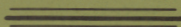


OFFICIAL

THIRTEENTH ANNUAL REPORT

Republican River
Compact
Administration

FOR THE YEAR 1972



DENVER, COLORADO

June 18, 1973

THIRTEENTH ANNUAL REPORT

REPUBLICAN RIVER
COMPACT
ADMINISTRATION

For the Year 1972

Denver, Colorado

June 18, 1973

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Thirteenth Annual Report

REPUBLICAN RIVER COMPACT ADMINISTRATION

In conformity with the Rules and Regulations of the Republican River Compact Administration, the Thirteenth Annual Report is submitted as follows:

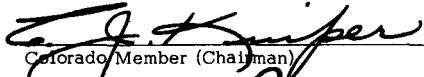
1. Pursuant to Rule 12, as amended, this report covers the period from June 9, 1972 to June 18, 1973.
2. Members of the Republican River Compact Administration are the officials of each of the States who are charged with the duty of administering the public water supplies, as follows:

Dan S. Jones, Jr., Director, Department of Water Resources, Nebraska
C. J. Kuiper, State Engineer of Colorado
Guy E. Gibson, Chief Engineer, Division of Water Resources, State Board of Agriculture, Kansas
3. The Fourteenth Annual Meeting of the Administration was held on June 18, 1973 in Conference Room 331, Cosmopolitan Hotel, Denver, Colorado. Minutes of the meeting are included in this report.
4. During the period covered by this report, one meeting of the Engineering Committee was held. A report from that Committee together with summary tabulations of the computed annual virgin water supply and consumptive use for the 1972 water year in the Republican River Basin were presented to and accepted by the Administration at the Fourteenth Annual Meeting. Copies of these presentations are included elsewhere in this report.
5. One June 18, 1973, Mr. C. J. Kuiper, Colorado member of the Administration, was elected Chairman to serve until the next annual meeting of the Administration.

Respectfully submitted,

REPUBLICAN RIVER COMPACT ADMINISTRATION

By:



C. J. Kemper

Colorado Member (Chairman)



Dan S. Jones, Jr.

Nebraska Member



Roy E. Linton

Kansas Member

Minutes of the
Fourteenth Annual Meeting

Republican River Compact Administration

Denver, Colorado - June 18, 1973

The meeting was called to order by C. J. Kuiper, Chairman, at 9:30 a.m., in the Conference Room 331, Cosmopolitan Hotel, Denver, Colorado.

The following were in attendance:

<u>Name</u>	<u>Agency</u>	<u>Location</u>
C. J. Kuiper	Official Member	Denver, Colorado
Guy E. Gibson	Official Member	Topeka, Kansas
Dan S. Jones, Jr.	Official Member	Lincoln, Nebraska
M. E. Ball	Chairman, Engr. Committee	Lincoln, Nebraska
Gerald E. Hilmes	Div. of Water Resources	Topeka, Kansas
Glen E. Brees	Div. of Water Resources	Denver, Colorado
Ray E. Aldrich	U.S. Bureau of Reclamation	McCook, Nebraska

Approval of the Minutes of the previous meeting:

Motion was made by Mr. Gibson and seconded by Mr. Jones that the minutes of the Thirteenth Annual Meeting, as published in the Twelfth Annual Report, be approved as published. The motion was passed unanimously.

Report of the Chairman:

The Chairman stated that studies on the withdrawal of underground water out of the tributary portions of the streams involved in the Compact had been completed and that they had been incorporated into the Engineering Report this year.

Report of Official Members:

Mr. Jones stated that all reservoirs in Nebraska had filled this year with the exception of Enders Reservoir on Frenchman Creek. This is the third year that it has not filled.

Mr. Gibson stated that copies of the Twelfth Annual Report had been sent to interested agencies. Norton Reservoir on Prairie Dog Creek has been low for a number of years and the District has installed a number of wells to supplement the supply. Mr. Gibson reported that Gerald E. Hilmes would be the Kansas member of the Engineering Committee replacing Harris Mackey who had been promoted in the Kansas Division of Water Resources.

Mr. Gibson raised the question of the responsibility of the Chairman to distribute the annual reports to the President of the United States and Federal Agencies. After discussion, it was decided that this was the responsibility of the Chairman as outlined in the Ninth and Tenth Annual Reports. Mr. Gibson made the motion that the Director of Water Resources Council and the Chairman of the Missouri River Basin Commission be added to the list. Mr. Jones seconded the motion, and it was passed unanimously.

