3)	1/17	6	1/17	6	(11/17)	(65)
Chloride	1/17	6	-	-	-	-
Total Cyanide	0/17	0	0/17	0	11/17	65
Nitrogen (nitrite)	0/17	0	0/17	0	1/17	6

(1) Proposed Colorado Water Quality Standards in Appendix A.

(2) N/T = number of samples exceeding standard compared with total number of samples analyzed.

(3) Parenthesis indicate that the proposed standard was below the detection limit of analyses.

Table 8. Constituents that exceeded the proposed Colorado Water Quality Standards in the Upper Colorado at New Castle.(1)

Parameter (All metals "total" unless specified)	Water Use: Class II Water Supply N/T(2)	%	Agriculture N/T(2)	%	Aquatic Biota N/T(2)	%
Aluminum (dissolved)	-	-	-	-	13/17	76
Cadmium(3)	5/17	29	5/17	29	(9/17)	(93)
Copper(3)	0/17	0	0/17	0	(7/17)	(41)
Iron (total)	-	-	-	-	4/17	23
Lead	0/10	0	0/10	0	2/10	20
Manganese (dissolved)	1/17	6	-	-	-	-
Manganese (total)	-	-	2/17	12	0/17	0
Mercury(3)	1/17	6	-	-	(17/17)	(100)
Silver(3)	0/17	0	-	-	(2/17)	(12)
Zinc(3)	0/17	0	0/17	0	(12/17)	(71)
Chloride	2/17	12	-	-	-	-
Total Cyanide	0/17	0	0/17	0	8/17	47
Nitrogen (nitrite)	0/17	0	0/17	0	1/17	6

(1) Proposed Colorado Water Quality Standards in Appendix A.

(2) N/T = number of samples exceeding standard compared with total number of samples analyzed.

(3) Parenthesis indicate that the proposed standard was below the detection limit of analyses.

at New Castle and twice at Silt, whereas in West Divide Creek the dissolved manganese standard was exceeded during nearly half (8 out of 17) of the sampling periods. The standard for dissolved manganese was established on the basis of the undesirable taste and brownish staining associated with the use of waters containing high concentrations of dissolved manganese. On this basis, the water from West Divide Creek would be less desirable than water from the Colorado River as a source of municipal water supply.

The water from the Colorado River at Silt and at New Castle exceeded the proposed agricultural use standard for cadmium during seven and five sampling periods, respectively. In addition, the agricultural standard for total manganese was exceeded on two occasions in the Colorado River at New Castle and the standards for total selenium and total zinc were exceeded (once each) in the Colorado River at New Castle. Many of the heavy metal standards were exceeded during the irrigation season. The salinity of the Colorado River at these two stations never exceeded 700 mg/l during the irrigation season. This level of salinity would be suitable for irrigation of all but the most sensitive crops (NAS,1972). The water from West Divide Creek exceeded the proposed agricultural use standard for total cadmium during six sampling periods and for total manganese during five sampling periods. The standards for these metals were usually exceeded during the spring and summer months. The salinity of West Divide Creek may limit its use for irrigating sensitive crops, although the TDS never exceeded 1,000 mg/l during this study.

The water from the Colorado River exceeded many of the proposed standards for the protection of the aquatic biota. Concentrations of dissolved aluminum, total cadmium, total mercury, total zinc and total cyanide at both sites exceeded the proposed standards for the protection of aquatic biota during half or more of the sampling periods. The standards for several other constituents, including total copper, total iron, total lead, total silver and nitrite were exceeded at both Colorado River stations during one or more sampling periods (Tables 7 and 8). Algal bioassays conducted using the Algal Assay Bottle Test (EPA, 1971) with filtered water from the Colorado River at New Castle and Silt gave no indication of heavy metal toxicity during November, 1977, January, 1978, March, 1978, and May, 1978. Water from West Divide Creek also exceeded the proposed standards for the protection of the aquatic biota with respect to numerous metals. Concentrations of dissolved aluminum, total cadmium, total iron, total mercury, total zinc and total cyanide exceeded the proposed standards during over half of the samples from West Divide Creek. Concentrations of total copper, total lead, total silver and nitrite also exceeded the proposed standards, but less frequently. Bioassays were not conducted on water from West Divide Creek.

APPENDIX A

Proposed Colorado Water Quality Standards

Table A-1 Proposed Colorado water quality standards: Class II water supply.

Parameter	Standard
Physical	
D.O. (mg/ℓ)[1]	Aerobic[2]
pH	5.0-9.0
Suspended solids and turbidity	[3]
Temperature	X
TDS (mg/ℓ)	Y
Biological	
Algae[4]	Free of toxic and objectionable algae
Fecal coliforms (#/100 mℓ)	1,000
Inorganics	
Ammonia (mg/ℓ as N)	0.5
Total residual chlorine (mg/ℓ)	X
Cyanide (mg/ℓ)	0.2
Fluoride (mg/ℓ)	[5]
Nitrate (mg/ℓ as N)	10
Nitrite (mg/ℓ as N)	1.0
Sulfide as H_2S (mg/ℓ)	0.05
Boron (mg/ℓ)	X
Chloride (mg/ℓ)	250
Magnesium (mg/ℓ)	125
Sodium adsorbtion ratio	X
Sulfate (mg/ℓ)	250
Phosphorus (mg/ℓ as P)	Bioassay[6]
Toxic Metals (mg/ℓ)	
Aluminum	X
Arsenic	0.05
Barium	1.0
Beryllium	X
Cadmium	0.01
Chromium	0.05
Copper	1.0
Iron	0.3 (soluble)
Lead	0.05
Manganese	0.05 (soluble)
Mercury	0.002
Molybdenum	Y
Nickel	X

X = numerical limit generally not needed for protection of classified use.
Y = limit may be required but there is insufficient data for setting a general standard.

Table 1-1 Continued.

Parameter	Standards
Toxic Metals (mg/ℓ)	
Selenium	0.01
Silver	0.05
Thallium	X
Zinc	5.0
Organics[7] (μg/ℓ)	
Chlorinated pesticides[8]	
Aldrin[9]	Y
Chlordane[9]	Y
Dieldrin[8]	Y
DDT[9]	Y
Endrin	0.2
Heptachlor[9]	Y
Lindane	4
Methoxychlor	Y
Mirex	100
Toxaphene	5
Organophosphate pesticides[8]	
Demeton	Y
Endosulfan	Y
Guthion	Y
Malathion	Y
Parathion	Y
Chlorophenoxy Herbicides	
2, 4-D	100
2, 4, 5-TP	10
PCB's[10]	Y
Phenol	1
Radiological[11] (pCi/ℓ)	
Alpha[11, 12]	15
Beta[11, 12]	50
Cesium 134	80
Plutonium	15
Radium 226 and 228[12, 13]	5
Strontium 90[12, 13]	8
Thorium 230 and 232	60
Tritium	20,000
Uranium (total, mg/ℓ)	5

[1]Where dissolved oxygen levels less than the standard occur naturally, a discharge shall not cause a further reduction in dissolved oxygen in receiving water.

[2]An effluent shall be regulated to maintain aerobic conditions, and a guideline of 2.0 mg/ℓ dissolved oxygen in an effluent should be maintained, unless demonstrated otherwise.

[3]Suspended solid levels will be controlled by Effluent Limitations and Basic Standards.

[4]Free from objectionable and toxic algae. It has been well established that heavy growth of some strains of blue-green algae, upon death and degradation, may release one or more substances which are toxic to humans and many other animals. Although no fixed numbers can be recommended at this time, it is clear that streams, lakes and reservoirs should not be permitted to bear heavy growth of algal blooms, nor allow these blooms to disintegrate. Every effort should be made to control algal growths to levels that are not hazardous.

[5]Fluoride limits vary from 2.4 mg/ℓ at 12.0 C and below, to 1.4 mg/ℓ between 26.3 C and 32.5 C, based upon the annual average of the maximum daily air temperature (see *National Interim Primary Drinking Water Regulations* for specific limitations).

[6]Phosphorus standards are to be determined by an algal bioassay using the method described in the latest edition of *Standard Methods for the Examination of Water and Wastewater*.

[7]All organics, not on this partial list, are covered under Basic Standards, Section 3.1., 1978 Colorado Water Quality Standards.

[8]Numerical limits in tables based on experimental evidence of toxicity. No point source discharges of organic pesticides shall be permitted to state waters.

[9]The persistence, bioaccumulation potential, and carcinogenicity of these organic compounds cautions human exposure to a minimum (EPA).

[10]Every reasonable effort should be made to minimize human exposure (EPA).

[11]Concentrations given are maximum permissible concentrations above naturally occurring or "background" concentrations except where otherwise noted.

[12]If Alpha or Beta are measured in excess of 15 or 50 pCi/ℓ respectively, it will be necessary to determine by specific analysis the particular radionuclide or radionuclides responsible for the elevated level. Particular radionuclides should not exceed the limit given in the table. If an elevated level of Alpha or Beta emissions is caused by radionuclides, the Division should be consulted.

[13]Maximum permissible concentrations including naturally occurring or background contributions.

Table A-2 Proposed Colorado water quality standards (non-metallic): Protection of Aquatic Biota.

Parameter	Cold Water Biota	Warm Water Biota
Physical		
D.O. (mg/ℓ)[1]	6.0 7.0 (spawning)[2]	5.0
pH	6.5 - 9.0	6.5 - 9.0
Suspended solids and turbidity	[3]	[3]
Temperature (°C)	Maximum 20°C w/ 3° increase[4]	Maximum 30°C w/ 3° increase[4]
TDS (mg/ℓ)	Y	Y
Biological		
Algae[5]	Free from objectionable and toxic algae	Same as Cold Water
Fecal coliforms	X	X
Inorganics		
Ammonia (mg/ℓ as N)	0.02 unionized	0.10 unionized
Total residual chlorine (mg/ℓ)	0.002	0.01
Cyanide (mg/ℓ)	0.005	0.005
Fluoride (mg/ℓ)	X	X
Nitrate (mg/ℓ as N)	X	X
Nitrite (mg/ℓ as N)	0.05	0.5
Sulfide as H_2S (mg/ℓ)	0.002 undissociated	0.002 undissociated
Boron (mg/ℓ)	X	X
Chloride (mg/ℓ)	X	X
Magnesium (mg/ℓ)	X	X
Sodium adsorbtion ratio	X	X
Sulfate (mg/ℓ)	X	X
Phosphorus (mg/ℓ as P)	Bioassay[6]	Bioassay[6]
Organics[7] ($\frac{\mu g}{\ell}$)		
Chlorinated Pesticides[8]		
Aldrin[9]	0.003	0.003
Chlordane	0.01	0.01
Dieldrin[9]	0.003	0.003
DDT	0.001	0.001
Endrin	0.004	0.004
Heptachlor	0.001	0.001
Lindane	0.01	0.01
Methoxychlor	0.03	0.03
Mirex	0.001	0.001
Toxaphene	0.005	0.005

Table A-2 Continued.

