SEVENTH ANNUAL REPORT

Republican River Compact Administration

For the Year 1966

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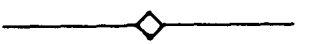

Seventh Annual Report

REPUBLICAN RIVER COMPACT ADMINISTRATION

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

1. Pursuant to Rule 12, as amended, this report covers the period from April 7, 1966, to June 19, 1967.

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:

   A. Ralph Owens, State Engineer of Colorado
   Dan S. Jones, Jr., Director, Department of Water Resources, Nebraska
   R. V. Smrha, Chief Engineer, Division of Water Resources, State Board of Agriculture, Kansas

3. The Eighth Annual Meeting of the Administration was held on June 19, 1967, in Room 223 of the State Services Building in Denver, Colorado. Minutes of that 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 a summary tabulation of the computation of virgin water supply for the 1966 water year and a summary tabulation of consumptive use for the 1966 water year were presented to and accepted by the Administration at the Eighth Annual Meeting. Copies of these presentations are included elsewhere in this report.

5. On June 19, 1967, Mr. A. R. Owens, Colorado Member, was unanimously elected Chairman to serve until the next annual meeting of the Administration.

Respectfully submitted,

REPUBLICAN RIVER COMPACT ADMINISTRATION

By:

R. V. Smrha — Kansas Member

Dan S. Jones, Jr. — Nebraska Member

A. Ralph Owens — Colorado Member (Chairman)

Minutes of the
Eighth Annual Meeting
Republican River Compact Administration

Denver, Colorado - - June 19, 1967

The meeting was called to order by the Chairman, A. Ralph Owens, at 10:00 A. M., in Room 223 of the State Services Building in Denver, Colorado.

In attendance at the meeting were:

Name	Agency	Location
A. Ralph Owens	Official Member	Denver, Colorado
Dan S. Jones	Official Member	Lincoln, Nebraska
Harris L. Mackey	Representative	Topeka, Kansas
M. E. Ball	Nebr. Water Resources	Lincoln, Nebraska
F. Butler Shaffer	U. S. G. S.	Lincoln, Nebraska
K. A. MacKichan	U. S. G. S.	Lincoln, Nebraska
L. E. Carron	U. S. G. S.	Denver, Colorado
Ken Kauffman	U. S. B. R.	McCook, Nebraska
Harlan W. Erker	Colo. Water Resources	Denver, Colorado
F. Duffy Murry	U. S. B. R.	McCook, Nebraska
James M. Ingles	U. S. B. R.	McCook, Nebraska
Ray E. Aldrich	U. S. B. R.	McCook, Nebraska
William R. Smith	Colo. Water Resources	Denver, Colorado
Glen E. Brees	Colo. Water Resources	Denver, Colorado

Mr. Owens, Chairman, advised that a letter had been received from Mr. R. V. Smrha appointing Mr. Harris L. Mackey as his personal representative at the meeting. It was moved and recorded that the letter be accepted, and Mr. Mackey was seated as the Representative from Kansas. A copy of Mr. Smrha's letter is attached as Exhibit "A."

The Chairman stated that this meeting constitutes the regular Annual Meeting of the Administration in accordance with the Rules and Regulations.

1. Approval of Minutes of the Seventh Annual Meeting

Mr. Jones noted that the minutes of the Seventh Annual

Meeting (held April 7, 1966) have been previously approved by each member through correspondence and moved they be formally approved at this meeting. Mr. Owens recorded the motion, and it was unanimously approved. Mr. Glen Brees, Chief Hydrographer for Colorado, was appointed Secretary.

2. Report of the Chairman

No official action was taken during the year, other than the calling of the Annual Meeting.

There appears to be a variance in the acreage under the Haigler Canal which serves the Pioneer Irrigation District. It is reported that there are approximately 1,000 acres in Colorado and 2,000 in Nebraska. Mr. Owens stated that he felt there was more than 1,000 acres in the District in Colorado, and, in fact, he felt that there were some other small ditches on the North Fork of the Republican that were not mentioned. He noted that the report showed 2040 acre feet used on 1,080 acres in Colorado and 3,390 acre feet on 2,020 acres in Nebraska. Mr. Owens indicated that he would like to look into the matter and recommended a land cruise on both the North Fork and the South Fork.

