11-18-1952

City and County of Denver v. Northern Colo. Water Conservancy Dist.

No. 16881
No. 16888

IN THE

Supreme Court

OF THE

State of Colorado

CITY AND COUNTY OF DENVER, CITY OF COLORADO SPRINGS, and SOUTH PLATTE WATER USERS ASSOCIATION,
Plaintiffs in Error,

vs.

UNITED STATES OF AMERICA, NORTHERN COLORADO WATER CONSERVANCY DISTRICT, COLORADO RIVER WATER CONSERVATION DISTRICT, F. E. YUST, CLAYTON HILL, GRAND VALLEY IRRIGATION CO., and GRAND VALLEY WATER USERS ASSOCIATION,
Defendants in Error.

Error to the District Court of the County of Summit
HONORABLE WM. H. LUBY, Judge

APPENDIX

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Denver, Colorado.
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Telephone Building,
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Ray F. Frey Company

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DENVER'S EXHIBITS

Exhibit Number	DESCRIPTION	Offered	Accepted	Rejected
A	Map and Statement of Blue River Diversion Project, filed in the Office of the State Engineer under No. 13758 on May 31, 1923	1444	2038	
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K	Denver Population Curve, prepared by Engineering Board of Review in 1922	2488	2514 2768	

DENVER'S EXHIBITS (Continued)

Exhibit Number	DESCRIPTION	Offered	Accepted	Rejected
L	Metropolitan Denver Population Curve, prepared by H. L. Potts in 1949	2488	2768	
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N	Map and Statement of Two Forks Reservoir dated April 1, 1927, filed with the United States	1788	1788	
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P	Letter report from Geo. M. Bull to Board of Water Commissioners dated June 16, 1921, "In Re. Survey Work in Connection with Western Slope Development," incorporated in Water Board Minutes of June 21, 1921	1738	2038	
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U	Map of Blue River Diversion Project, filed for approval with Secretary of Interior in 1923	1480	1480	
V	Preliminary Report for a New Water Supply for the City of Denver, by J. B. Lippincott, dated August, 1914	1751	1992	

DENVER'S EXHIBITS (Continued)

Exhibit Number	DESCRIPTION	Offered	Accepted	Rejected
W	A Trans-Mountain Water Supply from the Fraser, Williams Fork and Blue Rivers for the City of Denver, by R. I. Meeker, dated May 18, 1914	1751	1992	
X	Growth of Population in Denver Area, by F. L. Carmichael	2225	2225	
Y	Excerpts from Minutes of Meeting of Board of Water Commissioners held September 20, 1922	2293 2295	2383	
Z	Report of Engineering Board of Review to Board of Water Commissioners dated August 15, 1922, by Cory, Maury and Crocker	2295	2383	
AA	Rights of Way acquired by Board of Water Commissioners, as of December 13, 1949	2316	2326	
BB	Water Rights Available for Potable Water Plant of Denver, November 22, 1949	2389	2389	
CC	Portion of Decree relating to Denver's Fraser River Diversion Project, Williams Fork Diversion Project and Williams Fork Reservoir	4404	4404	
YY	Summary by Years of Costs on Blue River Project, together with Work Orders describing work done and cost thereof	Accuracy and authenticity stipulated f. 364-69		
ZZ	Summary by years and Work Order Nos. of costs on Blue River Project	Accuracy and authenticity stipulated f. 364-69		

PROTESTANTS EXHIBITS

Exhibit Number	DESCRIPTION	Offered	Accepted	Rejected
1	Answer filed June 4, 1948, by City & County of Denver in Civil Action No. A 59093, entitled the City of Englewood, Colorado vs. the City & County of Denver.	2927		
2	Certified copy of Map and Statement of Reservoir No. 22 filed in the office of the State Engineer Feb. 23, 1946, No. 17,957.	2927	2927	
3	Certified copy of Map and Statement of Empire Reservoir filed in the office of the State Engineer August 5, 1937, No. 16257.	2927	2927	
5	Copy of Amended Map of the Blue River Diversion Project certified by the U. S. Dept. of of Interior, General Land Office and showing filing date with the Land Office as Dec. 5, 1927, also showing the 22.82 mile Trans-mountain Tunnel.	2927	2927	
6	Form of tap stamp used by Board of Water Commissioners.	2351	2351	
7	Tap application containing essentially the same provisions as Exhibit 6.	2351	2351	
8	Form of Water Distributor's contract.	2351	2351	
9	Rules and Regulations of Board of Water Commissioners dated Nov. 1, 1938, as supplemented to April 22, 1947.	2351	2351	
10	Excerpt from the Minutes of the Board of Water Commissioners meeting of April 23, 1948.	2351	2351	

PROTESTANTS EXHIBITS (Continued)

Exhibit Number	DESCRIPTION	Offered	Accepted	Rejected
11	Form of General Corporation Agreement executed between Denver and Adams, Jefferson or Arapahoe Counties.	2351	2351	
12	Agreement dated October 29, 1942 between the South Platte Water Users Association and the City & County of Denver.	3001		
13	Photostatic copy of Decree in No. 657, Water District 51, said Decree being dated March 4, 1940.	2732	2732	
14	Photostatic copy of Pages from Decree relating to Platte Canyon Reservoir and Marston Reservoir.	3001	3001	
15	Report of the Board of Water Commissioners for the year ending Dec 31, 1948.	2739	2739	
16	Graph entitled "Populations Served with Municipal Water by Denver Water Board."	2768	2768	
17	Graph entitled "Population Growth Trends of Various Cities."	2774	2774	
18	The Colorado River Water Conservation District, Map Analyzing Blue River Diversion, filing of 1923.	2948	2948	
19	The Colorado River Water Conservation District, Map Analyzing Blue River Diversion, filing of 1927.	2948	2948	
20	The Colorado River Water Conservation District, Map Analyzing Blue River Diversion, filing of 1928 and 1942 Dillon Reservoir.	2948	2948	

PROTESTANTS EXHIBITS (Continued)

Exhibit Number	DESCRIPTION	Offered	Accepted	Rejected
21	Analysis of Losses and Water Divertible in Acre-Feet based on 1923 filing, years 1930-1942.	2948	2948	
22	Analysis of Losses and Water Divertible in Acre-Feet based on 1927 filing, years 1930-1942.	2948	2948	
23	Excerpt from Decree in Cases No. 466, 477 and 533 in Water District No. 53 relating to Glenwood Power Canal and Pipe Line.	2974	2974	
24	Statement of Claim of the City & County of Denver filed in the District Court of Summit County, February 4, 1935, in No. 1709, in re priorities of water rights in Water District No. 36.	2979		
25	Statement of Claim of the City & County of Denver filed in the District Court of Summit County February 4, 1935, in No. 1710, in re priorities of water rights in Water District No. 36.	2979		
26	Graph entitled "Study of Future Water Supply for City of Denver."	2967	2967	
27	Operation Study—Denver Future Water Supply.	2967	2973	
28	Use of Releases—Dotsero & Cameo.	2969	2973	
31	Certified photostatic copy of Bureau of Land Management Records under Filing Denver 032121, the original application being filed April 8, 1927.	4013	4013	

PROTESTANTS EXHIBITS (Continued)

Exhibit Number	DESCRIPTION	Offered	Accepted	Rejected
32	Certified copy of Map and Statement of Enlargement of Two Forks Reservoir filed in the Office of the State Engineer Nov. 3, 1926, numbered 14615.	4013	4013	
33	Certified copy of Amended Map and Statement of Eagle Rock and Two Forks Reservoirs, filed in the office of the State Engineer April 16, 1921, and numbered 13263.	4013	4013	
34	Certified copy of Preliminary Map of Two Forks Reservoir, filed by Allen and Maloney in the State Engineer's office Feb. 24, 1905, and numbered 1963.	4013	4013	
50	Operational Study of Green Mountain Reservoir.	4427	4427	
51	Annual Run-off by Months from that portion of Blue River watershed lying below Dillon.	4450	4450	
52	Graph showing Inflow to Blue River between Dillon and Green Mountain Reservoir.	4450	4450	

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ABSTRACT OF TESTIMONY

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1407 MR. SAUNDERS stated that the City and County of Denver would offer its proof with respect to the Blue River Diversion Project and that all testimony and exhibits would be offered with respect to both cases, namely, Nos. 1805 and 1806 unless the contrary was made to appear.

Folios

TESTIMONY OF MALCOLM LINDSEY

DIRECT EXAMINATION

BY MR. SAUNDERS:

1408 My name is Malcolm Lindsey. I was admitted to the bar in February of 1906. Since that date I have specialized in Water Law. I have
1409 been employed by the City of Denver continuously since July 15, 1925, either by its general govern-
1410 ment or by its Board of Water Commissioners.

The first work I did for the City was to prepare a legal inventory of the water rights of
1411 Denver, showing their status and what was needed to be done to complete them. In this connection I familiarized myself with the water history of the City and County of Denver. It
1412 begins with a conflict between The Denver Union Water Company and the City and County of Denver which resulted in the acquisition by the City of Denver of the property of The Denver Union Water Company. The Denver Union Water Company was a private corporation engaged in supplying water to the people of Denver and to persons around Denver and outside the city limits. For a number of years in the early part of this century negotiations and litigation had been going on for the acquisition of its plant by Denver.

1413 The first step taken by the people of Denver to acquire their own water system was to pass a Charter Amendment creating a Public Utilities Commission consisting of three members who were A. C. Anderson, President, Edward Van Cise, a lawyer and A. Lincoln Fellows, an engineer. The duty of the Public Utilities Com-

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1414 mission as set out in the Charter Amendment creating it was to acquire the plant of The Denver Union Water Company or else to secure an independent municipal plant to supply Denver with water. The Commission was formed in 1911 and 1912.

The Commission took steps to relate the development of a water supply to the work of the United States Bureau of Reclamation. As early
1415 as October 7, 1913, the minutes of the Commission show that a meeting was held between Mr. Van Cise and Mr. Lane, then Secretary of the Department of the Interior on this subject.

1421 In January, 1914, Mr. Fellows, the engineering member of the Commission, in conjunction with Mr. Allen, a well-known attorney of Denver, and Mr. Van Diest, a well-known attorney of Colorado Springs, made a report on the Western Slope water for the City of Denver. In May, 1914, Mr. R. I. Meeker, a hydraulic engineer, made a report (Exhibit W) on the possibilities of Western Slope water for Denver. In August, 1914, Mr. J. B. Lippincott, a well-known water engineer,
1422 made his report (Exhibit V). The next report was made in 1916 by Van Sant-Houghton Company and in 1917 a re-vamped Van Sant-Houghton report was made.

1423 In 1918 the people of Denver amended their Charter to provide for a Board of Water Commissioners to take over the work formerly done by the Public Utilities Commission of Denver. That Board succeeded to the powers of the old Public Utilities Commission and has carried on

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1428 the water work of Denver. The following are excerpts from the 1918 Charter Amendment taken from Section 297 B of the 1927 compilation of the Charter, and was formerly numbered 264 D:

> "There shall be and hereby is created a nonpolitical Board of Water Commissioners of five members, to have complete charge and control of a water works system and plant for supplying the City and County of Denver and its inhabitants for water for all uses and purposes; * * * The Board shall have and exercise all the powers given to the Public Utilities Commission of the City and County of Denver and its successors by Article XIX
1429 of the Charter, as amended to May 17, 1916, and as amended by Section 264C adopted May 15, 1917, and not inconsistent with the provisions of this amendment. The Board shall have and exercise all the powers of the City and County granted by the constitution and laws of the State of Colorado by the Charter, in the matter of purchasing, condemning and purchasing, acquiring, constructing, leasing, extending and adding to, maintaining, conducting and operating a
1430 water works system and plant for all uses and purposes, and everything necessary, pertaining, or incidental thereto. It may tem-
1431 porarily lease water and water rights to be used outside the limits of the City and County of Denver when the water supply for the City and County of Denver and its inhabitants is above that necessary for its present needs; said leases, however, to be
1432 for periods not exceeding one year and to be made subject to the future needs and require-

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ments of the City and County of Denver and its inhabitants. * * *"

1435 George M. Bull was employed by the Board of Water Commissioners in 1920 as a consulting
1436 engineer on Western Slope rights. I worked with him personally for a number of years.

MR. SAUNDERS asked when the people of Denver authorized the Moffat Tunnel including the Moffat water bore. MR. DELANEY ob-
1437 jected. MR. SAUNDERS pointed out that it was a matter of judicial knowledge that the year was 1920.

1439 MR. LINDSEY: Mr. Bull made an investigation of Western Slope water rights. On June 16, 1921, he made his report (Exhibit P) to the Board of Water Commissioners of the steps necessary for the acquisition of Western Slope rights. He began his field work on Fraser River water rights on July 4, 1921, and did work on the Wil-
1440 liams Fork portion of the Denver water system that same summer. The Williams Fork and Fraser rights have been decreed under a date of
1441 July 4, 1921.

In 1922 Mr. Bull made preliminary surveys for filing purposes on the Blue River and its tributaries. In the same year the Board of Water Commissioners created an Engineering Board of
1442 Review composed of Herbert S. Crocker, Dabney H. Maury and Harry T. Cory, one of those men coming from Los Angeles, the other from Chicago. They made a study of the Denver water system and on August 15, 1922, made their report (Exhibit Z) to the Board of Water Commissioners.

In the fall of 1922 the original Colorado River Conference was held in Santa Fe, New
1443 Mexico. The Board of Water Commissioners sent

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L. Ward Bannister, then and now a well-known Denver lawyer, to Santa Fe to present to the Commission the claims and needs of Denver for Western Slope water. During the years 1922-23 Mr. Bull had the necessary office work done so as to complete the filing (Exhibit A) in the office of the State Engineer on the Blue-South Platte project. The Board also filed in the General Land Office (Exhibit U) for Federal rights-of-way over so
1444 much of the land as was government land at that time. The survey was made in the summer of 1922, the engineering work was done during that winter and the filings were completed and made in 1923.

MR. SAUNDERS offered Denver Exhibit A, a Map and Statement titled "Map of the Blue River Diversion Project," filed May 31, 1923, in the office of the State Engineer. MR. DELANEY objected that the statement showed that work commenced by survey March 21, 1914. MR.
1447 SAUNDERS asked the witness to explain the date.

MR. LINDSEY: During 1914 the Public Utilities Commission, which I mentioned, made a number of reconnaissance surveys, very preliminary in their nature, and all Western Slope filings incorporate that 1914 date because of those preliminary surveys.

THE COURT reserved its ruling. Denver Exhibit A was later admitted (f. 2038).

MR. LINDSEY: I have mentioned a number of engineers. Colonel Crocker was one of
1448 the most distinguished engineers that Denver ever had. He was recognized nationally and was president of the National Association of Civil Engineers. I knew him personally. I did not know

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Mr. Lippincott personally. He was an engineer
1449 of repute. Mr. Corey, who I did not know personally, was also an engineer of repute. Both Mr. Lippincott and Mr. Corey were recommended by the Society of Civil Engineers.

1450 Mr. R. I. Meeker was an engineer of very high standing in the State of Colorado and later he represented Kansas in a great deal of water litigation. Mr. Bull was and is a well-known and distinguished engineer. During the depression he was the engineering member of the Colorado P.W.A. Board and later became chairman of the
1451 P.W.A. Board involving Oklahoma, Texas, Colorado and New Mexico.

MR. BARNARD objected that the testimony had no object. MR. SAUNDERS replied that the Court should know that the people who designed the Denver water system were prominent well-
1452 qualified people with a reputation for doing good work. MR. BARNARD asked what that had to do with it. MR. SAUNDERS replied that a sound and sensible approach is relevant on the question
1453 of due diligence.

MR. LINDSEY: During 1923, the year that the filing Denver Exhibit A was made, the Denver Water Board filed for a federal right-of-way
1454 across public lands (Exhibit U).

The water, when diverted under the project shown on Denver Exhibit A goes into one of the tributaries of the South Platte River. Efforts were made in 1923 to secure a place to store that
1455 water. The Two-Forks reservoir was re-surveyed for an enlargement and filings were made for rights-of-way for that Two-Forks Reservoir site
1456 in 1923.

Denver Exhibit S is an illustrative map of

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the general terrain involved in this proceedings. I became familiar with the terrain shown by Exhibit S by driving over the roads and walking over
1457 the trails and climbing some of the mountains in every one of the mountainous areas shown on the map.

MR. SAUNDERS offered Denver Exhibit S as an illustrative map of the general terrain.
1458 Cross-examination on the Exhibit was permitted.

CROSS EXAMINATION

BY MR. DELANEY:

Exhibit S is a sketch map showing the rela-
1459 tive locations of the component parts of the Denver Municipal Water System such as streams, reservoirs, the Moffat tunnel diversion, the Williams
1460 Fork diversion, the Blue River diversion, etc. It is not drawn to any particular scale. The area shown in the colored line surrounding the words "Blue River Diversion Project" represents the area from which water will be intercepted. It is
1461 perhaps one-third larger or possibly one-half larger than the area for such diversion shown in the 1923 filing. The 1923 map shows the project as originally planned with a short tunnel about 4½ miles long with an estimated diversion there of 135,000 acre feet. The present red lines show an area to be drained by a long tunnel 22 or 24 miles long. The tunnel shown in the 1923 filing
1462 does not appear on Exhibit S.

BY MR: BARNARD:

Exhibit S was prepared very recently by the
1463 Engineering Department of Denver. It was taken from an old map used by the Water Board for many, many years.

1464 THE COURT admitted Exhibit S in evidence.

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DIRECT EXAMINATION

BY MR. SAUNDERS:

The Two-Forks Reservoir will be at the point of the junction of the two forks of the South Platte and will back water up a number of miles on the north fork and for a greater number on the
1465 south fork. The tunnel shown on Exhibit A is at a higher elevation than the tunnel shown on Exhibit S ending at Grant. The tunnel shown on Exhibit A started at about the center point of what is marked "Blue River Diversion Project" and ran easterly and southerly through the mountains for 4½ miles and would have dumped water into Jefferson Creek, a tributary to Tarryall
1466 Creek. With permission I would like to sketch that tunnel in on Exhibit S.

After I entered the employment of the Water
1467 Board on July 15, 1925, Mr. Bull, Mr. L. Ward Bannister and I were called upon to advise the Board in regard to following up the Western Slope rights of the City of Denver. Under date
1468 of February 9, 1926, we made a report to the Board of Water Commissioners on the steps required, one of which was the need for additional
1471 legislation in Colorado. With respect to the legislative recommendation, I prepared a bill for introduction in the Legislature at the next session in 1927. It did not pass, was redrafted and introduced in 1929, and again did not pass. It was further redrafted and introduced in 1931. After amendment, the bill was passed and became a part of the Session Laws of Colorado of 1931, page 811, and later Chapter 163 of Colorado
1472 Statutes Annotated, Sec. 398.

The passage of the bill was essential to the water diversion program of the City and County of Denver because the Supreme Court had de-

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1475 cided that the City of Denver could lease water temporarily not needed for immediate city use, but the decision did not go so far as to say that if the water was leased and if return waters were taken, that the city could discontinue as to subsequent junior appropriators who might have claimed that return water. We considered it necessary to secure from the legislature a specific declaration that under temporary leasing of water no rights to the return water could be established so as to defeat the terms of the lease.

