

SURFACE WATERS
OF
THE REPUBLICAN BASIN
(INCLUDING SMOKY HILL RIVERS)
COLORADO

From Excerpts of Ground Water Report, Eastern Colorado
by Glenn M. Schroeder of Colorado State Planning Commission

CONFIGURATION

ALTITUDE AND SLOPE

The Republican Basin lies in the form of a saucer, slightly tipped in an eastward slope. The western rim of the boundary has an elevation from 5400 feet to 4200 feet. Altitude of the rim at the southern state line is slightly over 4100 feet and the northern altitude is 3480 feet. Lowest point of drainage on the Colorado state line is 3318 feet in the North Fork Republican River Bed.

DRAINAGE

The Republican Basin is drained by the following rivers and creeks in order of occurrence from north to south:

	DRAINAGE AREA	LENGTH OF COLORADO BED	GRADIENT
Sand Draw Creek	432 Sq.Mi.	22 miles	18.1 Ft. per mile
Frenchman Creek	705 " "	48 "	12.9 " " "
Red Willow Creek (Rock Creek)	576 " "	68 "	9.9 " " "
North Fork Republican River	2360 " "	61 "	12.8 " " "
Arickaree River	1512 " "	112 "	17.8 " " "
South Fork Republican River	2340 " "	79 "	20.2 " " "
North Fork Smoky Hill	310 " "	40 "	10.1 " " "
South Fork Smoky Hill	382 " "	30 "	9.6 " " "
Ladder Creek	207 " "	16 "	17.1 " " "
Total	8824 " "	476 "	

RIVER UNDERFLOW

Valley land on the Colorado side of the State line with water within 25 feet of surface.

	WIDTH IN MILES	LENGTH IN MILES
North Fork of Republican River	.50	15
Arickaree River	.25	10
South Fork of Republican River	.50	10

REPUBLICAN BASIN BOUNDARY

The variance of subsurface drainage from the established Basin Boundary is shown in the shaded zones on the large geological map.

SURFACE FLOW

FRENCHMAN AND SAND DRAW CREEKS. These two creeks are included in one measurement at a Nebraska gaging station at Culbertson. Unfortunately, these creeks flow 73 miles to this station. The bed of these streams is only an indentation in the Tertiary grit in Colorado. State line flow is intermittent. Across the state line the Pierre Shales outcrop and springs and seepage provide a steady flow. This flow of spring water and seepage, all Colorado originated from the Fox Hills formation, is the reason for the submission of the 16-year record at Culbertson. The Mean Annual value of the surface flow is estimated to be 15,000 acre feet. The Mean Annual value of spring flow and seepage is placed at 30,000 acre feet, not inclusive of the creek underflow.

RED WILLOW OR ROCK CREEK. The Red Willow Creek is generally dry at the state line. It drains into the North Fork of the Republican above Benkelman., Nebraska. Appears on most maps as Red Willow Creek but commonly known as Rock Creek.

NORTH FORK REPUBLICAN RIVER? The central part of the basin of the North Fork has no definite drainage pattern. Sand hills absorb the precipitation, and even in flood times, the flow does not travel far. The North Fork penetrates the Pierre Shales ten miles from the state line. Shale outcrops in the river bed a mile above this point, and springs from above the Pierre Shales, from here provide a constant flow. The North Fork measurement is by a Nebraska-U.S.G.S. gaging station at the state line. The 12-year record from the Nebraska report gives a Mean Annual flow of 37,291 acre feet.

ARICKAREE RIVER. The Arickaree drains a rolling country with a definite drainage pattern. The area is dry farmed and a large portion still has the native buffalo sod. Springs on the north side of the valley provide the flow. Stream is subject to short floods and has a torrential character. Tertiary is eroded to the Pierre Shales 27 miles west of the state line, and it is here that the springs provide a steady flow. The Nebraska-U.S.G.S. report records a 12-year Mean Annual flow of 23,458 acre feet. Gaging station at Haigler, Nebraska, 4 miles east of the state line.

SOUTH FORK REPUBLICAN RIVER. The basin of the South Fork is similar in character to the Arickaree. At the head waters, above Flagler, a large area of erosion of Tertiary to Pierre has a spring flow of considerable volume. The South Fork again penetrates the Pierre 17 miles east of the state line. Springs augment the flow here. Nebraska gaging station at Benkelman, Nebraska, representing 42 miles of river flow north and east of the state line gives a Mean Annual flow of 35,755 acre feet. As this flow is the northward hypotenuse of a triangle to a point 26 miles of the state line, and as after leaving Colorado the only additional flow comes from springs, patently Colorado water; it is reasonable to consider the entire flow as Colorado originated.