3. Reports of the Official Members or Representatives

Neither of the representatives of Kansas or Nebraska had any comments at the time. Each expressed the desire to comment on the Engineering Report after its presentation.

4. Unfinished Business

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

5. New Business

A. Report of the Engineering Committee: Mr. M. E. Ball, Chairman, presented a Report of the Engineering Committee. A Copy of that report is attached hereto as Exhibit "B." Accompanying the Report are Exhibits "C" and "D" (tabulations of the Computed Annual Virgin Water Supply and the Computed Annual Consumptive Use for the 1966 Water Year, respectively).

Mr. Ball brought up the problem of submergence of the Parshall Flume on the Haigler Canal. Although, he commented, there is no reason to question the acreage reported, records from the measurements through the flume are questionable. Mr. Brees commented that he understood the flume was reset in 1966; however, there still seemed to be some problem of submergence.

Mr. Brees commented that the figure of 3,100 used in 1965 included acres in Colorado and Nebraska when the division of 3/8 and 5/8 was made. He further noted that a new station had been set near the state line during 1966. Mr. Brees further recommended that two representatives from Nebraska and Colorado check the measuring flumes if a time can be set when there is water in them. In response to a discussion pertaining to irrigation under the Haigler Ditches, Mr. Ball pointed out that in addition to seepage losses there was quite a bit of irrigation under wells in Colorado drilled the last few years.

He further commented that perhaps corrections could be made every five years to account for errors which became apparent after original reports had been accepted. Mr. Ball further cautioned that reassessments for pumps and other factors might result in some erroneous figures if wrong assumptions on well use were made.

Mr. Ball asked for a report from the Operations Group of the Bureau of Reclamation as to allocations of losses from the Courtland System, and the following report and comments were presented:

MR. ALDRICH: U.S.B.R. In regard to the division of water losses in the Bostwick area, we use instructions which we received from our Regional Office on the division of the Courtland Canal between Nebraska, Kansas, and the Bureau of Reclamation, and this was used on the monthly distribution reports which were primarily for statistical records. We divide the losses according to the water used by three groups. One is the Lovewell Reservoir. Another user is the Kansas-Bostwick Irrigation District. The third is the Bostwick Irrigation District in Nebraska. We divide the measurement of the Courtland Canal uses and losses above Lovewell Reservoir into three areas. One is the mile 0.7 below the Superior Courtland Diversion Dam; the next is at mile 15.1 on the State Line; and the third is at mile 34.8 at the inflow from Courtland Canal to Lovewell Reservoir. Flows as recorded at 0.7 include the Nebraska use which would include diversions to laterals, farm turnouts, and any waste from the main canal and the flows passing the State Line. From these, we determine the losses in Nebraska. Then we divide these losses proportionately according to the uses of the Bostwick in Nebraska, Kansas Bostwick, and Lovewell Reservoir. We use the amount passing the State Line as the total use by the

Lovewell operations and the Kansas-Bostwick. The next segment we take is State Line to Lovewell Reservoir. We deplete the State Line record by the Kansas-Bostwick use, which is the lateral diversions, farm turnout diversions, pump diversions, and wastes from the main canal. The Lovewell use which is the portion measured at inflow station, mile 34.8, is also subtracted from the State Line record to compute losses. Then we divide the Kansas losses between Lovewell Reservoir and the Kansas-Bostwick. Does that explain?

MR. BALL: You have another factor - The Secretary of Interior assumes part of the losses?

MR. ALDRICH: That's the Lovewell operation - the portion we call Bureau of Reclamation Losses. But that's what it is from, Lovewell operations. In our Water Study Operation Report, we still credit this as Kansas use.

MR. MACKEY: What's the advantage of this? Are the districts paying any less money on this basis?

MR. ALDRICH: No.

MR. MACKEY: It is just strictly a bookkeeping thing?

MR. ALDRICH: Yes. That's what it amounts to now. Earlier it was a contract administration problem, and when the legal aspects came into being, our Solicitor told us we were not in any position under our repayment contract to charge the Kansas-Bostwick Irrigation District for the Lovewell Reservoir operation's share of the losses from Superior-Courtland diversion dam to Lovewell Reservoir.