1476 Exhibit A is the 1923 filing in the office of the State Engineer of the Blue River unit of the Denver Water System. Exhibit U is a copy of the map filed in the Federal Land Office as a basis for the right-of-way from the United States for the same unit of the Denver Municipal Water System.

1480 THE COURT admitted Exhibit U over objection. MR. SAUNDERS pointed out that Exhibit U contained map statements showing 76 miles of collection conduits of which 64 miles are open canals.

1481 MR. LINDSEY: The area outlined by the red line on Exhibit U indicates the drainage area from which the water was to be diverted; the blue dotted lines show canals, tunnels and similar structures aside from the main tunnel; the broken
1482 red line indicates the area from which no water was to be drawn.

After the preparation of Exhibits A and U and the engineering work in connection with them, the Board of Water Commissioners ordered further work on the Blue River Project. In 1926 they ordered Mr. Bull to study a more simple method of collecting the water from the Blue and

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its tributaries. Pursuant to that order, in the spring of 1926, Mr. Bull put a party in the field
1483 to make the necessary survey for a re-location of the system. The party stayed in the field many months, in fact, until winter set in in the fall of 1926. During the winter months of 1926-1927 the office work was done for the preparation of the amended filing maps of this unit of the Denver Municipal Water Works, and those maps, both
1484 State and Federal were filed during 1927.

MR. SAUNDERS asked if the work done was intended to be a simplification only or an enlargement of the work as shown on Exhibits A and U. MR. BARNARD objected that intention was not controlling, that the question was what effect the work had and what was actually done. MR.
1485 SAUNDERS then offered to prove by the witness that the intention was to enlarge the project. THE COURT denied the offer.

MR. LINDSEY: Denver Exhibit B is a certified copy from the office of the State Engineer of a filing map entitled "Amended Map of the Blue River Diversion Project, Summit County, Colorado". It was filed in the office of the State
1486 Engineer on October 19, 1927.

MR. SAUNDERS offered Denver Exhibit B in evidence. After hearing objections, THE
1491 COURT admitted the same in evidence.

MR. LINDSEY: Denver Exhibit C is a certified copy from the office of the State Engineer
1492 of a map entitled "Amended and Composite Map of the Denver Municipal Water System" filed in the office of the State Engineer on January 19, 1928, and certified by the State Engineer on November 23, 1949.

MR. SAUNDERS offered Exhibit C in evi-

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1496 dence. After hearing objections THE COURT
1497 rejected the exhibit. The exhibit was re-offered later (f. 1746 and 2038) but was not admitted.

In 1927 the City of Denver did not own all the rights-of-way necessary for its Blue River Project. At the time that the 1923 filing was made in the office of the State Engineer a corresponding filing was made in the General Land Office for such part of the rights-of-way as were to be constructed on government land. The right-
1498 of-way was not immediately granted. The Federal
1499 application for a right-of-way on the 1923 filing was followed up in every way I could think of, but I was never able to get the right-of-way granted and it was denied about 1932.

In regard to the amendment and enlargement of the Blue River Unit as shown on Exhibit B,
1501 I had the filing for that right-of-way made in the Denver Land Office for transmittal to the General Land Office. The filing in the office of the State Engineer was made October 9, 1927, and the filing in the Land Office was made December 5, 1927.
1502 I followed the Land Office filing up in every way I could think of and it was denied in the early part of 1932 by the Commissioner of the General Land Office. I thereupon filed a motion for a rehearing which was granted. The right-of-way was finally approved late in 1932.

MR. SAUNDERS asked if the Water Department financed the work of developing the Western Slope Projects with substantial sums of money.
1503 MR. DELANEY objected that the question was too broad. THE COURT sustained the objection and MR. SAUNDERS offered to prove by the answer to the question that the Board of Water Commissioners did expend substantial sums of money on the perfection of trans-mountain di-

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version projects including the Blue River unit.
1504 THE COURT denied the offer.

MR. SAUNDERS asked if the City and County of Denver in its general governmental capacity appropriated any money for the development of the transmountain diversion system of the City of Denver. MR. DELANEY objected that the question should be limited to the particular diversion or project involved and described in
1505 the claim statement on file with the court. THE COURT sustained the objection. MR. SAUNDERS requested permission for the witness to answer the question under the rule. MR. DE-
1506 LANEY objected that evidence relating to the Moffat Tunnel and Williams Fork diversions had no bearing on this adjudication. MR. SAUNDERS replied that Denver was developing a single water
1507 system (Exhibit C, 1928 filing); that Denver from 1914 contemplated developing the waters in the Colorado River from its several tributaries as rapidly as feasible; that work done on one portion of the project is work done on the whole project.
1512 THE COURT sustained the objection. MR. SAUNDERS stated that the answer to the ques-
1513 tion, if permitted, would be that the City and County of Denver appropriated under Ordinance 160 of 1928, $50,000 for Western Slope water rights.

1514 MR. LINDSEY: IN 1928 the City and County of Denver spent money towards the development of the Blue River unit of its transmountain diversion system. During that year filings were made showing the entire Denver Municipal Water System of which the Blue River unit is a part. Money was expended in the preparation of that filing (Exhibit C) and on the surveys on which it was based.

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There is a difference between money spent by the Water Department and money spent by the City. Money from the City is derived from taxes
1515 and money from the Water Department is derived from water rentals.

The City started proceedings in 1928 before the Interstate Commerce Commission to secure the abandonment of the railroad which at that time passed through the Two Forks Dam Site shown on Exhibit S. The location of that dam is just below the junction of the North Fork and South Fork of the South Platte River and is marked on Exhibit S as "Elevation 6420." During
1516 the progress of the proceedings, the City offered to accept instead of the complete abandonment of the railroad a relocation of the railroad at an elevation above the proposed dam. The Interstate Commerce Commission did not give permission
1517 to relocate the railroad. Later, about 1943, the railroad brought it own proceedings and was allowed to abandon its railroad through that reser-
1518 voir site. Most of the land for the reservoir was purchased in 1942 by the Water Board from
1519 Louis Kinkel.

The City in its governmental capacity out of tax moneys made three appropriations in the year
1520 1929 for the further development of its Western Slope projects. The money appropriated during 1929 went for the Western Slope project as a whole. I am not familiar with the accounting system and do not know how much money was
1521 spent on each unit.

MR. SAUNDERS asked how much money was appropriated. MR. DELANEY objected that the testimony should be confined to the appropriation for the Blue River. THE COURT sustained

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the objection. MR. SAUNDERS offered to prove that the City and County of Denver by Ordinance 137 appropriated $50,000 for further work on its Western Slope Diversion Project, including the Blue River unit, and by Ordinance 152 the further sum of $56,000, and by Ordinance 165 the further sum of $50,000 for the same purpose.

1522 THE COURT denied the offer.

1523 MR. LINDSEY: In the years preceding 1929, efforts were made to secure Blue River water under the Colorado River Compact. At the direction of the Denver Water Board, Mr. Bull and I prepared a statement of the needs of Denver for Blue River, Fraser and Williams Fork water and

1524 supplied that to the Colorado River Commissioner, Mr. Carpenter, for his use in securing the water rights in question.

My duties included helping the Board of Water Commissioners perfect the Blue River

1525 water rights and the rights to the whole transmountain system.

In the early 30's I made efforts on behalf of the Board to secure the cooperation of the Bureau of Reclamation in the construction of the Blue

1526 River Unit. I prepared a statement for Dr. Meade, Director of the Bureau, showing Denver's Western Slope claims, including the Blue River. This

1527 statement was prepared in 1932.

The Bureau's work was influenced by the depression. During 1930 and 1931 conditions in Denver and in Colorado were bad, and it was impossible to finance any substantial enterprise. This condition prevailed for several years after

1528 1932. In behalf of the Board I made efforts to obtain financing for those transmountain diversion projects and particularly the Blue River

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unit out of Federal funds which became available as a result of the panic. The Public Works Administration formed, and in each state a Public Works Board of three was created. In
1529 Colorado the engineer of the Board was Mr. Bull, who up to that time had been consulting engineer on our Western Slope rights. As a result of formation of the P.W.A. in Colorado we went to work to secure the money for our three Western Slope units including the Blue. Colorado received
1530 a number of federal allotments and grants. Denver received three allotments and grants—one of them for the Fraser, another for the Williams Fork, and a third for the Blue.

Denver Exhibit Q is an application dated December 6, 1935, which I prepared and pre-
1531 sented on behalf of the Denver Water Board, for an allotment of P.W.A. funds for work on the Blue River unit.

1532 COUNSEL stipulated that the below listed Denver Exhibits were filed with the Clerk and Recorder of Summit County, Colorado, on the dates and under the filing numbers set opposite such exhibit:

Exhibit	*Filing No.*	*Date*
A	39685	June 12, 1923
B	42394	Oct. 29, 1927
C	42496	Jan. 27, 1928

MR. SAUNDERS offered Denver Exhibit Q.
1533 MR. DELANEY objected on the ground that Exhibit Q was an application by Denver for the allotment of P.W.A. funds to the Bureau of Reclamation to make surveys to determine the feasibility of the Blue River Project. MR.
1535 SAUNDERS replied that before Congress would authorize projects, it required the Bureau to make

Folios

its own independent engineering investigation.
1540 THE COURT reserved its ruling and later admitted the exhibit (f. 2038).

MR. LINDSEY: The application requested $100,000 and it took a number of months to obtain the grant. We worked with the aid of Congress-
1541 man Lewis and finally in the spring of 1936 secured the $100,000. We then had a conference with the head officials of the Bureau of Reclamation in Denver as to how the money should be expended, and, at the request of the Water Board, I presented and left with the Bureau of Reclamation officials an outline of the suggestions of Denver for
1542 the spending of the $100,000. Denver Exhibit R is my office carbon copy dated in 1936, of that outline.

MR. SAUNDERS offered Denver Exhibit R
1546 in evidence and it was admitted over objections.

1547 MR. LINDSEY: The practice that the Bureau of Reclamation follows for obtaining one of its projects is for the Bureau's engineers to investigate and make a report to the Director of the Bureau who in turn lodges the report and his recommendations with the Secretary of the Interior and then with the Congress of the United
1548 States. The officials of the Bureau of Reclamation in Denver spent a number of months in making an investigation and finally notified us that they were ready with a preliminary report for a conference to be held in their office with representatives of Denver Water Board and other Denver officials including myself. At that confer-
1551 ence we found that the plan they discussed involved bringing the water not by the tunnel marked "Montezuma Tunnel" on Exhibit S, but by a different series of tunnels starting at Dillon and running as a canal, then a tunnel, into the Wil-

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liams Fork watershed, then an additional tunnel into the Fraser watershed, and finally through the Moffat tunnel and then down along the Eastern Slope of the mountains and dumping the water into Clear Creek.

1552 This conference was held June 1, 1938. We explained to the officials of the Bureau that the project was not satisfactory to us because it dumped the water too far down the stream to be of any substantial benefit to Denver. It was to be dumped into Clear Creek and would go into the South Platte below Denver. We pointed out that the area Denver was concerned in furnishing water to was the area around Denver.

We continued to work with the Bureau of Reclamation and with the help of Mr. Lewis secured another $75,000 for a further investigation
1553 and report by the Bureau. They sent for us a second time and a second conference was held in their office. They showed us a modification of the plan which would bring a canal from the East Portal of the Moffat Tunnel down to a point near that marked "Intake" on Exhibit S which is the principal source of Denver's water at the present time. ("Intake" is approximately seven miles below the junction of the north and south forks of the South Platte River.) We told them that this was not satisfactory because it meant about 25 miles of tunnels on the Western Slope, about the same amount of tunnel that was proposed for the Montezuma Tunnel and it had the additional expense of bringing the water from the east portal of the Moffat Tunnel
1554 clear down to here (pointing to "Intake"). This second conference was held late in 1938 or 1939.

1557 The P.W.A. appropriations were spent by the Bureau of Reclamation, not Denver.

Folios

1560 Exhibit E grew out of Denver's efforts to cooperate with the Bureau of Reclamation for additional surveys. The $100,000 had been spent; the $75,000 had been spent, and in this agreement dated December 31, 1941, we agreed to match money with the Bureau. In 1943 another cooperative agreement was entered into. During this period Denver was spending large amounts of
1561 money on the Blue River unit.

THE COURT admitted Denver Exhibit E, there being no objection.

MR. LINDSEY: Paragraph 5 of Exhibit E provides that the United States and the City of Denver contemplate an expenditure of $100,000 each on the investigation referred to in the agreement. The City Council appropriated $100,000. The City and the Bureau of Reclamation carried forward cooperative work on the preparation of
1563 plans for construction of the Blue River diversion from that time to the present. In particular, Mr. Debler of the Bureau of Reclamation suggested the formation of an Engineering Board of Review in order to check the various possible sites and determine the general course to be followed.

Referring to Exhibit S, on the original filing on the "Montezuma" Tunnel, the tunnel started near Dillon and came straight through to a point near Grant. During the course of the studies it was determined that part of the ground along that line was badly broken up, so the tunnel was
1564 shifted, not as to portals, but a little change in the line of the tunnel was made; it was bent somewhat.

Mr. Debler suggested that all agencies interested appoint an Engineering Board of Review. The State Water Board appointed Mr. Pat-

Folios

terson, the Chief Engineer of the Colorado State Conservation Board. By this time there was formed the South Platte Water Users Association. Its articles of incorporation were filed January 27,
1565 1941. This association, which is here represented by Mr. Gaunt, appointed Mr. Tipton as its member of the Board. The Water Board of Denver appointed Mr. Gross. Mr. Debler for the Bureau made an appointment, but in fact he served most of the time himself. This committee held its first meeting on December 12, 1941, and after a series
1567 of studies reported in favor of the long tunnel.

1570 Denver Exhibit T is a report dated February 16, 1946, made by the four engineers on the Board of Review. I am personally familiar with the signatures of three of the signers, but do not know Mr. Knights' signature.

MR. SAUNDERS offered Denver Exhibit T.
1572 MR. DELANEY objected that Exhibit T summarized a report contained in some 14 or 15 volumes,
1573 and that the proposed expenditures on a project of which the United States will be legal owner had no bearing on Denver's claims. MR. SAUNDERS
1574 replied that Denver expects to take water through structures owned by the United States, that the purpose of Exhibit T was to demonstrate that Denver finally succeeded in 1946 in obtaining
1575 Bureau approval of its plan. THE COURT admitted the Exhibit.

MR. LINDSEY: The project outlined and included in Exhibit T is the tunnel shown as the Montezuma Tunnel on Exhibit S. The elevation
1577 is a few feet higher. Because of that slight difference in elevation negotiations have continued to the present time between Denver and the Bureau of Reclamation to reconcile the difference.

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1578 From 1925 to the present time I have been employed by the Board of Water Commissioners with the exception of a period when I was City Attorney or Assistant City Attorney. During the period when I was City Attorney or Assistant City Attorney, I devoted most of my time to Water
1579 Board work. During both periods I devoted my time particularly to work on the Western Slope water works.

1580 In 1932 an emergency claimed my attention. The year of 1926 was a wet year which filled our main reservoir, Cheesman, full with approximately 80,000 acre feet. Beginning in 1927 a drouth period set in in the Platte Valley. We had to pull down the Cheesman reservoir because the normal flow of the streams was not sufficient to supply Denver and also farmers below Denver who begged so hard for water that we let them have quite a substantial bit of water during that period. The result was that by the end of the first 6 years of the 7-year cycle Cheesman was drained dry and we had no reserve of any kind except a 90-day
1581 supply of water in our local reservoirs. To meet the emergency we obtained options on every piece of water we could get from Denver to the headwaters of the South Platte River. These options gave us the right to use the water for the first year and then the right to use it subsequently if we purchased. In that way we acquired the right to use every bit of agricultural water that we could find anywhere in the South Platte valley. But
1582 even out of that we did not take care of the needs of Denver. A fortunate series of snowstorms in the spring of 1933 helped us to some extent. But even those 1933 storms did not fill Cheesman reservoir.

1583 The emergency demonstrated that the water

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supplies of the Platte River were not adequate to supply Denver with water in a drouth period. The only possible available water for Denver in addition to what it had was from the Western Slope and the only one of the three projects that could be constructed within a reasonable time to supply Denver with additional water was Fraser project. The reason that the Fraser project was available rather than the Williams Fork or the Blue was the driving of the Moffat tunnel. A small pioneer tunnel had been driven near the line
1584 of the main tunnel. After the main tunnel had been driven the pioneer tunnel only needed to be lined in order to make it available as a carrier of water. That was work we could do quickly to relieve the emergency. The Blue River unit was postponed at the beginning of this drouth because of the immediate availability of the Moffat
1586 water tunnel.

1587 The superintendent of the Blue River unit, Mr. Oliver, was pulled off the Blue River unit because we felt that he was the only available man to rush the Moffat tunnel work through. And for some years he devoted his entire time to the Moffat tunnel work. As he got men trained under him to go ahead with the Moffat tunnel work he went back to the Blue.

MR. SAUNDERS asked if the work done on the Moffat tunnel related to the development of the Blue River unit of the transmountain diversion project. An objection was sustained. MR. SAUNDERS offered to prove by the answer to the question that the Moffat tunnel work related to the Blue River unit of the Denver Transmountain Diversion System. He then asked how the Moffat Tunnel unit was related to the Blue River unit of the Denver Transmountain Diversion Project.

Folios

1588 An objection was sustained and MR. SAUNDERS offered to prove by the answer of the witness that the work on the Moffat Tunnel unit was such as to supply from the headwaters of the Colorado River a portion of the water to be used through the purifying and distribution facilities for the use of the people of Denver and through facilities to be constructed for the use of all three units of the Transmountain Diversion Project including
1589 the Two-Forks Reservoir, Cheesman Reservoir, Eleven Mile Reservoir and Antero Reservoir and various distribution conduits and the filters necessary to create a municipal plant. The offer was rejected.

MR. SAUNDERS asked if the Moffat Tunnel exhausted the financial resources of the City and
1590 County of Denver temporarily. After the court sustained the objection, MR. SAUNDERS offered to prove by the answer to the question that Denver
1591 had bonded itself for a large amount of money for the construction of the Moffat Tunnel and the Williams Fork Tunnel and that during the period of drouth and financial stress from 1929 to 1937 the people of Denver had extended themselves as far as reasonably could be expected in the con-
1592 struction of Moffat Tunnel and Williams Fork units of the Transmountain Diversion System. THE COURT denied the offer.

MR. LINDSEY: A general adjudication was had in this court in 1936, the cases being numbered 1709 and 1710. I appeared for the City and County of Denver in those cases and put on evidence in regard to the very project we are now talking about.