SMOKY HILL CREEKS. The two forks of the Smoky Hill and the Ladder Creek drain an area featured by the rising to the surface of the Pierre Shales. Beds of the Smoky underflow are forced to the surface in these dry drainage beds and provide small runs of water. The flow is intermittent. Gaging stations in Kansas are too far to provide a reliable basis for estimate. A reconstructed flow at state line, based on South Fork drainage, and on Cheyenne Wells precipitation records, is submitted. The twelve-year Mean Annual flow is estimated as 8,590 acre feet.

SPRING FLOW, SEEPAGE, RIVER UNDERFLOW. The semi-artesian water of the Fox Hill sandstones, shales and gravels provide the constant flow of Nebraska and Kansas streams through springs and seepage. A quantitative value is placed on these waters in the completed report on Ground Waters of the Republican Basin. Annual amount of river underflow, and recoverable water by townships are also evaluated.

TOTAL SURFACE FLOW.

	<u>MEAN ANNUAL</u>		
North Fork of Republican River	37,291	acre	feet
Arickaree River	23,458	"	"
South Fork of Republican River	35,755	"	"
Smoky Hill Creeks	8,590	"	"
Frenchman Creek, est.	<u>15,000</u>	"	"
Total	120,094	"	"

SOURCES. Various reports and papers of the U.S.G.S., Nebraska State Geological Reports, Department of Agriculture Surveys, Army Report #308, Winchester's Ground Water Survey.

GROUND WATER. The Republican Drainage Basin is in a "zone of flow" of low pressure artesian water. The annual safe relizable value of this water is set at ten times the surface flow. Estimates of state-line ground water flow and estimates by townships of safe recoverable water appear in the Republican Basin Ground Water Report. The above is not inclusive of river or creek underflow.

MONTHLY AND ANNUAL DISCHARGE, IN ACRE FEET, OF FRENCHMAN RIVER
AT CULBERTSON, NEBRASKA

From U.S.G.S. - Nebraska Report

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
1895	*6,440	*6,250	*5,960	*4,300	*4,450	*6,460	*8,150	*7,930	*7,850	*9,720	*5,900	*4,640	78,030
1896	*6,820	*5,940	*4,900	*5,820	*5,450	*5,520	*5,940	*7,010	*6,190	*5,780	*4,670	*4,880	68,920
1922	#5,828	#7,437	#8,947	7,993	8,462	8,777	5,032	2,898	1,571	1,347	4,358	4,901	67,551
1923	2,866	6,252	11,613	11,365	9,332	9,749	5,643	24,406	25,081	11,153	6,407	4,213	128,080
1924	9,188	11,682	4,355	13,527	12,424	12,059	9,520	7,787	6,426	6,458	4,562	2,499	100,497
1925	6,148	9,520	12,297	12,298	11,914	16,249	12,034	11,129	4,070	1,384	2,233	2,569	101,845
1926	4,552	7,563	11,129	11,621	8,942	8,484	3,907	3,076	5,197	5,903	3,778	4,165	78,317
1927	4,058	4,939	#8,947	12,297	10,996	16,048	15,272	9,427	10,651	2,185	2,667	1,785	99,272
1928	4,046	4,365	6,148	10,268	10,124	9,235	8,569	26,870	30,050	13,222	8,362	4,046	135,355
1929	6,024	11,008	9,898	8,301	9,251	12,131	11,157	10,770	7,650	2,648	853	2,321	92,012
1930	10,699	9,433	9,967	8,787	9,836	7,369	6,276	6,645	4,800	9,156	10,274	10,235	103,477
1931	9,156	10,274	9,461	8,785	8,588	8,951	8,630	6,640	2,930	2,870	7,070	2,330	85,605
1932	4,530	8,630	9,220	9,530	9,780	12,700	8,750	5,290	8,150	2,830	3,810	1,140	84,160
1933	2,990	6,130	8,240	11,100	11,100	12,200	8,150	6,060	1,460	1,460	8,240	12,400	89,530
1934	7,000	5,570	11,990	11,680	10,760	10,340	7,590	1,880	9,830	2,370	1,700	4,220	85,530
1935	3,110	4,000	10,080	10,840	9,160	11,080	6,890	29,840	22,860	7,230	2,250	5,290	122,630
TOTAL	93,255	118,993	145,152	158,512	150,549	168,002	131,510	167,658	154,766	85,716	77,134	71,654	1,520,881
MEAN	5,829	7,437	8,947	9,907	9,409	10,500	8,219	10,479	9,673	5,357	4,821	4,477	95,055