In view of this ruling (from a statistical standpoint in our statistic records) irrigation from this district is strictly on a prorated basis now, and we maintain our distribution records on this basis. Since the Irrigation District assumed responsibility for O&M Kansas-Bostwick in 1957, they have amended their contract so that we furnish them a normal full supply with no water savings clause; or, in other words, they do not pay on a per-acre-foot basis. They distribute their water to the users on a water savings basis where the farmer pays so much for a basic allowance and then at a higher rate for additional water to encourage conservation of water. The district contract with the Government no longer has this water saving requirement.

MR. BALL: Would you comment further about canal losses, or canal waste I should say, that are direct to the river.

MR. ALDRICH: We've made studies and have tried to come up with figures that we can use. We have found that any waste on a daily basis of a real short duration of less than 10 days usually doesn't get back to the stream as live water. Any flow continuing over a 10-day period, we figure a portion does reach the river as surface flow. We have gone into this on a day-to-day basis rather than on a monthly basis.

MR. BALL: The figures you furnish us in the report you give us are from the canal - it is not the water reaching the river.

MR. ALDRICH: No. It leaves the canal in that amount.

MR. BALL: The reason I bring it up is that in the year 1965 you filled the Franklin North Side Canal, and they went through rainy periods and wasted during that period of time, so that under those conditions we should consider waste, shouldn't we?

MR. ALDRICH: Yes. There are canal systems there that, almost in their entirety, should be considered, I would think.

MR. BALL: Would it be possible for the Bureau of Reclamation to indicate on their Report that part that they consider returns to the river, so that we could take that into account in making our canal losses?

MR. ALDRICH: I think I can come up with a figure for you on that that would be very realistic.

MR. BALL: Would you care to comment on the matter of the use of water by the oil concerns and return flow study in the Meeker Project?

MR. ALDRICH: None that I know of. Do you know of any, Kenny?

MR. KAUFFMAN: They have taken some water under contract, the oil companies - a small amount.

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Mr. Mackey then presented for the Engineering Committee in some detail the methods used in determining virgin water supply. The report is attached as Exhibit "B."

Mr. Mackey moved that the tabulation be included with the Engineer's Report. The motion, seconded by Mr. Jones, was unanimously approved.

After consideration of the matters previously discussed, the members of the Administration requested that the Engineering Committee continue its cooperation with the U. S. Geological Survey as set forth in Summary 4 of Exhibit "E" of the Committee Report.

B. Report of the U. S. Bureau of Reclamation

(1) New Study in Bonny Area: Mr. Kauffman advised that during the past year the Bureau had experienced some renewed interest in the old St. Francis Unit associated with the Bonny Reservoir. This area of interest is located primarily in the old Armel Pumping Area and an additional area adjacent to it northeast. This area is near the Colorado-Nebraska State Line. The Bureau feels that the interest is stemming from ground water development in the general area, accompanied by the fact that residents have attempted to get wells but were unsuccessful.

Plans are currently under way to make a new feasibility study of the area starting about 1968 or 1969. It is felt that an acceptable development could be made for about a 7,000-acre project consisting of almost all Class 1 lands. No detail study of water supply has been made as yet.

Mr. Owens pointed out that the area lies in Colorado on the north side of the South Fork of the Republican and primarily east and north of Bonny Reservoir. Due to the difference in elevation, pump lift from the Reservoir would be needed.

There was further discussion on this Unit relating to extension of area, costs, and other items of concern.

(2) Nelson Buck Project on Beaver Creek: A complete report was submitted previously to each of the members of the Administration. There was considerable discussion in regard to the effect

of wells on the overall system. Consideration was made as to the effect on stream flow and the effect that dam construction would have on downstream wells.

Mr. Dan Jones discussed the possibility of modifying the plan for consideration of some Class 1 lands in Nebraska. He asked about land classification in that regard.

Mr. Kauffman pointed out that perhaps Nebraska could use Beaver Creek allocation. He pointed out that only some 3,000 acres had been set for irrigation under the Herndon Reservoir. This Reservoir site is for flood control and other functions.