1595 THE COURT, over objection, permitted MR. SAUNDERS to read the decree in case 1710, pages 73 to 76 into the record as follows:

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"Blue River Diversion Project. That said project is in Water District No. 36, State of Colorado; that the City and County of Denver, State of Colorado, claimant thereto, did on May 31, 1923, file in the office of the State Engineer of Colorado its statement of claim, which said statement was approved by
1596 said State Engineer and numbered by him as filing No. 13758 in his said office, for a proposed system of collecting ditches and a transmountain tunnel under the name of the Blue River Diversion Project; that under date of October 19, 1927, an amended filing, changing the location of the project down stream, was made by the claimant in the office of said State Engineer, which said amended filing was given filing number 14,837 by said State Engineer in his said office; that a right of way for so much of the amended project as lies on public land was granted by the Secretary of the Interior on October 12, 1932; that the Blue River Di-
1599 version Project is claimed by claimant to be part of the Denver Municipal Water System, consisting of numerous tunnels, reservoirs and other works, some constructed, some being constructed and others to be constructed; that the filing showing such Denver Municipal Water System was made in the office of the State Engineer of Colorado on January 19, 1928 (and approved by him and numbered 14,894 in the files of his office); that claimant, in the prosecution of the construction work on its Denver Municipal Water System, is spending very large sums of money; that claimant has spent many
1600 thousands of dollars on its said Blue

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River Diversion Project for surveys, geological investigations and other preliminary work; but that no physical construction work has yet been done by claimant on said Blue River Diversion Project, and that the rights of claimant, if any, cannot be finally or con-
1601 ditionally fixed at this time by reason of the fact that physical construction of the diversion works has not yet occurred. And it is hereby ordered, adjudged and decreed by the Court: 1. That claimant ought not to be concluded by any decree rendered in this case from claiming a priority which shall antedate this decree in case in some future adjudication proceeding claimant produces evidence that it has proceeded on said Blue River Diversion Project with due diligence to the completion of construction, and the application of water to beneficial use. 2. That nothing herein contained shall preclude said claimant, City and County of Denver, from hereafter obtaining, in a proper proceeding upon due notice, such priority, if any, for its
1602 Blue River Diversion Project as the evidence may warrant, but any priority hereafter awarded for said Blue River Diversion Project, even if earlier than the priorities herein decreed are hereby made expressly subject to the priorities awarded in this decree, and shall not limit the use by the owner or owners of the various ditches, canals, pipe lines, reservoirs or other facilities for the diversion, appropriation and use of the water herein and in this proceeding decree to said various ditches, canals, pipe lines, reservoirs
1603 or other facilities, whether same are final or conditional decrees. 3. That the rights, if

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any, of the claimant, City and County of Denver, under its Blue River Diversion Project
1604 are hereby reserved for future determination in some proper adjudication proceeding. 4. That in any future proceeding concerning rights to the water of the Blue River and its tributaries nothing contained in this decree shall prevent claimant, City and County of Denver, from claiming a priority for its Blue River Diversion Project which shall ante-date this decree and the priorities herein awarded (subject always, to the conditions contained in paragraph 2 hereof) ; and that, in any such proceeding, anyone desiring to oppose the claim of this claimant may do so and may
1605 litigate all questions in relation to said claim, including the question of use of due diligence by claimant in the prosecution of its Blue River Diversion Project. 5. Claimant, City and County of Denver, is hereby permitted by order of this Court to submit its proofs in support of its said claim at any subsequent adjudication day for hearing upon conditional decrees, subject to the provisions of this decree as hereinabove set forth. 6. The fact that the rights of claimant, City and
1606 County of Denver, are hereby reserved for future consideration or determination, shall not prevent this decree from being final and appealable as to all other matters herein contained."

1607 MR. SAUNDERS stated that the foregoing provisions also appear at pages 60 to 62 in the decree in case 1709. He then offered in evidence pages 63 to 76 of the decree in case 1710 and pages 60 to 62 in case number 1709. MR. DE-
1608 LANEY objected and the court sustained the

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1609 objection. MR. SAUNDERS then asked the witness if the City had acquired any conflicting rights which might prove a bar or interfere with the project claimed in this proceedings. Again an objection was made and again it was sustained. MR. SAUNDERS offered to prove that the City
1610 and County of Denver had acquired from one Goldsborough and Bancroft certain claimed water rights upon which those persons had expended the sum of $40,000 and which were located above the diversion points claimed by the City in this proceedings and which would have conflicted to the extent of many thousand acre feet with the water claimed in this proceeding and which rights had been initiated in 1904. The city acquired the rights to prevent the water represented by them
1611 from being diverted from the water shed. THE COURT denied the offer.

MR. LINDSEY: The physical work on the Montezuma Tunnel first commenced at the West Portal on September 17, 1942. Work commenced
1612 on the East Portal on June 24, 1946. The work has continued to the present time on either one portal or the other and is now continuing on the East Portal.

CROSS EXAMINATION

BY MR. DELANEY:

The City and County of Denver derives and exercises its power from the Amendment to the Constitution, Article XX, and to the Amendment of that Article which is Section 6. Section 1 of
1617 the Article reads in part that Denver has the right to acquire water rights and other public utilities "* * * in whole or in part, and everything required therefor, for the use of said city and county and the inhabitants thereof, * * *." The

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1618 Supreme Court has held that Denver has the right to distribute water outside the city limits.

1619 At the present time an action is being litigated by Englewood against Denver regarding Denver's obligation to furnish water to Englewood. The District Court ruled in favor of Denver some months ago and the action has been appealed to the Supreme Court. (*Englewood v. Denver*, 123 Colo. 290, affirmed February 19, 1951).

1621 Protestant's Exhibit 1 is a certified copy of the answer filed by Denver in the case referred to.

1622 It reflects Denver's attitude as to its obligation to supply water outside of its city limits and states that Denver has no authority to do so except on a temporary rental basis when Denver has surplus water.

1623 A number of minor reservoir sites which the city claims are not shown in detail on Exhibit S. The Williams Fork River Reservoir is just off the edge of the map, Exhibit S (upper left-hand corner), Reservoir 22 is on South Boulder Creek. It is not shown on Exhibit S except it is very lightly indicated under the word "Creek" and above the

1624 "Elevation 6305." That Reservoir, when constructed, will be a very important part of our municipal water system.

1625 Protestant's Exhibit No. 2, a Map and Statement of two sheets, shows the exact location of Reservoir 22, which is approximately shown on Exhibit S and Denver's claim with respect to the reservoir. That reservoir would be used in connection with the whole Denver municipal system, which consists of many links. The reservoir is

1626 on Boulder Creek. The discharge from the Blue would go down the South Platte River.

Certain preliminary surveys were made for

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an Empire Reservoir near the head of Clear Creek on the west fork and possibly a filing was made
1627 for such a reservoir. It will not be built because Reservoir 22 will take its place. At one time we
1628 filed on the American Reservoir site which is on Exhibit S about where Tarryall enters the Platte. We gave up the American. Reservoir in favor of Eleven Mile Canyon Reservoir. That is the only reservoir I can think of that we gave up.

We purchased an old series of reservoir filings on the South Fork above where Two Forks
1629 Reservoir is going to be. These were purchased in order to remove them as obstructing and as an obstacle to Two Forks, which is a better site because it would conserve water from both forks.

1631 Protestant's Exhibit 3 is a map of the Empire Reservoir filed in the State Engineer's Office as No. 16257 and signed by the City and County of Denver and also by the Board of Water Commissioners. The City and County of Denver made a filing on that reservoir in 1939. I do not know
1632 whether it has been abandoned.

1638 I have previously mentioned a period of low water supply resulting in an emergency in 1932. This shortage in supply began shortly after 1926 and included the years 1927, 1928, 1929, 1930, 1931 and into 1932. There may have been individual years which were up to normal but the average was low. We entered 1926 with full reservoir storage and by the spring of 1933 the
1639 reservoir storage was nothing. The reserve in storage during the period 1926 to 1933 did not show a constant steady decline. There would be a drop and then the reservoirs would pick up a
1640 little, so the chart would show a jagged line.

During those years Denver leased water to

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farmers outside of the corporate limits of the city. Had there been no water leasing, the shortage
1641 would have existed but not to quite so great an extent.

The actual construction work on the Blue River project commenced July 1, 1942, at the approach to the western portal of the tunnel. There
1642 is a sloping mass of earth leading up to solid formations and an open cut was started in the western toe of that slope to get to the tunnel proper. I do not know how far construction of the tunnel proper proceeded, but it was not a great distance. I have not seen the tunnel recently.
1643 The tunnel is not caved in.

Construction work on the East Portal started immediately after June 24, 1946, the date on which the work order was given.

REDIRECT EXAMINATION

BY MR. SAUNDERS:

Referring to Article XX, Section 6, of the Constitution of Colorado, the following paragraph indicates more extensive powers than contained in the words from the Constitution read in cross-
1646 examination. This language follows:

> "It is the intention of this article to grant and confirm to the people of all municipalities coming within its provisions the full right of self-government in both local and municipal matters and the enumeration herein of certain powers shall not be construed to deny such cities and towns, and to the people thereof, any right or power essential or proper to the full exercise of such right."

1647 I am familiar with the interpretation of Article XX of the Constitution by our Supreme Court.

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1648 It has decided that the powers contained in Article XX are not the exclusive powers of the City and County of Denver. In serving water users outside the city limits, the Board of Water Commissioners does not act as a public utility according to the District Court of Denver. Denver's
1649 Charter states that Denver has the power to lease water outside the city limits subject to a yearly contract and subject to the needs and requirements of Denver.

I can't explain the relationship between Reservoir 22 and the Blue River project without calling attention to certain other portions of the
1650 entire system. Referring to Exhibit S, Cheesman Reservoir, Eleven Mile Canyon Reservoir, and Antero Reservoir are all on the South Fork of the South Platte. There is not enough water above the location of those reservoirs to fill all of them. They have to be filled partly by exchange from water brought through the Moffat Tunnel. When these reservoirs are full, then the Moffat Tunnel
1651 water must be wasted because there is no place where the Moffat Tunnel water can be stored except the Ralston Creek Reservoir. Consequently, there is a very close relationship between Reservoir 22 and the Blue River project. The Blue River project will drop its water down into the North Fork of the South Platte River and that water will be stored in the large Two Forks Reservoir, and in the meantime Reservoir 22 will pick up the slack by enabling us to make better use of the Moffat Tunnel water until such time as the Blue River project can be finished.

1652 The Two Forks Reservoir will have the same effect on water which would otherwise pass through Reservoir 22. When the Two Forks Reservoir is built and the Blue River diverted, it

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will take the strain off the Moffat Tunnel water. The Two Forks Reservoir will absorb all the capacity of the Platte River now available for exchange, so the excess water will be stored in Reser-
1653 voir 22. Two Forks is so large that it can pick up all the Blue River diversion and also the exchange, so the result will be that some excess water or exchange water will be stored in Boulder Creek.

1654 I indicate on Exhibit S by a circle in pencil the position (extreme upper lefthand corner of Exhibit S) of the Williams Fork Reservoir. There comes a time in the fall of the year when water is badly needed for crops. Water drops down so low that our Western Slope rights will not be old enough to pick it up. During those periods water is let out of the Williams Fork Reservoir and the same amount is allowed to pass through the Moffat Tunnel.

1655 The Empire Reservoir if built, would be a small, regulatory reservoir for the water of the Williams Fork River. The Williams Fork water comes through mountains in the Jones Pass Tunnel, which dumps water into the West Fork of Clear Creek. The Empire Reservoir would be on the west fork of Clear Creek. That project is not directly under the Water Board. It is under the Department of Improvements and Parks of the City and County of Denver because the primary purpose would be to supply water at a sewage
1656 disposal plant. The reservoir probably will never be built.

The Williams Fork Reservoir is used to let out the water into the stream during low water periods. It can act just as well for the Blue River project as it has been acting for the Williams
1657 Fork and Fraser Rivers. It is a compensatory

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reservoir. We do not use the water from that reservoir ourselves. It is used to compensate for water taken through the Moffat Tunnel. The waters of Reservoir 22 will be used in the same way, that is, by exchange.

1658 The waters in Cheesman Reservoir, Eleven Mile Canyon Reservoir and Antero Reservoir are used by the City and County of Denver. The waters of the Two Forks Reservoir will be used by the City and County of Denver.

All reservoirs are interrelated in their operation.

TESTIMONY OF F. L. CARMICHAEL

DIRECT EXAMINATION

BY MR. SAUNDERS:

1660 My name is F. L. Carmichael. I am a member of the faculty of the University of Denver. I devote a small part of my time to teaching, the
1661 larger part of my time is devoted to the Bureau of Business and Social Research of the University of Denver.

I am a statistician, having had six years col-
1662 lege training in mathematics and statistical techniques. I have had almost twenty years experience with the Research Bureau in making studies of problems of concern to the City of Denver.

The Bureau makes studies of housing in Den-
1663 ver. One series of studies is an annual survey of certain aspects of housing in Denver. We are now completing the 20th such annual survey. Experience has demonstrated the accuracy of the Bureau's work.

1664 I have recently made a study for the Board
1665 of Water Commissioners of population growth

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in the Denver area. The Denver area used in the study consisted of four counties, Denver, Adams,
1666 Arapahoe and Jefferson. Certain of the problems in that area are closely interrelated. The Denver Metropolitan District as defined in the past by the Bureau of Census comprises the greatest part of that whole area. The plans as I understand them for the 1950 census are to make the entire four county area the Denver Metropolitan
1667 District and to consider the four county area as a single metropolitan unit.

1668 In 1940 Denver itself had a shade under 80% of the total population of the four counties. The population of Denver in 1940 was 322,412; for the four counties, 407,768. The population of the Denver Metropolitan Area located outside of Denver is located very close to the city limits.

1671 In making my study of the trend of population in Denver I have used census data for the years 1910, 1920, 1930 and 1940, and to estimate
1672 present population, have used our most recent housing study.

1673 The trend of population in the past forty years is a criterion upon which workable estimates of growth can be made.

1675 The population study which I have made has been prepared for the four county area and not for Denver itself. I made use of four different hypotheses. The first used is the 1930-1940 rate of growth projected from 1940. This hypothesis does not take into account the rapid increase since 1940 in rate of growth which is almost double
1676 that of the period 1930-1940. The rate of population growth between 1930 and 1940, the depression years, was the least of any of the past four decades. This hypothesis is certainly most

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reasonable as to probable rate of growth in the future.

1677 Another method used is to project the average rate of growth of the three decades 1910 to 1940 forward from 1940. I think this a very reasonable method also, but not quite as conservative as the first method mentioned. Under the first method described, that of continuing the 1930-1940 rate of growth forward from 1940, the population of the four county area in the year 2000
1678 would be 976,000. Under the second assumption the population in that area would be 1,113,000.

The third assumption used is that of growth from 1950 at the 1930 to 1940 rate. The four county population in 1950 is estimated at 525,000 and projecting the 1930-1940 rate from this figure to the year 2000, a population of 1,086,000 is indicated.

I have used one other method which is described as growth based upon the area's increasing proportion of total U. S. population which is a
1680 fraction of 1%. There has been a rather sharp steady increase of Denver's proportion of the total U. S. population and a projection of that to 2000 A. D. gives us a figure 58/100 of 1% of the total U. S. population. By this method we have to make some assumptions as to the total U. S. population in 2000. I do not have this officially, but in the United States News and World Reports there is a statement made of studies by the Bureau of Economic Research that by 1975 the population
1681 of the U. S. will be 188,000,000. Again to be conservative I have used 175,000,000 as the total U.S. population in 2000 A. D. Applying that 58/100ths of 1% to the 175,000,000 we have 1,015,000 as the projected figure.

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Up to this point of my testimony I have not indicated estimates; I have simply used what I regard as reasonable assumptions and stated the projected figures according to assumptions made.
1682 A statistician considers other factors in arriving at his own estimates. These may be summarized briefly. One of the things which I consider important in testing the reasonableness of the projections is what is happening to business generally. There is a trend toward the decentrali-
1683 zation of business and industry which reached great impetus during the war. The continued rapid growth of Denver is closely tied in with this factor.

Studies made by the Census Bureau in 1947 of some 30-odd metropolitan districts shows that
1684 Denver's importance as a trading center has increased greatly. In wholesale and retailing there was an increase in the number employed in those lines from 1940 to 1947 of 53.4%. There was a corresponding increase in service industries of the same period of 32% and in manufacturing industries of 73.6%. In all those respects the percentage gains of Denver are greater than the
1685 general average in other metropolitan districts. These factors are summarized in an overall employment increase for Denver of 49.3% and for the 33 other metropolitan districts of 32.5%. Another point worth mentioning is the diversity of manufacturing in the Denver area. We have actually a large number of manufacturing establishments widely diversified that have contributed to the strength of the Denver area. One further point is Denver's rank as an air center which has increased rapidly since 1940.

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CROSS-EXAMINATION

BY MR. DELANEY:

1688 In making my estimates, I did not go back to 1900 because the area of the four counties decreased in size between 1900 and 1910 rendering
1689 comparison difficult. The 40-year period is suf-
1692 ficiently long. If you go back to too early a date the percentages are badly distorted because of an increase of a small number over a small base. The population of the four county area actually increased more percentage-wise from 1900 to 1910.

1694 The Bureau of Census made an estimate of the population of metropolitan Denver in April of 1947. The metropolitan district as defined covers more than Denver itself but less than the four counties. The estimate was 471,460. In
1695 1940 the four-county area had a population 6.1 percent greater than the 1940 population of the Denver metropolitan district, so applying 6 percent to a base of 471,460, you obtain a figure a shade over 500,000 as the population for the four counties in April of 1947.

1697 MR. SAUNDERS stated that pursuant to permission granted by the Court, Mr. Carmichael would return later for further cross-examination.

TESTIMONY OF DWIGHT D. GROSS

BY MR. SAUNDERS:

1698 My name is Dwight D. Gross. I am a civil engineer by profession and am chief engineer in charge of the operation of the Denver Water Plant. I received a degree in civil and irrigation engineering from the Agricultural College at Ft.
1699 Collins in 1903.

Folios

MR. DELANEY admitted the witness' qualifications.

MR. GROSS: I was employed by the Denver Union Water Company in September of 1903 after I graduated from college and I have been with the Water Department of Denver ever since, both under private ownership from 1903 to
1700 1918 and from 1918 to date under City ownership.

I have been Chief Engineer since 1926. Part
1701 of that time I was employed to do drafting or field work and was assigned to test cement in the construction of Cheesman Dam. I remained in that class of work until after the plant was purchased by the City in 1918 and then I became chief draftsman. In 1926 I became Chief Engineer and in 1933 was given charge of operation of the plant as Superintendent as well as Chief Engineer. As chief draftsman and office engineer I had charge of the records and prepared plans and estimates, and in that way am familiar with the records
1702 of the department. As Chief Engineer these records are under my custody and control.

The duties of the Chief Engineer's office are to prepare plans and make investigations of work that should be done. We secure bids and see that construction is executed after our recommendations are approved by the Board of Water Commissioners. As Superintendent, I am in charge of operation of the plant. I have charge of the reservoirs, filter plants, conduit lines, and all parts of the plant that have to do with securing, treating and delivery of water. I am in charge of construction, operation and maintenance of the physical water works system that supplies Denver
1704 with water. Most of the men that now hold

Folios

positions as supervisors and engineers have been with us for some time and were put into those positions on my recommendation. I am responsible for their work.

The water system serves what is known as Metropolitan Denver which includes the City itself and considerable adjacent area such as the suburb towns of Englewood, Aurora, Edgewater,
1705 Lakeside and a number of unincorporated communities. The system serves these areas with treated water and a very small quantity of raw water through raw water ditches, owned and
1706 operated by the City. The City owns the High Line Canal, the City Ditch and the Farmers and Gardners' Ditch which do not carry potable water. The treated water which is served by the Denver Municipal water system is served by taps. The tap is the connection between the consumers'
1707 property and the water system.

