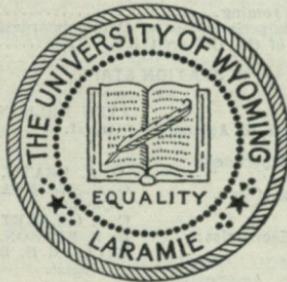*(handwritten: Wyomings)* *(handwritten: 1937)*

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UNIVERSITY OF WYOMING
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Salinity Conditions in the Big Horn River
During the Years 1938 and 1939

UNIVERSITY OF WYOMING
Agricultural Experiment Station

Salinity Conditions in the Big Horn River During the Years 1938 and 1939

By T. J. Dunnewald

INTRODUCTION

The Big Horn River rises in west central Wyoming and flows northward to join the Yellowstone River in Montana. Thence its water flows into the Missouri River which, in turn, joins the Mississippi River which discharges into the Gulf of Mexico. The waters of the Big Horn are extensively used for irrigation in Wyoming and to a less extent in Montana. The irrigated lands in both states are contiguous to the stream and its tributaries and are so situated that the return water, including artificial drainage, returns to the stream to be used again for irrigation. The natural stream waters contain some dissolved salts also, which impair, to some extent, the value of the stream water for irrigation purposes.

In view of the fact that in some of the irrigated areas, served by the Big Horn and its tributaries, conditions of salinity are such as to impair the productivity of the soil and cause concern as to the trend and rate of change of these conditions, it has seemed advisable to make a study of the conditions of salinity in the main stream to ascertain what quantities of dissolved salts are involved and the areas from which these salts originate. It is believed that such information will be of value in connection with planning for the improvement by drainage of the existing irrigated lands and also for planning further irrigation developments along the stream.

Such a study was planned in the summer of 1937 and was begun on October 1 of that year. The investigation was carried forward by a program of informal cooperation involving the United States Geological Survey, the University of Wyoming, and the Montana State Experiment Station.[1] The U. S. Geological Survey in cooperation with the states of Wyoming and Mon-

tana has for some years maintained gaging stations on the Big Horn River for measuring the discharge of the stream. This fact made it possible, at small additional expense, to obtain samples of the stream water periodically at these gaging stations where the volume of discharge represented by the samples was known. These samples were then analyzed to determine the concentration and composition of the dissolved salts carried by the stream at each gaging station.

THE SAMPLING STATIONS

The investigations for the year ending September 30, 1938, were given in a progress report.[2] The present report covers the entire work to October 1, 1939, and is based on water samples collected at four gaging stations on the main stream. Three of these stations, namely, Riverton, Thermopolis, and Kane, are located in Wyoming. The samples from these stations were collected by local hydrographers under the supervision of Mr. Robert Follansbee, District Engineer, U. S. Geological Survey, Denver, Colorado. The samples from these stations were analyzed by the Wyoming State Experiment Station at Laramie, Wyoming. The fourth station was located near St. Xavier, Montana, where the samples were collected at first under the supervision of Mr. W. A. Lamb, and later under the supervision of Mr. A. H. Tuttle, District Engineer, U. S. Geological Survey, Helena, Montana. The analyses of the St. Xavier samples were made at the Montana State Experiment Station. The discharge data for these stations were furnished by Messrs. Follansbee and Tuttle.

The Riverton gaging station is located on the main stream, (locally known as Wind River) about three-quarters of a mile southeast of Riverton, Wyoming. This is downstream from the junction of Popo Agie River with Wind River at approximately 4845 feet above sea level. The drainage area above this station is 2320 square miles.

The Thermopolis gaging station is located at Thermopolis, Wyoming, which is downstream from a canyon section of the

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[2]Salinity Conditions in the Big Horn River, 1938. Progress Report from the Wyoming Experiment Station, May, 1939. Mimeographed.

Figure 1. Gaging Stations on the Big Horn River.

stream through a gap at the south end of the Big Horn mountains which lie east of the river. The drainage area above Thermopolis is 8080 square miles.

The Kane gaging station is located on the main stream one-half mile east of Kane, Wyoming. It is a short distance upstream from the junction of the Shoshone River, an important tributary from the west. The elevation of the stream at this station is approximately 3610 feet above sea level and the drainage area above the station is 15,900 square miles.

The St. Xavier gaging station is located 22 miles upstream from St. Xavier, Montana, and near the north end of the Big Horn mountains. It is below the junction of the Shoshone River

but above that of the Little Horn, and also above the diversions that serve the irrigated lands of the Crow Reservation.

The water samples were collected at each station approximately once a week except for the St. Xavier station, where, owing to changes in personnel, no samples were taken in 1938 subsequent to April. In 1939 samples at this station were taken from May to September. The outline map, Figure 1, shows the relation of the stations to the river.

ANALYSIS AND INTERPRETATION

As the water samples were received at the laboratory, the concentration of dissolved salts was determined for each sample by the electrometric method and reported as specific conductance (K x 10^5 @ 25°C.). All the data on conductance are on the basis of this formula at 25°C. Subsequently the several samples from each station for each month were made into a composite sample for detailed analysis.[3]

The present report includes for each of the four gaging stations a table showing the conductance of each sample and a table showing the results of the detailed analysis of each composite monthly sample, for the years ending September 30, 1938 and September 30, 1939, respectively.

From the data of the detailed analysis of the composite samples and the discharge data, in acre feet per month, furnished by the hydrographers, computations were made to show the tonnage of total dissolved solids (T.D.S.) and the tonnage of each of the seven more important salt constituents passing each station each month. The results of these computations are summarized for the year ending September 30, 1938, for the three stations in Wyoming in Tables 13 and 14. These tables show, not only the volumes of water and the tonnage of dissolved solids and of salt constituents passing each station for the year, but also the net volumes and quantities contributed from that portion of the drainage basin between each two successive gaging stations.

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[3]Methods of analysis used in the Rubidoux Laboratory, Riverside, Calif., U. S. Department of Agriculture, Bureau Plant Industry, 62 pp. revised January, 1938.

Because of the fact that at the St. Xavier station samples were collected for only seven months, October to April, inclusive, the summaries for all four stations for this 7-month period are shown in Table 15. The runoff for this 7-month period was less than one-third the total for the year, being 25 per cent at Riverton, 26 per cent at Thermopolis, 30 per cent at Kane, and 28 per cent at St. Xavier. However, the inter-station comparisons for the 7-month period appear to be valid.