Mr. Jones expressed concern over changing allocations.

Mr. Mackey expressed the opinion that any adjustment of allocations should be made for all sources at the same time and that at least 2 more years (records) should be used in making such adjustments.

Mr. Jones and Mr. Owens both agreed that such a plan was the only basis on which changes in allocations should be considered.

Mr. Jones pointed out that the waters of Beaver Creek, Sappa Creek, and Prairie Dog Creek are apportioned between the states by the Compact; however, the details of administration will have to be worked out between Kansas and Nebraska.

There was further discussion of the Nelson Buck Unit relative to reservoir evaporation, return flows and other factors affecting administration of the stream.

It was pointed out by Mr. Kauffman that the system will provide for some regulations at the State Line in constant flows.

(3) Scandia Unit: This study is a feasibility study of the last increment of the Bostwick Division. This area is on the lower Republican, entirely in the State of Kansas.

The Bureau is studying the feasibility of using Republican River water on an upland area around Belleville, Kansas, across the river from the Kansas-Bostwick. They are comtemplating a 16,000-acre development with possible supply to the City of Belleville during peaking seasons. It is anticipated that this will close out the Bostwick development and the development out of Lovewell and Harlan County Reservoirs. It is, however, resulting in somewhat lesser acreage as it is now anticipated that there will be 80,000 acres instead of the original 89,000.

C. Republican River Reconnaissance of June 15-17, 1966:

Mr. Ball introduced Mr. Butler Shaffer, with the U. S. Geological Survey, for a report on the subject reconnaissance. The report is included as Exhibit "E."

Following the presentation of the report, Mr. Ball gave a brief resume of the work that led up to and preceded the work for this actual report. He commented on conditions governing selection of location for return flow studies. Mr. Ball commented that it might be quite costly to make return flow studies and on some of the problems involved.

Mr. MacKichan advised that although the U. S. Geological Survey was vitally interested in these return flow studies, he felt that perhaps they were not funded at the present time.

Informal discussion of return flow study problems followed, including, among other things, effects of well pumping on flows.

Mr. Owens asked Mr. Brees if he felt that Colorado might make some studies on the North and South Forks of the Republican, and Mr. Brees agreed to investigate the possibility this fall.

D. Comments - Federal Agencies: The Members of the Administration expressed their appreciation for the fine cooperation of the Federal Agencies involved during the past year and for the reports presented at this meeting.

6. Engineering Committee Assignments

Mr. Ball asked if the Committee should go back and correct previous records in line with the matters brought up in the previous discussions. Mr. Jones did not think it was justified at this time. Mr. Owens commented that perhaps they should agree to upgrade the information at about the time the 10-year study review is undertaken. The Administration, as a unit, agreed to this comment and assigned the Engineering Committee similar responsibilities to those of 1966, as follows:

(a) Compute annual virgin water supply for 1967.

(b) Compute annual consumptive use for 1967.

(c) Continue studies of method of computing inflow to Lovewell Reservoir.

(d) Continue study of proration of reservoir evaporation losses.

(e) Compute adjusted allocations on annual, 5-year, and average annual basis.

(f) Continue investigation of depletions by wells in the alluvium and the effect of well distance from a stream on those depletions.

(g) Explore the need for modifying Annual Virgin Water Supply and Consumptive Use Formulae to include municipal and industrial diversions from ground water and surface water.

7. Election of Chairman

Mr. Jones nominated Mr. A. Ralph Owens, Colorado Member, as Chairman for the ensuing year. He was unanimously elected.

8. Adjournment

The meeting adjourned at 4:00 P. M. upon motion of Mr. Jones.

A. Ralph Owens
Chairman

KANSAS STATE BOARD OF AGRICULTURE

ROY FREELAND
Secretary

DIVISION OF WATER RESOURCES
R. V. SMRHA, Chief Engineer
1026-S State Office Building
Topeka, Kansas 66612

June 15, 1967

Mr. A. Ralph Owens, Chairman
Republican River Compact Administration
Division of Water Resources
232 State Services Building
1525 Sherman Street
Denver, Colorado 80203

Dear Mr. Owens:

I will be unable to attend the annual meeting of the Republican River Compact Administration to be held in Denver, Colorado, on June 19, 1967, and I hereby appoint Mr. Harris L. Mackey as my personal representative at that meeting.