The ditches are incidental. The great bulk of the plant is a treated water plant. The treated water System serves an area of approximately
1708 120 square miles lying both inside and outside the Denver city limits. The Denver Union Water Company also sold water outside the city limits of Denver. Since Denver took over the water system from the Denver Union Water Company in 1918, service has greatly increased and is still
1709 increasing very rapidly. Recently we made the 100,000th tap. The City has doubled in population since it took over the plant, and the population served by the water system has doubled since the City took over the plant. The area
1710 served has become more densely populated. With-
1711 in the area now served, the potential unused area is diminishing rapidly.

Folios

Water is distributed inside the city by mains. The Water Board does not extend mains outside of the city. The consumers make their own extensions. If the consumer is a city, it will organize and in some cases private individuals organize and extend mains at their own expense. The area outside the city which can be served is limited only by the water supply and in some directions
1712 by natural conditions. The maximum area that can be served outside the city limits is perhaps 140 additional square miles located in the immediate vicinity and adjacent to Denver.

Denver Exhibit O is a map of the Denver Metropolitan area. The area now served with water is shaded blue and the areas it is assumed may be served in the future are shaded red. The
1713 map accurately represents the things shown thereon to the best of our information.

MR. SAUNDERS offered Denver Exhibit O
1717 and it was admitted over objection.

MR. GROSS: Exhibit O shows the Denver City limits by a heavy dark line. Part of the area within that line is colored red indicating that the area will be served with water in the
1718 future. Just inside the southern city limits of Denver are two small islands which did not choose to become a part of Denver when contiguous areas were recently annexed. These islands are very small in relationship to the area within the city limits.

1721 Mr. George M. Bull was first employed by the Board of Water Commissioners sometime
1722 previous to 1921. He was a graduate of Rensselaer Polytechnic Institute and was an engineer of considerable experience in irrigation, water rights and the development of water. He had

Folios

experience in investigating transmountain water and water sources and for that reason was employed by the Board of Water Commissioners.
1723 He was not a part of the Engineering Division of the Water Department; he operated separately, but in cooperation with the Engineering Department in conducting surveys and in preparing maps and records in order that the City might acquire additional water. The records of the performance of his work for the City are a part
1725 of the records of my department.

There are in the files of the Board of Water Commissioners reports prepared by Mr. Meeker and Mr. Lippincott (Exhibits W and V, respectively), consulting engineers who had been employed to investigate water conditions on the
1728 Western Slope. Mr. Bull studied those reports and then made a reconnaissance of the Blue River water supply and followed that up with surveys.

MR. SAUNDERS inquired what Mr. Bull had done with respect to the Colorado River resources of the Water Department prior to making the reconnaissance survey just described. MR.
1729 BARNARD objected that evidence as to other projects had nothing to do with the case. MR.
1730 SAUNDERS then stated that on the basis of the evidence which had been adduced in this hearing, Denver has a single water works system with two sources of water supply, one source in the South Platte River and the other source in the tributaries of the Colorado River; that the evidence on this point is that the Colorado River sources constitute a single system divided into a number of units; that an objection had been made by counsel to the introduction of evidence to show to the Court the fact that the Williams Fork system, the
1731 Fraser River system, the Blue River system, are

Folios

all part of a single water project; that the Court will never be in a position to judge whether or not this is truly a single system or many systems unless Denver was permitted to place before the Court the evidence which indicates that there is a single system. The refusal to allow testimony which would show this fact is in effect a refusal to permit this claimant to expound to the Court
1732 its theory of its own case. The COURT over-
1734 ruled the objection for the time being.

1735 MR. GROSS: In 1921 Mr. Bull put a party of engineers in the field in order to get the necessary information for the preparation of filing maps on water on the Fraser River and Williams Fork. In the winter months of 1921 and 1922 the
1736 filing maps were prepared in the office. In the summer of 1922 the field parties were put in the valley of the Blue River near Dillon to make the necessary surveys for the information to prepare filing maps for Blue River water. In the winter those maps were prepared and filed in 1923 (Exhibit A).

1737 Before doing this work in 1921, 1922 and 1923, Mr. Bull made a written recommendation for it to the Board of Water Commissioners before they authorized him to start the work. Denver Exhibit P is a copy of his report to the Board entitled, "In Re Survey Work in Connection with Western Slope Development" (dated June 16, 1921) which comprises a part of the minutes of the Board (dated June 21, 1921).

1738 MR. SAUNDERS offered Denver Exhibit P in evidence and after hearing objections, the
1741 COURT reserved ruling. The exhibit was later admitted (f. 2038).

1742 MR. GROSS: I testified that in 1921

Folios

and 1922 surveys were made and filing maps were prepared and filed with the State Engineer. After some study of the situation it developed that the surveys ran through a very steep country along mountain sides where it would be difficult to construct ditch lines. Nature had made the hills about as steep as they could stand. Other diffi-
1743 culties were involved. There were to be some 65 miles of collection ditches, so in 1926 it was decided to investigate further the desirability of locating an intake at a lower elevation where there would be less difficulty in the construction of collecting ditches. As part of that investigation it was discovered that a satisfactory location could be secured near Dillon and a survey was made and the maps prepared and filed with the State Engineer (Exhibit B) with the idea the diversion of water would be made through a long
1744 tunnel from a point near Dillon on the Blue River to a point near Grant on the north fork of the South Platte.

Denver Exhibit C (filed with State Engineer, January 19, 1928) is a composite map of the Denver water system showing the proposed improvements in the matter of securing an additional water supply. It shows the Blue River catchment area, the proposed diverting tunnel from Dillon to the South Platte, the various areas in relation-
1746 ship to one another. It shows Denver's transmountain system from the head waters of the Colorado as proposed by the City and County of Denver.

MR. SAUNDERS re-offered Exhibit C, MR. BARNARD objected and the COURT reserved ruling.

1747 MR. GROSS: On page 3 of Denver Ex-

Folios

hibit A (1923 Map and Statement of Blue River diversion project), the following words appear: "Work on the entire Blue River Project was commenced by survey on the 21st day of March, A. D. 1914." Mr. Lippincott made the survey which is referred to by those words and his report of his work is in the files of the Board of Water Com-
1748 missioners. Denver Exhibit V ("Preliminary Report for a New Water Supply for the City of Denver by J. B. Lippincott dated August, 1914") is
1749 the report to which I referred.

Denver Exhibit W is a report to the Public Utilities Commission of Denver made by R. I. Meeker (report dated May 18, 1914, entitled "A Transmountain Water Supply from the Fraser, Williams Fork, and Blue Rivers for the City of Denver").

1750 R. I. Meeker was a Denver engineer who specialized in water rights and water development. His report was made before the Lipincott report, Exhibit V. Meeker investigated the water rights and Lippincott advised the Public Utilities Commission as to the matter of a new system for Denver. Lippincott used the Meeker report. While he investigated the Colorado River personally, the information he had came from the Meeker report, Exhibit W.

1751 MR. SAUNDERS offered Denver Exhibits V and W in evidence with the understanding that counsel could object to them later if they so desired. The exhibits were later admitted (f. 1992).

1752 MR. GROSS: Rights-of-way were secured from the federal government for the location of the conduits and tunnels shown on Denver Exhibit A, but I can't remember about those shown on Exhibit B. Efforts were made looking

Folios

toward securing them, but the granting was delayed and I do not remember what happened. The Engineering Department prepared the necessary maps to file for the purpose of obtaining Federal rights-of-way.

The Water Department prepared the necessary plats and plans and specifications for the
1753 works described in the Bull letter of June 16, 1921, which is Exhibit P. That was a major job
1754 requiring the expenditures of large sums of money which took considerable time.

The first work I mentioned was surveys and the preparing of filing maps and filing them on the Fraser River water sources and the Williams Fork sources and on the Blue. Then there was a second map prepared on the Blue. There was then an agreement entered into between the Board of Water Commissioners and the Moffat Tunnel
1756 Commission. Under the terms of this agreement, the Board of Water Commissioners took over the pilot bore of the Moffat Tunnel and improved it to make it a water carrier by enlarging and lining it. This work was in progress for a number of years and later actual diversion of the water on the Fraser River was commenced and water was brought through this pilot bore and delivered to Denver for use of Denver citizens.

The Williams Fork Tunnel was built by the Department of Improvements and Parks of Denver acting under authority from the
1757 Board of Water Commissioners and the Williams Fork Reservoir was constructed below that diversion project as part of the Williams Fork project. Williams Fork water stored in that reservoir is used to compensate water users down the Colorado River at times when water is diverted

Folios

into the Denver system at periods of the year when the water supply is low. They are given water from the Williams Fork in lieu of water
1758 the city takes from the Fraser River. That water is also available for trading for Blue River water and is a benefit to the users on the Colorado Rivers as well as the Denver Water Department.

We also proceeded with additional work on the Blue River Tunnel. In 1931 Mr. Oliver, who is here, laid out a system of triangulation to locate on the ground the line of the Blue River
1759 transmountain tunnel. The tunnel line was staked and Mr. Lovering was loaned by the Government to geologize the tunnel site. He found some places difficult to determine and asked that further geophysical work be done. Further geophysical work was done by Mr. Wilson, whose address is
1760 Golden, and in 1931 or 1932 a report was prepared by Mr. Lovering. After that report was prepared some new obstacles were met and he reported unfavorably on this tunnel. There were a great many ground faults in the site and if the tunnel was driven as located on Denver Exhibit B, there would be a great deal of expense
1761 involved. Mr. Lovering recommended that a change be made in the tunnel to avoid the bad ground. He suggested that if what we called dog legs were run in the tunnel or an angle built in it so that the tunnel would go by way of Montezuma, we would meet better ground and it would be easier to drive the tunnel and it would be worth while to make it half a mile longer in length.

1762 Mr. Oliver made another survey of the line, then prepared a map and staked the line on the ground. This tunnel was also geologized in part by Mr. Lovering, but he could not be spared for a sufficient time from the Government to finish

Folios

the work. So another geologist, Mr. Wallstrom, was engaged and he worked under Mr. Lovering for a time and finished the work under his own direction the following season. I can't place the
1763 exact time, but Mr. Oliver, who is here, can. There was some time between the geologizing of the straight tunnel and the Montezuma, but I don't recall the dates.

1764 While this geologizing was in process, diamond core drilling work was done in order to determine ground that was difficult for the geologist to form opinion on. The Board of Water Commissioners entered into an agreement with the Reclamation Service to do the diamond core
1765 drilling at several points on the site of the tunnel. The engineers for the Board of Water Commissioners concluded that it would be better to use the tunnel described as the Montezuma Tunnel. There was no substantial deviation in the portals of the two tunnels. The West Portal of the straight tunnel shown on Exhibit B (1927 filing) and the West Portal of the tunnel as proposed to be changed by reason of geological considerations is different in elevation by 20 feet, that is, the new portal is 20 feet higher. The distance between the two portals is 3500 feet. Both
1768 of these portals would control all of the watershed that would have been controlled by the transmountain tunnel shown on Exhibit A (1923 filing) and both will control a greater area of runoff.

The physical means by which water was to be brought to the West Portal of the tunnel shown
1769 on Exhibit B (1927 filing) was a low diverting weir designed to divert 1,600 feet per second into the tunnel located on the Blue River. A conduit and tunnel would bring the water from the Snake to the Blue above the weir. Ten Mile empties into

Folios

1770 the Blue above the weir. Diversion was near the town of Dillon.

The new portal required a higher weir or dam to be located further downstream as compared to the original one. Denver Exhibit D is a filing map for the higher weir or dam which is

1771 designated as Dillon Reservoir, which is to be a part of the Denver Municipal Water System. The diverting weir for the tunnel and the dam for the

1772 reservoir are identical.

MR. SAUNDERS offered Denver Exhibit D and it was admitted in evidence without objection. MR. SAUNDERS stated that without reading the entire claim statement it was a Map and Statement for a storage reservoir at Dillon claiming 252,000-odd acre feet storage.

1773 MR. GROSS: Construction of the transmountain tunnel from approximately Dillon to Grant as shown on Exhibits B and C started with excavating an approach at the West Portal. A small exploratory tunnel was driven about 400 feet through the rock formation. Considerable water was met, and it was decided to do further work at the East Portal. Construction work was started at the East Portal for a tunnel 11 feet in

1774 diameter to be 10 feet when lined.

The original plan called for a much larger tunnel and contemplated the low weir described a while ago. In the process of diverting water, the weir backs up water, raising the elevation so as to force the water into the tunnel. There is a holdback of water for a short time. Under the new plan the water will be held back for a longer period

1775 of time until it is possible for all water to pass through the tunnel. This idea was adopted because of the expense of driving a large tunnel.

Folios

The water when carried through the tunnel will be stored in a reservoir on the Eastern Slope. It is now contemplated to hold this water back until it can flow through the tunnel at a uniform rate.

1776 The flow of water in the Blue River is seasonable. It starts to rise in April, more in May, reaches its peak in June, is less in July and August and September. When the minimum flow period arrives there would be no water for diversion into the tunnel except by trade, and hence the development of power would not be practical. It would take a large plant to handle the water in June and in the wintertime the plant would be idle. But under this scheme as outlined an efficient power
1777 plant could be built with a continuous supply of power the year around. The savings in cost and the advantage of power were important things to be considered. The net value per year of this change in design would be more than $200,000 as to the power side, and the savings in cost on the tunnel, more than $10,000,000.

1778 Under the original plan with the low weir the plan was to drive a small tunnel at the start and then as demand increased for water to enlarge the tunnel to the large size required to handle the peak flow, or 1600 feet per second. The present
1779 work on the tunnel is consistent with the original program in that the tunnel could be enlarged if the present plan is not approved. By that I mean that if it is not possible to obtain a decree for the handling of the water supply on the basis of the high weir, then the plan of driving the larger tunnel could still be followed. As a matter of ordinary construction, the small tunnel would be
1780 first driven as a pilot bore, and then enlarged as required.

Folios

1781 The first physical construction work at the West Portal was done in 1942. This excavation work was discontinued because we met so much water. Later work was started on the other portal. The mouth of the West Portal tunnel, perhaps 80 feet of it, has caved in. The tunnel was driven in wartime and the timber used came
1782 from poles cut on the site. In the spring when heavy rains came, it caused caving there. The main object in driving the tunnel was to ascertain the condition of the ground.

During the war we could not get steel timbers for the tunnel. The work at the East Portal started in 1946 and is in progress at present. The
1783 tunnel has been driven over 2800 feet in good ground. Practically no water has been encountered at the eastern end of the tunnel. If water was encountered the grade is a rising grade and the water would drain without pumping. At the inlet portal it would be necessary to pump continuously to handle the water.

1784 It is estimated that it will cost $30,000,000 to drive the tunnel. As of December 31,
1785 1948, $156,726.50 had been spent driving the tunnel and, in addition, equipment costing $68,903.53 had been purchased. Additional work has been
1786 done since December 31, 1948.

The reservoir on the Eastern Slope which will receive the water when this tunnel is completed is
1787 Two Forks. Denver Exhibit N is a filing map of the Two Forks Reservoir (dated April 7, 1927) and was filed with the United States Government for the purpose of obtaining a right-of-way for the reservoir. It accurately represents the Two Forks Reservoir as proposed.

Folios

1788 MR. SAUNDERS offered Exhibit N in evidence, and it was received without objection.

MR. GROSS: In my testimony I have referred to treated water and the treated water system of Denver. To obtain treated water, it is first necessary to filter the water and then to treat it with chlorine. A very small percentage of our
1789 water is secured from underground galleries, and that water is just chlorinated—filteration is not required for it. Conduits convey water to Denver's four filtration plants. From these filtration plants the water goes into control reservoirs which hold filtered water and from there into the city.
1790 In the daytime when water demand is heavy water is drawn from the control reservoirs and at night when demand is less, water continues flowing into them from the filter plants. These are called control reservoirs and float on the pipes connected to them. It is one single whole system having
1791 two major sources of water supply, one in the South Platte River and its tributaries and the other in the headwaters of the Colorado River. In the operation of the system there is a commingling of the water from each source and the water is
1793 interchangeable.

In its operation the Denver Water Department has served water inside and outside municipal boundaries. The water served has been the
1794 same—everybody gets the same water. The water
1795 supply is used for the whole system without regard to where it is going to be delivered. There is no distinction made between quality of water delivered inside and outside the city. There was a time during the war when additional water could not be sold outside to new consumers.

1797 In serving the entire population which is

Folios

furnished treated water, in about 1935 the Platte River resources became insufficient to serve a larger community than was then being served. There had been a shortage of water prior to that time and if no supply other than the Platte River had been available, there would have been no reason to extend the facilities of the treated water system beyond what they were prior to 1935. The
1798 water shortage creating the emergency of 1932-
1799 1933 caused the people of Denver to wake up to the situation and to the fact that they would have to have another source of supply. They became interested in the development of water from the headwaters of the Colorado River. Previous to that time many people thought there was enough water in the South Platte River to supply the city, and were not interested in voting the necessary
1800 funds to carry on the construction and development of Colorado River water.

1801 As Chief Engineer, I have made both written and oral recommendations to the Board of Water Commissioners for the pushing of construction of
1882 structures to bring additional water into Denver. The 1932-1933 drought period resulted in the im-
1803 mediate pushing of development of Fraser River water. We finished the lining of the Moffat Tunnel and constructed the Ralston Reservoir. We
1804 did not have enough money to build all three transmountain projects at the same time. It would not be practicable to construct all three at one time. It is not physically impossible, however. At that time (1932-1933) Mr. Oliver was in charge of construction of the Blue River unit. When the
1805 emergency developed he was taken off the Blue and put on the Moffat Tunnel project. We did not have enough money to hire other men. In
1806 1933, the low point in the emergency, we only had

Folios

about 4,000 acre feet of water left in Cheesman, and we could not get all of that out. At that time
1807 Denver was using about 80,000 to 85,000 acre
1808 feet of water per year. The Cheesman reserve was wholly inadequate and there was no place to go for additional water to build the reserve up immediately.

The best available quick source of water to meet the emergency was water from ranch lands in South Park, and this water was developed but
1809 the success of this development was only minor. By that time we were in position to start construction of the Moffat Tunnel Diversion Project. Construction was started on the Moffat Tunnel unit instead of the Blue River because it was easiest from the standpoint of practicability. The Blue River Tunnel would be miles long. The Moffat Tunnel was already constructed. It took only a short time to enlarge the Moffat Tunnel
1810 to make it available to carry water and to make the water available. The Moffat Tunnel could be put to use quickly and the Blue River Tunnel would have taken a long time to build. The
1812 Moffat Tunnel was adequately financed after a time to the extent of $11,000,000. The Moffat
1813 Tunnel supplies water to the Denver Water System.

MR. SAUNDERS asked if the system which carries Moffat Tunnel water consisted of the same system which will carry Blue River water. THE COURT sustained the objection and MR. SAUNDERS offered to prove that the answer would be "Yes".

1815 MR. GROSS: In connection with the Two Forks Reservoir and the use of the water from the Blue River unit be-

Folios

tween Grant and the Two Forks Reservoir, topographical surveys were made looking toward
1816 the development of power from the water. The Board of Water Commissioners cooperated with the Geological Survey in making what is called a quadrangle sheet to show the topography of the
1817 area. Some $14,000 was spent on this work. The work was done by government engineers and the $14,000 was the Board's share of the expense, according to my recollection. It took several summer months to complete the work, and it was more than a year before we received the maps.

My signature appears on Denver Exhibit T. (Report of Engineering Board of Review, dated February 16, 1946.)