Unfinished Business:

There was no business carried over from the previous meeting that had not been concluded.

New Business:

A. Report of Engineering Committee:

Mr. M. E. Ball, Engineering Committee Chairman, presented a report of the Engineering Committee. A copy of that report is attached hereto as Exhibit "A". Accompanying the report are tabulations of the Computed Virgin Water Supply, and the Computed Annual Consumptive Use for the 1972 Water Year, respectively. A summary of the computations was presented by Mr. G. E. Hilmes. A motion was made by Mr. Jones that the report of the Engineering Committee be accepted. The motion was seconded by Mr. Gibson and carried unanimously.

A motion was made by Mr. Gibson and seconded by Mr. Jones that the Engineering Committee be authorized to continue their study and assignments the same as during the past year. The motion carried unanimously. The motion was later amended to delete item No. 6 concerning the water budget study.

B. Assignments to the Engineering Committee for the coming year:

1. Compute annual virgin water supply, 1973 water year;
2. Compute annual consumptive use, 1973 water year;
3. Compute inflow to Lovewell Reservoir and net evaporation of Republican River water stored in Lovewell, 1973 water year;

4. Compute adjusted allocations on annual, five-year average and ten-year average basis;
5. Continue investigations of depletions by wells in the alluvium.

C. Reports of Other Agencies:

Mr. Ball presented, for Mr. K. A. MacKichan, District Chief, WRD, U.S. Geological Survey, Lincoln, Nebraska, a review of the computations of the Republican River return-flow study of the Engineering Committee Report dated June, 1972 that was included in the Twelfth Annual Report. Mr. MacKichan's review is included in the record and is marked Exhibit "B". Members of the Compact Administration agreed that further study would not help to reach any definite conclusions and that the U.S. Geological Survey not be asked to continue the study.

Mr. Ray E. Aldrich of the U.S. Bureau of Reclamation Office in McCook, Nebraska gave a report of the plans to remote control seven reservoirs in the Republican River Basin. The remote control center location will be in the Bureau of Reclamation Office in McCook, Nebraska.

Resolution:

Mr. Gibson read a resolution commending Mr. Harris L. Mackey for his contribution to the Republican River Compact Engineering Committee. A motion was made by Mr. Gibson that the resolution be sent to Mr. Mackey and a copy be made a part of the record. Mr. Jones seconded the motion, and it carried unanimously. A copy of the resolution is attached.

Election of Chairman:

A motion was made by Mr. Gibson that the name of C. J. Kuiper, Official Member from Colorado, be placed in nomination for Chairman for the coming year. The motion was seconded by Mr. Jones and carried unanimously.

Adjournment:

On motion of Mr. Jones and seconded by Mr. Gibson, the Fourteenth Annual Meeting of the Republican River Compact Administration was adjourned at 11:45 a.m., June 18, 1973.

RESOLUTION

WHEREAS, Harris L. Mackey, Senior Engineer, Division of Water Resources, Kansas State Board of Agriculture, has been a member for Kansas on the Republican River Compact Administration Engineering Committee since November 19, 1959; and

WHEREAS, Mr. Mackey has voluntarily elected to relinquish his duties as Secretary of the Engineering Committee of the Republican River Compact Administration; and

WHEREAS, Mr. Mackey, through the years, has contributed his knowledge, professional skills and services to the fulfillment of the purposes of the Republican River Compact Engineering Committee;

NOW, THEREFORE, BE IT RESOLVED, that the Republican River Compact Administration does hereby acknowledge the outstanding contribution of Harris L. Mackey to the Republican River Compact Engineering Committee and expresses sincere appreciation and commendation for his services.

BE IT FURTHER RESOLVED, that this resolution be entered into the records of this Administration and the Chairman be instructed to send a copy to Mr. Mackey.

Adopted at the Fourteenth Annual Meeting of the Republican River Compact Administration at Denver, Colorado, on the 18th day of June, 1973.