* Frenchman at Palisade

*# Flood Flows, not in mean but shown in Annual

Mean substituted

MONTHLY AND ANNUAL DISCHARGE, IN ACRES FEET, OF FRENCHMAN RIVER
AT CULBERTSON, NEBRASKA

From U.S.G.S.-- Nebraska Report

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
1895	*6,440	*6,250	*5,960	*4,300	*4,430	*6,460	*8,150	*7,930	*7,850	*9,720	*5,900	*4,640	78,030
1896	*6,820	*5,940	*4,900	*5,820	*5,450	*5,520	*5,940	*7,010	*6,190	*5,780	*4,670	*4,880	68,920
1922	#5,828	#7,437	#8,947	7,993	8,462	8,777	5,032	2,898	1,571	1,347	4,358	4,901	67,551
1923	2,866	6,252	11,613	11,365	9,332	9,749	5,643	24,406	25,081	11,153	6,407	4,213	128,080
1924	9,188	11,682	4,355	13,527	12,424	12,059	9,520	7,787	6,426	6,458	4,562	2,499	100,487
1925	6,148	9,520	12,297	12,298	11,914	16,249	12,034	11,129	4,070	1,384	2,233	2,569	101,845
1926	4,552	7,563	11,129	11,621	8,942	8,484	3,907	3,076	5,197	5,903	3,778	4,165	78,317
1927	4,058	4,939	#8,947	12,297	10,896	16,048	15,272	9,427	10,651	2,185	2,667	1,785	99,272
1928	4,046	4,365	6,148	10,268	10,124	9,235	8,569	26,870	30,050	13,222	8,362	4,046	135,355
1929	6,024	11,008	9,898	8,301	9,251	12,131	11,157	10,770	7,650	2,648	853	2,321	92,012
1930	10,699	9,433	9,967	8,787	9,836	7,369	6,276	6,645	4,800	9,156	10,274	10,235	103,477
1931	9,156	10,274	9,461	8,785	8,588	8,951	8,630	6,640	2,930	2,870	7,070	2,330	85,605
1932	4,530	8,630	9,220	9,530	9,780	12,700	8,750	5,290	8,150	2,830	3,810	1,140	84,160
1933	2,990	6,130	8,240	11,100	11,100	12,200	8,150	6,060	1,460	1,460	8,240	12,400	89,530
1934	7,000	5,570	11,990	11,680	10,760	10,940	7,590	1,880	9,830	2,370	1,700	4,220	85,530
1935	3,110	4,000	10,080	10,840	9,160	11,080	6,890	29,840	22,860	7,230	2,250	5,290	122,630
TOTAL	93,255	118,993	143,152	158,512	150,549	168,002	131,510	167,658	154,766	85,716	77,134	71,654	1,520,881
MEAN	5,829	7,437	8,947	9,907	9,409	10,500	8,219	10,479	9,673	5,357	4,821	4,477	95,055

* Frenchman at Palisade

‡ Flood Flows, not in mean but shown in Annual

Mean substituted

MONTHLY AND ANNUAL DISCHARGE IN NEBRASKA OF ARICKAREE
AT HAIGLER, NEBRASKA

U. S. G. S.-Nebraska Report

Unrecorded diversion for irrigation

YEAR	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
1924	*491	*475	*983	*860	*2,010	*2,520	*1,600	*1,960	*1,720	*614	*61	*59	13,353
1925	*307	*475	*552	119	2,055	2,670	1,297	603	1,035	0	156	471	9,740
1926	1,384	785	307	123	222	1,045	873	543	694	1,230	30	297	7,533
1927	236	525	307	736	1,160	2,460	2,201	753	357	1,174	307	416	10,632
1928	553	1,041	543	553	2,396	1,607	714	9,574	3,035	1,004	676	1,100	22,796
1929	686	1,368	984	1,523	1,610	21,300	1,190	1,835	1,765	291	945	734	34,231
1930	823	1,170	1,557	1,783	2,721	678	724	2,620	4,592	1,269	1,650	1,101	20,668
1931	984	555	1,722	984	555	1,722	1,362	1,125	1,785	2,412	1,341	1,160	15,707
1932	141	125	244	#932	#1,519	1,750	1,340	1,480	1,550	910	5,360	506	15,857
1933	824	869	762	1,040	1,670	1,700	1,370	2,420	363	7,260	3,660	2,290	24,228
1934	891	1,100	1,410	1,480	1,170	1,320	1,280	528	2,430	86	3,040	317	15,050
1935	369	1,135	1,350	1,060	1,140	1,060	1,580	43,610	35,640	1,850	2,450	470	91,704
TOTAL	7,689	9,623	10,721	11,183	18,228	39,832	15,531	67,049	54,966	18,100	19,656	8,921	281,499
MEAN	641	802	893	932	1,519	3,319	1,294	5,587	4,581	1,508	1,638	744	23,458