1818 The Board of Water Commissioners cooperated with the United States Bureau of Reclamation to develop the Blue River unit of Denver's transmountain water system. During the depression there were extensive PWA projects in which men were trained and worked with the Geological Survey in developing quadrangle sheets of the whole area above Denver and large areas in which we were interested in getting information as to the topography of the country. The Board cooperated with payments of money over
1819 a long period of time and by exchanging information with the Bureau of Reclamation.

I was a member of a committee known as "Engineering Board of Review". The committee was organized to review different projects that the Reclamation Service had in mind. It con-
1820 sisted of members from the Board of Water Commissioners of Denver, one from the South Platte Water Users Association, one from the Bureau of Reclamation, and one from the Colorado Water

Folios

Conservation Board. The Reclamation service had been investigating several different methods or routes by which water could be diverted from the Colorado River to the valley of the South Platte. They had one plan which took water from the Blue into Williams Fork and then into Clear Creek. Another route came from the Blue to Williams Fork, and into St. Louis Creek, and then along the Fraser River and through the Moffat
1821 Tunnel into South Boulder Creek. A third was much the same as the route selected by the Board of Water Commissioners for the Blue River Project. These projects all developed the same water. The Bureau proposed to take water from The Blue River, Eagle and Williams Fork and put it through a common tunnel. There was some question in their mind as to which route was best, so it was decided to form this Board of Review and let them consult with the Bureau as to which route
1822 to take. Mr. Knights was one of the engineers with the Bureau who had been put in charge of the surveys of different routes. The Engineering Board of Review also considered some other matters set forth in this report (Exhibit T) but the main question considered was the route to be selected. The Board was set up in 1944, I believe. Work of correlation is still going on.

1823 Denver Exhibit G ("Summary of Charges to Blue River Diversion System, October 1, 1920 to October 31, 1949") lists items of work and the cost thereof performed on the Blue River Unit of the Transmountain Diversion System to October 31, 1949.

1824 As a part of my duties as Chief Engineer, my department makes estimates of the cost of items of work to be done by the Water Department and furnishes estimates for physical construction

Folios

to be done during each calendar year for the pur-
1825 pose of budget making. Denver Exhibit J is the Capital Outlay Budget for 1950 for the Board of Water Commissioners of Denver. The budget includes items of work for the Blue River Unit of Denver's Transmountain Diversion System. One of the items in S-12 of $127,000 is budgeted for the coming year on the Blue River Diversion Project.

1826 MR. SAUNDERS offered Denver Exhibit J. MR. DELANEY admitted the authenticity of the Exhibit and stated that he was willing to admit that there were items shown on page 4 of the Budget carrying budget numbers S-12-24, 25, 26 and 27, aggregating $127,000, which pertained to the Blue River project and which was summarized as one item in S-12 on page 3.

MR. GROSS: I have marked items with
1828 penciled checks on page 4 of the Budget. These items are a part of the Blue River Diversion Project. Item S-3 is to "Acquire Right of Way—Williams Fork Reservoir, $2500.00." As brought out in the testimony, the Williams Fork water will be treated as compensatory water for the Blue River. The money is to be spent in 1950 to acquire land for an enlargement of that reservoir, and that reservoir will enable my department to develop
1829 water for a longer season through the Blue River Tunnel.

Item S-9 is "Clear Water Reservoir in lieu of Coagulation Basin—North Marston Lake, $210,600.00." When Blue River water is brought into Denver, some of it will go into that plant. Item S-10, "City Pipe Line System—Extension of Service Mains, $700,000.00." These mains are being extended for use in a newer area in the City and will receive water from the Blue River. Under

Folios

Item S-12 there is a sub-item "City pipe system—extension of service mains, $355,170." This money
1830 was budgeted this year (1949) and the work will not be done until next year. The work will consist of the extension of service mains in the city pipe system.

THE COURT admitted Denver Exhibit J over objection.

CROSS-EXAMINATION

BY MR. BARNARD:

1833 Denver supplies all of Englewood's water but it does not supply Littleton's water, with the exception of a few people there who get water from a Denver conduit that runs through the town. Littleton has its own system.
1834 The Denver water system does not supply Golden but it supplements Golden's water. It does
1835 not supply Derby or Adams City.

I am somewhat familiar with the contracts under which consumers beyond the city limits of Denver are supplied. These contracts are drawn on a year-to-year basis and are terminable at the option of the City. The untreated water supplied
1837 to irrigators is not on a year-to-year basis. When Denver acquired the ditches they were going concerns and Denver just continues to operate them. Some of the users under the ditch have rights of a temporary nature which they renew each year. All pay assessments. As to new users, the city
1838 could refuse to renew their contracts. Denver
1840 does not build water mains to deliver water to houses outside of Denver.

I previously testified that a filing (Exhibit A) was made in the State Engineer's Office on the Blue River Unit in 1923. Further study indi-

Folios

cated that there would be difficulty in construction and in 1926 a decision was reached to investigate
1842 a different intake to avoid those difficulties. It was after 1926 that the Dillon site was discovered
1843 and we fixed upon the present plan of diversion. The efforts to obtain the right-of-way from the Federal Government for the Blue River Diversion project were made shortly after the 1927 filing (Exhibit B).

I do not remember whether any applications for rights-of-way were made in connection with
1845 Denver Exhibit A. The Government has not given us any right-of-way for the Two Forks Reservoir. We have made application for such a right-of-way. There has been a power withdrawal and now there is a Reclamation withdrawal that prevents Denver from using the site at present. It is quite certain that we will be permitted to use it if the Reclamation Service does not proceed with their construction.

1846 Referring to Denver Exhibit A (1923 filing) the plan called for a series of collection ditches meandering around the mountains and for the Transmountain Tunnel to carry the water from Swan River to Jefferson Creek. The new tunnel (Exhibit B) starting at Dillon would pick up all of the water picked up by the
1847 tunnel shown on Exhibit A. It is not the present intention to construct the Transmountain Tunnel reflected by Exhibit A. We would prefer to drill the other one.

1848 Exhibit B (1927 filing) shows the long tunnel that discharges water on the Eastern Slope
1849 into the North Fork of the South Platte River near Grant. The tunnel shown on Exhibit A discharged the water into Jefferson Creek, which is south of Grant. With the exception that there

Folios

have been some minor changes in the portals of the long tunnel, that tunnel as shown on Exhibit B is the present plan of construction. We just put elbows or dog legs into that tunnel to avoid bad ground.

1850 The water from either of these tunnels shown on Exhibits A and B would be discharged from the Western Slope into tributaries of the South Platte River above the site of the Two Forks Reservoir. The Two Forks Reservoir could be used to store water carried from the Western Slope through either the original four and a half mile tunnel or the present planned tunnel and
1851 would serve the same purpose regardless of which tunnel is used.

An exploratory tunnel was driven a distance of about 400 feet in 1942 at the West Portal of the Montezuma Tunnel. Work at the East Portal
1852 of that tunnel was started in July of 1946. That was the first actual construction work, but we claim work was started by survey.

I have testified that originally the plan was to divert water through the Montezuma Tunnel by means of a low weir. A weir is a diversion dam. If something were not put in the stream, the water
1853 would go down the stream instead of going into the tunnel. It is necessary to retard the water to divert it from its natural channel.

1854 The present plan comprehends a high weir for diversion purposes. The weir is the dam for the projected Dillon Reservoir. The proposal is to hold water in the Dillon Reservoir until it can be diverted by means of the Montezuma Tunnel.
1855 The Dillon Reservoir makes a separate claim for storage rights. The capacity of the Montezuma

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Tunnel when completed and lined will be 788 cubic feet per second of time.

1856 I previously testified on direct examination that in 1935 Denver had reached the point of exhaustion of available water from then existing sources of supply to serve the users it was obligated to serve. These include the users
1857 of water under annual contracts. At that time there were not many of them and they did not cut much of a figure one way or the other.

I testified previously as to the creation of the Engineering Board of Review, containing representatives of the Bureau of Reclamation, the Denver Water Board, the Colorado River Conservation Board and the South Platte Water Users
1858 Association. The function of that committee was to select the best means of getting water from the Blue River to the South Platte. The committee made their report under date of February 16, 1946 (Exhibit T).

1859 Referring to Exhibit J, which is the Capital Budget of the Denver Water Board for 1950, the breakdown of the expenditure of the $127,000 for the Blue River is as follows: $10,000 to pay the cost of adjudicating the city's water rights in the Blue River Water District No. 36; $5,000 for the purchase of land for the Dillon Reservoir site; $100,000 for driving the Montezuma Tunnel; and $12,000 for further investigations and engineering work on the Blue River project with special attention to the Montezuma Tunnel. Each of these items is a part of the $30,000,000 that I estimated the tunnel will cost.

Item S-3 on the budget is $2,500 for acquiring rights-of-way for the Williams Fork Reservoir.

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1861 Item S-9 would not be built if Denver's growth were to be stopped by lack of water.

1862 Item S-10, the extension of the Denver pipe line system inside the city limits will be built all over the city. The same thing is true of the Item S-12, except that the work described in S-12 was work budgeted in 1949 that will be carried over
1863 and completed in 1950.

CROSS-EXAMINATION

BY MR. DELANEY:

The Board of Water Commissioners has obtained private property for the Two Forks Reservoir, but has not obtained a government right-of-way for that part of the site on public domain.
1867 It is my understanding that the right-of-way for
1868 the tunnel from Dillon to Grant was granted. An application was made to the Federal Power Commission for a power project in connection with the Two Forks Reservoir. The land involved was withdrawn. The land is not given to the party making the application unless they proceed with the project.

Protestant's Exhibit 5 is a map filed with the Department of the Interior for the right-of-way for the straight tunnel from Dillon to Grant, not
1870 the Montezuma Tunnel. I do not know whether the particular right-of-way requested as repre-
1872 sented by Protestant's Exhibit 5 was granted.

Exhibit E attached to Protestant's Exhibit 1
1873 are the Rules and Regulations of the Board of Water Commissioners. Rule 17 on page 11 of Exhibit E to Protestant's Exhibit 1 refers to the Charter Amendment under which the Board of Water Commissioners acts and which requires
1875 the water to be sold on a permit basis. The service

Folios

that is rendered to consumers outside of Denver is rendered under contracts which incorporate substantially the language of Rule 17. That particular language has existed ever since the city took over the plant from the old Denver Union
1876 Water Company. Any appropriations of water to be used to supply persons outside of the city limits would supply water to them under the terms and conditions of that rule.

1878 Denver Exhibit V (Lippincott report "Preliminary Report for a New Water Supply for the City of Denver," August, 1914) was made to the
1879 Public Utilities Commission of Denver and later was transmitted along with all their other records to the Board of Water Commissioners and since has been in the records of the Board of Water Commissioners. On page 48 of Exhibit V, the following statement is found:

> "If sufficient water is furnished for the irrigation of an acre of land, this agricultural supply is enough to care for this acre
> 1880 after it has been built up as a city. (2) This is an important coincidence. If the City of Denver secures a supply for its present inhabitants, and obtains water for the proper agricultural development of lands that are contiguous, she may then place the waters beneficially on these lands, possibly not as a direct profit, but at a very great indirect benefit, and as the city expands, as it must ultimately, over such areas, the transformation of the use of the water from agricultural to urban conditions will be without shock or strife."

1881 I subscribe to that statement in theory only. There is difficulty in carrying it out. It is good

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advice but difficult to follow. Exhibit O shows 106 sq. miles now being supplied by water and
1882 140 additional sq. miles in the metropolitan district which will some day wish water. The area
1883 that will want water is colored red. I do not know how much of the 140 sq. miles is now irrigated agricultural land.

In 1933 there were 4,000 acre feet of water
1885 in Cheesman and the other reservoirs. Marston Lake and Antero were dry. The yield from the
1886 Platte direct flow rights was scant. There was also a small reservoir called Platte Canyon Reser-
1887 voir, and it was probably nearly full. In 1933 we speeded up our efforts to get water. In my opinion
1888 Denver needs all the water it can possibly get. Denver will grow until its water supply is exhausted. Previous to 1933 the Board had ordered filings on the Fraser-Williams Fork and Blue
1889 River in the hope of getting that water. Forecasts were made of water needed in the next 10, 15 and 20 years.

1891 You read a statement from page 48 of Exhibit V a few moments ago to the effect that water for agricultural land can be used for municipal purposes. This can be done provided the water is there when you need it. The use per individual in Denver is about ¼ acre foot per year. If land is to be irrigated, it uses 3 to 5 acre feet per year, so there would be a sufficient amount of water there to supply from 12 to 20 people on an acre of
1892 ground. In some places there is more water used on the land than in others. So the statement in his report as to what will be satisfactory is variable.

I testified that the total cost of the tunnel from the Blue River is estimated to be $30,000,000.

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The total cost of the proposed system shown on the plat which is the plan under which we are pro-
1893 ceeding is estimated at a trifle over $100,000,000. Since we started construction on the tunnel, on the east and on the west ends we have spent a little more than $156,000, and next year have budgeted
1894 an expenditure of $100,000 on the tunnel. We expect to have Blue River water in our distribution system in the next 15 or 20 years. It will take some time to build the system.

1895 The city expects to spend $355,170 on the extension of service mains next year. Blue River water will ultimately be used in the distribution
1896 system and in the extension of service. If there were no Blue River water available we would not be making expenditures for very long in the future to distribute Moffat Tunnel water. Some of the expenditures, however, would be made regardless
1897 of whether there was a Blue River. That is true of the city pipeline system, the $355,720 item, but I expect that we would cut that down some if we knew we were not going to get Blue River water.

CROSS-EXAMINATION

BY MR. BARNARD:

1898 The statement of claim on Denver Exhibit B is in part as follows:

1899 "The tunnel will extend southeasterly a distance of approximately 24 miles to the North Fork of the South Platte River near the Town of Grant, along a modified course hereinafter referred to. The tunnel will have a cross-section of 140 sq. feet, a grade of 10 ft. per mile and a carrying capacity of 1600 cubic feet of water per second of time."

1900 That statement of claim was signed by Mr.

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Bull on October 17, 1927, and the Map and Statement were filed in the office of the State Engineer on October 19, 1927. At that time there had been
1901 no change in plans. I cannot determine the exact date on which it was decided to build the tunnel having a capacity of 788 cu. feet, but presume
1904 that the decision was made before work started on the east end of the tunnel. The west end of the tunnel was just an exploratory tunnel. The work
1905 at the east end started in July of 1946. I presume that the decision was reached between November 16, 1942 and the month of July, 1946.

1906 The 788 second-foot tunnel will divert as much water through the mountains as the 1600 second-foot tunnel on account of the construction
1907 of the Dillon Reservoir. In that way the Dillon Reservoir and the 788 second-foot tunnel work together.

1908 I previously stated that the flow from the Blue River is seasonable, that for a short period in the spring and summer there is a high flow fol-
1909 lowed by a low flow later. During the period of low water it would have been possible for Denver to divert only a small amount of water through the Montezuma Tunnel as originally planned. The only substantial diversion of water would be during the high water period. The high water might start in April and extend over into October, but usually would be for a shorter period in May, June and to some extent in July.

1910 Diverting water through the Montezuma Tunnel only during periods of high water makes it impractical to develop a power generation system. Substitution of the high weir, the Dillon dam, for the low weir made it possible to maintain
1912 a steady flow of water and to include the gener-

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ation of power in the project. The power that could be generated would pay the expense of the electrical development and leave a surplus of some two million dollars; in other words, the power features of the project would be worth two million
1914 dollars to the city. Reducing the bore of the tunnel would reduce its cost by ten million dollars.

REDIRECT EXAMINATION

BY MR. SAUNDERS:

1915 The changes in the physical structures does not involve a change in the amount of water required for the operation of the structures. The same of water is involved. We will continue to
1918 divert 1,600 second-feet as before. If the larger tunnel were constructed, the quantity of water diverted would be 1,600 second-feet during the time when there was that much available and a lesser amount as the river diminishes, but in total the tunnel would deliver some 218,000 acre-feet of water. With the smaller tunnel the delivery will be the same, but at a slower rate. Part of the water will be held back by the higher weir and released later, but the total diverted will be 218,000 acre-feet. As water is the main object of
1919 the diversion, there would be little point in making the change, if the change was to reduce the amount of water which would ultimately be obtained. There would be no object in Denver's changing its plans to diminish the amount of water diverted just in order to put in effect a plan for the development of power.

1920 Under the original plan 1,600 second-feet of water would be stopped at Dillon for immediate diversion through the tunnel. Under the modified plan it is the intention to stop 1,600 feet of water
1922 at Dillon, but for delayed diversion. Under the

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original plan the intention was to take through the diversion works to the tunnel at Dillon a flow of 1,600 feet and a low weir was put in there to hold the water back so that up to that quantity of water would flow when it was available. It was expected that an average year would yield under this process 218,000 acre-feet of water. In a year
1923 that was better than average, more water than average would be diverted and you would expect to get more than 218,000 acre-feet. In a poor year that much water would not be divertable.

Under the new plan with the high weir the water will be stopped or held back for a longer period of time but the same total quantity of water will be diverted through a smaller tunnel but over a longer period. It is not planned to store water in the Dillon Reservoir but simply to hold it long
1924 enough to deliver it through the tunnel. The reservoir would be built so that any time there was not water needed for prior senior rights, water might be held over so that this dam would perform the purpose of diverting water in average years up to 218,000 acre-feet, probably more in years of larger flow and less in years of small flow. It was the intention that the yield per year would be the same total per annum as under the original plan.

1925 Some question has been raised about the availability of the Two Forks Reservoir site from a right-of-way standpoint. If the Two Forks Reservoir could not be built, there are other reservoir sites available. Not so desirable and with more expense involved, but there are other places. The Blue River Project is not dependent upon the availability of the Two Forks site.

1926 In the Statement of Claim made in this case there are a number of reservoirs listed, including

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the Dillon Reservoir and Cheesman Reservoir. Cheesman Reservoir would form a part of the system of water supply for Denver when the Blue River Project is completed and would continue so to function. The South Platte water would be held back in Cheesman and delivered for use in Denver as needed in conjunction with the supply of Blue
1927 River water. It has been the intention and policy to supply Denver's needs from the Platte River up to its availability. All available South Platte supply is being used. The future growth of Denver depends upon water from the Colorado River.

Referring to Exhibit S, it is clear that Blue River water would not flow into Cheesman because
1928 Cheesman is on the other fork of the Platte. Blue River water, however, would be stored in Cheesman by a trading process. Water users below Cheesman would be supplied with Blue River water permitting Platte water to be caught and retained in Cheesman. In that manner Cheesman would be made to store Blue River water.
1929 The same thing is true of Eleven Mile Canyon Reservoir and Antero.

1930 When the water has been stored in any of these reservoirs, Eleven Mile, Two Forks, Cheesman or Antero, the water is then used for municipal purposes, including domestic, mechanical, manufacturing and the gener-
1931 ation of power. Exhibit S indicates that as the water flows from these reservoirs towards Denver power can be generated. Power salvaged from the water is a product of the system.

Uses of the Blue River water include fire
1932 protection, sewage treatment, street sprinkling, water park lawns and so forth.

1933 Marston Reservoir is southwest of Denver. It

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is used as a settling reservoir and as a supply for the filtering plant. Blue River water will be stored in that reservoir and from there will be taken to the filter beds.