Report of Engineering Committee
Republican River Compact Administration

June 18, 1973

The Republican River Compact Administration at its 13th Annual Meeting held June 9, 1972, agreed the assignments to the Engineering Committee would be as follows:

1. Compute annual virgin water supply, 1972 water year;
2. Compute annual consumptive use, 1972 water year;
3. Compute inflow to Lovewell Reservoir and net evaporation of Republican River water stored in Lovewell, 1972 water year;
4. Compute adjusted allocations on annual, five-year average and ten-year average basis;
5. Continue investigations of depletions by wells in the alluvium;
6. Make a water-budget study, in cooperation with the U.S. Geological Survey, of the Trenton-Palisade to Cambridge reach of the Republican River.

The Engineering Committee held one meeting during the year, May 10 through 11, 1973, to study the virgin water supply and consumptive use of the water supply 1972. Submitted here and made a part of this report are the following:

1. Computed annual virgin water supply Republican River Basin 1972; and,
2. Computed annual consumptive use Republican River Basin, 1972.

The detailed computations of the virgin water supply and consumptive use, the adjusted allocations on an annual basis for 1972, and a five-year and ten-year average basis are available for inspection here at this meeting.

Tables are also available for inspection identified as attachments 10A through 10E showing the following. These tables have been made available previously to the Compact Administrators.

- 10A. 1959-1972, Computed Annual Virgin Water Supply;
- 10B. 1959-1972, Allocations Adjusted on Basis of Annual Virgin Water Supply;
- 10C. 1959-1972, Average Annual Virgin Water Supply for Five-Year and Ten-Year Running Averages;
- 10D. 1959-1972, Adjusted Allocations by Five-Year and Ten-Year Running Averages;
- 10E. 1959-1972, Computed Annual Consumptive Use by Years.

These attachments are not made a part of the engineering report.

Municipal and industrial uses are not included in the virgin water supply formulas, but, for the record, those available to the Committee are given below:

	<u>1972 Calendar Year</u>
City of Norton	600 Ac.-Ft.
Midwest Oil Company	429 Ac.-Ft.
L. V. O. Oil Company	11 Ac.-Ft.

Recorded division of diversions from the North Fork Republican River by the Haigler canal for 1972 was:

Colorado	3,620 Ac.-Ft.
Nebraska	<u>9,740 Ac.-Ft.</u>
Total	12,360 Ac.-Ft.

Other recorded diversions from surface water in Colorado with the exception of the Hale Ditch were:

S. Fork Republican River	1,280 Ac.-Ft.
N. Fork Republican River	5,040 Ac.-Ft.
Arikaree River	0 Ac.-Ft.
Beaver Creek	0 Ac.-Ft.

Colorado's diversions from groundwater, based on information and data

compiled by the U.S. Geological Survey, were estimated by applying an average diversion of 169 Ac.-Ft. per well to the number of wells in the alluvium and are shown below:

<u>Sub-Basin</u>	<u>Acre-Feet</u>
S. Fork Republican River	1,010
N. Fork Republican River	510
Arikaree River	3,720
Beaver Creek	0

Nebraska recorded diversions from surface water by other than major canals were:

Frenchman Creek	1,780 Ac.-Ft.
Medicine Creek	1,140 Ac.-Ft.
Red Willow Creek	330 Ac.-Ft.

In other basins in Nebraska surface water diversions were computed as 1.35 ac.-ft. per acre intended to be irrigated. Groundwater diversion rate used for 1972 was 1.4 ac.-ft. per acre irrigated as determined from reports of irrigators for 12% of wells pumping from the valley alluvium.

Diversions by individual irrigators from alluvial wells or streams in Kansas were estimated on the basis of water use reports from 37% of the water users. Average of all reported diversions in the Republican River Basin in Kansas was 1.7 ac.-ft./ac. Average rate of diversion from alluvium was 1.8 ac.-ft./ac. and from surface water was 1.35 ac.-ft./ac.