THE DISCHARGE AND SALT BURDEN IN 1938

The river discharged approximately 550,000 acre feet of water at Riverton, the upper station. This was increased to 928,000 acre feet at Thermopolis, to 1,496,000 acre feet at Kane, and to 2,416,000 acre feet at St. Xavier. In respect to the salt burden, the data show that the river carried 163,000 tons of total dissolved solids at Riverton, 516,000 tons at Thermopolis, 1,166,000 tons at Kane, and an estimated 2,600,000 tons at St. Xavier. The weighted mean concentrations of total dissolved solids, computed as tons per acre foot, ranged from .396 at Riverton, .697 at Thermopolis, and .968 at Kane, to an estimated 1.09 at St. Xavier. The data for the 7-month winter period show higher concentrations for that period of low discharge than for the full year, because of the diluting effect of the summer flood waters.

The summarized data of Tables 13 and 15 show also the volume and concentration of the contributions to the stream from the sections of the drainage basin between the gaging stations. In the section between Riverton and Thermopolis, the net volume of water contributed was 380,580 acre feet. The concentration of this contribution was .928 tons per acre foot. Between Thermopolis and Kane the net volume contributed was 567,220 acre feet having a concentration of 1.146 tons per acre foot. The estimated net volume contributed between Kane and St. Xavier was 920,500 acre feet having an estimated concentration of 1.59 tons per acre foot. The higher concentrations of the inter-station contributions appear to indicate that the return flow of drainage water from irrigated lands along the stream carries a higher

proportion of dissolved salts than the natural runoff from precipitation.

The data of Tables 1 to 12 inclusive show the concentration and composition of the dissolved salts carried by the stream waters at each gaging station for each month for the period of record. These detailed data are summarized for all four stations in Table 16 in which the weighted mean values are given. As summarized in this table these data show not only the salinity conditions found at each station, but also the trend and rate of change in concentration as the water moves downstream. It may be noted, for example, that while there is in general an increase in the concentration of each constituent in the downstream direction the rate of increase is much greater with sodium and with sulfate than with the other constituents.

The more significant characteristics of the dissolved salts, regardless of concentration may be shown best by computing the percentage composition. These characteristics are shown for each of the gaging stations in Table 17. In this table is shown the percentage of each cation, expressed as milligram equivalents per liter, to the sum of the cations, and similarly the percentage of each anion to the sum of the anions. The concentration values used are those shown in Table 16. In the last column of Table 17 is shown the ratio of the sum of the tonnages of the salt constituents (as given in Tables 13 and 15) to the tonnage of the total dissolved solids.

DISCHARGE AND SALT BURDEN IN 1939

During 1939 the total discharge of the Wind-Big Horn River was much less than during the preceding year, showing 439,000 acre feet at Riverton, 723,980 acre feet at Thermopolis, 1,125,000 acre feet at Kane and 1,943,400 acre feet at St. Xavier, Montana.

The data show that the river carried 137,247 tons of dissolved matter at Riverton, 492,323 tons at Thermopolis, 905,503 tons at Kane and 2,059,708 tons at St. Xavier during the year. The weighted mean concentration of dissolved salts computed as

tons per acre foot of water, ranged from .313 at Riverton, .680 at Thermopolis, .805 at Kane to 1.060 at St. Xavier.

As shown in Table 14, the mean concentration of dissolved salts at the three up-stream stations was slightly greater in 1939 when the annual discharge decreased. Calcium decreased and sodium, magnesium and sulfate increased with passage down stream, both in 1938 and 1939. The sodium for 1939 was two per cent higher than for 1938, showing that in a year of decreased discharge, the concentration of alkali salts increased and the quality of water was lowered. The proportion of sodium increased about ten per cent from Riverton to St. Xavier. The proportions of the cations varied more than the anions did.

Summary Tables 17 and 18, which give the percentage composition of the salts in solution for the two years, bring out the changes in quality of water which occur in a dry year as compared to a year of more normal discharge.

SUMMARY

During the years 1938 and 1939, the Big Horn River discharged from one and a half to one and a tenth million acre feet of water at the north Wyoming boundary. This water held over a million tons to 881,000 tons of dissolved salts in solution and an unknown amount of silt, colloid, sand, and organic matter in suspension.

The character and amount of dissolved matter varies with season and nearness to the mountains. The chief materials in solution are calcium, sodium, magnesium, potassium, and a little iron and aluminum in the form of sulfate, chloride, carbonate, and bi-carbonate chiefly. The amount of other plant food elements is very small.

As one passes down river from head to mouth, the composition of the dissolved matter changes from chiefly calcium and magnesium to a higher proportion of the alkalies. This is due in part to the admixture of seepage and alkali water from side streams of the drainage area and return flow from irrigated areas. Sulfates increase and carbonate and chloride decrease. Nitrate is greatest at Riverton near the head.

The dissolved matter in this water, when used for irrigation, reacts chemically with the soils, the sodium being absorbed by the soil and other bases given off in soluble form to the waste water. Absorption of sodium causes sticky soil, slow water absorption, poor drainage and hard lumpy soil when dried out.

The quality of the water for irrigation is good near the mountains, but as the sodium content increases, the quality is reduced. The sulfate, bi-carbonate and sodium contents are greater than the calcium content. The months when there is least salt concentration in the water are May, June, and July. The farmer can reduce the bad effects on the soil by using the most water when the salt content is lowest; by reducing evaporation from the soil surface and by frequent small irrigations designed to keep the major movement of water downward. High water tables in the subsoil favor the concentration of salt at the surface and can be lowered by drainage; by avoiding the continuous flow method of irrigation; by sealing up ditch and canal bottoms. When water tables are low, the capillary rise of moisture from the subsoil is retarded and so less salt is brought to the surface.

The measurements and computations reported in this bulletin indicate that in 1939 the water discharge was 77 per cent of that of 1938 and the salt burden 88 per cent of that of 1938.

A hopeful conclusion follows from the fact that the total salt burden carried by the river during both years of this report increased from station to station down stream. This shows that salt is being washed out of the irrigated land rather than being deposited on it and indicates that the general salinity situation will improve in the Big Horn Valley, provided the farm lands are cut off from large local deposits of salt.

TABLE 1

Concentration of dissolved salts in the water of Big Horn (Wind) River at the Riverton, Wyoming, gaging station during the year ending September 30, 1938. Samples and discharge data by the U. S. Geological Survey; conductance determinations by the Wyoming State Experiment Station. **Location**—In Sec. 2, T. 1S. R. 4E, three-quarters of a mile southeast of Riverton. Zero of gage is 4,844.38 feet above mean sea level.
Drainage area, 2,320 square miles.