Parameter	Cold Water Biota	Warm Water Biota
Organophosphate Pesticides[8]		
Demeton	1	1
Endosulfan	0.003	0.003
Guthion	0.01	0.01
Malathion	1	1
Parathion	0.04	0.04
Chlorophenoxy Herbicides		
2, 4-D	Y	Y
2, 4, 5-TP	Y	Y
PCB's	0.001	0.001
Phenols	1	1
Radiological[10] in (pCi/ℓ)		
Alpha (excluding uranium and radium[11])	15	15
Beta (excluding Sr^{90} [11]	50	50
Cesium 134	80	80
Plutonium 238, 239, and 240	15	15
Radium 226 and 228	5	5
Strantium 90[12]	8	8
Thorium 230 and 232	60	60
Tritium	20,000	20,000
Uranium (total)[13]	--	--

X = numerical limit generally not needed for protection of classified use.

Y = limit may be required but there is insufficient data for setting a general standard.

[1]Where dissolved oxygen levels less than the standard occur naturally a discharge shall not cause a further reduction in dissolved oxygen in receiving water.

[2]A 7 mg/ℓ standard, during periods of spawning of coldwater fish, shall be set on a case by case basis as defined in the NPDES permit for those dischargers whose effluent would affect fish spawning.

[3]Suspended solid levels will be controlled by Effluent Limitations and Basic Standards.

[4]Temperature shall maintain a normal pattern of diurnal and seasonal fluctuations with no abrupt changes and shall have no increase in temperature of a magnitude, rate and duration deemed deleterious to the resident aquatic life. Generally, a maximum 3°C increase over a minimum of a 4-hour period, lasting for 12 hours maximum, is deemed acceptable for discharges fluctuating in volume or temperature. Where temperature increases cannot be maintained within this range using BMP, BATEA, and BPWITT control measures, the Division will determine whether the resulting temperature increases preclude an Aquatic Life classification.

[5]Free from objectionable and toxic algae. It has been well established that heavy growth of some strains of blue-green algae, upon death and degradation, may release one or more substances which are toxic to humans and many other animals. Although no fixed numbers can be recommended at this time, it is clear that streams lakes and reservoirs should not be permitted to bear heavy growth of algal blooms, nor allow these blooms to disintegrate. Every effort should be made to control algal growths to levels that are not hazardous.

[6]Phosphorus standards are to be determined by an algal bioassay using the method described in the latest edition of *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association.

[7]All organics, not on this partial list, are covered under Basic Standards, Section 3.1., 1978 Colorado Water Quality Standards.

[8]Numerical limits in tables based on experimental evidence of toxicity. No point source discharges of organic pesticides shall be permitted to state waters.

[9]Aldrin and dieldrin in combination should not exceed 0.000003 mg/ℓ.

[10]Concentrations given are maximum permissible concentrations above naturally occurring or "background" concentrations except where otherwise noted.

[11]If Alpha or Beta are measured in excess of 15 of 50 pCi/ℓ respectively, it will be necessary to determine by specific analysis the particular radionuclide or radionuclides responsible for the elevated level. Particular radionuclides should not exceed the limit given in the table. If an elevated level of Alpha or Beta emissions is caused by radionuclides, the Division should be consulted.

[12]Maximum permissible concentrations including naturally occurring or background contribution.

[13]See Uranium in Table A-3 for aquatic life limitations.

Table A-3 Proposed Colorado water quality standards (metallic): Protection of Aquatic Biota.

Parameter	Water Hardness[1] - Cold and Warm Water Biota				
	0-100	100-200	200-300	300-400	over 400
Toxic Metals[2] (mg/ℓ)					
Aluminum (soluble)	0.1	0.1	0.1	0.1	0.1
Arsenic	0.05	0.05	0.05	0.05	0.05
Barium	X	X	X	X	X
Beryllium	0.01	0.3	0.6	0.9	1.1
Cadmium	0.004	0.001	0.005	0.01	0.015
Chromium	0.1	0.1	0.1	0.1	0.1
Copper	0.01	0.01	0.01	0.02	0.04
Iron	1.0	1.0	1.0	1.0	1.0
Lead[3]	0.004	0.025	0.050	0.100	0.150
Manganese	1.0	1.0	1.0	1.0	1.0
Mercury	0.00005	0.00005	0.00005	0.00005	0.00005
Molybdenum	X	X	X	X	X
Nickel	0.05	0.10	0.20	0.30	0.40
Selenium	0.05	0.05	0.05	0.05	0.05
Silver	0.00010	0.00010	0.00015	0.00020	0.00025
Thallium	0.15	0.15	0.15	0.15	0.15
Uranium	0.03	0.2	0.4	0.8	1.4
Zinc	0.05	0.05	0.10	0.30	0.60

X = numerical limit generally not needed for protection of classified use.

[1]Concentrations of total alkalinity or other chelating agents attributable to municipal, industrial or other discharges or agriculatural practices should not alter the total alkalinity or other chelating agents of the receiving water by more than 20 percent. Where the complexing capacity of the receiving water is altered by more than 20 percent or where chelating agents are released to the receiving water which are not naturally characteristic of that water, specific effluent limitations on pertinent parameters will be established. In no case shall instream modification or alteration of total alkalinity or other chelating agents be permitted without Commission authorization.

[2]Bioassay procedures may be used to establish criteria or standards for a particular situation. Requirements for bioassay procedures outlined in Section 3.1.10, Colorado Water Quality Standards, May 2. 1978.

[3]For bioassay lead concentration is based on soluble lead measurements (*i.e.* non-filterable lead using a 0.45 micron filter).

Table .-4 Proposed Colorado water quality standards: Agricultural Use.

Parameter	Standard
Physical	
D.O. (mg/ℓ)[1]	Aerobic[2]
pH	X
Suspended solids and turbidity	[3]
Temperature	X
TDS (mg/ℓ)	Y
Biological	
Algae[4]	Free of toxic and objectionable algae
Fecal coliforms (#/100 mℓ)	1,000
Inorganics	
Ammonia (mg/ℓ as N)	X
Total residual chlorine (mg/ℓ)	X
Cyanide (mg/ℓ)	0.2
Fluoride (mg/ℓ)	X
Nitrate (mg/ℓ as N)	100[5]
Nitrite (mg/ℓ as N)	10[5]
Sulfide as H S (mg/ℓ)	X
Boron (mg/ℓ)[2]	0.75
Chloride (mg/ℓ)	X
Magnesium (mg/ℓ)	X
Sodium adsorbtion ratio	X
Sulfate (mg/ℓ)	X
Phosphorus (mg/ℓ as P)	X
Toxic Metals (mg/ℓ)	
Aluminum	X
Arsenic	0.1
Barium	X
Beryllium	0.1
Cadmium	0.01
Chromium	0.0
Copper	0.2
Iron	X
Lead	0.1
Manganese	0.2
Mercury	X
Molybdenum	Y
Nickel	0.2

X = numerical limit generally not needed for protection of classified use.

Y = limit may be required but there is insufficient data for setting a general standard.

Table A-4 Continued.

Parameter	Standard
Toxic Metals (mg/ℓ)	
Selenium	0.02
Silver	X
Thallium	X
Zinc	2.0
Organics[6], ($\frac{\mu g}{\ell}$)	
Chlorinated Pesticides[7]	
Aldrin[8]	Y
Chlordane[8]	Y
Dieldrin[8]	Y
DDT[8]	Y
Endrin	Y
Heptachlor[8]	Y
Lindane	Y
Methoxychlor	Y
Mirex	Y
Toxaphene	Y
Organophosphate Pesticides[7]	
Demeton	Y
Endosulfan	Y
Guthion	Y
Malathion	Y
Parathion	Y
Chlorophenoxy Herbicides	
2, 4-D	Y
2, 4, 5-TP	Y
PCB's[9]	Y
Phenol	Y
Radiological[10] (pCi/ℓ)	
Alpha[11, 12]	15
Beta[11, 12]	50
Cesium	80
Plutonium	15
Radium 226, and 228[12]	5
Strontium 90[12]	8
Thorium 230 and 232	60
Tritium	20,000
Uranium (total, mg/ℓ)	5

[1]Where dissolved oxygen levels, less than the standard, occur naturally, a discharge shall not cause a further reduction in dissolved oxygen in receiving water.

[2]An effluent shall be regulated to maintain aerobic conditions, and a guideline of 2.0 mg/ℓ dissolved oxygen in an effluent should be maintained, unless demonstrated otherwise.

[3]Suspended solid levels will be controlled by Effluent Limitations and Basic Standards.

[4]Free from objectionable and toxic algae. It has been well established that heavy growth of some strains of blut-green algae, upon death and degradation, may release one or more substances which are toxic to humans and many other animals. Although no fixed numbers can be recommended at this time, it is clear that streams, lakes and reservoirs should not be permitted to bear heavy growth of algal blooms, or allow these blooms to disintegrate. Every effort should be made to control algal growths to levels that are not hazardous.

[5]In order to provide a reasonable margin of safety to allow for unusual situations such as extremely high water ingestion or nitrite formation in slurries, the NO_3-N plus NO_2-N content in drinking waters for livestock and poultry should be limited to 100 ppm or less, and the NO_2-N content alone be limited to 10 ppm or less.

[6]All organics, not on this partial list, are covered under Basic Standards, Section 3.1., 1978 Colorado Water Quality Standards.