Very truly yours,

R. V. Smrha
Chief Engineer

RVS:sa

Report of Engineering Committee
Republican River Compact Administration
June 19, 1967

The Republican River Compact Administration in its 7th annual meeting held April 7, 1966, agreed that the assignments to the Engineering Committee would include the following:

1. Compute annual virgin water supply for 1966;
2. Compute annual consumptive use for 1966;
3. Continue studies of method of computing inflow to Lovewell Reservoir;
4. Continue study of the proration of reservoir evaporation losses;
5. Compute adjusted allocations on annual, 5-year and average annual basis;
6. Continue investigation of depletions by wells in the alluvium and the effect of well distance from a stream on those depletions.
7. Explore the need for modifying Annual Virgin Water Supply and Consumptive Use Formulas to include municipal and industrial diversions from ground water and surface water.

The Engineering Committee held one meeting during the year, March 29 and 30, 1967, the 13th meeting of the committee, to study these assignments. The Secretary of the Committee, by letter of April 7, 1967, submitted the following exhibits to the members of the Compact Administration for review prior to the annual meeting.

1. Virgin water supply computations, 1966 water year;
2. Summary Computed annual virgin water supply, Republican River Basin, 1966;
3. Computed annual consumptive use, Republican River Basin, 1966 water year;
4. Computation of inflow to Lovewell Reservoir, 1966 water year;
5. Computed operations of Lovewell Reservoir, 1966 water year;
6. Consumptive use computations--Kansas-Main Stem Republican River;
7. Computation of adjusted allocations, 1966 water year;
8. Adjusted allocations on a 5-year average basis, 1962 thru 1966.

The virgin flow and consumptive use formulas, presented in previous reports of the Committee, were used without change in the preparation of the above data. All exhibits are presented for discussion without recommendations.

The 13th meeting of the Engineering Committee was attended only by members of the Committee. Mr. C. E. Schnurr passed away due to an illness during the past year and Mr. Glenn Brees, appointed by Colorado to replace Mr. Schnurr, was present at the meeting.

No new investigations were made by the Committee concerning assignment Number 6 concerning depletion by wells and consequently no new data is furnished in this report. Assignment Number 7 suggested that the Committee explore the need for modifying the annual virgin water supply and consumptive use formulas to include municipal and industrial diversions.

The Committee decided since such diversions for which the Committee had records were relatively small that they would not be included in the 1966 computations. Listed below are the diversions available to the Committee:

	1966 Water Year	Calendar Year
City of Norton	732 Ac. Ft.	743 Ac. Ft.
Midwest Oil Co.	0 Ac. Ft.	66.2 Ac. Ft.
Livingston Oil Co.	5.4 Ac. Ft.	10.6 Ac. Ft.

The Committee decided to include the bank storage loss in Hugh Butler Lake on Red Willow Creek and in Norton Reservoir on Prairie Dog Creek. Other reservoirs in the basin had filled and the bank storage losses were negligible by the time the water supply computations were initiated for the 1959 water year. The bank storage losses in High Butler Lake for the 1962 to 1966 period were substantial, therefore, it was decided to include the bank storage losses for both of these reservoirs.

Water Year	Hugh Butler Lake Bank Storage Loss Ac. Ft.	Bank Storage Loss Norton Reservoir Ac. Ft.
1962	5,290	- - -
1963	8,600	- - -
1964	4,850	- - -
1965	2,430	2,600
1966	4,770	1,690

The Committee agreed to ask the Administration whether the 1962 through 1965 computations of virgin water supply should be revised to include bank storage water losses.

An error was found in the 1965 record of diversion for the Hale Ditch but the Committee decided to defer revising the 1965 computations until after discussing the matter with the members of the Administration concerning this and other corrections which should be made.

The Committee agreed to compute the diversions by the three states using the same formulas as were used in 1965.