Date Sampled	Conductance	Gage Reading	Discharge Sec. Feet	Ml. for Composite
9-25-37	40.6	2.96	530	225
10- 2-37	51.6	3.09	635	265
10- 9-37	55.0	3.09	635	265
10-16-37	53.4	3.59	1,120	490
10-23-37	49.8	2.95	525	225
10-30-37	58.9	2.68	350	135
11- 6-37	51.9	2.84	254	320
11-13-37	55.0	2.84	254	320
11-20-37	55.8	3.02	376	470
11-27-37	63.4	2.87	272	355
12- 4-37	61.3	2.93	308	400
12-11-37	56.2	3.00	300	380
12-18-37	56.6	2.20	220	...
1- 1-38	63.4	2.25	200	450
1- 8-38	50.5	2.20	168	440
1-16-38	46.1	2.10	150	420
1-25-38	62.3	2.00	140	400
2- 1-38	106.9	2.10	100	315
2- 9-38	63.4	2.50	140	375
2-16-38	71.9	2.00	175	300
2-23-38	59.3	2.15	250	325
3- 2-38	53.8	3.00	300	400
3- 9-38	52.7	3.25	325	430
3-16-38	50.9	3.50	350	465
4- 2-38	58.0	2.81	248	...
4- 9-38	58.3	2.80	224	180
4-16-38	60.3	2.98	352	280
4-23-38	42.5	3.24	600	475
4-30-38	39.4	3.38	600	475
5- 7-38	39.4	3.16	432	125
5-14-38	42.5	2.93	314	100
5-21-38	31.9	3.11	472	150
5-31-38	20.4	4.47	1,500	450
6- 4-38	18.4	4.38	1,752	455
6-11-38	18.8	3.92	1,370	355
6-18-38	16.8	4.00	1,370	355
7- 9-38	12.5	4.38	2,110	...
7-16-38	17.8	4.26	1,920	...
7-23-38	18.7	4.14	1,730	...
7-30-38	19.2	3.76	1,180	...
8- 6-38	20.3	3.44	817	450
8-13-38	21.1	3.27	690	450
8-22-38	35.3	3.27	516	210
8-27-38	35.1	3.76	1,040	425
9- 3-38	40.4	4.22	1,760	460
9-10-38	30.6	3.85	1,360	262
9-17-38	40.5	3.30	690	141
9-24-38	44.3	3.02	427	100

Note—Discharge and gage readings as reported by observer, later adjusted by Denver office U.S.G.S.

TABLE 2

Concentration of dissolved salts in the water of Big Horn (Wind) River at the Riverton, Wyoming, gaging station during the year ending September 26, 1939. Samples and discharge data by the United States Geological Survey; conductance determinations by the Wyoming State Experiment Station. **Location**—In Sec. 2, T. 1S. R. 4E, three-quarters of a mile southeast of Riverton. Zero of gage is 4,844.38 feet above mean sea level. Drainage area 2,320 square miles.

Date Sampled	Conductance	Gage Reading	Discharge Sec. Feet	Ml. for Composite
10- 4-38	.....	3.14	526	All
11-12-38	39.4	3.20	544	...
11-19-38	41.7	3.16	498	...
11-26-38	46.2	3.12	452	...
12- 3-38	40.7	3.23	554	460
12-10-38	40.9	3.10	436	395
12-17-38	.....	....	390	...
12-27-38	46.5	....	530	186
1- 3-39	38.6	....	600	400
1- 7-39	40.0	....	360	400
1-14-39	41.7	....	350	288
1-21-39	50.4	....	370	280
1-28-39	47.9	....	300	280
2- 4-39	51.2	....	310	366
2-11-39	37.0	....	325	379
2-18-39	41.2	....	360	347
2-25-39	40.7	....	360	390
3- 4-39	43.1	....	390	277
3-11-39	40.9	....	370	306
3-25-39	41.3	3.32	660	425
4- 1-39	43.1	3.12	470	264
4- 8-39	43.1	3.07	427	254
4-15-39	41.7	3.12	470	266
4-22-39	37.3	3.32	660	335
4-29-39	28.5	3.69	1,080	445
5- 6-39	22.6	3.94	1,430	396
5-13-39	32.5	3.13	480	275
5-20-39	21.3	3.68	1,070	423
5-24-39	29.5	3.39	730	303
6- 3-39	24.6	4.06	1,640	450
6-10-39	26.9	3.51	886	234
6-17-39	23.1	3.58	970	259
6-24-39	22.03	3.51	885	263
7- 1-39	21.5	3.60	1,010	465
7- 8-39	26.8	3.14	526	278
7-15-39	20.5	3.44	828	413
7-22-39	25.5	3.01	411	230
7-29-39	33.9	3.27	650	324
8- 5-39	25.6	3.14	535	470
8-12-39	29.2	3.12	516	448
8-19-39	29.6	3.05	452	414
8-26-39	26.6	3.09	489	442
9- 2-39	30.9	3.08	470	421
9-16-39	33.9	3.14	544	450
9-23-39	44.4	2.95	346	421
9-30-39	44.1	2.72	243	392
10- 6-39	43.6	2.92	340	420
10-14-39	43.9	2.96	350	425
10-21-39	50.4	2.90	330	420

TABLE 3

Discharge of water, concentration and composition of dissolved salts of Big Horn (Wind) River at the Riverton, Wyoming, gaging station by months for the two-year period ending September 30, 1939. Samples and discharge data by the U. S. Geological Survey; analyses by the Wyoming State Experiment Station.
Location—See Table 1.

Month	Discharge Acre Feet	Conductance	Tons per Acre Foot	Milligram Equivalents per Liter						
				Ca	Mg	Na	HCO$_3$ +CO$_3$	SO$_4$	Cl	NO$_3$
1937										
October.........	24,480	51.45	.408	2.50	1.05	1.10	2.84	2.29	0.31	.032
November........	19,620	56.5	.472	2.88	1.28	1.20	3.30	2.21	0.31	.032
December........	14,990	58.03	.503	3.04	1.60	1.20	3.20	2.20	0.38	.058
1938										
January..........	9,310	55.59	.571	3.10	1.57	1.20	3.20	2.16	0.37	.032
February.........	10,910	75.39	.653	3.64	1.46	2.86	3.75	3.65	0.32	.061
March...........	20,090	52.47	.476	2.67	1.31	1.35	3.13	2.13	0.24	.050
April...........	26,450	51.7	.421	2.38	1.19	1.35	2.71	1.93	0.20	.048
May.............	58,600	33.55	2.99	1.72	.79	.64	1.94	.78	0.18	.061
June............	142,800	18.0	.204	1.31	.55	.56	1.60	.25	0.22	.038
July............	120,700	17.05	.170	1.09	.45	.58	1.34	.32	0.30	.036
August..........	47,770	27.95	.260	1.24	.10	.58	1.49	.41	0.203	.035
September.......	52,230	38.95	.310	2.04	.12	.81	2.20	.69	0.16	.045
October.........	45,510	... *	0.31	1.89	0.16	1.00	2.24	1.15	0.10	.057
November........	31,610	42.4	0.35	2.13	0.14	1.42	2.54	1.32	0.17	.051
December........	28,200	42.7	0.38	2.19	0.12	1.04	2.62	1.89	0.11	.027
1939										
January..........	24,540	43.7	0.34	2.20	0.93	0.93	2.60	1.57	0.22	.029
February.........	18,550	42.5	0.35	2.17	0.96	1.51	2.65	1.08	0.30	.055
March...........	29,670	41.3	0.42	2.14	1.04	1.45	2.65	1.53	0.20	.01
April...........	32,240	38.7	0.28	1.83	1.25	0.97	2.39	1.31	0.20	.02
May.............	64,830	26.5	0.25	1.61	0.70	1.12	1.84	0.83	0.25	.015
June............	63,580	24.15	0.21	1.56	0.86	0.79	2.15	0.71	0.24	.003
July............	41,520	25.6	0.31	1.57	0.52	0.81	1.92	0.73	0.16	.039
August..........	33,340	28.4	0.35	1.57	0.65	1.04	1.80	0.94	0.18	.033
September.......	25,430	43.4	0.43	1.79	1.14	1.48	2.75	0.96	0.15	.043