[7]Numerical limits in tables based on experimental evidence of toxicity. No point source discharges of organic pesticides shall be permitted to state waters.

[8]The persistence, bioaccumulation potential, and carcinogenicity of these organic compounds cautions human exposeure to a minimum (EPA).

[9]Every reasonable effort should be made to minimize human exposure (EPA).

[10]Concentrations given are maximum permissible concentrations above naturally occurring or "background" concentrations except where otherwise noted.

[11]If Alpha or Beta are measured in excess of 15 or 50 pCi/ℓ respectively, it will be necessary to determine by specific analysis the particular radionuclide or radionuclides responsible for the elevated level. Particular radionuclides should not exceed the limit given in the table. If an elevated level of Alpha or Beta emissions is caused by radionuclides, the Division should be consulted.

[12]Maximum permissible concentrations including naturally occurring or background contributions.

Table -5 Proposed Colorado water quality standards: Recreational Use.

Parameter	Standard: Class I (Primary Contact)	Standard: Class II (Secondary Contact)
Physical		
D.O.[1] ($\frac{mg}{\ell}$ D.O.)	Aerobic[2]	Aerobic[2]
pH	6.5-9.0	X
Suspended solids and turbidity	X	X
Temperature	X	X
TDS (mg/ℓ)	X	X
Biological		
Algae[4]	Free of objectionable and toxic algae	Free of objectionable and toxic algae
Fecal coliforms (#/100 mℓ)	200	1,000
Inorganics		
Ammonia ($\frac{mg}{\ell}$ as N)	X	X
Chloride (mg/ℓ)	X	X
Cyanide (mg/ℓ)	X	X
Fluoride (mg/ℓ)	X	X
NO_3 (mg/ℓ as N)	X	X
NO_2 (mg/ℓ as N)	X	X
Sulfide as H_2S (mg/ℓ)	X	X
Boron (mg/ℓ)[2]	X	X
Chloride (mg/ℓ)	X	X
Magnesium (mg/ℓ)	X	X
SAR	X	X
Sulfate (mg/ℓ)	X	X
Phosphorus (mg/ℓ as P)	Bioassay[5]	Bioassay[5]
Toxic Metals (mg/ℓ)		
Aluminum	X	X
Arsenic	X	X
Barium	X	X
Beryllium	X	X
Cadmium	X	X
Chromium	X	X
Copper	X	X
Iron	X	X
Lead	X	X
Manganese	X	X
Mercury	X	X
Molybdenum	X	X
Nickel	X	X
Selenium	X	X

Table A-5 Continued.

Parameter	Standard Class I (Primary Contact)	Standard Class II (Secondary Contact)
Toxic Metals (mg/ℓ)		
Silver	X	X
Thallium	X	X
Uranium	X	X
Zinc	X	X
Organics[6]		
Chlorinated Pesticides[7]		
Aldrin[8]	Y	Y
Chlordane[8]	Y	Y
Dieldrin[8]	Y	Y
DDT[8]	Y	Y
Endrin	Y	Y
Heptachlor[8]	Y	Y
Lindane	Y	Y
Methoxychlor	Y	Y
Mirex	Y	Y
Toxaphene	Y	Y
Organophosphate Pesticides[7]		
Demeton	Y	Y
Endosulfan	Y	Y
Guthion	Y	Y
Malathion	Y	Y
Parathion	Y	Y
Chlorophynoxy Herbicides		
2, 4-D	Y	Y
2, 4, 5-TP	Y	Y
PCB's[9]	Y	Y
Phenol	Y	Y
Radiological		
Alpha	X	X
Beta	X	X
Cesium 134	X	X
Plutonium 238, 239, and 240	X	X
Radium 226 and 228	X	X
Strantium	X	X
Thorium 230 and 232	X	X
Tritium	X	X
Uranium (total)	X	X

X = numerical limit generally not needed for protection of classified use.
Y = limit may be required but there is insufficient data for setting a general standard.

[1]Where dissolved oxygen levels, less than the standard, occur naturally, a discharge shall not cause a further reduction in dissolved oxygen in receiving water.

[2]An effluent shall be regulated to maintain aerobic conditions, and a guideline of 2.0 mg/ℓ dissolved oxygen in an effluent should be maintained, unless demonstrated otherwise.

[3]Suspsended solid levels will be controlled by Effluent Limitations and Basic Standards.

[4]Free from objectionable and toxic algae. It has been well established that heavy growth of some strains of blue-green algae, upon death and degradation, may release one or more substances which are toxic to humans and many other animals. Although no fixed numbers can be recommended at this time, it is clear that streams, lakes and reservoirs should not be permitted to bear heavy growth of algal blooms, nor allow these blooms to disintegrate. Every effort should be made to control algal growths to levels that are not hazardous.

[5]Phosphorus standards are to be determined by an algal bioassay using the method described in the latest edition of *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association.

[6]All organics, not on this partial list, are covered under Basic Standards, Section 3.1., 1978 Colorado Water Quality Standards.

[7]Numerical limits in tables based on experimental evidence of toxicity. No point source discharge of organic pesticides shall be permitted to state waters.

[8]The persistence, bioaccumulation potential, and carcinogenicity of these organic compounds cautions human exposure to a minimum (EPA).

[9]Every reasonable effort should be made to minimize human exposure (EPA).

APPENDIX B

Raw Water Quality Data

Table B-1. Water quality parameter codes.

A. METALLIC CONSTITUENTS
(μg/l unless noted)

101. Aluminium, Dissolved
102. Aluminium, Total
103. Barium, Dissolved
104. Barium, Total
105. Cadmium, Dissolved
106. Cadmium, Total
107. Calcium (mg/l)
108. Chromium, Hexavalent
109. Chromium, Total
110. Copper, Dissolved
111. Copper, Total
112. Hardness, Total
113. Iron, Dissolved
114. Iron, Total
115. Lead, Dissolved
116. Lead, Total
117. Magnesium (mg/l)
118. Manganese, Dissolved
119. Manganese, Total
120. Mercury, Dissolved
121. Mercury, Total
122. Molybdenum, Dissolved
123. Molybdenum, Total
124. Nickel, Dissolved
125. Nickel, Total
126. Potassium (mg/l)
127. Selenium, Dissolved
128. Selenium, Total
129. Silver, Dissolved
130. Silver, Total
131. Sodium (mg/l)
132. Zinc, Dissolved
133. Zinc, Total

B. NON-METALLIC CONSTITUENTS
(mg/l unless noted)

201. Alkalinity, Total
202. Arsenic, Dissolved (μg/l)
203. Arsenic, Total (μg/l)
204. Bicarbonate Hardness
205. Boron
206. Carbonate Hardness
207. Chloride
208. Cyanide
209. Fluoride
210. Nitrogen, Nitrate
211. Nitrogen, Nitrite
212. Nitrogen, Total Organic
213. Phosphorus, Ortho
214. Phosphorus, Total
215. Sulfate
216. Total Dissolved Solids

Table B-2. Water quality data for West Divide Creek.