The ground water diversions in Nebraska were based on the data obtained from 22% of well users in the Republican Valley, which indicated a rate of 1.0 acre-feet per acre diversion. The diversion rate of 1.4 acre-feet per acre obtained from records in Kansas was used for diversions by stream pumps. Recorded diversions in Colorado from surface water were 2,540 acre-feet from the South Fork Republican River and 2,088 acre-feet from the North Fork Republican River. There were no recorded diversions from surface water from Arikaree River and Beaver Creek in Colorado. All ground water diversions in Colorado were assumed, as in previous years, to be up-land wells and were not involved in these computations.

Records for the Haigler Canal presented by Colorado for the canal diversions at the headgate and gauging station at the state line showed more water at the state line than at the headgate.

New Parshall flumes were installed prior to this past irrigation season near the headgate and at the state line. Apparently these flumes were not correctly installed and submerge under high flow conditions.

Due to the apparent error in the records, the Committee agreed to use the record for the headgate diversion only and to divide the water used in Colorado and Nebraska in the same manner as in 1965.

The diversion of flow was as follows:

Colorado	1,080 Ac.	=	3/8 =	2,040 Ac. Ft.
Nebraska	2,020 Ac.	=	5/8 =	3,390 Ac. Ft.
Total	3,100 Ac.			5,430 Ac. Ft.

The Bureau of Reclamation furnished the Committee a report entitled "Use of Water in Federal Irrigation Projects" 1966. This report contained consumptive use studies for the Meeker-Driftwood Project which was commenced in 1965 and discussed by Mr. Hedges of the Bureau of Reclamation before the Administration in 1965. The results of this consumptive use study to date were not considered to be conclusive for changing any of the return flow figures used in virgin flow computations for the principal canals in the Republican River Basin.

The Chairman of the Engineering Committee, with Mr. Kenneth MacKichan of the U.S.G.S., together with several members of his organization made a field investigation of the "Return-Flow" study section between the Trenton dam and Cambridge, during the summer of 1966. A member of the United States Geological Survey will discuss the field report of this investigation briefly for the Administration at the 1967 Annual Meeting.

The Committee has no new recommendations concerning the formulas for computation of the virgin water supply and consumptive use. In addition, the Committee has not discovered any new information for changing its policies for computing the consumptive use by irrigation wells.

A member of the Bureau of Reclamation will be called upon at the annual meeting to discuss the plans of that organization in the Republican River Valley.

Respectfully submitted,

M. E. Ball

M. E. Ball, Chairman
Nebraska

Harris L. Mackey
Kansas

Glen E. Brees
Colorado

Computed Annual Consumptive Use
Republican River Basin

1966 Water Year

Drainage Basin	Colorado	Kansas	Nebraska	Total
Prairie Dog Creek	-	13,350	0	13,350
Sappa Creek	-	2,300	7,360	9,660
Beaver Creek	0	4,000	6,100	10,100
Medicine Creek	-	-	6,930	6,930
Red Willow Creek	-	-	13,430	13,430
Driftwood Creek	-	0	420	420
Frenchman Creek	-	-	45,710	45.710
South Fork of the Republican River	9,110	1,870	140	11,120
Rock Creek	-	-	600	600
Buffalo Creek	-	-	690	690
Arikaree River	0	90	0	90
North Fork of the Republican River	2,820	-	2,100	4,920
Main Stem of the Republican River	-	60,280	128.990	189.270
TOTALS	11,930	81,890	212.470	306.290

Computed Annual Virgin Water Supply
Republican River Basin

Drainage Basin	Compact Ac. Ft.	1965 W.Y. Ac. Ft.	1966 W.Y. Ac. Ft.
Prairie Dog Creek	27,600	50,120	53,680
Sappa Creek	21,400	62,180	119,940
Beaver Creek	16,500	51,160	46,520
Medicine Creek	50,800	32,250	55,300
Red Willow Creek	21,900	17,380	28,640
Driftwood Creek	7,300	8,350	2,110
Frenchman Creek	98,500	118,800	129,210
South Fork of the Republican River	57,200	53,220	45,130
Rock Creek	11,000	11,590	10,940
Buffalo Creek	7,890	5,670	6,210
Arikaree River	19,610	16,850	13,150
North Fork of the Republican River	44,700	47,300	48,980
Main Stem of the Republican River plus Blackwood Creek	*94,500	71,700	231,730
Totals	478,900	546,570	791,540

*Main Stem	87,700
Blackwood Creek	6,800

EXHIBIT "E"

Conference in U.S.G.S. Office June 27, 1966

Participants: Marion E. Ball, Assistant Director, Nebraska Department of Water Resources
K. A. MacKichan, District Chief, U.S.G.S.
Butler Shaffer, Hydraulic Engineer, U.S.G.S.