*Conductance computed from average of the weekly samples, conductance of composite not being available in all cases.

TABLE 4

Concentration of dissolved salts in the water of Big Horn River at Thermopolis, Wyoming, gaging station during the year ending September 30, 1938. Samples and discharge data by the U. S. Geological Suvey; conductance determinations by the Wyoming State Experiment Station. **Location**—In Sec. 36, T. 43N, R. 96W, at Thermopolis. Drainage area 8,080 square miles.

Date Sampled	Conductance	Gage Reading	Discharge Sec. Feet	Ml. for Composite
10- 1-37	96.5	1.44	556	260
10- 9-37	74.9	1.93	818	350
10-16-37	84.3	2.50	1,160	450
10-23-37	92.9	1.90	760	340
10-31-37	99.2	1.60	630	290
11- 6-37	97.9	1.64	652	295
11-13-37	95.9	1.78	729	410
11-21-37	91.2	1.95	825	450
11-27-37	94.5	2.05	895	470
12- 6-37	90.1	1.90	760	435
12-11-37	139.0	1.80	734	415
12-18-37	83.1	1.72	710	395
1- 1-38	89.1	1.55	416	430
1- 8-38	91.5	1.70	385	470
1-15-38	92.3	1.53	388	425
1-22-38	97.1	1.65	395	460
1-31-38	98.4	1.68	365	465
2- 5-38	92.3	1.53	374	385
2-28-38	79.5	1.90	442	480
3- 5-38	86.0	2.10	618	375
3-12-38	86.0	2.15	699	385
3-19-38	95.9	2.45	948	435
3-25-38	97.1	2.05	589	365
4- 1-38	124.7	1.75	....	215
4- 9-38	89.0	1.90	980	230
4-16-38	118.7	3.00	996	365
4-23-38	65.6	3.21	1,920	395
4-30-38	57.5	3.10	1,480	380
5- 7-38	55.0	3.33	2,520	260
5-14-38	64.5	2.68	1,410	200
5-21-38	48.3	4.04	4,180	320
5-28-38	34.0	5.80	5,600	455
6- 4-38	32.2	6.05	7,600	470
6-11-38	26.7	5.77	8,000	450
6-18-38	33.1	4.94	5,090	385
7- 9-38	31.1	5.27	3,060	...
7-17-38	55.0	4.54	2,000	...
7-23-38	45.3	4.56	1,990	...
8- 6-38	60.8	3.51	1,120	...
8-13-38	49.0	3.28	989	...
8-20-38	46.1	2.97	820	...
8-27-38	82.7	3.60	1,170	...
9- 3-38	72.0	4.69	2,100	420
9-10-38	56.1	4.63	1,890	410
9-17-38	65.1	3.82	1,200	344
9-24-38	70.1	3.35	950	299

Note—Gage height and discharges reported by observer were later adjusted by Denver office U. S. G. S.

TABLE 5

Concentration of dissolved salts in the water of Big Horn River at Thermopolis, Wyoming, gaging station during the year ending September 30, 1939. Samples and discharge data by the United States Geological Survey; conductance by the Wyoming State Experiment Station. **Location**—In Sec. 36, T. 43N, R. 96W, at Thermopolis.
Drainage area 8,080 square miles.

Date Sampled	Conductance	Gage Reading	Discharge Sec. Feet*	Ml. Used for Composite
10- 1-38	75.8	3.11	825	All Used
2-11-39	80.5	2.48	498	428
2-18-39	78.4	2.52	546	410
2-25-39	78.3	2.47	554	408
3- 5-39	76.1	2.48	602	182
3-12-39	66.9	3.00	857	426
3-18-39	72.6	3.11	862	453
4- 1-39	86.2	2.99	830	335
4- 9-39	77.6	2.93	795	333
4-15-39	76.4	2.95	800	335
4-23-39	71.9	3.40	1,070	389
4-29-39	62.6	3.74	1,220	402
5- 6-39	22.6	4.97	2,250	425
5-13-39	52.3	3.90	1,290	334
5-20-39	39.3	4.70	1,850	394
5-27-39	75.9	4.43	1,690	370
6- 3-39	70.0	6.35	4,350	440
6-11-39	52.1	4.48	1,720	311
6-17-39	58.6	3.50	1,180	240
6-24-39	54.8	3.80	1,200	264
7- 1-39	57.5	3.07	1,220	341
7- 8-39	59.6	3.48	890	387
7-16-39	55.4	3.82	1,090	425
7-22-39	73.7	2.60	512	289
7-30-39	60.9	3.48	880	387
8- 5-39	63.8	3.45	850	460
8-16-39	74.1	2.80	572	372
8-19-39	75.9	1.75	584	233
8-26-39	66.6	3.00	644	399
9- 1-39	66.03	3.10	656	445
9- 9-39	69.0	3.27	790	467

*Discharge from unpublished record, subject to revision.

TABLE 6

Discharge of water, concentration and composition of dissolved salts of the Big Horn River at the Thermopolis, Wyoming, gaging station, by months for the two-year period ending September 30, 1939. Samples and discharge data by the U. S. Geological Survey; analyses by the Wyoming State Experiment Station.
Location—See Table 4.