WEST DIVIDE PROJECT

STATION 131 WEST DIVIDE CREEK

CODE	5/25/77	6/16	6/30	7/19	8/24	9/21	10/19	11/15	12/13	1/19/78	2/15	3/21	4/18	5/16	6/16	7/19	8/24
101	235.	340.	310.	460.	410.	200.	93.	76.	-50.	55.	272.	154.	184.	147.	1700.	294.	202.
102	2147.	740.	1690.	670.	38100.	4760.	3384.	755.	411.	1037.	1592.	15915.	11416.	23000.	7900.	9427.	1635.
103								160.	-100.	116.	134.	207.	172.	-100.	127.	106.	131.
104								194.	-100.	184.	171.	677.	404.	1353.	569.	216.	131.
105	-3.	-3.	-3.	-3.	-3.	-3.	4.	-3.	-3.	-3.	-3.	-3.	3.	-3.	-3.	-3.	-3.
106	52.	6.	25.	-3.	12.	14.	13.	-3.	-3.	-3.	-3.	5.	11.	-3.	5.	3.	6.
107	48.	49.	80.	114.	69.	87.	79.	106.	63.	94.	82.	51.	45.	29.		42.	54.
108		2.	6.	1.	-1.	6.	-1.	2.	-1.		2.	5.	5.	6.	4.	-1.	-1.
109										-20.	-20.	-20.	-20.	-20.	-20.	-20.	-20.
110	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	13.	-10.
111	15.	-10.	26.	-10.	34.	72.	-10.	14.	-10.	10.		20.	-10.	41.	49.	21.	-10.
112	303.	144.	298.	401.	201.	360.	324.	387.	395.	412.	378.	185.	123.	66.	95.	132.	200.
113	-21.	33.	26.	36.	87.	85.	71.	-21.	32.	-21.	-21.	86.	36.	100.	72.	236.	54.
114		547.	1236.	251.	8070.	3795.	3234.	695.	596.	494.	1394.	26400.	3147.	23694.	6570.	6892.	1440.
115								-1.	6.	-1.	-1.	-1.	1.	2.	2.	-1.	-1.
116								-1.	12.	-1.	-1.	10.	4.	6.	22.	-1.	-1.
117	44.	5.	23.	28.	13.	30.	31.	30.	45.	93.	42.	14.	3.	2.		6.	32.
118	6.	11.	60.	49.	18.	120.	81.	115.	111.	149.	146.	57.	27.	24.	0.	21.	32.
119	62.	38.	210.	127.	349.	316.	132.	115.	115.	151.	149.	421.	126.	676.	159.	137.	56.
120	0.2	0.6	1.2	-0.2	0.6	0.7	0.5	-0.2	-0.2	1.8	0.5	0.9	0.6	-0.2	0.4	0.7	0.6
121	1.5	0.6	5.1	0.9	1.2	0.7	0.5	0.3	-0.2	3.0	0.5	0.9	0.9	0.4	0.4	0.7	0.7
122	-5.	5.	13.	6.	5.	10.	5.	-5.	-5.	7.	5.	-5.	-5.	-5.	-5.	-5.	9.
123	-5.	8.	13.	19.	23.	13.	13.	-5.	-5.	7.	14.	-5.	14.	-5.	-5.	7.	22.
124	-6.	-6.	6.	-6.	-6.	-6.	11.	54.	-6.	-6.	-6.	-6.	-6.	-6.	-6.	-6.	-6.
125	6.	23.	43.	7.	111.	158.	11.	54.	18.	-6.	7.	25.	92.	44.	6.	-6.	-6.
126	2.0	2.0	5.3	5.0	8.9	11.0	5.5	2.6	6.1	2.4	2.9	3.1	1.7	3.8	4.0	3.0	5.0
127	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	5.	-1.
128	-1.	-1.	-1.	-1.	2.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	5.	2.
129	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.
130	-9.	-9.	-9.	-9.	-9.	-9.	15.	-9.	11.	-9.	-9.	13.	-9.	-9.	-9.	-9.	-9.
131	36.	34.	47.	192.	65.	77.	141.	196.	151.	176.	147.	71.	25.	5.	15.	24.	114.
132	-5.	-5.	-5.	6.	5.	12.	15.	14.	-5.	14.	30.	9.	7.	15.	-5.	59.	-5.
133	194.	130.	244.	365.	657.	417.	288.	567.	-5.	27.	26.	210.	469.	252.	225.	214.	14.
201	189.		210.	531.	285.	383.	435.	463.	452.	417.	436.	263.	138.	196.	110.	166.	366.
202	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	-1.	-1.
203	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	21.	-1.		-1.	-1.	4.
204	177.		216.	516.	265.	379.	429.	429.	452.	417.	424.	263.	138.	106.	100.	146.	314.
205	1.43	-0.05	1.16	0.76	0.43	0.11	-0.05	0.10	-0.05	0.23	0.77	0.03	0.32	0.41	0.05	0.23	-0.05
206	12.			15.		6.	14.	34.			12.				16.		22.
207	20.	5.	3.	-1.		23.	-1.	35.	36.	-1.	32.	21.	55.	-2.	4.	6.	
208	0.02	0.02		-0.01	-0.01	0.11	0.12	0.19	-0.01	-0.01	0.01	0.02	-0.01	0.01	0.01	0.02	0.05
209	0.23	0.19	0.48	0.65	0.47	0.74	1.11	0.66	1.00		0.73	0.03	0.01	-0.01		0.02	0.09
210	0.01	0.02	0.21	0.09	1.27	0.66	0.26	0.11	3.69	0.34	0.29	0.48	0.35	0.23	0.20	0.11	0.10
211	0.001		0.013	0.004	0.004	0.002	0.002	0.002	0.002	0.005	0.005	0.012	0.005	0.004	0.005	0.005	0.003
212	0.7	0.4	0.1	1.5	1.0	0.9	0.8	1.1	0.9	0.8	1.0	-0.1	0.4	1.4	0.6	1.0	1.6
213	0.001	0.008	0.018	0.007	0.055	0.013	0.005	0.003	0.012	0.013	0.005	0.049	0.029	0.040	0.044	0.007	0.004
214	0.035	0.008	0.175	0.364	0.055	0.212	0.161	0.046	0.040	0.025	0.057	0.275	0.212	0.750	0.096	0.192	0.064
215	62.	40.	164.	393.	83.	136.	139.	199.	177.	146.	171.	56.	24.	7.	43.	26.	151.
216	196.	262.	596.	945.	403.	646.	750.	791.	763.	734.	711.	436.	171.	112.	166.	211.	576.

Table B-3. Water quality data for the Lower Colorado River at Silt.

WEST DIVIDE PROJECT

STATION 20: LOWER COLORADO AT SILT

CODE	5/25/77	6/16	6/30	7/19	8/24	9/21	10/19	11/15	12/13	1/19/78	2/15	3/21	4/18	5/18	6/16	7/12	8/24
101	248.	360.	210.	370.	130.	220.	118.	123.	-50.	84.	190.	-50.	109.	124.	1440.	294.	328.
102	1093.	530.	750.	880.	1700.	635.	258.	162.	159.	110.	196.	461.	3637.	19700.	4390.	5926.	328.
103								-100.	-100.	-100.	-100.	-100.	154.	-100.	-100.	-100.	-100.
104								-100.	142.	-100.	-100.	146.	344.	1393.	115.	519.	-100.
105	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	3.	-3.	-3.	4.
106	110.	10.	-3.	-3.	16.	16.	10.	-3.	-3.	-3.	-3.	-3.	59.	14.	-3.	3.	4.
107	67.	63.	70.	69.	77.	79.	90.	108.	81.	78.	84.	89.	62.	44.	33.	50.	60.
108		-1.	1.	-1.	-1.	3.	-1.	2.	-1.		-1.	2.	2.	5.	3.	-1.	2.
109										-20.	-20.	-20.	-20.	-20.	-20.	-20.	-20.
110	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.
111	-10.	-10.	-10.	-10.	102.	58.	-10.	14.	27.	19.	-10.	-10.	15.	59.	23.	22.	-10.
112	203.	215.	215.	223.	232.	246.	283.	300.	286.	263.	266.	256.	187.	129.	96.	107.	241.
113	33.	-21.	-21.	50.	57.	26.	-21.	-21.	28.	22.	-21.	-21.	24.	80.	98.	178.	40.
114	601.	566.	259.	521.	960.	804.	250.	192.	250.	22.	212.	371.	1387.	24971.	4600.	3991.	205.
115								-1.	4.	-1.	-1.	-1.	4.	4.	7.	2.	-1.
116								2.	7.	-1.	-1.	-1.	16.	23.	7.	20.	-1.
117	9.	10.	10.	12.	10.	12.	16.	8.	20.	18.	13.	11.	4.	2.	3.	5.	10.
118	9.	6.	-5.	6.	10.	15.	16.	14.	26.	18.	14.	34.	33.	64.	15.	64.	25.
119	38.	24.	23.	45.	73.	58.	22.	23.	34.	30.	20.	55.	106.	160.	152.	125.	49.
120	0.2	0.2	0.6	-0.2	0.3	-0.2	0.7	-0.2	0.9	-0.2	0.2	0.7	0.5	-0.2	0.2	-0.2	1.2
121	0.9	0.2	1.3	0.8	0.6	0.4	0.8	0.5	0.9	-0.2	0.4	0.7	0.6	-0.2	0.4	0.2	1.0
122	-5.	8.	18.	29.	25.	16.	27.	9.	9.	18.	8.	6.	-5.	-5.	-5.	-5.	9.
123	-5.	16.	20.	50.	25.	29.	36.	9.	9.	320.	12.	6.	11.	-5.	-5.	-5.	9.
124	-6.	-6.	-6.	-6.	-6.	18.	-6.	101.	-6.	-6.	-6.	-6.	-6.	-6.	-6.	-6.	-6.
125	6.	54.	6.	22.	13.	56.	-6.	102.	6.	-6.	-6.	-6.	31.	66.	3.	12.	-6.
126	4.0	3.0	5.0	4.0	5.0	5.0	4.5	3.0	7.0	3.1	3.0	3.5	2.0	5.1	4.0	3.0	4.0
127	-1.	-1.	-1.	-1.	-1.	2.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	-1.	-1.
128	-1.	-1.	-1.	-1.	-1.	22.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	2.	2.
129	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.
130	15.	-9.	-9.	-9.	-9.	-9.	10.	-9.	-9.	-9.	-9.	9.	-9.	-9.	-9.	-9.	-9.
131	102.	73.	124.	129.	89.	56.	151.	218.	162.	210.	171.	144.	68.	9.	9.	38.	99.
132	33.	-5.	-5.	-5.	8.	8.	12.	18.	-5.	76.	53.	-5.	30.	15.	14.	107.	-5.
133	297.	177.	211.	123.	321.	240.	331.	18.	-5.	76.	53.	-5.	6763.	372.	34.	259.	-5.
201	118.	111.	130.	120.	122.	122.	143.	166.	131.	125.	138.	127.	110.	172.	73.	116.	132.
202	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	-1.	-1.
203	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	2.	-1.
204	116.	111.	130.	119.	122.	117.	141.	147.	131.	126.	128.	127.	114.	172.	75.	116.	139.
205	2.14	0.19	0.45	1.26	0.69	-0.05	-0.05	-0.05	-0.05	0.05	-0.05	0.08	0.15	0.21	0.58	-0.05	-0.05
206	2.	0	0	1.	0	16.	0.	21.	0	0	0	0	0	0	0	0	14.
207	146.	115.	168.	178.	14.	186.	161.	286.	238.	215.	211.	213.	215.	24.	12.	61.	159.
208	-0.01	0.01		-0.01	0.01	0.12	0.09	0.18	-0.01	0.01	0.02	0.02	-0.01	-0.01	0.01	0.02	0.04
209	0.12	0.10	0.14	0.15	0.19	0.19	0.17	0.17	0.27		0.20	0.01	-0.01	-0.01	-0.01	0.01	0.03
210	0.06	0.08	0.63	0.08	0.76	0.12	0.25	0.66	3.33	0.50	0.40	0.34	0.30	0.32	0.27	0.55	0.12
211	0.003		0.006	0.004	0.013	0.007	0.001	0.005	0.003	0.070	0.004	0.015	0.013	0.006	0.006	0.005	0.004
212	0.7	0.6	-0.1	-0.1	0.2	0.2	0.2	0.2	0.2	1.4	-0.1	0.2	-0.1	3.2	1.5	0.5	1.2
213	0.005	0.014	0.004	0.005	0.006	0.006	0.010	0.004	0.006	0.023	0.017	0.019	0.006	0.016	0.007	0.023	0.001
214	0.010	0.014	0.031	0.024	0.080	0.056	0.040	0.028	0.190	0.047	0.049	0.044	0.120	0.205	0.055	0.152	0.024
215	73.	92.	138.	91.	105.	99.	130.	172.	138.	134.	130.	126.	88.	83.	67.	62.	107.
216	482.	550.	696.	572.	518.	563.	748.	826.	661.	716.	637.	681.	396.	213.	162.	284.	562.

Table B-4. Water quality data for the Upper Colorado River at New Castle.