The Grant, Estabrook, Strontia Springs and Waterton Reservoir sites will be available for the storage of Blue River water if the Two Forks
1935 Reservoir site cannot be secured. Referring to Exhibit S, the Grant Reservoir would be located a short distance below Grant, where the water from the Montezuma Tunnel is discharged into the North Fork of the South Platte River. The Strontia Springs site is located between the Two Forks Dam site and "Intake".

On cross-examination yesterday relating to the sale of water outside of the city limits of Denver under contracts, I testified that the people were served on a year-to-year basis. The implication may have been given that these people
1936 could be cut off. If they were cut off, I know of
1938 no other source of supply for them. Although there is a city limit drawn around Denver, in a business way there is no division. It would be
1942 disaster to cut these people off. In practice Denver has not cut off any outside users.

I have previously testified that the city was
1945 spending money extending its pipe system. We are using cast iron pipes that have a very long life. The oldest cast iron pipe was installed in the Denver system in 1872. We recently made some connections to it and found that pipe in excellent condition. There is cast iron pipe in France
1946 that was laid in the time of Louis XIV, more than 300 years ago. In this country there is no water system old enough to determine the life of cast iron pipe. The distribution system work being

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done under the budget, Exhibit J, will be available for use as a part of the distribution facilities for Blue River water.

1947 Questions were asked on cross-examination implying that it might take a very long time to build the Blue River Project because of its magnitude. Plans have been prepared for speeding up the work. The Board hesitates to conduct the work on any large scale until a decree is granted. They feel that they would not be justified in spending any larger sums of money than now being spent until the amount of water they
1948 are to receive from the Western Slope has been determined. When that is done, I have been given to understand by the Board—

MR. BARNARD objected, and THE COURT sustained the objection. MR. SAUNDERS offered to prove that the understanding given to Mr. Gross by the Board is that an adequate program of greatly accelerating the speed of the Blue
1949 River Diversion program will be undertaken as soon as a conditional decree will have been granted.

THE WITNESS: The war delayed the speed of construction on the project. This war-caused delay extended over several years' time.

RECROSS-EXAMINATION

BY MR. BARNARD:

The statement of claim for the Dillon Reservoir claims storage rights of 256,780 acre feet.
1951 Cheesman has a storage capacity of 79,000 acre-feet. The Dillon Reservoir would have a greater storage capacity than any other reservoir in the
1952 Denver water system except Two Forks. If the 788 second-foot tunnel is constructed without the

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Dillon Reservoir, all water in excess of 788 second-
1953 feet would go on down the Blue River.

Under the present plan we are claiming 1,600 second-feet direct flow diversion. We do not plan to store the surplus over 788 second feet; it will be just retained there. The water stored there would be under a different decree. In getting a decree for the reservoir, a decree for the total capacity would be obtained, but use of the total capacity in a normal operation would not be feasible.

The original filing calls for 1,600 second-feet from the Blue and Ten Mile, and then called
1954 for 800 second-feet from the Snake. Now the tunnel could not carry that much water but it was expected we would get as much from either supply as could be taken through the tunnel. Each supply would be influenced by the other, and the object would be to so conduct the reservoir to get the best
1955 1,600 second-foot supply from that dual source and deliver that through the tunnel at the rate of 788 second-feet. The reservoir would also be used to store water. The storage would be held over for an indefinite length of time but the retained water would be required to go through as fast as it could be delivered.

1956 By building the Dillon Reservoir we claim the right to retain 812 second-feet of the total of 1,600 second feet and deliver that through the tunnel later on. The water would be measured into the reservoir under the decreed rights at a flow of 1,600 second-feet and then would be put
1957 through the tunnel. The 812 second-feet of water will not be held in the Dillon Reservoir depending
1958 upon the demands and needs of Denver. We would move that water down to Two Forks on the same principals we would move the 1,600

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second-feet. It would be moved pronto. It will only be held until it could be taken out. If the high water would terminate some time in the middle of June we would have this 812 feet stored at
1959 Dillon. Then after the middle of June we would let it go through the tunnel as fast as it could go through by continuous flow. The storage of that 812 feet during this period when we cannot take it through the tunnel is not a part of the storage
1960 claim for 252,678 acre-feet.

The storage claim of the 252,678 acre-feet is in addition to the 812 second-feet of water and claim the right to detain 812 second-feet of the 1,600 second-feet direct flow rights into the Dillon Reservoir. In addition we claim the right to store
1961 in the Dillon Reservoir 252,000 acre-feet of water.

1962 You asked if it would be necessary for 1,600 second-feet of water to flow into the reservoir to develop 252,000 acre-feet of water. It would take about 80 days. At the rate of 812 second-feet it
1963 would take something like 150 days.

The object of storage would be to carry some of the water in flood years over to lean years. We would not expect to fill the reservoir in one year. Any water that came in under our storage rights would be retained until we needed it, but water that came in under the direct flow rights would be
1964 taken out as it could be delivered through the tunnel. We make a distinction between detention and storage water. The scheme of detaining water, storing it and running it through on a 788 cubic-foot basis instead of our old plan of diverting 1,600 second-feet when we got it are the various elements and component parts of our present plan devised between 1942 and 1946.

Folios

BY MR. DELANEY:

1965 I have examined the map of the Dillon Reservoir, Denver Exhibit D, that calls for a maximum storage right of 256,758 acre-feet. If the water
1966 is available to store that amount of water we expect to have the right to hold it at the Dillon Reservoir. Depending on conditions in the South Platte, it might happen that the stored water up to the maximum capacity would be held over from
1967 one year to another. At no time would we use part or all of the 1,600 second-feet for which we make claim for direct diversion for storage. We would use it for diversion when there was an available place in the reservoirs. If there was not an available place, we would forfeit some of the stored water if we wished to divert the 1,600 second-feet.

1968 Assuming that we have a decree for 1,600 second-feet direct flow through the tunnel which we propose to construct, that the Dillon Reservoir has been constructed, that in the month of May in the year 1960 the reservoir is empty and that 1,600 second-feet of water are coming into the reservoir site under the decree, some 15,000
1969 acre-feet would go into dead storage in the reser-
1970 voir because that is below the outlet. After that is filled and if some 1,600 feet were running into the reservoir, 788 feet would be diverted through the tunnel and the remainder would be retained in the reservoir until it could be put through the
1971 tunnel. Just as soon as the flow of the river dropped to a point where the direct flow furnished from these tributaries was less than 788 feet, we would commence to flow out some of the retained water, the idea being that we will run the tunnel at its full capacity at all times there is a supply on the Western Slope available for that purpose.
1972 The amount of water retained in the Dillon Reser-

Folios

voir and the period of time that it would run through the tunnel would depend entirely on the runoff of a given year.

It is the factor of the ability to retain the water at Dillon and feed it to the Eastern Slope in a steady stream instead of in peaks that will enable us to develop the power project.

The power plants will be located largely on the North Fork of the South Platte as indicated on Exhibit S. One will be located at Insmont, which is about halfway between Two Forks and Grant. Another will be located at a point above the inlet to the Two Forks Reservoir, and another at a point below the outlet of Two Forks. The
1974 installed capacity at Insmont is expected to be 25,072 kilowatts. The head of water will be 870
1975 feet. The installations of the power plants would fit the quantity of water developed. The power plant at Foxton which would be at about the high water mark at the head of Two Forks would de-
1976 velop 32,075 kilowatts. The plan as outlined would be to build a smaller plant below Two Forks, about 1,513 kilowatts, to use 75 second-feet of
1977 water. I am not prepared to say under what business conditions and arrangements the power would be used.

The one hundred million dollar cost that I gave you included approximately $29,000,000 for power plants and conduit lines for them. One
1979 conduit line would take the water as soon as it was discharged from the tunnel at Grant and discharge it back to the river at Insmont. Then the water would be picked up and carried to Foxton. There would also be transmission lines to where the power will be disposed of. The power generation and transmission features of the plan were introduced sometime between 1942 and 1946.

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1980 In the event the Two Forks Reservoir site is not available, there are a number of other sites near Strontia and Estabrook which are avail-
1981 able. Strontia is about 2½ or 3 miles below Two Forks and Easterbrook is a short distance above. If we didn't have Two Forks, those reservoirs would have to be built somewhat larger. The designs that have been considered were smaller reservoirs. Grant would be close up here (indicating). There also might be Geneva, which could be filled on a trade basis, and Shawnee.

1982 The Board contemplates building such reservoirs as may be necessary to utilize the water most beneficially. And this is a part of the plan regardless of whether these diversions come from the large or small tunnel.

1983 Referring to the castiron pipe that we are laying, we are replacing some undersized pipe. Most of the expenditures are for replacements and
1984 enlargements. It is the policy of the Board to use castiron pipe for all pipe 6 inches and larger, and as to smaller pipe it is the practice to use castiron, but some places they use steel pipe, which may have a shorter life because it is thinner material. In relaying pipe that will feed from the Moffat Tunnel Diversion we are using castiron pipe.

1985 During the war the officials in Washington would let us have material only when necessary.
1986 They denied me considerable work. We did not attempt any development on the Blue. We knew we could not get materials or labor to do work on the Blue during the war. The question of a bond issue for the construction of the Blue River Project has never been submitted to a vote of the people of the City and County of Denver. At least as such it
1987 has not. There was some money for the Blue included in the bond issue that was passed.

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I have referred to the physical limits of Antero Reservoir as to storage. It has a small watershed and there are times when we are not permitted to take water. There is also a condition at the outlet which makes it difficult to get the
1988 water out of the reservoir. In using Blue water
1989 by exchange it is essential that we store the water in the most favorable reservoir because we are penalized for loss. There is more penalty at An-
1990 tero than there is at Cheesman. We have the difficulty of running the water down the river by a great many users who have small ditches and who set their headgates to take the water. There is a loss from this source. It is more desirable to store
1991 the water at Cheesman or at other places.

1992 THE COURT admitted Denver Exhibit V and W, there being no objection.

TESTIMONY OF H. R. OLIVER
DIRECT EXAMINATION

BY MR. SAUNDERS:

My name is H. R. Oliver. I have been a civil
1993 engineer for 48 years, specializing in mining and
1994 irrigation. I have been with the Board of Water Commissioners since 1922.

1996 In 1924 I was directed to go to the South Platte and define on the ground the place where the Two Forks dam site had been located by others on previous surveys. I had two men in my party. This work lasted about two months and led to core drilling the dam site which started just about the
1997 first of the year and continued for some months.

Later in the spring similar work was done at the Intake and Strontia Springs sites.

1998 My next work on the Blue River Diversion Project occurred in 1925 when I took a party of

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six men into the mountains to get some information for the firm of Wood and Webber, consulting engineers, who had been retained by the Board of Water Commissioners to investigate the possibility of storage in the Two Forks and Eagle Rock reservoirs and a hydroelectric power project.

1999 Our work also embraced the Intake and Strontia Springs sites. It consisted of running a traverse line starting at the mouth of the canyon at Kassler and extending up the canyon to the Two Forks and Eagle Rock dam sites. This was followed by an enlargement survey on the Two Forks site wherein we raised the height of the dam about 80 feet over the previous surveys to 350 ft. high. On that work I had 6 or 8 men. The work was completed in September, 1925.

2000 Kassler is at the mouth of the South Platte canyon near the old railroad station of Watertown. Eagle Rock reservoir is between two and three miles up the South Fork of the South Platte River and would be covered over by the Two Forks Reservoir with its increased elevation.

2001 Following the enlargement survey we did the necessary office work during the early winter and prepared filing maps for this enlargement on the Two Forks site.

2002 In 1926 I went to the American Reservoir site near Lake George on the South Platte River which is shown on Exhibit S at the mouth of Tarryall Creek. I prepared a filing map for this reservoir. It would be used as a storage reservoir
2003 in connection with Blue River water. Water could be stored there by the medium of exchange.

On April 16, 1928, Mr. Gross and I made inspections of the Two Forks Reservoir and the
2004 Eagle Reservoir in order to answer questions core

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drilling had raised. The core drilling had been done to determine the character of the subsurface for the dam site, the rock conditions and the type
2005 of dam suitable for the site. Further trips were made to the dam site in 1929.

On May 2, 1930, we started the Federal Power survey which consisted of a carefully run traverse from Kassler to the town of Grant and also from the South Platte up the South Fork to Rainbow Lodge. I was in charge of a party of 9 men who did that work. At the same time Mr.
2006 Webber, another engineer, had another party who ran a line from the site of Eleven Mile Reservoir which had not then been built, down the river past Cheesman and connected with my line at Rainbow Lodge. This took the entire summer season
2007 of 1930. This work was used in connection with the development of the Blue River Unit of the transmountain diversion, for the further consideration of these reservoir sites and has been used for various surveys since. It was used in connection with the power development referred to by Mr. Gross and in connection with the realignment of the long tunnel.

2008 The next work I did was supervising the different surveys for the straight line Dillon to Grant Blue River Tunnel. This work started on July 1, 1931, and consisted of a system of triangulation to properly control the location of this tunnel. Triangulation was adopted because it seemed very likely that changes might be made
2009 in the location of the portals. Triangulation provided a control which would apply to any of these changes—it would not be necessary to run another line for the tunnel after a change.

Triangulation is a special type of surveying. It offers a means of determining with accuracy

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the distance between two or more points. In its simplest form it consists of a series of triangles connected together in which the length of a side of one of the triangles and all of the angles between the sides of these triangles are known. With this data it is possible to compute the length of all other sides. Then by computing the coordinates either plane or geodetic the positions of these stations or points which mark the apex of the triangles may be determined and the distance between any two points of the system may be calculated.

In triangulation permanent monuments
2011 are placed at the apex of these several triangles. Our monuments or stations consist of a brass tablet on which the letters "D.M.W.W." are cast and in addition the name of the station and the year are stamped on these tablets. The tablets are then cemented in the rock outcroppings where suitable rock is found or they are set in concrete. They are permanent monuments which can be located at a future time.

2012 This work was necessary in order to calculate the direction between the two portals because the tunnel was to be a long tunnel. It was also economical. If you run a single line through and
2013 plans are changed it is then necessary to run another line. Another change will call for still another line. The change that was made from the 1931 straight line to what is known as the Montezuma line has two angles in it. By the establishment of a few additional stations in our scheme of triangulation, it was possible to control and to bring into coordination these new established points for the portal without a lot of extra surveying. That has been done.

2014 We have established stations at two probable

Folios

shaft sites. One shaft is located about six miles from the west portal of the proposed tunnel and would be 600 ft. deep to reach the tunnel grade. The shaft site is under the letter "e" in the word "Snake" on Exhibit S. It is right beside the
2015 Loveland Pass highway at the junction of the road which leads to Montezuma. The second shaft site is located a short distance further east and below the town of Montezuma. On Exhibit S it is under the word "River" between the letters "v" and "e" and would be about a 1000 ft. in depth. A right-of-way for it has been obtained.

Shafts facilitate the construction of a tunnel. By use of two shafts it will be possible
2017 to operate from six headings. On a three-shaft basis it would be possible to complete the tunnel in from six to eight years by prosecuting the work from all headings.

Following the completion of the triangulation there was a considerable amount of office work to be done in connection with it. In addition during the winter months I had parties of from
2018 six to eight men in the field on the eastern slope investigating possible routes for conduit lines from the vicinity of Eldorado Springs to Denver in connection with these transmountain diversions.

2019 We finished the work on the Blue River unit in the seasons of 1931 and 1932. We ran the line which had been computed as to direction on the straight tunnel for the purpose of furnishing the proper control for the geologists to study the area through which the tunnel was to pass. I was in touch with these geologists when they did their work in 1932 on the first line and in 1943, 1944, and 1945 on the present line. Starting in October 1941 I had a party in the field working on the Dil-

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lon reservoir site. That was followed with the core drilling of the tunnel site which took several months. During 1942 and 1943 we put in the
2021 additional control stations in our triangulation system in connection with the second proposed tunnel.

The studies of the geologists were the cause of the realignment of the tunnel. The line of 1931 was straight. The geologists studied that line in 1932 after we had staked it. Mr. Tom Lovering was in charge of that study. He also employed Mr. Wilson to do some geophysical work to verify some of his conclusions. He came to the conclusion that there was a considerable area of
2022 bad rock which would be expensive to drive through and suggested that a study be made of a line somewhat further north, moving the west portal some 3,500 ft. to the north, and putting two angles in the tunnel, but arriving on the north fork of the South Platte at practically the same place we had selected in 1931. Although this
2023 lengthened the line of the tunnel about half a mile it was thought that we could drive that extra half mile more cheaply than we could go through the bad ground that the geologists were sure existed. That was the reason for the change in plans from the 1931 line to the proposed tunnel to the North.

Geologizing the new proposed line was completed in 1945. It was started in 1943 by Mr. Lovering who devoted a part of his time to it and the balance of the work was done by Professor Walstrom of the University of Colorado. That
2024 work is complete and their reports are in our files. The work done by the various geologists was at the expense of the Board of Water Commissioners.

There were several serious interruptions in the devotion of my personal time to the planning

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and construction of the Blue River unit. I do not recall all the things I was doing in 1933. I did some work and made some inspections in connection with the Blue River Unit. In 1934 I was brought into the office to take over the position of office engineer to release Mr. John Burgess who was needed for some other work. I was on that
2026 desk for one year lacking two months. From June, 1935, to January, 1938, I was engaged in building the Moffat Tunnel diversion system, that is the lining of the Moffat Tunnel, the building of collection ditches on both sides of the Divide and building the necessary pipe line on the eastern
2027 side to reach Denver. This project was completed in early January of 1938.

After its completion I was appointed Superintendent of Moffat Tunnel diversion and as such was in charge of the operation of the Moffat Tunnel system, the collection ditches and delivery of water through the Moffat Tunnel, the conducting of the water to Ralston reservoir and from there through a pipe line to the Moffat filters.

2028 I trained personnel to take my position and I was released in 1944. Since 1944 I have been devoting practically all of my attention to the Blue River diversion project. During the interval 1933 to 1944 I devoted time to the Blue River diversion project whenever the occasion demanded it.

2029 The physical construction of the Blue River Tunnel started in the fall of 1942 when we made an open cut at the west portal of the tunnel some 600 ft. in length. The work was suspended during the winter and resumed in the summer of 1943
2030 when it was completed. The following season in 1944 we drove a top heading or pilot bore to investigate the nature of the ground to determine

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how far it was to bed rock and to determine the nature of that bed rock. We drove a small heading instead of a full-sized tunnel because supports for a full-sized tunnel could not be obtained during the war. We could cut timbers on the ground adjacent to the work of a size which would support a smaller bore. We drove the bore for 300 feet through partially cemented gravel, at which point
2031 we met shale. We passed through the shale for 100 ft. and then encountered quartzite bed rock. The bore was down grade and the formation was making water which required pumping. After we reached the quartzite we learned what we wished to know, so we did nothing further at the west portal.

2032 In 1946, the following year, we started work at the east portal above the town of Grant. We started in July opening up the portal and have continued without omission since that time. We are working on a one-shift basis. We installed a
2033 plant of machinery which was used for about a year and a half. We then moved it to another tunnel near Denver and installed a larger compressor, a Diesel generating plant, larger car loaders and have continued the work to the present time. We are now in about 2,850 ft. as of this morning.

On Denver Exhibit H the number of men employed and the period noted there are carried correctly. I am unable to verify the dollar amounts.