Month	Discharge Acre Feet	Conductance	Tons per Acre Foot	Milligram Equivalents per Liter						
				Ca	Mg	Na	HCO₃ +CO₂	SO₄	Cl	NO₂
1937										
October..........	39,440	89.56	.734	3.96	2.66	2.34	3.84	5.15	0.51	.057
November........	32,700	94.92	.829	4.48	2.48	2.20	3.94	5.27	0.50	.060
December........	27,150	104.06	.829	4.48	2.48	2.20	3.94	5.27	0.50	.060
1938										
January..........	24,350	93.69	.979	4.58	2.64	2.86	4.18	5.01	0.50	.040
February.........	21,880	85.9	.843	4.48	2.38	2.76	3.84	4.87	0.50	.072
March...........	43,270	91.25	.870	4.36	2.44	2.98	3.25	5.66	0.52	.073
April............	56,580	91.1	.775	3.88	2.37	3.11	3.40	5.24	0.56	.063
May.............	127,000	50.45	.472	2.67	1.25	1.17	2.43	2.17	0.24	.065
June............	255,700	30.66	.367	2.42	.63	.84	2.43	1.17	0.26	.036
July.............	149,300	43.8	.470	2.38	.95	2.06	2.08	2.53	0.37	.030
August..........	66,680	64.65	.650	4.03	.86	2.38	3.06	3.51	0.44	.053
September.......	84,480	65.82	.550	3.13	.93	1.40	2.76	2.86	0.17	.045
October..........	75,420	75.8	.95	3.53	0.40	2.34	3.24	1.85	0.52	.062
November........	57,050	....	.95	...	...	...	....	...	....	...
December........	44,320	....	.95	...	...	...	....	...	....	...
1939										
January..........	36,970	....	.95	...	...	...	....	...	....	...
February.........	28,430	79.1	.625	3.26	1.91	2.51	2.98	3.52	0.59	.055
March...........	54,490	71.9	.645	3.55	.77	2.17	3.23	3.74	0.60	.073
April............	55,380	74.9	.630	3.36	1.76	2.47	3.07	3.95	0.47	.058
May.............	107,700	47.5	.515	2.55	0.54	1.79	2.55	2.57	0.31	.011
June............	120,300	58.9	.523	2.27	1.47	2.22	2.11	2.77	0.47	.004
July.............	56,790	61.4	.544	2.98	1.39	2.05	2.94	3.17	0.49	.027
August..........	47,100	70.1	.693	3.87	0.59	3.44	3.22	3.77	0.48	.078
September.......	39,940	67.5	.489	3.62	0.58	2.55	3.10	3.70	0.28	.046

TABLE 7

Concentration of dissolved salts in the water of Big Horn River at the Kane, Wyoming, gaging station during the year ending September 30, 1938. Samples and discharge data by the U. S. Geological Survey; conductance determinations by the Wyoming State Experiment Station. **Location**—In Sec. 4, T. 56N, R. 94W, half a mile east of Kane. Zero of the gage is 3,610.23 feet above mean sea level (Chicago, Burlington and Quincy Railroad datum.)   Drainage area 15,900 square miles.

Date Sampled	Conductance	Gage Reading	Discharge Sec. Feet	Ml. for Composite
10- 1-37	120.6	2.03	1,060	345
10- 7-37	113.3	2.22	1,250	405
10-16-37	116.9	2.22	1,250	405
10-25-37	115.1	2.42	1,450	470
11- 2-37	124.7	2.10	1,130	370
11-11-37	118.7	2.26	1,290	420
11-23-37	114.7	2.62	1,560	470
11-29-37	103.4	2.48	1,520	455
12- 5-37	112.9	2.29	1,320	330
12-12-37	128.7	2.43	1,463	360
12-19-37	107.9	2.56	1,606	395
12-27-37	123.5	2.84	1,928	475
1-11-38	111.6	3.67	715	435
1-18-38	110.0	3.93	770	465
1-25-38	111.6	3.50	690	415
2- 1-38	122.7	2.96	630	290
2- 6-38	115.1	3.90	710	385
2-13-38	105.3	4.70	790	465
2-23-38	120.7	3.81	730	370
2-27-38	98.4	4.00	910	460
3- 6-38	91.2	2.76	1,400	460
3-20-38	105.3	2.72	1,390	460
3-27-38	110.0	2.14	950	365
4- 3-38	110.0	1.94	2	325
4-12-38	107.5	2.06	638	340
4-17-38	116.9	2.28	922	375
4-25-38	77.1	2.77	1,190	480
5- 6-38	52.6	3.62	1,430	450
5-12-38	77.1	3.57	981	320
5-17-38	72.5	3.14	1,710	385
5-24-38	54.6	3.82	1,720	480
6- 2-38	37.0	5.76	3,990	410
6- 7-38	31.1	6.71	5,430	470
6-13-38	33.7	5.99	3,630	355
6-20-38	39.4	6.12	3,720	450
6-26-38	63.9	6.54	4,340	460
7-10-38	50.2	4.64	4,540	...
7-18-38	82.2	3.60	2,840	...
7-26-38	61.8	4.11	3,440	...
7-31-38	91.2	2.79	1,820	...
8- 9-38	86.0	1.63	732	...
8-14-38	113.3	1.41	541	...
8-21-38	117.0	1.47	567	348
8-28-38	123.5	1.92	960	460
9- 5-38	90.6	3.30	2,500	...
9-10-38	.....	3.21	2,340	...
9-18-38	89.0	2.47	1,450	...

Note—Gage readings and discharges submitted by observers were later adjusted by Denver office U. S. G. S.

TABLE 8

Concentration of dissolved salts in the water of Big Horn River at the Kane, Wyoming, gaging station during the year ending September 30, 1939. Samples and discharge data by the United States Geological Survey; conductance determinations by the Wyoming State Experiment Station. **Location**—In Sec. 4, T. 56N, R. 94W, half mile east of Kane. Zero of the gage is 3,610.23 feet above mean sea level (C. B. & Q. R. R. Datum). Drainage area 15,900 square miles.