WEST DIVIDE PROJECT

STATION 21: UPPER COLORADO AT ·E· CASILE

CODE	5/25/77	6/16	6/30	7/19	8/24	9/21	10/19	11/15	12/13	1/18/78	2/15	3/21	4/18	5/18	6/15	7/19	8/24
101	248.	360.	300.	420.	360.	-50.	66.	208.	-50.	77.	265.	122.	144.	180.	1500.	235.	230.
102	980.	730.	740.	940.	2400.	342.	173.	208.	2558.	4354.	277.	359.	4613.	16560.	4420.	4713.	230.
103								-100.	-100.	-100.	107.	133.	104.	-100.	-100.	-100.	-100.
104								104.	119.	184.	162.	153.	419.	778.	-100.	671.	-100.
105	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.	-3.
106	11.	3.	5.	12.	39.	19.	8.	3.	-3.	-3.	-3.	-3.	10.	3.	-3.	4.	4.
107	67.	62.		61.	73.	82.	103.	101.	87.	79.	80.	86.	68.	43.	35.	48.	76.
108		-1.		-1.	-1.	10.	-1.	2.	2.		-1.	-1.	2.	4.	2.	2.	4.
109										-20.	-20.	-20.	-20.	-20.	-20.	-20.	-20.
110	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.	-10.
111	-10.	-10.	12.	39.	60.	50.	-10.	-10.	-10.	30.	-10.	-10.	-10.	61.	13.	13.	-10.
112	221.	194.		211.	208.	263.	284.	301.	267.	255.	509.	289.	177.	131.	94.	145.	236.
113	-21.	-21.	-21.	36.	38.	41.	-21.	64.	42.	-21.	-21.	-21.	36.	100.	104.	105.	38.
114	563.	555.	317.	722.	2379.	423.	239.	[illegible]	303.	391.	286.	199.	36.	24093.	5000.	3561.	226.
115								-1.	-1.	-1.	-1.	-1.	-1.	1.	2.	1.	-1.
116								2.	3.	2.	-1.	-1.	17.	34.	9.	13.	-1.
117	13.	9.		14.	7.	14.	6.	12.	12.	14.	74.	4.	2.	6.	2.	5.	11.
118	8.	10.	9.	-5.	6.	19.	22.	27.	26.	24.	15.	34.	35.	72.	24.	8.	-5.
119	38.	33.	22.	46.	86.	43.	26.	27.	34.	33.	25.	43.	105.	619.	233.	90.	22.
120	0.3	0.5	0.8	-0.2	0.9	-0.2	1.0	-0.2	1.6	0.7	0.5	0.4	0.6	-0.2	0.5	0.7	1.0
121	0.3	0.8	0.4	0.9	0.9	0.2	1.8	1.4	1.6	0.8	0.7	1.0	0.6	0.5	1.0	0.2	0.0
122	-5.	10.	14.	21.	26.	19.	20.	-5.	16.	16.	12.	-5.	-5.	-5.	-5.	7.	10.
123	-5.	21.	21.	27.	27.	19.	15.	-5.	15.	31.	25.	5.	59.	-5.	-5.	4.	11.
124	-6.	-6.	-6.	-6.	-6.	-6.	-6.	75.	-6.	-6.	-6.	-6.	-6.	-6.	-6.	-6.	-6.
125	17.	38.	-6.		63.	93.	6.	75.	11.	-6.	-6.	-6.	50.	41.	-6.	-6.	-6.
126	4.0	3.0	5.0	4.0	6.0	5.0	4.9	2.9	7.0	3.5	2.9	3.3	2.2	0.7	3.0	3.0	4.0
127	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	-1.	-1.
128	-1.	-1.	-1.	-1.	3.	-1.	-1.	-1.	-1.	-1.	5.	-1.	-1.		-1.	2.	1.
129	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.
130	11.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.	-9.
131	94.	77.	122.	128.	87.	84.	151.	240.	166.	212.	172.	139.	71.	11.	9.	35.	97.
132	9.	-5.	-5.	-5.	6.	12.	8.	13.	-5.	82.	24.	35.	24.	15.	1.	19.	-5.
133	774.	132.	189.	219.	391.	585.	213.	18.	421.	102.	24.	35.	340.	464.	45.	219.	33.
201	116.	107.		118.	120.	129.	143.	155.	139.	127.	124.	125.	112.	158.	77.	108.	130.
202	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	-1.	-1.
203	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.	-1.		-1.	2.	2.
204	116.	107.		118.	120.	129.	143.	149.	139.	127.	128.	125.	112.	134.	77.	108.	130.
205	1.66	0.31	1.34	0.38	0.56	-0.05	-0.05	0.55	-0.05	0.05	-0.05	0.11	0.15	0.32	-0.05	-0.05	-0.05
206	0	0		0	0	0	0	6.	0	0	0	0	0	0	0	0	0
207	135.	111.		174.		193.	167.	283.	288.	226.	220.	213.	213.	25.	13.	71.	154.
208	-0.01	-0.01		-0.01	-0.01	0.11	0.14	0.17	-0.01	-0.01	0.01	0.01	-0.01	-0.01	0.01	0.01	0.02
209	0.13	0.10		0.16	0.16	0.18	0.05	0.16	0.26		0.20	0.01	-0.01	-0.01	-0.01	0.01	0.03
210	0.09	0.13		0.12	0.62	0.13	0.08	0.19	0.37	0.49	0.28	0.35	0.23	0.21	0.67	0.46	0.11
211	0.003			0.004	0.058	0.008	0.001	0.005	0.003	0.007	0.004	0.005	0.006	0.006	0.007	0.006	0.014
212	0.7	0.2		1.0	2.1	0.7	0.2	0.3	0.3	0.5	0.4	0.3	0.7	0.8	1.4	1.3	0.6
213	0.007	0.014		0.005	0.001	0.026	0.007	0.008	0.008	0.022	0.020	0.014	0.011	0.006	0.016	0.049	0.003
214	0.007	0.014		0.047	0.043	0.107	0.037	0.040	0.029	0.037	0.053	0.042	0.117	0.265	0.273	0.162	0.026
215	75.	92.		88.	111.	110.	127.	174.	135.	117.	109.	123.	87.	93.	47.	56.	101.
216	480.	438.		594.	500.	502.	752.	818.	696.		665.	705.	374.	223.	170.	213.	552.

APPENDIX C

Statistical Analyses of Water Quality Data

Table C-1. Statistical analysis of the water quality data for West Divide Creek.

WEST DIVIDE PROJECT

STATION 13: WEST DIVIDE CREEK

CODE	CONSTITUENT	MEAN	VARIANCE	S.D.	C OF V	MAX	MIN	RANGE	
	***** GROUP A: METALLIC CONSTITUENTS *****								
101	ALUMINIUM, DISSOLVED (UG/L)	320.9	.1465E+06	385.4	120.1	1700.	55.	1645.	16
102	ALUMINIUM, TOTAL (UG/L)	6064.1	.7612E+08	8724.4	127.2	30100.	411.	29689.	17
103	BARIUM, DISSOLVED (UG/L)	140.6	.1134E+04	33.7	23.3	207.	106.	101.	8
104	BARIUM, TOTAL (UG/L)	435.4	.1571E+06	396.4	91.0	1353.	131.	1222.	9
105	CADMIUM, DISSOLVED (UG/L)	3.5	.5000E+00	0.7	20.2	4.	3.	1.	2
106	CADMIUM, TOTAL (UG/L)	14.0	.1962E+03	14.0	100.1	52.	3.	49.	11
107	CALCIUM (MG/L)	69.2	.6166E+03	24.8	35.9	114.	29.	85.	16
108	CHROMIUM, HEXAVALENT (UG/L)	4.1	.5211E+01	2.3	55.7	8.	1.	7.	10
109	CHROMIUM, TOTAL (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
110	COPPER, DISSOLVED (UG/L)	13.0	0.	0.0	0.0	13.	13.	0.	1
111	COPPER, TOTAL (UG/L)	30.2	.3711E+03	19.3	63.8	72.	10.	62.	10
112	HARDNESS, TOTAL AS CACO3 (MG/L)	262.8	.1344E+05	120.2	45.7	412.	66.	346.	17
113	IRON, DISSOLVED (UG/L)	73.6	.3023E+04	55.0	74.7	236.	26.	210.	13
114	IRON, TOTAL (UG/L)	5528.9	.6446E+08	8028.7	145.2	26400.	251.	26149.	16
115	LEAD, DISSOLVED (UG/L)	2.6	.4917E+01	2.2	80.6	6.	1.	5.	4
116	LEAD, TOTAL (UG/L)	11.2	.4520E+02	6.7	60.0	22.	4.	18.	5
117	MAGNESIUM (MG/L)	24.5	.2463E+03	15.7	64.1	45.	2.	43.	16
118	MANGANESE, DISSOLVED (UG/L)	62.2	.2461E+04	49.8	80.1	149.	8.	141.	17
119	MANGANESE, TOTAL (UG/L)	200.5	.2650E+05	162.8	81.2	670.	38.	632.	17
120	MERCURY, DISSOLVED (UG/L)	0.73	.1623E+00	0.40	55.13	1.8	0.2	1.6	13
121	MERCURY, TOTAL (UG/L)	1.49	.3441E+01	1.86	124.71	6.7	0.3	6.4	16
122	MOLYBDENUM, DISSOLVED (UG/L)	7.8	.7194E+01	2.7	34.5	13.	5.	8.	9
123	MOLYBDENUM, TOTAL (UG/L)	13.5	.2787E+02	5.3	39.2	23.	7.	16.	11
124	NICKEL, DISSOLVED (UG/L)	23.7	.6963E+03	26.4	111.5	54.	6.	48.	3
125	NICKEL, TOTAL (UG/L)	42.6	.2146E+04	46.3	108.8	158.	6.	152.	14
126	POTASSIUM (MG/L)	4.3	.5875E+01	2.4	56.4	11.	2.	9.	17
127	SELENIUM, DISSOLVED (UG/L)	5.0	0.	0.0	0.0	5.	5.	0.	1
128	SELENIUM, TOTAL (UG/L)	3.0	.3000E+01	1.7	57.7	5.	2.	3.	3
129	SILVER, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
130	SILVER, TOTAL (UG/L)	13.0	.4000E+01	2.0	15.4	15.	11.	4.	3
131	SODIUM (MG/L)	92.1	.4237E+04	65.1	70.7	196.	5.	191.	17
132	ZINC, DISSOLVED (UG/L)	17.0	.2390E+03	15.5	90.9	59.	6.	53.	11
133	ZINC, TOTAL (UG/L)	256.5	.2726E+05	165.1	64.4	567.	14.	553.	16
	***** GROUP B: NON-METALLIC CONSTITUENTS *****								
201	ALKALINITY, TOTAL AS CACO3 (MG/L)	308.4	.2063E+05	143.6	46.6	531.	106.	425.	16
202	ARSENIC, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
203	ARSENIC, TOTAL (UG/L)	15.0	.7200E+02	8.5	56.6	21.	9.	12.	2
204	BICARBONATE HARDNESS AS CACO3 (MG/L)	299.2	.1936E+05	139.1	46.5	516.	100.	416.	15
205	BORON (MG/L)	0.476	.1913E+00	0.437	91.859	1.43	0.08	1.35	13
206	CARBONATE AS CACO3 (MG/L)	15.6	.7598E+02	8.7	55.8	34.	6.	28.	8
207	CHLORIDE (MG/L)	21.8	.2790E+03	16.7	76.6	55.	3.	52.	11
208	CYANIDE (MG/L)	0.048	.2496E-02	0.050	103.698	0.14	0.01	0.13	11
209	FLUORIDE (MG/L)	0.459	.1374E+00	0.371	80.746	1.11	0.01	1.10	14
210	NITROGEN, NITRATE (MG/L)	0.507	.7749E+00	0.880	173.601	3.67	0.01	3.66	17
211	NITROGEN, NITRITE (MG/L)	0.0097	.3618E-03	0.0190	196.3591	0.080	0.001	0.079	16
212	NITROGEN, TOTAL ORGANIC (MG/L)	0.91	.1940E+00	0.44	48.60	1.8	0.1	1.7	16
213	PHOSPHORUS, ORTHO (MG/L)	0.0187	.3096E-03	0.0176	94.0631	0.055	0.001	0.054	17
214	PHOSPHORUS, TOTAL (MG/L)	0.1423	.2977E-01	0.1725	121.2517	0.730	0.006	0.724	17
215	SULFATE (MG/L)	114.3	.6356E+04	79.7	69.8	303.	7.	296.	17
216	TOTAL DISSOLVED SOLIDS (MG/L)	499.8	.7220E+05	268.7	53.8	948.	112.	836.	17