* Army Engineer's Report
Mean Substituted

MONTHLY AND ANNUAL DISCHARGE IN ACRE FEET, OF SOUTH FORK
OF REPUBLICAN RIVER AT BENKELMAN, NEBRASKA

U. S. G. S. - Nebraska Report

Unrecorded diversion for irrigation

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
1895	\$2,020	\$1,190	\$2,510	\$1,840	\$2,160	\$3,680	\$2,080	\$306	\$8,300	\$5,760	\$610	\$1,190	31,646
1903	2,400	2,260	\$2,580	\$3,070	\$3,930	\$8,600	\$5,640	1,140	2,200	922	1,540	655	34,937
1904	3,530	3,530	\$2,640	\$4,170	\$4,870	3,690	1,260	5,680	7,850	2,420	1,480	774	41,894
1905	\$1,840	\$2,080	\$1,780	\$3,440	\$5,260	4,730	8,390	6,150	4,080	2,180	1,230	\$3,090	44,250
1906	1,340	2,860	\$3,380	\$4,900	\$6,650	\$8,100	7,680	6,100	537	670	0	0	42,217
1924	3,380	2,970	2,400	5,349	5,004	4,602	3,412	3,261	1,369	893	2,340	297	35,277
1925	675	950	1,100	614	6,553	10,637	4,344	2,459	1,844	0	718	1,206	31,100
1926	3,104	2,559	1,350	1,230	1,660	2,525	2,261	587	1,490	2,705	3,094	2,384	24,949
1927	1,107	1,904	2,210	4,919	4,189	4,488	6,664	1,517	3,927	1,781	1,352	1,428	35,486
1928	983	1,963	2,257	3,505	2,070	3,326	2,520	4,735	5,234	5,645	4,489	2,559	39,286
1929	2,836	5,088	2,644	3,070	3,997	3,054	865	746	1,547	2,580	1,686	2,408	30,521
1930	2,130	3,320	2,460	1,100	2,830	2,760	2,380	5,460	6,530	2,950	5,280	3,500	40,700
1931	8,390	6,070	3,874	4,453	7,438	6,143	3,710	3,560	2,840	74	3,020	129	49,701
1932	615	2,980	4,610	5,530	4,310	3,590	3,640	4,510	11,400	823	4,700	5,950	52,658
1933	1,120	2,350	3,505	5,534	5,054	4,388	2,380	2,575	992	655	12,135	10,185	50,873
TOTAL	35,470	42,074	39,300	52,724	65,975	74,313	57,226	48,786	60,140	30,058	43,674	35,755	585,495
MEAN	2,365	2,805	2,620	3,515	4,398	4,954	3,815	3,252	4,009	2,004	2,912	2,384	39,033

* Estimated by Nebraska from changed position of gaging station

MONTHLY AND ANNUAL DISCHARGE IN COLORADO
OF SMOKEY HILL CREEKS AT STATE LINE

DRAINAGE AREA 899 SQUARE MILES

YEAR	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
1903	154	100	223	412	742	2,538	1,400	0	77	0	0	0	5,646
1904	588	588	246	835	1,104	650	0	1,415	2,250	162	0	0	6,838
1905	0	31	0	554	1,254	1,050	2,458	1,596	800	69	0	419	8,231
1906	0	331	531	1,115	1,788	2,346	2,146	1,577	0	0	0	0	9,834
1924	531	373	154	1,288	1,155	1,001	543	485	0	0	131	0	5,661
1925	0	0	0	0	1,751	3,322	902	177	0	0	0	0	6,152
1926	425	215	0	0	0	202	100	0	0	271	421	148	1,782
1927	0	0	81	1,123	842	957	1,794	0	741	0	0	0	5,538
1928	0	0	99	579	27	510	200	1,052	1,244	1,402	957	215	6,285
1929	322	1,188	248	412	768	405	0	0	0	223	0	157	3,723
1930	50	508	177	0	319	292	146	1,331	1,742	365	1,261	577	6,768
1931	2,458	1,565	721	943	2,092	1,593	658	600	323	0	392	0	11,345
1932	0	377	1,004	1,358	888	612	631	965	3,615	0	1,038	1,519	12,007
1933	0	135	579	1,359	1,175	918	146	221	0	0	3,898	3,144	11,575
TOTAL	4,528	5,411	4,063	9,978	13,905	16,396	11,124	9,419	10,792	2,492	8,098	6,179	102,385
MEAN	646	491	369	907	1,069	1,171	927	941	1,349	415	115	882	8,532

Reconstructed from South Fork Republican and Cheyenne Wells Precipitation Records
Difference in Drainage Area Adjusted