Date Sampled	Conductance	Gage Reading	Discharge Sec. Feet	Ml. Used for Composite
10- 4-38	101.9	2.17	1,130	...
2-22-39	90.3	4.96	900	460
2-26-39	96.8	4.89	980	460
3- 9-39	59.5	4.63	1,100	318
3-14-39	84.4	5.84	3,150	425
3-25-39	86.3	3.87	3,310	227
3-27-39	89.3	3.44	2,700	243
4- 2-39	103.5	2.58	1,640	440
4-15-39	102.1	2.42	1,460	400
4-23-39	97.8	2.40	1,430	409
4-30-39	76.1	2.61	1,660	442
5- 7-39	42.4	4.22	4,220	445
5-14-39	64.4	2.56	1,800	275
6- 4-39	94.4	5.18	6,340	435
6-11-39	62.3	3.28	2,850	396
6-18-39	69.9	2.94	2,290	350
6-25-39	71.3	2.72	1,780	325
7- 2-39	86.5	2.06	1,180	460
7-12-39	100.6	1.10	530	246
7-18-39	96.6	1.42	700	317
7-27-39	158.1	0.42	200	95
8- 7-39	146.02	2.22	436	410
8-15-39	102.8	1.03	513	189
8-22-39	119.4	0.00	285	95
8-29-39	158.1	0.00	278	95
9- 3-39	156.9	0.68	309	180
9-14-39	125.7	1.36	632	360
9-26-39	132.3	1.26	568	334
10- 1-39	128.6	1.60	990	424
10-10-39	123.6	1.70	1,480	450
10-18-39	121.3	1.70	1,640	450

TABLE 9

Discharge of water, concentration and composition of dissolved salts of Big Horn River at the Kane, Wyoming, gaging station, by months for the two-year period ending September 30, 1939. Samples and discharge data by the U. S. Geological Survey; analyses by the Wyoming Experiment Station.
Location—See Table 7.

Month	Discharge Acre Feet	Conductance	Tons per Acre Foot	Milligram Equivalents per Liter						
				Ca	Mg	Na	HCO₃ +CO₃	SO₄	Cl	NO₈
1937										
October	80,210	116.5	1.02	5.40	2.93	3.35	4.00	8.15	0.56	.070
November	69,760	115.4	1.07	5.38	3.08	2.87	4.12	8.01	0.48	.071
December	57,560	118.25	1.21	5.52	3.51	3.10	4.70	8.43	0.56	.066
1938										
January	45,440	111.06	1.156	5.07	3.26	4.08	4.48	7.58	0.56	.074
February	39,780	112.44	1,128	5.46	3.17	4.16	4.04	7.86	0.63	.107
March	79,060	102.17	1,047	4.88	2.70	4.23	3.30	7.66	0.70	.076
April	77,690	102.9	1.033	5.21	2.98	3.25	3.58	7.07	0.48	.165
May	216,100	64.2	0.680	3.70	1.77	1.94	2.88	4.29	0.31	.080
June	457,500	41.02	0.489	2.46	1.01	1.05	1.92	2.42	0.14	.075
July	225,200	71.35	0.70	3.24	1.32	2.54	2.06	4.47	0.36	.033
August	49,290	109.95	1.09	3.69	0.73	4.82	2.01	7.44	0.49	.043
September	98,160	89.8	0.99	4.78	0.83	4.19	3.20	6.61	0.51	.055
October	98,180	101.9	0.95	4.57	0.27	3.16	3.44	2.77	0.51	.052
November	90,790	.....	.95	....	....	....	....	....	....	....
December	81,040	.....	.95	....	....	....	....	....	....	....
1939										
January	67,280	.....	.95	....	....	....	....	....	....	....
February	49,810	93.6	0.856	4.16	2.52	3.11	3.53	5.53	0.60	.070
March	140,000	79.9	0.639	2.83	1.72	3.13	1.53	4.96	0.28	.070
April	90,780	94.9	0.855	4.36	2.37	3.88	3.55	6.00	0.42	.072
May	181,800	53.4	0.503	3.46	1.82	1.51	2.78	1.68	0.24	.022
June	222,700	74.5	0.757	3.80	1.48	2.42	3.21	4.45	0.43	.011
July	42,550	110.4	0.919	3.92	0.99	4.59	2.80	7.08	0.47	.053
August	28,610	129.1	1.224	5.87	1.329	7.28	3.83	8.32	0.24	.068
September	31,580	114.7	1.305	5.71	2.56	5.96	3.87	9.27	0.26	.054

TABLE 10

Concentration of dissolved salts in the water of Big Horn at the St. Xavier, Montana, gaging station during the year ending September 30, 1938. Samples and discharge data by the U. S. Geological Survey; conductance determinations by the Montana State Experiment Station. **Location**—In the N E ¼, Sec. 17, T. 6S, R. 31E, 22 miles southwest of St. Xavier, Montana, and 50 feet above the diversion dam of Crow agency irrigation ditch.

Date Sampled	Conductance	Gage Reading	Discharge Sec. Feet	Ml. for Composite
10- 5-37	122	1.50	2,890	470
10-10-37	118	1.07	1,587	258
10-15-37	117	1.05	1,535	250
10-21-37	116	1.15	1,805	294
10-25-37	126	1.10	1,665	271
10-30-37	122	1.05	1,535	250
11- 5-37	135	0.92	1,209	265
11-10-37	132.5	0.98	1,356	298
11-15-37	131.9	1.10	1,665	366
11-20-37	136.7	1.00	1,405	309
11-25-37	120.8	1.25	2,095	460
11-30-37	121.2	1.20	1,945	427
12- 5-37	123.2	1.10	1,665	311
12-11-37	121.2	1.20	1,945	363
12-16-37	119.3	1.10	1,665	311
12-20-37	113.0	1.15	1,805	337
12-25-37	126.2	0.70	738	138
12-31-37	127.5	1.04	1,509	282
1- 5-38	130.4	1.00	1,405	443
1-11-38	121.7	1.00	1,405	443
1-22-38	111.3	1.00	1,405	443
2- 5-38	119	1.00	1,405	310
2-12-38	115	1.00	1,405	310
2-19-38	122	1.00	1,405	310
2-25-38	121	1.12	1,721	380
3- 3-38	103	1.65	3,427	457
3-11-38	107	1.40	2,555	341
3-18-38	117	1.25	2,095	279
3-23-38	122	1.15	1,805	241
3-28-38	119	1.05	1,535	205
4- 2-38	119.7	1.00	1,405	269
4- 6-38	121.0	0.95	1,282	246
4-11-38	116.9	0.98	1,356	260
4-16-38	115.3	1.05	1,535	294
4-21-38	110.8	1.30	2,245	430
4-30-38	115.3	1.30	2,245	430

TABLE 11

Concentration of dissolved salts in the water of Big Horn River at the St. Xavier, Montana, gaging station during the year ending September 30, 1939. Samples and discharge data by the United States Geological Survey; conductance determinations by the Montana State Experiment Station. **Location**—N E ¼, Sec. 17, T. 6S, R. 31E, 22 miles southwest of St. Xavier, Montana, and 50 feet above the diversion dam of Crow Agency irrigation ditch.