Table C-2. Statistical analysis of the water quality data for the lower Colorado River at Silt.

WEST DIVIDE PROJECT

STATION 20: LOWER COLORADO AT SILT

CODE	CONSTITUENT	MEAN	VARIANCE	S.D.	C OF V	MAX	MIN	RANGE	N
	***** GROUP A: METALLIC CONSTITUENTS *****								
101	ALUMINIUM, DISSOLVED (UG/L)	263.2	.5524E+05	235.0	89.3	1040.	84.	956.	15
102	ALUMINIUM, TOTAL (UG/L)	2406.8	.2274E+08	4768.6	198.1	19700.	110.	19590.	17
103	BARIUM, DISSOLVED (UG/L)	134.0	0.	0.0	0.0	134.	134.	0.	1
104	BARIUM, TOTAL (UG/L)	441.2	.2425E+06	492.3	111.6	1393.	103.	1290.	6
105	CADMIUM, DISSOLVED (UG/L)	3.5	.5000E+00	0.7	20.2	4.	3.	1.	2
106	CADMIUM, TOTAL (UG/L)	26.3	.1214E+04	34.8	132.3	110.	3.	107.	4
107	CALCIUM (MG/L)	71.7	.3231E+03	18.0	25.1	108.	33.	75.	17
108	CHROMIUM, HEXAVALENT (UG/L)	2.5	.1429E+01	1.2	47.8	5.	1.	4.	6
109	CHROMIUM, TOTAL (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
110	COPPER, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	6
111	COPPER, TOTAL (UG/L)	36.7	.8365E+03	28.9	78.9	102.	14.	88.	9
112	HARDNESS, TOTAL AS CACO3 (MG/L)	223.0	.3411E+04	58.4	26.2	300.	96.	204.	17
113	IRON, DISSOLVED (UG/L)	57.1	.2062E+04	45.4	79.5	174.	22.	152.	11
114	IRON, TOTAL (UG/L)	2421.4	.3593E+08	5994.0	247.5	24971.	22.	24949.	17
115	LEAD, DISSOLVED (UG/L)	4.2	.3200E+01	1.8	42.6	7.	2.	5.	5
116	LEAD, TOTAL (UG/L)	12.5	.6990E+02	8.4	66.9	23.	2.	21.	6
117	MAGNESIUM (MG/L)	10.6	.2337E+02	4.8	45.4	20.	2.	18.	17
118	MANGANESE, DISSOLVED (UG/L)	23.1	.3269E+03	18.1	78.4	64.	6.	58.	16
119	MANGANESE, TOTAL (UG/L)	63.9	.2590E+04	50.9	79.6	162.	20.	142.	17
120	MERCURY, DISSOLVED (UG/L)	0.52	.1136E+00	0.34	65.05	1.2	0.2	1.0	11
121	MERCURY, TOTAL (UG/L)	0.91	.1029E+01	1.01	111.69	4.4	0.2	4.2	15
122	MOLYBDENUM, DISSOLVED (UG/L)	15.2	.6779E+02	8.2	54.3	29.	6.	23.	12
123	MOLYBDENUM, TOTAL (UG/L)	42.5	.7119E+04	84.4	198.7	320.	6.	314.	13
124	NICKEL, DISSOLVED (UG/L)	59.5	.3445E+04	58.7	98.6	101.	18.	83.	2
125	NICKEL, TOTAL (UG/L)	31.4	.9857E+03	31.4	99.9	102.	3.	99.	12
126	POTASSIUM (MG/L)	4.0	.1468E+01	1.2	30.6	7.	2.	5.	17
127	SELENIUM, DISSOLVED (UG/L)	2.0	0.	0.0	0.0	2.	2.	0.	1
128	SELENIUM, TOTAL (UG/L)	8.7	.1333E+03	11.5	133.2	22.	2.	20.	3
129	SILVER, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
130	SILVER, TOTAL (UG/L)	11.3	.1033E+02	3.2	28.4	15.	9.	6.	3
131	SODIUM (MG/L)	110.7	.3837E+04	61.9	56.0	218.	9.	209.	17
132	ZINC, DISSOLVED (UG/L)	34.7	.1032E+04	32.1	92.5	107.	8.	99.	11
133	ZINC, TOTAL (UG/L)	666.8	.3091E+07	1758.2	263.7	6763.	18.	6745.	14
	***** GROUP B: NON-METALLIC CONSTITUENTS *****								
201	ALKALINITY, TOTAL AS CACO3 (MG/L)	127.4	.4536E+03	21.3	16.7	172.	78.	94.	17
202	ARSENIC, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
203	ARSENIC, TOTAL (UG/L)	2.0	0.	0.0	0.0	2.	2.	0.	1
204	BICARBONATE HARDNESS AS CACO3 (MG/L)	125.5	.3758E+03	19.4	15.4	172.	78.	94.	17
205	BORON (MG/L)	0.528	.4531E+00	0.673	127.487	2.14	0.05	2.09	10
206	CARBONATE AS CACO3 (MG/L)	9.3	.6307E+02	7.9	85.1	21.	1.	20.	6
207	CHLORIDE (MG/L)	152.4	.6748E+04	82.1	53.9	286.	12.	274.	17
208	CYANIDE (MG/L)	0.048	.3256E-02	0.057	118.036	0.18	0.01	0.17	11
209	FLUORIDE (MG/L)	0.135	.6244E-02	0.079	58.678	0.27	0.01	0.26	13
210	NITROGEN, NITRATE (MG/L)	0.539	.5664E+00	0.753	139.516	3.33	0.06	3.27	17
211	NITROGEN, NITRITE (MG/L)	0.0091	.2709E-03	0.0165	181.6044	0.070	0.001	0.069	16
212	NITROGEN, TOTAL ORGANIC (MG/L)	1.34	.4954E+01	2.23	166.30	6.2	0.2	6.0	13
213	PHOSPHORUS, ORTHO (MG/L)	0.0098	.4640E-04	0.0068	69.3445	0.023	0.001	0.022	17
214	PHOSPHORUS, TOTAL (MG/L)	0.1035	.4410E-01	0.2100	202.9453	0.555	0.010	0.545	17
215	SULFATE (MG/L)	105.6	.1128E+04	33.6	31.8	172.	43.	129.	17
216	TOTAL DISSOLVED SOLIDS (MG/L)	545.1	.3537E+05	188.1	34.5	826.	162.	664.	17

Table C-3. Statistical analysis of the water quality data for the upper Colorado River at Newcastle.