In the fall of 1941 I took a party to Dillon and did quite a little engineering work in connection with the Dillon reservoir. We ran the high water line around the reservoir, made ties to corners of public surveys, and tied into our previous triangulation system. In addition to
2035 that in the year 1945 a geological examination of

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the site of the Dillon reservoir was made by Ogden Tweeto, a geologist with the United States Geological Survey. This work was done for the Denver Board of Water Commissions. Mr. Tweeto also made an examination of the Two Forks reservoir site in 1941 augmenting the work done by Mr. Lovering.

2036 The ties, distances and engineering shown on Denver Exhibits A, B, C and D are accurate.

2038 THE COURT admitted Exhibits A, P and Q over objection, and reserved ruling on Exhibit C.

CROSS-EXAMINATION

BY MR. DELANEY:

2039 In 1925 I made a survey for the enlargement of the Two Forks reservoir to be accomplished by increasing the height of the dam by 80 feet to 350
2040 feet. Shortly after the survey was completed the plat of the enlargement was filed. Prior to that time there had been a filing for a reservoir of smaller capacity.

2042 Wood and Webber were consulting engineers with offices in Denver, Colorado, in the Tramway Building. Their specialty was water supply and
2043 the report they made to the Board of Water Commissioners was in part to determine the possi-
2045 bilities of developing power on the South Platte. We did the surveying for Wood and Webber. We surveyed Estabrook, Two Forks, Intake and Strontia Springs as power sites for them. Intake is between the South Platte and the mouth of the canyon at Castle.

2046 Under the authority of Federal Power Permit No. 720 several surveys were made. The work was done in 1930. I do not know the language

Folios

of the permit, its date, its scope or whether the Federal Power Commission had anything to do
2048 with it. Lines were run up the South Platte to Rainbow Lodge which is between the mouth of
2050 the South Fork and Cheesman. Rainbow Lodge is a summer resort above what is now Deckers. Mr. Wilson ran down the river to connect up with my line. It was part of the same piece of work, but there was too much work for one party to do
2051 in one season. This survey had to do with power possibilities.

The shaft sights for the tunnel which I previously testified to were located in 1942.

2052 Mr. Lovering was a geologist with the United States Geological Survey in Washington whom we borrowed for the purpose of doing the geological work. I do not know whether Mr. Lovering's
2054 work was tied in with the cooperative agreement between the City of Denver and the Bureau of Reclamation for joint studies. The geological studies were made to obtain further and addi-
2055 tional information and to ascertain what changes were needed in the original plan.

Referring to the work done at the west portal,
2056 an open cut was made about 600 ft. long, which ran until the banks were 40 feet high. At the point we started underground the cut had a base of 20 feet and side slopes of two to one. The cut was approximately a quarter of a mile from the dam site of the Dillon reservoir, about 600 feet
2057 from the banks of the Blue River, and the same distance from the bank of the Snake River. It was north of the Snake River and east of the Blue
2059 River. While making the cut we had some buildings, a blacksmith shop, a change room and a machinery shed which were removed after we finished our excavation work.

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2060 The idea of driving the bore was to obtain some information and to enlarge it when we were ready to make it a permanent tunnel. When we
2061 timbered the tunnel we did not expect it to last too many years. At the present time the outer sets of timbers have broken down and the portal
2062 of the tunnel is caved in for a distance of 80 or 90 feet, judging by the settlement on the surface. It caved in in the spring of 1946.

TESTIMONY OF ORVILLE YETTER

DIRECT EXAMINATION

BY MR. SAUNDERS:

2063 My name is Orville Yetter. I am assistant office manager for the Denver Board of Water
2064 Commissioners. The office in which I am employed does the accounting and collection work for the Board. I am familiar with the books and accounts of the Board of Water Commissioners.

2065 Denver Exhibit G is a summary of charges to the Blue River diversion system, October 1, 1920 to October 21, 1949, as shown on the books and records of the Board of Water Commissioners. I prepared Exhibit G and the items shown thereon
2070 are correct. I did not do any of the work on the ground as to the items shown in Exhibit G. The
2071 information in the Exhibit was compiled from the books and records of the Board. The information in those records comes from the superintendents that are in charge of the work. The time sheets and purchase orders are all gathered together and set up on the books. The accounts sent in by the
2072 superintendents are audited and checked once a year by a Certified Public Accountant as to accuracy. The files of the Board contain the original work orders, reports, etc., to substantiate the

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figures shown on Exhibit G. Exhibit G was compiled from the original complete records of the
2073 Board and those records are available. We have time sheets for each man, store orders and purchase orders. These records are extremely voluminous.

2074 MR. SAUNDERS offered Exhibit G in evidence and it was rejected. The exhibit, after several re-offers, was admitted (f. 4050).

MR. YETTER: Denver Exhibit H contains a summary of the costs incurred in connection with driving in the Montezuma Tunnel, east and west portals, including the purchase of equipment. It covers the period September 1,
2075 1942 to October 31, 1949, inclusive. It shows a number of men who worked on the project. It was compiled from the same records as Exhibit G.

Mr. Saunders offered Exhibit H and the court permitted MR. DELANEY to cross-examine the witness before making an objection.

CROSS-EXAMINATION

BY MR. DELANEY:

2076 I cannot tell what items of equipment are included in this tabulation of figures but it does contain large compressors which were bought over several months.

2077 The witness who preceded me stated that certain equipment was purchased and later moved to another location at the time new equipment was brought in. This is explained by the note at the bottom of the Exhibit. There was a total expenditure of $5,768.61 (in March, 1949) for labor and materials which excludes equipment (a credit of $14,809.63 was made for the equipment re-

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moved), leaving a net credit figure for March of 1949 of $9,044.02.

2085 THE COURT admitted Exhibit H.

DIRECT EXAMINATION

BY MR. SAUNDERS:

The information contained in Exhibit H is within the total shown in Exhibit G.

Denver Exhibit I is a list of Capital Investments beginning with the year 1935 and running
2086 through October 31, 1949, and was compiled from the data, books and records of the Board of Water Commissioners. It is accurate.

2087 MR. SAUNDERS offered Denver Exhibit I and pointed out that Mr. Gross had testified that every item of capital investment listed for 1934 on had been made in connection with transmountain system. Messrs. DELANEY and BARNARD ob-
2088 jected that on the ground that investment in the
2089 Moffat Tunnel and Williams Fork Diversions has nothing to do with Blue River Diversion. MR. SAUNDERS pointed out that the only evidence before the Court was that they were all one sys-
2090 tem. THE COURT denied the offer.

MR. SAUNDERS then stated that Exhibit G had been rejected, and if the rejection was based on the best evidence rule, he would produce the original vouchers, etc., in
2096 support of each item. MR. DELANEY stated that the objection was not based on the best evidence rule and that Protestants would waive any requirement that Denver produce each voucher, but Mr. Gross's testimony that the Denver transmountain diversion system was one system was contrary to law and therefore information con-

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2098 tained in the Exhibit was immaterial. THE COURT reaffirmed its rejection of Exhibit G.

MR. SAUNDERS then asked the witness what the total amount of money was that the Board of Water Commissioners had spent on the construction of the Blue River unit of the trans-
2099 mountain diversion system through October 31, 1949. THE COURT sustained the objection. MR. SAUNDERS offered to prove by the answer to the question that the City had spent $586,407.55 on the Blue River unit of its transmountain diversion system up to October 31, 1949.

2102 Mr. Gross was recalled for the purpose of laying a further foundation for the admission of Denver Exhibit G.

TESTIMONY OF DWIGHT D. GROSS

DIRECT EXAMINATION

BY MR. SAUNDERS:

Denver Exhibit G is the same exhibit which I identified earlier in my testimony. When I testified earlier you asked me if all items shown on Exhibit G were part of the Blue River unit of the transmountain water system of Denver. The answer to that question is "Yes".

2106 The first item appearing in Exhibit G under the heading "Description of Work" entitled "Cost of Investigation for Dam Site on South Platte River at Two Forks", consisted of core drilling
2107 in 1924 to determine factors of design and cost of the dam. Some core drilling had been done earlier
2109 in 1921 for the same purpose. The Two Forks reservoir was to be used for storage of water from the Blue River. The water would pass through
2110 the Blue River Tunnel, be dumped into the north

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fork of the South Platte River and run into the Two Forks reservoir.

2112 The second item listed is "Cost of Reservoir Surveys and Diamond Drill Investigations of Dam Site on South Platte River near South Platte". This was work on the same reservoir. Two Forks
2113 reservoir could be used to store South Platte water, but ordinarily there is not enough water in the South Platte River to fill the reservoir. Blue River water would represent the larger quantity of water stored in that reservoir.

2114 The next item "Water Supply of Eastern Slope, South Platte Storage Development, Prepare Filing Maps for Two Forks Reservoir" describes the survey about which Mr. Oliver has previously testified. It related to the same Two Forks reservoir which is to be used for the storage of Blue River and South Platte water.

2115 The next item "Cost of Making Surveys and Filing Maps for Diversion of Water from Blue River to Webster Creek" itemizes the cost of some of the early surveys made by Mr. Bull and the cost of filing maps. These were made in 1926 as a part of the Blue River survey. Mr. Bull investigated a number of possibilities for diverting the Blue River water. This particular work was
2116 taking water from Peru Creek and some of the tributaries of the Blue River above Dillon over to the northeast and diverting it through a tunnel to Webster Creek which is a tributary to the north fork of the South Platte River. The purpose of this survey was to find out which was the most desirable diversion, and the result is shown on one of the exhibits present at this trial.

2118 The next item, "Make Investigations and Do Work at Strontia Springs Reservoir Site as

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2119 Required by Federal Power Permit No. 720" consisted of diamond core drilling done in 1929.

2121 MR. SAUNDERS asked how the Board planned to relate the work just described to the Blue River project. MR. DELANEY objected that the question called for a conclusion. THE COURT sustained the objection and MR. SAUNDERS offered to prove by the answer to this question that the Board of Water Commissioners expected to relate a reservoir at Strontia Springs to the Blue River project by using the reservoir
2122 for the storage of Blue River water and also to generate electric power at that point from the Blue River project. The offer was denied.

2124 MR. GROSS: Federal Power Permit 720 was issued by the Federal Power Commission to the Board of Water Commissioners giving them permission to make investigations involving government property for power purposes. The permit was taken out primarily in connection with
2125 Two Forks, but it also contemplated a dam at Strontia Springs and the making of surveys along the canyon preparatory to the laying out of a power system, conduits, penstocks, etc. The particular sum of money appearing on the exhibit as an item about which you inquired was spent at Strontia Springs getting information to prepare the preliminary filings that were required by the Federal Power Commission. The permit did not give the City permission to build the power plant, but it did give the City permission to proceed with
2126 the preparation of plans. The Government property involved under the permit could not be used for some other purpose while this plan was being prepared. The plan was to use the water of the South Platte and Blue River as a part of the

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power development. That is the relation between Strontia Springs and the Blue River diversion.

2127 MR. BARNARD and MR. DELANEY moved that the testimony be stricken because previous testimony by the witness indicated that there was no intention to use Blue River water for power purposes until sometime between 1942 and 1946; consequently there was no relationship between the expenditures appearing on Exhibit
2130 G and Denver's claim. MR. SAUNDERS stated that Mr. Gross had testified to a modification in
2131 the plans for power between Grant and Two Forks occurring between 1942 and 1946, and that it has always been Denver's plan to use Blue River water for power. He pointed out that Denver Exhibit A, the filing dated May 23, 1923, claimed water
2132 for use for domestic, irrigation and power purposes; that throughout the testimony he had been trying to make it clear that Denver has a number of uses for the water, including power; and that it is certainly relevant to show the means by which this water is to be put to use and the efforts to design, plan and coordinate the use with the diversion facilities.

2135 THE COURT denied the motion.

MR. GROSS: The next item on Exhibit G, "Make Investigations and Do Work at Two Forks Reservoir Site as Required by Federal Power Permit No. 720" was related to the Blue River project in the same way. The money was spent in 1929 for the development of information, for surveys and for preliminary preparation of necessary information for development of the power plant and reservoir storage. The next item
2136 on Exhibit G, "Install Gauging Station on Ten Mile Creek near Dillon and Maintain Same for Three-Year Period as Required under Federal

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Power Permit No. 720" was related to the Blue
2139 River project in the same way. The long tunnel had been surveyed and water from Ten Mile would be available. We needed more accurate information on the flow of Ten Mile Creek than was available from the State Engineer. The State Engineer told us he did not have funds to install another gauging station on Ten Mile, but that if we would contribute to the cost of building the station and to the cost of the gauge reader's salary, he would go ahead and build the gauging
2141 station. We contributed towards the reader's salary over a term of years in order to get a better record of the flow on Ten Mile.

The eighth item on Exhibit G is for the installation of a gauging station on the Snake River near Dillon and its maintenance. The Board needed the same type of information for the same reason.

The expenditure of money referred to in the item "Run Traverse and Levels of North Fork of South Platte River from Two Forks to Grant"
2142 was made in 1929. It was survey work to establish the line along which Blue River water would run when power conduits would be constructed.

The next item on Exhibit G, "Cost of Adjudicating the City's Water Rights on the Blue River"
2142 occurred in 1930 and covered Blue River water rights.

2144 As explained previously, we received an unfavorable report from geologists on the straight tunnel, so a survey of the longer tunnel with an elbow in it to throw the tunnel away from the bad ground was made. This survey appears on Exhibit G under the heading, "Make Surveys Required for Location of 22.8 Mile Tunnel for Diver-

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sion of Blue River Water into North Fork of South Platte River, etc."

2147 The next item, "Maintain and Operate Gauging Station on Blue River near Dillon as required under Federal Power Commission Permit No. 720" was done to obtain more accurate flow records on the Blue.

The next item of expense, "Investigation of Water Supply, Western Slope, Blue River" is an
2148 item of expense that occurred considerably previous to some of those I have just been discussing. It is the cost of the Blue River surveys that Mr. Bull made or part of them.

All of the remaining items on Exhibit G relate in one way or another to the Blue River Project.

2153 MR. SAUNDERS offered Denver Exhibit G
2156 and it was admitted. At the next session of court THE COURT vacated the order admitting Denver Exhibit G and the offer to receive the same was denied.

TESTIMONY BY F. L. CARMICHAEL

CROSS-EXAMINATION

BY MR. DELANEY:

2161 During the period from 1900 to date, there have been some slight reductions in the size of what has been described as the Four County Area. In 1900 Adams and Denver counties had not yet been organized. In 1902 Adams and Denver counties were created out of parts of Arapahoe
2162 County. Both Arapahoe and Adams counties lost small areas by annexation to Washington and
2165 Yuma counties in 1903. Jefferson county lost small areas by annexation to Park County in 1908

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and to Gilpin County in 1913. There have been no increases in the size of the Four County Area.

2166 The population of Arapahoe and Jefferson counties in 1900, an area somewhat larger than the present Four County area, was 162,323. In 1910 the population of the Four County area was 246,767. The growth, percentage-wise from 1900 to 1910 was greater than for subsequent decades. Since 1900 the population in this Four County area has trebled. If that experience is repeated
2167 in the next fifty years, a further trebling of the present population would give the area a population of one and one-half million in the year 2000 A.D. rather than the one million I estimated. In making an estimate of one million for the year 2000 I used the conservative rate of growth of the '30's and pointed out that in depression periods
2168 urban areas do not grow rapidly.

The areas detached from the counties had small populations, but I know of no available source from which the exact population in the areas detached can be determined.

2169 In my previous testimony I stated that there were factors other than population trends to be considered in appraising the reasonableness of a
2170 forecast. Among these factors are manufacturing, transportation, accessibility of natural resources and their extent, and the trade area, in
2172 which respect Denver is outstanding among metropolitan districts.

2174 The Colorado Fuel and Iron plant at Pueblo supplies Denver with steel. With respect to oil
2175 there appears to be no immediate prospect of growth so far as that resource is concerned.

2176 Denver is a wholesale and retail trading center for a wide area. In retail lines people come

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from all over Colorado and from out of state to trade in Denver. I do not know how the total capital investment in wholesale distribution in Denver compares with similar figures in Kansas
2179 City or Salt Lake City, nor to what extent there has been an increase in trade for Salt Lake City from western Colorado.

2180 Exhibit X summarizes my findings for the
2181 four county area. The first hypothesis assumed growth from 1940, at the rate of increase from 1930 to 1940, which was 15.7 percent. I multi-
2182 plied the 1940 population by 115.7 to arrive at the population for 1950. I then multiplied the 1950
2183 derived population by 115.77 to arrive at the 1960 population. I followed the same method to the year 2000. Starting with 407,768 as the population in 1940, the figure for 1950 was 471,000; for 1960, was 545,000; for 1970, was 630,000; for 1980, was 729,000; for 1990, was 843,000; and for 2000 was 976,000.

2184 Assumption 2 on page 3 of the manuscript (Exhibit X) shows growth from 1940 at the rate shown for the period 1910 to 1940. This rate of growth is somewhat more rapid and indicates a population of 1,113,000 by the year 2000 A. D.

2187 The rate of growth for many cities appears to level off between the 300,000 and 400,000 mark. Los Angeles and Chicago have been exceptions,
2188 but they have not been the only exceptions. Den-
2189 ver's growth since 1940 has been at a greater rate than any of the rates used in the assumptions 1, 2, and 3 in the manuscript and it occurred during the war. The was gave impetus to decentralization of business and industry. This is
2190 something that is likely to continue for some time to come. Denver has reacted in its growth to that trend and will continue to so react.

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During the four years of World War II, tremendous increases were brought about in the populations of many cities through the war effort
2191 because the United States government financed industries that brought in population from rural communities and various urban centers. From housing studies made in Denver we know that the war-time growth has persisted since the war.
2192 I was one of those who felt that there would be an outward movement of population from Denver after the war. That was a personal judgment. The outward movement has not taken place. Contrawise, there has been a continuation of the movement into Denver since the war.

2193 Since 1940 there have been annexations to the City of Denver. I estimated that the population of Denver in 1940 was 322,400, the population of the same area in 1945 was estimated at 360,000.
2194 The population of that same area is 400,000 at the present time, the increase from 1945 to the present being approximately 40,000 people in four years.

2195 The Four County area population in 1940 was 407,768. A conservative estimate of the population in the Four County area at the present time is 525,000; it may well be 10,000 or 15,000 greater than that. By using the conservative figure the growth of the Four County area since 1940 is more than 115,000.

2198 During the four-year period 1945 to the present, I estimate that the area inside Denver has increased 40,000 in population and the area outside of Denver has increased in population by 35,000.

2200 The Bureau of the Census makes population studies and since 1940 has made two in Denver

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in addition to the decennial census. Studies have also been made by the Bureau of Business and Social Research of the University of Denver, of which I am a director.

2205 Various statistical devices are employed to
2206 make population studies. Taking average growth in numbers rather than percentages is a method that might be used, but I do not believe that it is a recognized method.

2208 Historically there have been cycles of prosperity and cycles of recession and these can be expected to continue. One reason for selecting the population in the year 1940 as the starting point of projections was to eliminate the recent
2211 very rapid population growth from 1940 to 1950. The study which I made included all population in the Four County area including the city of Littleton and the city of Golden. It included areas that are not served by the Denver Municipal Water System.

REDIRECT EXAMINATION

BY MR. AKOLT:

Questions were asked inferring that I should have used 1900 as a starting point of my studies
2220 rather than population in 1910. If you take as
2221 an assumption the growth from 1940 at a rate shown for 1900 to 1940, the projection to 2000 A. D. is 1,600,000 plus.