Estimated diversions by individuals in Kansas for 1972 are given below in acre-feet:

<u>Sub-basin</u>	<u>Groundwater</u>	<u>Surface Water</u>
Arikaree River	260	0
S. Fork Republican River	8,520	210
Beaver Creek	7,790	520
Sappa Creek	8,650	280
Prairie Dog Creek	12,750	1,870
Republican River above Hardy	90	910

Return flow percentages were computed for the major canals from data provided by the U.S. Bureau of Reclamation as follows:

<u>Canal</u>	<u>Return as % of Total Diversions</u>	<u>Canal</u>	<u>Return as % of Total Diversions</u>
Culbertson	43%	Franklin	56%
Culbertson Ext.	50%	Franklin Pump	42%
Meeker-Driftwood	46%	Naponee	43%
Red Willow	44%	Superior	53%
Cambridge	43%	Courtland-Nebr.	26%
Bartley	36%	Courtland-Kansas	
Almena	52%	above Lovewell	47%
		below Lovewell	48%

Return flow percentages for other canals and diversions were estimated as given below:

Hale Ditch and Haigler Canal	38%
Champion and Riverside Canals	43%
Groundwater and surface water diversions	25%

Computation of the return flow from the Courtland Canal in Nebraska is shown to be 6,720 acre-feet.

In Kansas 67% of the irrigable land above Lovewell was irrigated in 1972 with an average diversion rate of 1.83 ac.-ft./ac. Based on this data it was established that 1,390 ac.-ft. were diverted on 762 acres above Hardy and the return flows were 650 ac.-ft.

Net evaporation from Harlan County Reservoir was divided (51%) 5,800 acre-feet to Kansas and (49%) 5,580 acre-feet to Nebraska based on total diversions by the canals in each state below Harlan County Reservoir.

Computations of inflow to Lovewell Reservoir gave a 1972 total inflow of 40,420 acre-feet of which 29,940 acre-feet was diverted from the Republican River. Computed operations of Lovewell Reservoir for 1972 gave a net evaporation loss of 510 acre-feet from Republican River water. Storage in Lovewell at the beginning of the water year was 30,970 acre-feet of which

9,620 acre-feet was water from the Republican River. At the close of the water year, storage in Lovewell was 38,980 acre-feet of which 6,700 acre-feet was water from the Republican River.

Computation of consumptive use in Kansas of water diverted from the main stem Republican River, including prorated shares of net evaporation from Harlan County Reservoir and Courtland Canal transportation loss through Nebraska was 36,170 acre-feet in 1971-72 water year.

Consumptive use to mouths of tributaries in Nebraska are shown below:

Consumptive Use in Nebraska - 1972

	By Formula <u>Ac.-Ft.</u>	Above Mouth <u>Ac.-Ft.</u>
Prairie Dog Creek	0	460
Beaver Creek	9,120	11,480
Sappa Creek	7,780	8,200
Medicine Creek	9,310	9,840
S. Fork Republican River	0	180
Buffalo Creek	680	870

The Twelfth Annual Report of the Administration does show that the Chairman of the Engineering Committee produced a tabulation entitled "Republican River Return Flow Study for the Years 1954-1971," and recommended to the Administration that the U.S. Geological Survey be requested to review this tabulation and to comment whether or not the study should be continued in the river reach from Trenton to Cambridge. The Administration accepted the recommendation and Mr. Butler Shaffer of the U.S. Geological Survey stated that they would be glad to make this study.

A report of the study by the U.S. Geological Survey was submitted to the Engineering Committee and this report will be discussed later. This report is not submitted as a part of the engineering report.

Respectfully submitted,

Nebraska

Paul E. Miller

Kansas

Glen E. Brown

Colorado

Computed Annual Virgin Water Supply
 Republican River Basin

<u>Drainage Basin</u>	<u>Compact Ac.-Ft.</u>	<u>1972 Water Year Ac.-Ft.</u>
Prairie Dog Creek	27,600	20,620
Sappa Creek	21,400	21,090
Beaver Creek	16,500	17,170
Medicine Creek	50,800	44,470
Red Willow Creek	21,900	26,740
Driftwood Creek	7,300	6,010
Frenchman Creek	98,500	122,780
South Fork of the Republican River	57,200	41,800
Rock Creek	11,000	9,930
Buffalo Creek	7,890	4,940
Arikaree River	19,610	18,740
North Fork of the Republican River	44,700	44,510
Main Stem of the Republican plus Blackwood Creek	*94,500	139,500
TOTALS	478,900	518,300
*Main Stem Blackwood Creek	87,700 6,800	