WEST DIVIDE PROJECT

STATION 21: UPPER COLORADO AT NEW CASTLE

CODE	CONSTITUENT	MEAN	VARIANCE	S.D.	C OF V	MAX	MIN	RANGE	N
	***** GROUP A: METALLIC CONSTITUENTS *****								
101	ALUMINIUM, DISSOLVED (UG/L)	321.0	.1358E+06	368.5	114.8	1600.	66.	1534.	15
102	ALUMINIUM, TOTAL (UG/L)	2661.0	.1601E+08	4000.7	150.3	16500.	173.	16327.	17
103	BARIUM, DISSOLVED (UG/L)	114.7	.2543E+03	15.9	13.9	133.	104.	29.	3
104	BARIUM, TOTAL (UG/L)	321.3	.7261E+05	269.5	83.9	778.	104.	674.	8
105	CADMIUM, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
106	CADMIUM, TOTAL (UG/L)	10.1	.1068E+03	10.3	102.5	39.	3.	36.	12
107	CALCIUM (MG/L)	71.9	.3667E+03	19.2	26.6	103.	35.	68.	16
108	CHROMIUM, HEXAVALENT (UG/L)	3.5	.7714E+01	2.8	79.4	10.	2.	8.	8
109	CHROMIUM, TOTAL (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
110	COPPER, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
111	COPPER, TOTAL (UG/L)	34.6	.4303E+03	20.7	59.9	60.	12.	48.	8
112	HARDNESS, TOTAL AS CACO3 (MG/L)	234.1	.8638E+04	92.9	39.7	509.	94.	415.	16
113	IRON, DISSOLVED (UG/L)	64.1	.1513E+04	38.9	60.7	140.	30.	110.	10
114	IRON, TOTAL (UG/L)	2366.3	.3360E+08	5797.0	245.0	24093.	30.	24063.	17
115	LEAD, DISSOLVED (UG/L)	1.3	.3333E+00	0.6	43.3	2.	1.	1.	3
116	LEAD, TOTAL (UG/L)	11.4	.1330E+03	11.5	100.9	34.	2.	32.	7
117	MAGNESIUM (MG/L)	13.1	.2797E+03	16.7	127.4	74.	2.	72.	16
118	MANGANESE, DISSOLVED (UG/L)	22.6	.2848E+03	16.9	74.7	72.	6.	66.	15
119	MANGANESE, TOTAL (UG/L)	89.8	.2130E+05	145.9	162.6	619.	22.	597.	17
120	MERCURY, DISSOLVED (UG/L)	0.73	.1173E+00	0.34	46.87	1.6	0.3	1.3	13
121	MERCURY, TOTAL (UG/L)	1.11	.7568E+00	0.87	78.67	4.0	0.2	3.8	17
122	MOLYBDENUM, DISSOLVED (UG/L)	15.5	.3207E+02	5.7	36.4	26.	7.	19.	11
123	MOLYBDENUM, TOTAL (UG/L)	22.0	.1820E+03	13.5	61.3	59.	5.	54.	13
124	NICKEL, DISSOLVED (UG/L)	75.0	0.	0.0	0.0	75.	75.	0.	1
125	NICKEL, TOTAL (UG/L)	49.3	.1126E+04	33.6	68.0	93.	6.	87.	9
126	POTASSIUM (MG/L)	4.0	.1595E+01	1.3	31.4	7.	2.	5.	17
127	SELENIUM, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
128	SELENIUM, TOTAL (UG/L)	2.8	.2917E+01	1.7	62.1	5.	1.	4.	4
129	SILVER, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
130	SILVER, TOTAL (UG/L)	10.0	.2000E+01	1.4	14.1	11.	9.	2.	2
131	SODIUM (MG/L)	111.6	.4166E+04	64.5	57.8	240.	9.	231.	17
132	ZINC, DISSOLVED (UG/L)	21.0	.4385E+03	20.9	99.7	82.	6.	76.	12
133	ZINC, TOTAL (UG/L)	251.5	.4795E+05	219.0	87.1	774.	18.	756.	17
	***** GROUP B: NON-METALLIC CONSTITUENTS *****								
201	ALKALINITY, TOTAL AS CACO3 (MG/L)	124.5	.3867E+03	19.7	15.8	158.	77.	81.	16
202	ARSENIC, DISSOLVED (UG/L)	0.0	0.	0.0	0.0	0.	0.	0.	0
203	ARSENIC, TOTAL (UG/L)	2.0	0.	0.0	0.0	2.	2.	0.	2
204	BICARBONATE HARDNESS AS CACO3 (MG/L)	124.1	.3645E+03	19.1	15.4	158.	77.	81.	16
205	BORON (MG/L)	0.543	.2888E+00	0.537	98.961	1.66	0.05	1.61	10
206	CARBONATE AS CACO3 (MG/L)	6.0	0.	0.0	0.0	6.	6.	0.	1
207	CHLORIDE (MG/L)	165.7	.6910E+04	83.1	50.2	288.	13.	275.	15
208	CYANIDE (MG/L)	0.060	.4657E-02	0.068	113.739	0.17	0.01	0.16	8
209	FLUORIDE (MG/L)	0.121	.6554E-02	0.081	66.498	0.26	0.01	0.25	12
210	NITROGEN, NITRATE (MG/L)	0.279	.3516E-01	0.188	67.267	0.67	0.08	0.59	16
211	NITROGEN, NITRITE (MG/L)	0.0085	.1911E-03	0.0138	163.2845	0.058	0.001	0.057	15
212	NITROGEN, TOTAL ORGANIC (MG/L)	0.72	.2683E+00	0.52	72.07	2.1	0.2	1.9	16
213	PHOSPHORUS, ORTHO (MG/L)	0.0149	.1883E-03	0.0137	91.8715	0.049	0.001	0.048	16
214	PHOSPHORUS, TOTAL (MG/L)	0.1059	.3492E-01	0.1869	176.5080	0.765	0.007	0.758	16
215	SULFATE (MG/L)	100.4	.1104E+04	33.2	33.1	174.	43.	131.	16
216	TOTAL DISSOLVED SOLIDS (MG/L)	516.1	.3837E+05	195.9	38.0	818.	170.	648.	15

APPENDIX D

Comparison of Water Quality Data with the Proposed Colorado Water Quality Standards

Table D-1. Comparison of the water quality data for West Divide Creek with the proposed Colorado Water Quality Standards.

WEST DIVIDE PROJECT

STATION 131 WEST DIVIDE CREEK

CODE	CONSTITUENT	STANDARD	SOURCE	NUMBER EXCEEDING	NUMBER OF SAMPLES	PERCENT EXCEEDING
101	ALUMINIUM, DISSOLVED (UG/L)	100.000	AB	13	16	81.25
104	BARIUM, TOTAL (UG/L)	1000.000	WS	1	9	11.11
106	CADMIUM, TOTAL (UG/L)	10.000	AG	6	11	54.55
		10.000	WS	6	11	54.55
		0.400	ABL1	1	11	9.09
		1.000	AB12	4	11	36.36
		5.000	AB23	3	11	27.27
		10.000	AB34	3	11	27.27
		15.000	ABG4	0	11	0.00
109	CHROMIUM, TOTAL (UG/L)	100.000	AG	0	0	0.00
		50.000	WS	0	0	0.00
		100.000	AB	0	0	0.00
111	COPPER, TOTAL (UG/L)	200.000	AG	0	10	0.00
		1000.000	WS	0	10	0.00
		10.000	ABL1	2	10	20.00
		10.000	AB12	2	10	20.00
		10.000	AB23	2	10	20.00
		20.000	AB34	1	10	10.00
		40.000	ABG4	0	10	0.00
113	IRON, DISSOLVED (UG/L)	300.000	WS	0	13	0.00
114	IRON, TOTAL (UG/L)	1000.000	AB	11	16	68.75
116	LEAD, TOTAL (UG/L)	100.000	AG	0	5	0.00
		50.000	WS	0	5	0.00
		4.000	ABL1	2	5	40.00
		25.000	AB12	0	5	0.00
		50.000	AB23	0	5	0.00
		100.000	AB34	0	5	0.00
		150.000	ABG4	0	5	0.00
117	MAGNESIUM (MG/L)	125.000	WS	0	15	0.00
118	MANGANESE, DISSOLVED (UG/L)	50.000	WS	8	17	47.06
119	MANGANESE, TOTAL (UG/L)	200.000	AG	5	17	29.41
		1000.000	AB	0	17	0.00
121	MERCURY, TOTAL (UG/L)	2.000	WS	3	16	18.75
		0.050	AB	16	16	100.00
125	NICKEL, TOTAL (UG/L)	200.000	AG	0	14	0.00
		50.000	ABL1	0	14	0.00
		100.000	AB12	0	14	0.00
		200.000	AB23	0	14	0.00
		300.000	AB34	0	14	0.00
		400.000	ABG4	0	14	0.00
128	SELENIUM, TOTAL (UG/L)	20.000	AG	0	3	0.00
		10.000	WS	0	3	0.00
		50.000	AB	0	3	0.00
130	SILVER, TOTAL (UG/L)	50.000	WS	0	3	0.00
		0.100	ABL1	0	3	0.00
		0.100	AB12	1	3	33.33
		0.150	AB23	0	3	0.00
		0.200	AB34	2	3	66.67
		0.250	ABG4	0	3	0.00
133	ZINC, TOTAL (UG/L)	2000.000	AG	0	16	0.00
		5000.000	WS	0	16	0.00
		50.000	ABL1	2	16	12.50
		50.000	AB12	4	16	25.00
		100.000	AB23	2	16	12.50
		300.000	AB34	2	16	12.50
		600.000	ABG4	0	16	0.00
202	ARSENIC, DISSOLVED (UG/L)	100.000	AG	0	0	0.00
		50.000	WS	0	0	0.00
		50.000	AB	0	0	0.00
205	BORON (MG/L)	750.000	AG	0	13	0.00
207	CHLORIDE (MG/L)	250.000	WS	0	11	0.00
206	CYANIDE (MG/L)	0.200	AG	0	11	0.00
		0.200	WS	0	11	0.00
		0.005	AB	11	11	100.00
209	FLUORIDE (MG/L)	2.400	WS	0	14	0.00
210	NITROGEN, NITRATE (MG/L)	100.000	AG	0	17	0.00
		10.000	WS	0	17	0.00
211	NITROGEN, NITRITE (MG/L)	10.000	AG	0	16	0.00
		1.000	WS	0	16	0.00
		0.050	ABC	1	16	6.25
		0.500	ABW	0	16	0.00
215	SULFATE (MG/L)	250.000	WS	1	17	5.88

SOURCE CODES:
AB = AQUATIC BIOTA
ABC = AQUATIC BIOTA (COLD)
ABW = AQUATIC BIOTA (WARM)
ABL1 = AQUATIC BIOTA (TOTAL HARDNESS) LESS THAN 100)
AB12 = AQUATIC BIOTA (TOTAL HARDNESS) 100-200)
AB23 = AQUATIC BIOTA (TOTAL HARDNESS) 200-300)
AB34 = AQUATIC BIOTA (TOTAL HARDNESS) 300-400)
ABG4 = AQUATIC BIOTA (TOTAL HARDNESS) GREATER THAN 400)
AG = AGRICULTURE
WS = CLASS 2 RAW WATER SUPPLY

Table D-2. Comparison of the water quality data for the lower Colorado at Silt with the proposed Colorado Water Quality Standards.