Purpose: Review of findings of Republican River reconnaissance of June 15-17, 1966, for a proposed continuation of return flow studies in that basin.

CULBERTSON CANAL

The Culbertson Canal and its extension was visited June 15 beginning at Highway 183 north of McCook driving upstream along the canal bank. The Culbertson extension which is in the H & R Irrigation District is characterized by long siphons carrying the canal under deep canyons with unmeasured drainage passing over the siphons. There was some drainage directly into the canal. Twelve miles of the canal were traversed. On Blackwood Creek we visited the new A-35 recorder station about 1½ miles above the canal. The portion of the Culbertson Canal upstream from Blackwood Creek which serves the old Frenchman Valley District lies close to the Frenchman River and has fewer major cross drainages.

Note - Mr. Ball inspected the canal specifications for rehabilitation of the Old Culbertson Canal and construction of the extension, which were on file in the Lincoln Office upon his return and these specifications showed several concrete drainage structures carrying water directly into the portion of the canal west of Blackwood Creek and also showed a number of automatic spillway siphons which would discharge excess rain water as required. The Parshall flume, the headworks and the diversion dam on the Frenchman River were also visited as well as the gaging stations at Palisade on the Frenchman River and Stinking Water Creek. On the following morning the digital

recorder gaging station on Blackwood Creek, located 1/2 mile above the mouth was visited. Approximately 6 second-feet was flowing in Blackwood Creek at this gaging station and was apparently return flow from the Culbertson system.

MEEKER-DRIFTWOOD CANAL

The Meeker-Driftwood Canal was inspected throughout almost its entire length June 16, 1966, beginning at the Trenton Dam and working downstream. Prior to commencing this inspection the party visited the gaging station on the Republican River below the Trenton Dam. The channel had degraded considerably below the dam with water flowing in a narrow channel next to the gaging station. The south portion of the main channel opposite the gaging station was at a level 3 to 4 feet above the level of water near the station. There was no growth of willows in the river channel immediately below the dam.

The Meeker-Driftwood Canal was visited by driving along the canal bank beginning at the Parshall flume gaging station. The ditch rider on the canal had just turned water into the canal to commence filling the canal for delivering water. There were many drainage areas which would drain directly into the canal. Rough concrete inlet structures have been built to arrest erosion. The canal was siphoned under the major cross stream channels. Orifice checks were provided at the head end of most of the larger siphons which were designed for measuring the water in the canal and to act as check structures. Gated spillways were provided at each of the orifice checks for releasing water in the drainage channels. Most of the orifice checks were not being used for the design purpose. In most cases the gates were raised and stop-logs have been placed in the openings so that the level at

the canal could be regulated to prevent overflow by permitting the excess water to flow over stop-logs down the wasteways. The orifice checks were designed to have recorder shelters built over each stilling well to accommodate stage recorders. No recorder shelters were observed on the canal system. There were many tumbleweeds and trash observed at the orifice checks which were not being removed prior to refilling the system with water, indicating rather sloppy operation of the system. There were staff gages in the stilling wells of the orifice checks. At several road crossings pipes were installed carrying the roadside drainage directly into the canal. It was evident that sediment was being carried into the canal through these drainage pipes.

A digital recorder is located on Driftwood Creek about a mile below the canal. This station was not visited. A newly installed type A-35 recorder station was observed on Ash Creek about 1/2 mile above the canal.

The Republican River was inspected at the road crossing south of the Red Willow School House. This bridge was not considered a suitable site for a gaging station. The water was well confined in one channel, however there were large flood plain areas on both sides of the river channel which would carry water under high water conditions.