Computed Annual Consumptive Use
Republican River Basin

1972 Water Year

<u>Drainage Basin</u>	<u>Colorado</u>	<u>Kansas</u>	<u>Nebraska</u>	<u>Total</u>
Prairie Dog Creek	-	12,830	460	13,290
Sappa Creek	-	6,700	8,200	14,900
Beaver Creek	0	6,230	11,480	17,710
Medicine Creek	-	-	9,840	9,840
Red Willow	-	-	10,970	10,970
Driftwood	-	0	820	820
Frenchman Creek	-	-	53,940	53,940
South Fork of the Republican River	6,490	6,550	180	13,220
Rock Creek	-	-	220	220
Buffalo Creek	-	-	870	870
Arikaree River	2,790	200	0	2,990
North Fork of the Republican River	6,400	-	5,420	11,820
Main Stem of the Republican River	<u>-</u>	<u>36,170</u>	<u>155,390</u>	<u>191,560</u>
TOTALS	15,680	68,680	257,790	342,150



United States Department of the Interior

GEOLOGICAL SURVEY
Water Resources Division
Room 127, Nebraska Hall
901 North 17th Street
Lincoln, Nebraska 68508
February 16, 1973

Mr. Marion Ball
Assistant Director
Department of Water Resources
P.O. Box 94697
Lincoln, Nebraska 68509

Dear Marion:

Mr. Shaffer and I have reviewed the computations of the Republican River return-flow study in accordance with Recommendation No. 2 of the Engineering Committee report dated June 1972.

The Engineering Committee made the following assumptions:

1. The unit runoff from the unengaged area equals that from the engaged, unregulated area.
2. The well water is equivalent to imported water. Computations are without wells operating (lines 26, 29, and 33).
3. As an alternative, the well water is assumed to be part of the basin supply. Computations are with wells operating (lines 27, 28, and 31).

The computations are correct using the above assumptions. However, if the order of the lines was rearranged and some lines more accurately described, the computations would be easier to follow. For example, line 27 should be made line 24, since line 27 as shown is the sum of lines 19 through 23.

The first assumption is not very critical because only about 10 percent of the inflow is unengaged. The percent error in the total inflow would be only one-tenth of that of the estimated unengaged flow.

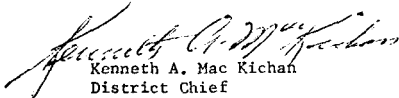
If assumption number two is used the water applied and the computed flow at Cambridge will be greater than if assumption number three is used by the amount of ground-water pumpage and the return flow will be less by the same amount. The water used is the same for either assumption.

We have plotted two double mass diagrams beginning with 1954 data. One diagram is accumulative return flow (including ground-water pumpage) vs. accumulated total water applied. The other is accumulative return flow vs. accumulative surface water applied. The diagrams show that there is not a pronounced trend in the return flow as a percentage of water applied since about 1957 when surface-water irrigation was started with stored surface water from Swanson Lake. Return flow without wells averaged 26 percent of water applied and with wells 37 percent. The other graph shows that the ground-water pumpage is small compared to inflows and outflows for this reach of the river.

These computations do not show the effect of ground-water pumpage on stream-flow. Furthermore, there is no way to recalculate the data available to show the effect. Additional information is needed to show the effect of ground-water pumpage on the stored ground water. This would require comparing ground-water conditions pre-irrigation and post-irrigation.

We will examine ground-water records to see if any conclusions can be drawn from them.