Date Sampled	Conductance	Gage Reading	Discharge Sec. Feet	Ml. Used for Composite
5- 8-39	40.6	1.92	4,498	400
5-13-39	56.5	1.26	2,125	189
5-18-39	56.5	1.56	3,101	276
5-23-39	55.1	1.60	3,242	288
5-28-39	84.6	1.82	4,085	363
6- 2-39	84.9	4.38	19,650	420
6- 8-39	51.4	2.78	8,718	186
6-13-39	65.7	2.24	5,935	127
6-19-39	66.5	2.37	6,514	139
6-24-39	60.7	2.02	4,929	105
6-29-39	60.4	1.76	3,847	82
7- 4-39	57.2	1.98	4,754	425
7- 9-39	67.5	1.60	3,242	290
7-14-39	66.9	1.44	2,689	240
7-19-39	80.5	1.16	1,833	164
7-24-39	87.4	0.96	1,307	117
7-29-39	104.5	0.86	1,071	96
8- 4-39	75.9	1.50	2,890	425
8-10-39	83.9	1.40	2,555	376
8-16-39	88.1	1.30	2,245	330
8-21-39	103.7	1.10	1,665	245
8-26-39	95.7	1.14	1,777	261
8-31-39	89.6	1.02	1,457	214
9- 5-39	103.9	....	1,509	292
9-10-39	100.2	....	1,777	344
9-15-39	100.5	....	2,245	435
9-20-39	110.6	....	1,833	355
9-25-39	108.9	....	1 613	313
9-30-39	120.8	....	1,777	344

TABLE 12

Discharge of the water, concentration and composition of dissolved salts of Big Horn River at the St. Xavier, Montana, gaging station, by months for the two-year period ending September 30, 1939. Samples and discharge data by the U. S. Geological Survey; analyses by the Montana State Experiment Station.
Location—See Table 10.

Month	Discharge Acre Feet	Conductance	Tons per Acre Foot	Ca	Mg	Na	CO_3	HCO_3	SO_4	Cl	NO_3
1937											
October....	124,200	120	1.23	4.92	2.92	5.36	0.32	3.58	8.78	0.44	.04
November..	93,100	123	1.28	4.91	3.42	5.33	0.34	3.50	9.42	0.46	.02
December..	75,420	119	1.25	5.45	3.51	4.47	0.35	3.98	8.72	0.42	.02
1938											
January....	78,580	120	1.24	5.90	3.39	4.19	0.40	4.48	8.25	0.46	.02
February...	74,150	119	1.24	5.86	3.34	4.00	0.38	4.28	8.32	0.45	.01
March......	124,600	111	1.15	4.95	2.86	4.32	0.36	3.46	8.03	0.45	.01
April.......	110,700	113	1.15	4.79	3.07	4.29	0.44	3.31	8.01	0.45	.02
May........	279,500	.....	.....	.....	.....	.....	.....	......	.....	.....	......
June.......	711,000	.....	.....	.....	.....	.....	.....	......	.....	.....	......
July........	469,100	.....	.....	.....	.....	.....	.....	......	.....	.....	......
August....	118,600	.....	.....	.....	.....	.....	.....	......	.....	.....	......
September.	157,300	.....	.....	.....	.....	.....	.....	......	.....	.....	......
Total 7 Mo. mean.....	680,750	118	1.21	5.18	3.17	4.61	.....	4.11	8.49	0.45	.02
Per cent Composition....	..:.....	......	....	40.0	24.4	35.6	.....	31.4	65.0	3.6	0.16
October....	159,100	.....	1.48	.....	.....	.....	.....	......	.....	.....	......
November..	128,300	.....	1.48	.....	.....	.....	.....	......	.....	.....	......
December..	98,410	.....	1.48	.....	.....	.....	.....	......	.....	.....	......
1939											
January....	92,810	.....	1.48	.....	.....	.....	.....	......	.....	.....	......
February...	67,690	.....	1.48	.....	.....	.....	.....	......	.....	.....	......
March......	171,700	.....	1.48	.....	.....	.....	.....	......	.....	.....	......
April.......	121,800	.....	1.48	.....	.....	.....	.....	......	.....	.....	......
May........	269,300	60.5	.565	2.10	1.42	2.49	0.18	1.56	4.19	0.17	0.0
June.......	416,200	71.5	.696	2.97	1.29	3.06	0.26	2.13	4.88	0.18	Trace
July.......	169,100	76.2	.734	2.99	1.73	3.21	0.12	2.32	5.11	0.24	0.04
August.....	134,800	91.8	.923	3.59	2.01	4.41	0.18	2.73	6.58	0.42	0.04
September.	114,200	107.3	1.107	4.36	2.65	5.09	0.38	3.06	8.37	0.38	0.03

TABLE 13

The Big Horn River in Wyoming. Discharge and Salt·Burden Conditions for the Year Ending September 30, 1938.

Item	Water Acre Feet	T. D. S. Tons Ac. Ft.	T. D. S. Tons	Constituents in Tons							
				Ca	Mg	Na	$CO_3 + HCO_3$	SO_4	Cl	NO_3	Sum Tons
At Riverton............	547,950 (594,200)	.396	162,706	27,337	5,827	13,485	44,694	30,155	6,390	1,928	129,826
Riverton— Thermopolis............	350,580	.928	353,199	51,225	14,111	36,775	62,481	147,287	9,200	1,813	322,882
At Thermopolis............	928,530 (1,006,000)	.697	515,905	78,562	19,938	50,260	107,175	177,442	15,590	3,741	452,708
Thermopolis— Kane............	567,220	1.146	649,841	75,662	23,516	65,651	65,380	316,626	10,443	5,305	562,583
At Kane............	1,495,750 (1,558,000)	.968	1,165,746	154,224	43,454	115,911	172,555	494,068	26,033	9,046	1,015,291
Kane— St. Xavier............	920,500*	1.59 *	1,468,500*	....	....	....	....	....	....	....	....
At St. Xavier† ‡	2,416,250 (2,509,340)	1.09 *	2,600,000*	....	....	....	....	....	....	....	....

*Estimated by interseasonal comparisons.

†2,416,250 Estimated discharge used in 1938 quality of water survey.

‡(2,509,340) Published discharge for Big Horn River for 1938 U. S. G. S.

TABLE 14

The Big Horn River in Wyoming. Discharge and Salt Burden Conditions for the Two Years Ending Sept. 30, 1938, and Sept. 30, 1939, Respectively.