The location of wells within the area covered by the Meeker-Driftwood Canal did not check with a well location as furnished by the State Conservation and Survey Division. The Department of Water Resources plans to field check these well locations and to ascertain whether used as supplemental to the gravity system or to serve non-irrigable lands between the canal and the river.

BARTLEY CANAL

Conditions on this canal were similar but somewhat better than on the Driftwood-Meeker Canal. There were less drainages directly into the canal, however at one of the major cross drainage channels there was an overflow weir at the inlet to the siphon which would discharge automatically the water in the canal above the crest of the weir. The canal was not visited east of Cambridge. Ten miles of the canal system was covered. A SR recorder was inspected on Dry Creek 1/2 mile below the canal. The recorder was recently installed.

RED WILLOW CANAL

The Red Willow Canal was inspected only in the section between Cambridge and 1/2 mile west of Bartley. There was an obvious effort in the construction of this canal to keep the drainage water from lands above the canal from flowing directly into the canal. For the smaller drainage areas there were collection basins above the canal and the drainage water was then siphoned under the canal or there were short siphons carrying the canal under the drainage channels. Only one major siphon was noted on a cross drainage channel east of Bartley. This concluded the canal inspection at the close of June 16, 1966.

No further inspection was made of the Red Willow Canal due to rain occurring during the night of June 16 and continuing during the early part of the morning of June 17. Red Willow Creek had, however, been inspected on June 15 at the outflow from Hugh Butler Reservoir and at the gaging station on Highway 83, one mile below the dam. This gaging station has a bubble type recorder with a good control constructed in the channel. A gaging station is also located on Highway 6 about 2 miles above the mouth.

CONCLUSIONS AND SUGGESTED PROCEDURE

It was agreed that another year of study on an annual basis would be continued since the gaging stations are established and in operation. It was thought that a determination of return flow might be made by selecting a period unaffected by direct precipitation and making a succession of measurements on principal tributaries at the river stations, perhaps with the thought of subdividing the river into shorter reaches.

Mr. MacKichan stated that the intakes to those stilling wells which were found to be plugged would have higher intakes installed in the very near future. Most of the intakes of the new stations installed were found in the inspection to be covered up with silt deposits in the stream channels, due to the moderate type of rainfall which had occurred this spring up to the time of the visit.

The party visited the office of the U.S. Bureau of Reclamation in McCook, talking with Kenneth Kauffman, Planning Engineer, and with Ed Halvinka of the Operations Section. Kenneth Kauffman stated that his office was very much interested in making a return flow study of the various systems and that his office would cooperate in any way possible. He agreed to furnish as-built plans of these projects and land area sheets of the irrigated areas. Ed Halvinka stated that there was a spillway from the Culbertson Canal into Blackwood Creek which was provided with an automatic recorder, and that measurements had been made of the discharge.

Jim Schlagel, Superintendent of the Frenchman-Cambridge Irrigation District met with the party on the morning of June 17 and offered his assistance in any return flow studies. He stated that one a day readings were made at

all discharge points along the canal including the wasteways at the cross drainage structures and at the tail ends of the canals. He stated that they were attempting to eliminate the drainage of roadside ditches into the Meeker-Driftwood system.

The party inspected the observation wells at Cambridge, Edison, and Orleans, returning to Lincoln via the Harlan County Dam.

The party was accompanied by Bob Liggett all day June 16 and on the inspection of the observation wells at Cambridge on June 17.

SUMMARY

1. To make a more detailed study of field conditions such as the locations of unrecorded drains and wastes, additional field inspection is necessary.

2. Consider a study of streamflow and diversion records prior to development of any Reclamation projects within the basin to ascertain if virgin-flow conditions can be determined from such records.

3. Within the near future, schedule a meeting with the Bureau of Reclamation and members of the Engineering Committee of the Republican River Compact Administration to discuss a direct course of action.

4. Consider a study consisting of a series of measurements on the Republican River and its tributaries within the study reach. These measurements to be made at times so as to reflect conditions during no diversions, as in April; maximum diversions, as in July; and maximum return flows, as in September. Inform Kansas and Colorado that such a study is being considered and invite them to participate if they so desire.