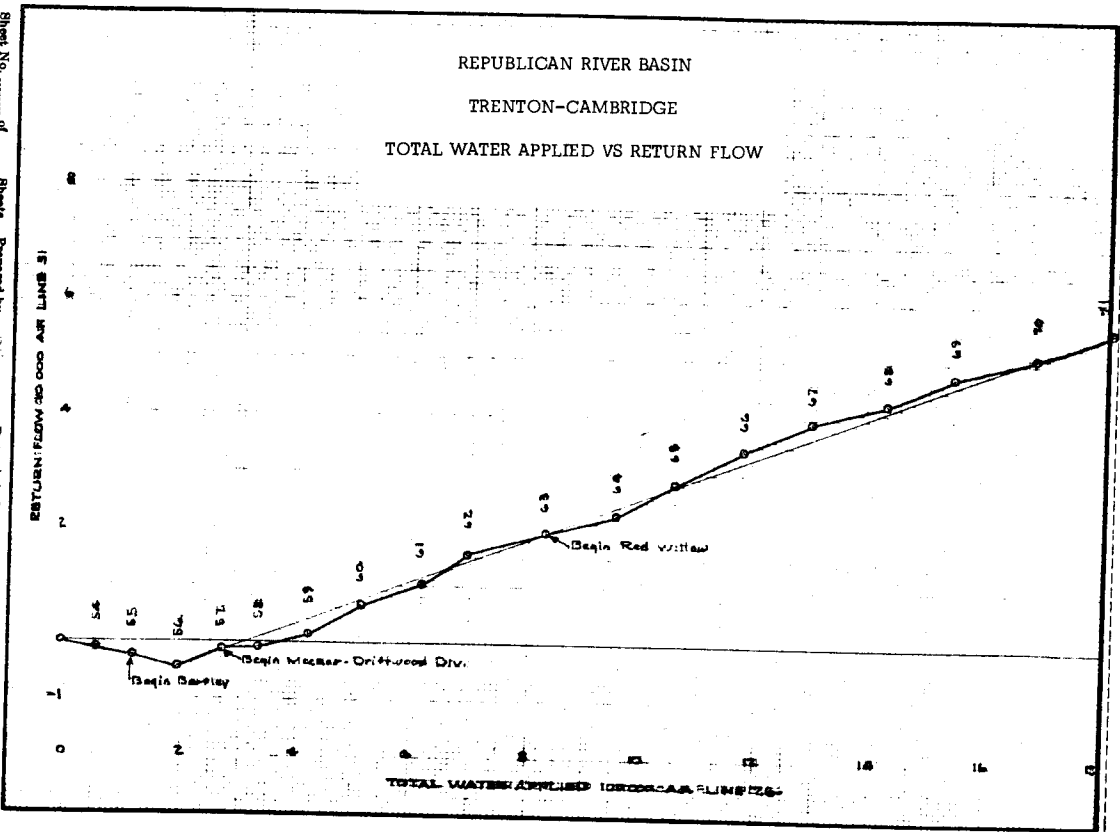
Sincerely yours,



Kenneth A. Mac Kichan
District Chief

Encls.