WEST DIVIDE PROJECT

STATION 20: LOWER COLORADO AT SILT

CODE	CONSTITUENT	STANDARD	SOURCE	NUMBER EXCEEDING	NUMBER OF SAMPLES	PERCENT EXCEEDING
101	ALUMINIUM, DISSOLVED (UG/L)	100.000	AB	14	15	93.33
104	BARIUM, TOTAL (UG/L)	1000.000	WS	1	6	16.67
106	CADMIUM, TOTAL (UG/L)	10.000	AG	7	9	77.78
		10.000	WS	7	9	77.78
		0.400	ABL1	0	9	0.00
		1.000	AB12	3	9	33.33
		5.000	AB23	5	9	55.56
		10.000	AB34	0	9	0.00
		15.000	ABG4	0	9	0.00
109	CHROMIUM, TOTAL (UG/L)	100.000	AG	0	9	0.00
		50.000	WS	0	0	0.00
		100.000	AB	0	0	0.00
111	COPPER, TOTAL (UG/L)	200.000	AG	0	9	0.00
		1000.000	WS	0	9	0.00
		10.000	ABL1	1	9	11.11
		10.000	AB12	3	9	33.33
		10.000	AB23	4	9	44.44
		20.000	AB34	0	9	0.00
		40.000	ABG4	0	9	0.00
113	IRON, DISSOLVED (UG/L)	300.000	WS	0	11	0.00
114	IRON, TOTAL (UG/L)	1000.000	AB	4	17	23.53
116	LEAD, TOTAL (UG/L)	100.000	AG	0	6	0.00
		50.000	WS	0	6	0.00
		4.000	ABL1	1	6	16.67
		25.000	AB12	0	6	0.00
		50.000	AB23	0	6	0.00
		100.000	AB34	0	6	0.00
		150.000	ABG4	0	6	0.00
117	MAGNESIUM (MG/L)	125.000	WS	0	17	0.00
118	MANGANESE, DISSOLVED (UG/L)	50.000	WS	2	16	12.50
119	MANGANESE, TOTAL (UG/L)	200.000	AG	0	17	0.00
		1000.000	AB	0	17	0.00
121	MERCURY, TOTAL (UG/L)	2.000	WS	1	15	6.67
		0.050	AB	15	15	100.00
125	NICKEL, TOTAL (UG/L)	200.000	AG	0	12	0.00
		50.000	ABL1	0	12	0.00
		100.000	AB12	0	12	0.00
		200.000	AB23	0	12	0.00
		300.000	AB34	0	12	0.00
		400.000	ABG4	0	12	0.00
128	SELENIUM, TOTAL (UG/L)	20.000	AG	1	3	33.33
		10.000	WS	1	3	33.33
		50.000	AB	0	3	0.00
130	SILVER, TOTAL (UG/L)	50.000	WS	0	3	0.00
		0.100	ABL1	0	3	0.00
		0.100	AB12	0	3	0.00
		0.150	AB23	3	3	100.00
		0.200	AB34	0	3	0.00
		0.250	ABG4	0	3	0.00
133	ZINC, TOTAL (UG/L)	2000.000	AG	1	14	7.14
		5000.000	WS	1	14	7.14
		50.000	ABL1	1	14	7.14
		50.000	AB12	3	14	21.43
		100.000	AB23	7	14	50.00
		300.000	AB34	0	14	0.00
		600.000	ABG4	0	14	0.00
202	ARSENIC, DISSOLVED (UG/L)	100.000	AG	0	0	0.00
		50.000	WS	0	0	0.00
		50.000	AB	0	0	0.00
205	BORON (MG/L)	750.000	AG	0	10	0.00
207	CHLORIDE (MG/L)	250.000	WS	1	17	5.88
208	CYANIDE (MG/L)	0.200	AG	0	11	0.00
		0.200	WS	0	11	0.00
		0.005	AB	11	11	100.00
209	FLUORIDE (MG/L)	2.400	WS	0	13	0.00
210	NITROGEN, NITRATE (MG/L)	100.000	AG	0	17	0.00
		10.000	WS	0	17	0.00
211	NITROGEN, NITRITE (MG/L)	10.000	AG	0	16	0.00
		1.000	WS	0	16	0.00
		0.050	ABC	1	16	6.25
		0.500	ABW	0	16	0.00
215	SULFATE (MG/L)	250.000	WS	0	17	0.00

SOURCE CODES:
AB = AQUATIC BIOTA
ABC = AQUATIC BIOTA (COLD)
ABW = AQUATIC BIOTA (WARM)
ABL1 = AQUATIC BIOTA (TOTAL HARDNESS: LESS THAN 100)
AB12 = AQUATIC BIOTA (TOTAL HARDNESS: 100-200)
AB23 = AQUATIC BIOTA (TOTAL HARDNESS: 200-300)
AB34 = AQUATIC BIOTA (TOTAL HARDNESS: 300-400)
ABG4 = AQUATIC BIOTA (TOTAL HARDNESS: GREATER THAN 400)
AG = AGRICULTURE
WS = CLASS 2 RAW WATER SUPPLY

Table D-3. Comparison of the water quality data for the upper Colorado River at New Castle with the proposed Colorado Water Quality Standards.

WEST DIVIDE PROJECT

STATION 211 UPPER COLORADO AT NEW CASTLE

CODE	CONSTITUENT	STANDARD	SOURCE	NUMBER EXCEEDING	NUMBER OF SAMPLES	PERCENT EXCEEDING
101	ALUMINIUM, DISSOLVED (UG/L)	100.000	AB	13	15	86.67
104	BARIUM, TOTAL (UG/L)	1000.000	WS	0	8	0.00
106	CADMIUM, TOTAL (UG/L)	10.000	AG	5	12	41.67
		10.000	WS	5	12	41.67
		0.400	ABL1	0	12	0.00
		1.000	AB12	4	12	33.33
		5.000	AB23	5	12	41.67
		10.000	AB34	0	12	0.00
		15.000	ABG4	0	12	0.00
109	CHROMIUM, TOTAL (UG/L)	100.000	AG	0	0	0.00
		50.000	WS	0	0	0.00
		100.000	AB	0	0	0.00
111	COPPER, TOTAL (UG/L)	200.000	AG	0	8	0.00
		1000.000	WS	0	8	0.00
		10.000	ABL1	1	8	12.50
		10.000	AB12	2	8	25.00
		10.000	AB23	4	8	50.00
		20.000	AB34	0	8	0.00
		40.000	ABG4	0	8	0.00
113	IRON, DISSOLVED (UG/L)	300.000	WS	0	10	0.00
114	IRON, TOTAL (UG/L)	1000.000	AB	4	17	23.53
116	LEAD, TOTAL (UG/L)	100.000	AG	0	7	0.00
		50.000	WS	0	7	0.00
		4.000	ABL1	1	7	14.29
		25.000	AB12	1	7	14.29
		50.000	AB23	0	7	0.00
		100.000	AB34	0	7	0.00
		150.000	ABG4	0	7	0.00
117	MAGNESIUM (MG/L)	125.000	WS	0	16	0.00
118	MANGANESE, DISSOLVED (UG/L)	50.000	WS	1	15	6.67
119	MANGANESE, TOTAL (UG/L)	200.000	AG	2	17	11.76
		1000.000	AB	0	17	0.00
121	MERCURY, TOTAL (UG/L)	2.000	WS	1	17	5.88
		0.050	AB	17	17	100.00
125	NICKEL, TOTAL (UG/L)	200.000	AG	0	9	0.00
		50.000	ABL1	0	9	0.00
		100.000	AB12	0	9	0.00
		200.000	AB23	0	9	0.00
		300.000	AB34	0	9	0.00
		400.000	ABG4	0	9	0.00
128	SELENIUM, TOTAL (UG/L)	20.000	AG	0	4	0.00
		10.000	WS	0	4	0.00
		50.000	AB	0	4	0.00
130	SILVER, TOTAL (UG/L)	50.000	WS	0	2	0.00
		0.100	ABL1	0	2	0.00
		0.100	AB12	0	2	0.00
		0.150	AB23	2	2	100.00
		0.200	AB34	0	2	0.00
		0.250	ABG4	0	2	0.00
133	ZINC, TOTAL (UG/L)	2000.000	AG	0	17	0.00
		5000.000	WS	0	17	0.00
		50.000	ABL1	1	17	5.88
		50.000	AB12	4	17	23.53
		100.000	AB23	7	17	41.18
		300.000	AB34	0	17	0.00
		600.000	ABG4	0	17	0.00
202	ARSENIC, DISSOLVED (UG/L)	100.000	AG	0	0	0.00
		50.000	WS	0	0	0.00
		50.000	AB	0	0	0.00
205	BORON (MG/L)	750.000	AG	0	10	0.00
207	CHLORIDE (MG/L)	250.000	WS	2	15	13.33
208	CYANIDE (MG/L)	0.200	AG	0	8	0.00
		0.200	WS	0	8	0.00
		0.005	AB	8	8	100.00
209	FLUORIDE (MG/L)	2.400	WS	0	12	0.00
210	NITROGEN, NITRATE (MG/L)	100.000	AG	0	16	0.00
		10.000	WS	0	16	0.00
211	NITROGEN, NITRITE (MG/L)	10.000	AG	0	15	0.00
		1.000	WS	0	15	0.00
		0.050	ABC	1	15	6.67
		0.500	ABW	0	15	0.00
215	SULFATE (MG/L)	250.000	WS	0	16	0.00

SOURCE CODES:
AB = AQUATIC BIOTA
ABC = AQUATIC BIOTA (COLD)
ABW = AQUATIC BIOTA (WARM)
ABL1 = AQUATIC BIOTA (TOTAL HARDNESS) LESS THAN 100)
AB12 = AQUATIC BIOTA (TOTAL HARDNESS) 100-200)
AB23 = AQUATIC BIOTA (TOTAL HARDNESS) 200-300)
AB34 = AQUATIC BIOTA (TOTAL HARDNESS) 300-400)
ABG4 = AQUATIC BIOTA (TOTAL HARDNESS) GREATER THAN 400)
AG = AGRICULTURE
WS = CLASS 2 RAW WATER SUPPLY

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