Place		Annual Discharge Acre Feet	Weighted Mean Concentration Dissolved Solids	T.D.S. Annual Tons	Constituents in Tons Per Year							
					Ca	Mg	Na	CO_3+HCO_3	SO_4	Cl	NO_3	Sum Tons
At Riverton	1938	547,950	.284	155,710	27,337	5,827	13,485	44,694	30,155	6,390	1,928	129,816
	1939	439,020	.313	137,247	22,389	5,149	15,497	42,802	37,665	4,026	1,110	128,635
Riverton to Thermopolis	1938	380,580	.947	360,395	51,225	14,111	36,775	62,481	147,287	9,200	1,813	322,892
	1939	284,960	1.246	355,076	41,524	7,374	38,646	45,513	115,078	12,388	1,699	262,222
At Thermopolis	1938	928,530	.556	516,105	78,562	19,983	50,260	107,175	177,442	15,590	3,741	452,708
	1939	723,980	.680	492,323	63,913	12,523	54,143	88,315	152,743	16,411	2,809	390,357
Thermopolis to Kane	1938	567,220	1.145	649,640	75,662	23,516	65,651	65,380	316,626	10,443	5,305	562,583
	1939	401,140	1.030	413,180	67,376	18,527	82,647	59,622	255,622	4,210	2,118	490,232
At Kane	1938	1,495,750	.779	1,165,745	154,224	43,454	115,911	172,555	494,068	26,033	9,046	1,015,291
	1939	1,125,120	.805	905,503	131,289	31,050	136,890	147,987	408,375	20,021	4,927	881,089
Kane to St. Xavier	1938	920,500	1.558	1,434,255	73,429	48,649	114,198	140,659	501,198	13,116	......	901,425
	1939	818,290	1.410	1,154,205	......	......	......	......	......	......	......	......
At St. Xavier	1938	2,416,250	1.080	2,600,000*	215,718	79,699	251,088	288,596	909,573	33,737	4,001	1,782,512
	1939	1,943,410	1.060	2,059,708	......	......	......	......	......	......	......	......

*Estimated last five months from data of other stations.

TABLE 15

The Big Horn River in Wyoming and Montana. Discharge and Salt Burden for Seven Months Ending April 30, 1938.

Item	Water Acre Feet	T. D. S. Tons Ac. Ft.	T. D. S. Tons	Constituents in Tons							
				Ca	Mg	Na	CO_3+HCO_3	SO_4	Cl	NO_3	Sum Tons
At Riverton..........	125,850 (594,200)	.476	50,924	9,177	2,695	5,431	16,074	18,685	1,756	465	54,583
Riverton— Thermopolis..........	119,320	1.190	142,218	18,864	7,371	15,178	21,509	65,499	4,386	808	133,615
At Thermopolis..........	245,370	.821	202,142	28,341	10,066	20,609	37,583	84,184	6,142	1,273	188,198
Thermopolis— Kane..........	204,130	1.393	284,394	35,968	12,585	28,974	36,338	144,999	6,092	2,167	267,123
At Kane..........	449,500	1.082	486,536	64,309	22,651	49,583	73,921	229,183	12,234	3,440	455,321
Kane to St. Xavier..........	231,250	1.469	339,653	31,555	12,966	48,576	42,133	147,978	2,469	2,249	283,428
At St. Xavier..........	680,750	1.214	826,189	95,864	35,617	98,159	116,054	377,161	14,703	1,191	738,749

TABLE 16

The Big Horn River, Wyoming and Montana. Weighted Mean Concentration of the Dissolved Salts for the Several Gaging Stations.

Year Ending September 30, 1938.

	Conductance	Milligram Equivalents						
		Ca	Mg	Na	CO₃+ HCO₂	SO₄	Cl	NO₃
Riverton.............	56.7*	1.83	.64	.80	1.97	.84	.24	.04
Thermopolis.........	88.2*	3.11	1.30	1.73	2.78	2.93	.35	.05
Kane.................	106.1*	3.79	1.76	2.48	2.78	5.06	.36	.07

Seven Months Ending April 30, 1938.

Riverton.............	56.7	2.77	1.30	1.38	3.08	2.27	.29	.04
Thermopolis.........	88.2	4.25	2.48	2.69	3.69	5.26	.52	.06
Kane.................	106.1	5.26	3.05	3.53	3 96	7.81	.56	.09
St. Xavier...........	117.4	5.18	3.17	4.61	4.11	8.49	.45	.02

Year Ending September 30, 1939.

Riverton.............	36.30	1.88	.71	1.13	2.35	1.17	.19	.03
Thermopolis.........	67.45	3.22	1.05	2.39	2.94	3.23	.47	.046
Kane.................	94.71	4.29	1.67	3.89	3.17	5.56	.38	.052
St. Xavier†..........	102.69	4.09	2.49	4.13	3.58	7.15	.36	.025

*Based on incomplete data for the year.
†Data averaged 7 months 1938 plus 5 months 1939.

TABLE 17

The Big Horn River, Wyoming and Montana.   Percentage Composition of the Dissolved Salts for the Several Gaging Stations.

Year Ending September 30, 1938.

	Per Cent of Cations			Per Cent of Anions			Ratio Total Ions to T. D. S.
	Ca	Mg	Na	CO_3+ HCO_3	SO_4	$Cl+$ NO_3	
Riverton..........	56.0	19.6	24.4	63.8	27.2	9.0	79.8
Thermopolis......	50.6	21.2	28.2	45.5	48.0	6.5	87.7
Kane..............	47.2	21.9	30.9	33.6	61.2	5.2	87.1

Seven Months Ending April 30, 1938.

	Ca	Mg	Na	CO_3+ HCO_3	SO_4	$Cl+$ NO_3	Ratio
Riverton...........	50.8	23.9	25.3	54.2	40.0	5.8	91.1
Thermopolis.......	45.1	26.3	28.6	38.7	55.2	6.1	93.1
Kane..............	44.4	25.8	29.8	31.9	62.9	5.2	93.6
St. Xavier.........	40.0	24.4	35.6	31.4	65.0	3.6	89.4

TABLE 18
The Big Horn River, Wyoming and Montana. Percentage Composition of the Dissolved Salts for the Several Gaging Stations.
2 Years Ending September 30, 1939.

	Per Cent of Cations						Per Cent of Anions						Ratio Total Ions to T. D. S.	
	Ca		Mg		Na		HCO_3+CO_3		SO_4		Cl and NO_3			
	1939	1938	1939	1938	1939	1933	1939	1938	1939	1933	1939	1938	1939	1938
Riverton	50.5	56.0	19.2	19.6	30.3	21.4	62.8	63.8	31.2	27.2	6.0	9.0	93.8	79.8
Thermopolis	48.3	50.6	15.9	21.2	35.8	28.2	44.0	45.5	48.3	48.0	7.7	6.5	79.8	87.7
Kane	43.5	47.2	17.1	21.9	39.4	30.9	34.6	33.6	60.7	61.2	4.7	5.2	97.3	87.1
St. Xavier	38.1	42.0	23.5	21.4	38.4	36.6	32.2	32.0	64.3	64.0	3.5	3.7	86.5	85.4