REPUBLICAN RIVER BASIN
 TRENTON-CAMBRIDGE
 TOTAL WATER APPLIED VS RETURN FLOW

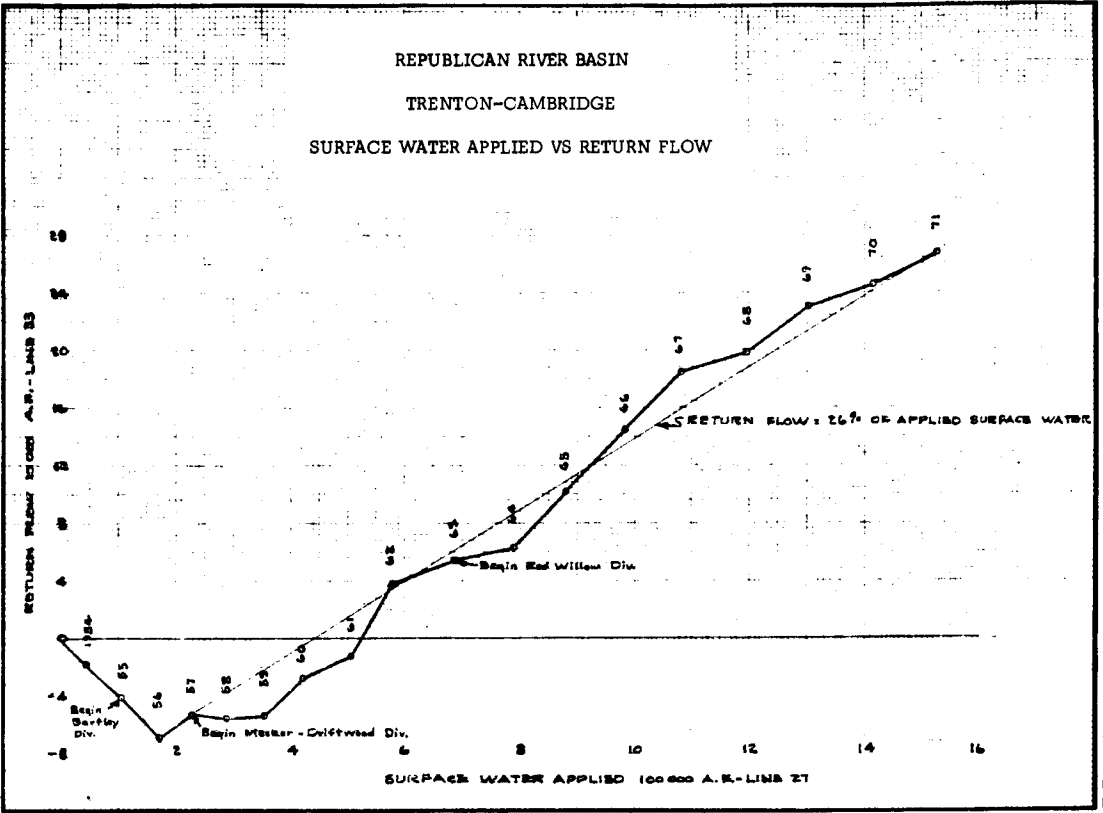


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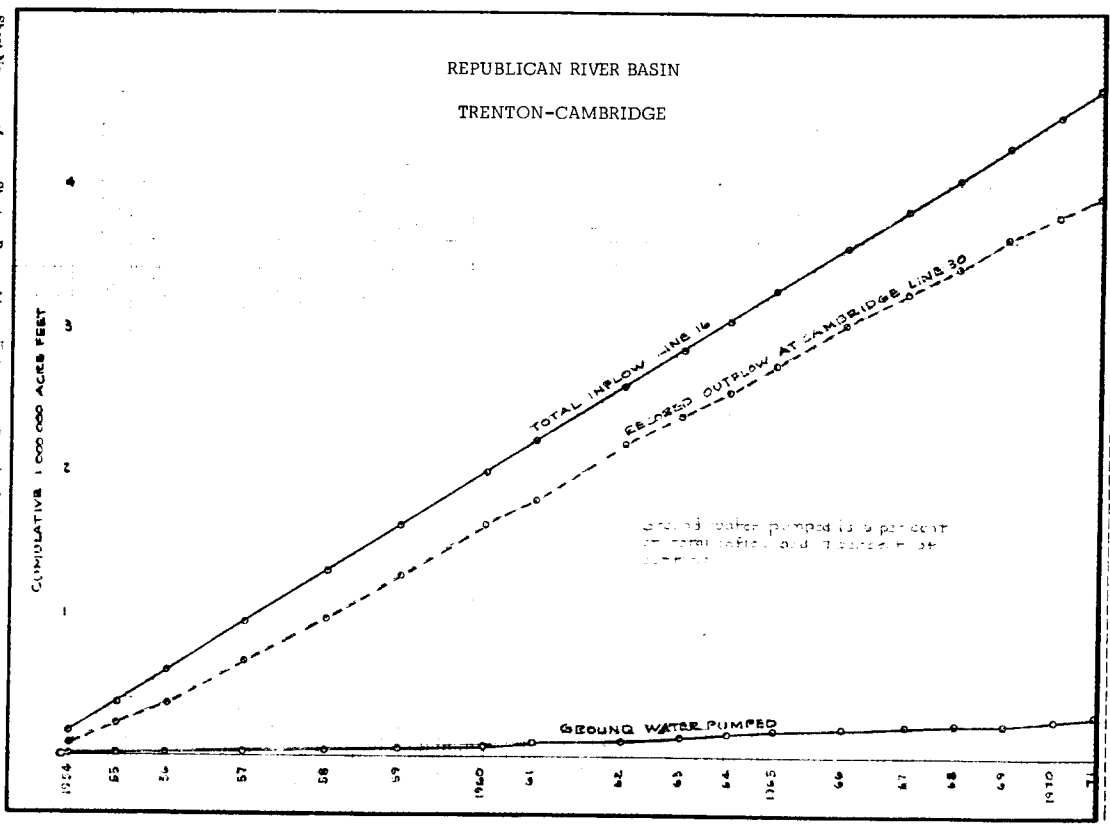
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REPUBLICAN RIVER BASIN
TRENTON-CAMBRIDGE
SURFACE WATER APPLIED VS RETURN FLOW



Sheet No. 4 of 4 Sheets Prepared by E. J. ... Date 7-6-73 Checked by ... Disk GPO 888-738



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