2223 The 1940 population of the four counties was 407,768 and the estimated 1950 population of that area on a conservative basis is 525,000, an increase of 117,000. If that increase is continued at that rate per decade for the next five decades to
2224 2000 A.D., the population would be considerably in excess of one million.

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2225 Following is a table showing the projected population at ten-year intervals according to assumptions number 1, 2 and 3 (Exhibit X):

Year	Assumption No. 1	Assumption No. 2	Assumption No. 3
1950	471,000	482,000	525,000
1960	545,000	569,000	607,000
1970	630,000	673,000	702,000
1980	729,000	796,000	812,000
1990	843,000	941,000	939,000
2000	976,000	1,113,000	1,086,000

MR. AKOLT offered Denver Exhibit X for the purpose of identifying the things referred to by the witness and the exhibit was admitted for this purpose without objection.

2229 THE WITNESS: From 1940 to the spring of 1949 there have been several annexations to the city of Denver. That annexed area has a population of approximately 10,000 people at the present time. For the area that was Denver in 1940 I indicated my estimate of population was somewhat in excess of 400,000. As Denver is
2231 now constituted I estimate its present population at somewhat in excess of 410,000.

2235 The great bulk of the 525,000 people located in the Four County area live within the city limits of Denver or within an area ten miles from those city limits.

2236 The United States Bureau of Census report for 1945 states that in the Four County area 18,204 persons were living in occupied dwellings on
2237 farms. The Four County population in 1945 is estimated at somewhat in excess of 450,000. 18,204 in round numbers is just 4% of that 450,000. As
2238 the city grows and the urban area expands there will certainly be further encroachment upon the

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area devoted to farming, and we may expect a decrease in the percentage of people living in these dwellings on farms in the years ahead. As against
2239 that 4% in 1945 it is my judgment that the percentage in 1949 is somewhat less.

2247 Denver Exhibit O shows a blue area and a red area. It is my opinion that 90% or more of the 525,000 people living in the Four County area in 1949 live in the blue and red areas shown on
2250 Exhibit O. From my knowledge of the Four County area I can state Denver Exhibit O shows correctly the locations of towns, boundaries, etc., at the
2258 places shown thereon. In my opinion, on a conservative basis, 85% to 90% of the predicted population of the Four County area for the year 2000 will be living in the area shown on Denver Exhibit O in blue and red.

RECROSS-EXAMINATION

BY MR. DELANEY:

2259 One of the factors which will influence Denver's growth is the decentralization of industry.
2260 Decentralization means that companies with headquarters in centers to the east are to an increasing extent establishing branches or head offices in other parts of the country. Such a movement has taken place with reference to Denver,
2261 and other western cities. Decentralization is involved with the question of national security and also with a realization on the part of businessmen that there must be a spreading out of activities.
2262 The tendency is nation-wide. There is a point which we have not approached beyond which decentralization will not extend. It is my judgment
2264 that Denver will not reach the limit of population growth caused by decentralization by the time the population has reached a million people. It is my

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2266 opinion that decentralization will manifest itself in Denver's growth during the next 50 years. Not all industry that moves to Colorado moves to Denver, some goes to Pueblo and some goes to Colorado Springs.

2268 As I have previously testified, it is my opinion that Denver will continue to grow and to grow more rapidly than the average city having a population of between 250,000 and 500,000 in 1940. From 1930 to 1940 the average growth of this size city exclusive of Denver was 5% and Denver's growth during this period was 12%. The cities in this class to which the comparison is made are Akron, Atlanta, Birmingham, Cincinnati, Colum-
2269 bus, Dallas, Dayton, Houston, Indianapolis, Jersey City, Kansas City, Missouri, Louisville, Memphis, Minneapolis, Newark, New Orleans, Oakland, Oklahoma City, Omaha, Portland, Providence, Rochester, St. Paul, San Antonio, San Diego, Seattle, Syracuse and Toledo. The western cities by and large appear to show more population growth than the eastern cities.

2273 I cannot say whether or not cities such as Cleveland, Baltimore, St. Louis, Boston and Seattle have come to a very decided leveling off process in their growth at somewhere between 300,000 and 800,000 people. If this happened to cities 25 years ago, the same growth factor would not apply today because of this trend towards decentralization.

2276 Denver serves a larger area than Salt Lake City. In jobbing lines it covers essentially Colorado and Wyoming with parts of Kansas and Nebraska included.

Folios

REDIRECT EXAMINATION

BY MR. AKOLT:

2279 In my opinion decentralization is not going to limit the growth of Denver. I think in the long run the limiting factor in Denver's growth is going to be the lack of water; we all know there is not an unlimited supply of water in this country.

TESTIMONY OF A. P. GUMLICK

DIRECT EXAMINATION

BY MR. SAUNDERS:

2281 My name is A. P. Gumlick. I have been a member of the Board of Water Commissioners
2282 continuously since 1929, a period of a little more than 20 years. I am President of the Board and am now serving my 9th year as such, not continuously, however. There have been some years of intermission.

2283 We have various committees on the Board. I have been chairman of the Water Committee
2284 since 1932. The function of that committee is to supervise the administration and procurement of water for the city. My first work on the committee was with the acute shortage of water we had
2285 in Denver in 1932. At that time I was given power by the Board to purchase water from any available source, principally from irrigators. We purchased some water temporarily and a small amount that was incorporated afterwards into the system as permanent supply. The water rights
2286 purchased were all in the Platte River water shed. The river was over-appropriated, so to get water it was necessary to purchase water rights with early date of priority. By "over-appropriated" I mean that there are so many decrees on the South
2287 Platte River that there is not enough water in the

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river to take care of the decrees. For instance, we have a decree in the highline ditch for South Platte water which is dated 1879 and we consider that decree borderline. Decrees on the river with a later date are not much good.

2288 In 1929 when I was appointed to the Board, the other members of the Board and Mayor Stapleton impressed on me the urgent need for water. In 1929 the City was putting up certain monies to aid the Board in prosecuting work on the Pioneer Bore of the Moffat Tunnel. I made it a part of my duties to look into Denver's plans to get additional supplies from the headwaters of the
2290 Colorado River. There was no other available supply. The Board considered our last source of supply must come from Colorado River water.

2291 At the time I became a member of the Water Board it had an established policy with respect to securing water from sources other than the Platte.
2292 Page 3 of Minute Book 4 is a correct copy of the minutes of the Board of Water Commissioners of September 20, 1922. The resolution adopted at that meeting establishes the policy of the Board of Water Commissioners with respect to water supply.

2293 MR. SAUNDERS offered page 3 of Minute Book 4 of the Board of Water Commissioners, which was marked Exhibit Y, containing a resolution as follows:

> "Resolved, that the Report of the Board of Engineering Review, submitted under date of August 15, 1922, is accepted as a basis of the future improvements to the Denver water system of the City and County of Denver."

By agreement a copy of the resolution was substituted for the page in the Minute Book.

Folios

2294 MR. GUMLICK: Denver Exhibit Z is the "Report of Engineering Board of Review to Board of Water Commissioners" dated August 15, 1922, which is referred to in the minutes, Denver Exhibit Y.

2295 MR. SAUNDERS offered both Exhibits Y and Z and ruling was reserved. The exhibits were later admitted (f. 2383).

2296 MR. GUMLICK: I am familiar with the policy of the Board with respect to the development of water rights and water supply. As Chairman of the Water Committee, it is my principal responsibility to execute that policy.

2297 The Board has authorized the expenditure of various sums of money at different times for the Blue River Diversion project and has directed the engineers to proceed with the work on the Blue River project, always keeping in mind that the Blue River was our last source of water supply and that we should protect it. Expenditures of
2298 money were authorized for topographical surveys on different parts affected by the Blue River diversion and surveys were made for pipelines for power generation purposes. Large sums were
2299 expended in connection with investigations of different dam sites at the location of the Two Forks Reservoir site and for the purchase of rights-of-way that might be required for reservoir
2300 purposes. During the time I was Chairman of the Water Committee work has been done looking toward the more economical construction of the Blue River Diversion Tunnel. The first straight line tunnel was laid out before my time, but the dogleg tunnel was laid out after I became a member of the Board. Money was also saved by taking water through a smaller tunnel and by having a reservoir at the Dillon Reservoir site.

Folios

2301 We also cooperated in investigations with the Bureau of Reclamation, the thought being that the project would carry water other than water for Denver, so that Denver's part of the cost would be less. Exhibit E is a contract between the United States and the City and County of Denver providing for a cooperative investigation with the
2302 Bureau of Reclamation. Under that contract Denver contributed $100,000 to investigations of the Blue River project. The money was spent in part for core drilling and stripping reservoir sites.
2303 The information secured by Denver was made available to the Bureau of Reclamation under contract and the Bureau's information, to some extent, was made available to the Board. While
2304 the funds are now exhausted, the interchange of information continues.

2305 In addition to the expenditure of the $100,000 various meetings were had with the Bureau. I personally had several meetings with the Bureau of Reclamation's officials in regard to the Blue River project. I met with Mr. E. B. Debler, the director of the Bureau for the Denver region on
2306 several occasions, in an effort to get the Bureau of Reclamation to speed up the work on the report we were relying upon to go ahead with the plans we had. There was a continual delay in getting any definite commitment from the Bureau of Reclamation. We were several years trying to obtain a final report from them and to the best of my knowledge, there is no final determination
2307 made to this date. We tried to get the Bureau of Reclamation to see the reasonableness of our type of project.

Concerning the sale of water outside the city limits of Denver from Denver's treated water supply, the Board does not sell such water to all

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who apply outside the city limits for it. It refuses
2308 to enter into any type of contract or to give such persons a tap or lease in those cases where the Board does not think it has reasonable assurance that it can continue to furnish water.

2309 The Board has always felt that it had the moral responsibility to furnish water to anyone to whom it could furnish water with a reasonable expectation of continuing the water on a permanent basis. We have hesitated and refused to enter into contracts with anyone we thought might have to be refused water at a later date. We have never cut anyone off of a
2310 treated water supply. We have, from time to time, imposed restrictions on the use of water inside the city limits while at the same time permitting outside users to have water. In planning the water supply for Denver as Chairman of the Water Committee, we include the requirements for raw water sufficient to supply both city consumers and consumers outside the city. It is also
2311 the practice to include those who we anticipate serving in the future, both inside and outside the city.

The power use which we would make of the water would be merely an incidental result of the use of water for domestic purposes that we would
2312 make. Denver's use of water, both inside and outside the city, is at the elevation of approximately one mile. The water resources of Denver
2314 are located at higher elevations. It is planned to use the fall of the water from its source to the point of use for the generation of electrical energy, insofar as such generation does not interfere with the primary consumptive use of the water by the people of the Denver area. The power that would be generated could be sold to the Public Service

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Company of Colorado. They have indicated to us that they would buy all the power that we could possibly generate through our water system. They
2315 would be willing to pay five mills for the power provided they got both dump and firm power. The city could use electrical energy in street lighting and the water department could use a considerable amount in pumping plants.

2316 MR. SAUNDERS offered Denver Exhibit AA, a tabulation of deeds showing property acquisitions for the Dillon Reservoir, Montezuma Tunnel, Trontia Springs Reservoir, Montezuma Tun- Reservoir, by name of Grantee, recording data, acres acquired and consideration paid. COUNSEL for Protestants stated that they were not objecting to the Exhibit any more than they would object to the original deeds, but did object that the four deeds shown under the heading Stratonia Springs and the eighteen deeds shown under the heading Two Forks Reservoir had no relevancy to the Blue River Diversion project, and were out-
2323 side the water district. MR. SAUNDERS replied that the entire Denver water system is one integrated system and work on any part of the system was necessarily work on the whole system. He pointed out that work on the Blue River Diversion segment of the system would be outside of this water district before the tunnel was finished and after getting water to the East Portal of the tunnel, tracing the water all the way down to the sewage treating plants would take it through diverting dams, conduits to filter plants, conduits from filter plants into distribution pipes,
2326 etc. THE COURT admitted Exhibit AA in evidence.

Folios

CROSS-EXAMINATION

BY MR. DELANEY:

2330 MR. SAUNDERS, pursuant to stipulation of counsel, made the following statement:

Protestants' Exhibit 6 is a tap stamp. It is a notice which the Board of Water Commissioners had placed on all tap applications from users of
2331 water outside the city limits. That stamp was used for a great many years prior to the time of Denver's ownership and has been used since.

Protestants' Exhibit 7 is a form of tap application which includes approximately the same provisions as are contained in Protestants' Exhibit 6, but somewhat amplifies it. This form is in current use and supplants the stamp Exhibit 6. Exhibits 6 and 7 have to do with individual consumers of water.

Exhibit 8 is a distributor's contract which is
2333 made with some variations to meet individual conditions for those connections to the Denver water system that will be used to distribute water outside the limits of the city through the distributor's mains. In spite of the existence of a contract as shown by Exhibit 8, the individual user also makes application in the form shown on Exhibit 7 for water service, as well as making arrangements with the distributor who is a party to a contract like Exhibit 8.

2334 Exhibit 9 is a copy of the Rules and Regulations of the Board of Water Commissioners revised to November 1, 1938, and showing a supplement included in the minutes of the Board of April 22, 1947. These rules and regulations are substantially complete but there are a few minor amendments or modifications of these rules not contained in Exhibit 9.

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Exhibit 10 is an excerpt from the minutes of a meeting of the Board of Water Commissioners of April 23, 1948, having to do with the resumption of water service to outside communities after a discontinuance which had taken place during the war.

Exhibit 11 is a form of general cooperation agreement which was executed by Denver and each one of the other three counties of the Four County area. It is a two-party contract and the form was signed by Denver and Adams, Denver and Jefferson, and Denver and Arapahoe counties.

2336 MR. GUMLICK: In my direct examination I stated that Denver cooperated with the Bureau of Reclamation for the joint development of facilities for conveying water from the Blue needed by Denver. The provisions of the 1941 contract between Denver and the Bureau were followed out in general but there were some modifications. I
2338 can't tell you the total amount of money spent on
2341 this investigation. At one time we put up $100,000 and I think, another time, put up an additional $50,000. The Bureau of Reclamation matched our $100,000, so there was $200,000 in the first instance. I am not sure that the Bureau matched our $50,000. There was one time we put up some additional money and the Bureau did not participate.

2343 The funds were handled by transferring them to the Bureau of Reclamation and the Bureau made the disbursements for the actual expenditures. The cost of the work of change of location of the Montezuma Tunnel was borne entirely by
2345 the Board of Water Commissioners, I think. None
2346 of the joint funds were spent in determining the location of the Dillon Reservoir; a part was spent

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2347 on the Two Forks Reservoir site. The South Platte Water Users Association was interested in this diversion and the Board entered into a contract with the Association under which they were to make filings on additional water that might be conveyed through the Blue River tunnel.

2351 MR. DELANEY offered Protestant's Exhibits 6, 7, 8, 9, 10 and 11 and they were admitted without objection.

MR. GUMLICK: Protestant's Exhibit 11 is the form of cooperative agreement in use between Denver and each of the other three counties in the

2353 Four County area. The Board of Water Commissioners requires that the conditions set forth in this agreement be adhered to before they will issue any tap water service.

2354 We have areas in the City of Denver where further service to persons outside of Denver is denied because mains are insufficient to take care of the demand.

2356 We supply treated water and raw water. We have a number of lines entering our filter plants and Marston Lake. These lines carry raw water and the inhabitants of farms adjacent to the raw water conduits have frequently made application to the Board for taps on those lines. Those people have been given taps and they receive raw water. Some of the raw water conduit lines come from the South Platte River to Marston Lake and others from Ralston Reservoir to Marston Lake, but all conduits for raw water that lead into Marston Lake come from the South Platte source.

2358 The Bureau of Reclamation and the Water Board have had differences about the kind of plan that should be adopted for the diversion of water from the Blue River to the Eastern Slope. The

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Bureau did not concur in our plan and we certainly did not concur in the Bureau's plan. I rather think, however, that the Bureau leans toward our plan.

RE-DIRECT EXAMINATION

BY MR. SAUNDERS:

2360 The Bureau had three different plans. One plan was to take the water from the Blue River area and conduct it by high open canals into the Williams Fork area and then pass it through the Jones Pass Tunnel and down through Clear Creek. This plan included transferring the water from Clear Creek into Bear Creek and finally down around the foothills into the Platte River so as to empty it into the Two Forks Reservoir.

2361 Another plan contemplated building a reservoir on Ten Mile and on the Blue and on the Snake and by system of tunnels and conduits to bring the water through to the place close to the intake of the Montezuma Tunnel but at a higher ele-
2362 vation. The last plan was to bring the water by high open ditches into the Williams Fork country, to then pass it into the Moffat Tunnel country, to bring the water through the Moffat Tunnel and down Boulder Creek and across into a reservoir in the Ralston Creek area.

2363 All of the Bureau plans were involved and complicated and one required pumping. In a conversation that I had with Mr. Debler of the Bureau at one time, in talking about these plans, I made the remark that I thought the Board's plan was the best plan and he said our plan was a natural. Our plan does not involve pumping; it
2366 is gravity flow all the way.

I testified on cross-examination concerning

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raw water. The Water Board also sells raw water to the City of Golden through pipes which
2367 Golden owns, and we sell raw water to users under the High Line Canal to satisfy their direct ditch
2368 rights. The City also operates the City Ditch. It is my understanding that the City Ditch was transferred to the City from the original owners subject to the rights they had to water. We have
2369 no authority to terminate these rights as long as they keep up their assessments. There are other rights deemed to be year-to-year rights so long as we have the water to supply these secondary rights. The High Line rights are subject to availability from direct rights in the river and as long as the people pay their assessment, we give them the water. The Farmers and Gardeners ditch is
2370 operated by the Board for the primary benefit of the persons who are located on what was formerly known as the Denver Poor Farm. The City is obligated to deliver water at certain prices to these people. The water sold under the other portions of the ditch are sold on a year-to-year contract.

2371 There is an area between Aurora and the U. S. Government air installations which was refused service in 1948. We refused to allow an extension of mains to be run out there for service because of the inadequate water supply that was available to serve that particular area. We knew that if we started to serve them we would be unable to give them permanent service. Under the contracts which are in the form of Exhibit 8 (water Distributor's Contract) the area which can be served is strictly defined.

The Consolidated Mutual Water Company has been denied extension of service. The Aurora
2373 situation, previously unsatisfactory, has been cor-

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rected by installation of additional mains so that the Aurora area now has a satisfactory supply. We have repeatedly refused to grant extension of mains in certain areas to outside districts because
2374 we could not assure them of an adequate water supply, either on a temporary basis or on a permanent basis.

2375 I testified concerning the Bureau of Reclamation agreement, Exhibit E. The Bureau of Reclamation did the work on the Two Forks Reservoir consisting of core drilling and excavation, using its own machinery and equipment. The Bureau
2376 presented us with statements of expenditures made and we paid them our share.

Exhibit E states in Paragraph 5, "The United States and the City contemplate an expenditure of $100,000 each on the investigations referred to in the agreement, but neither party should be obli-
2377 gated to spend any specific amount thereon." Aside from the Two Forks investigation the Bureau and the Board made their investigations independent of each other. The funds were not all put into one common pot.

2380 MR. DELANEY objected to the admission of Denver Exhibits Y and Z (offered at f. 2295), Exhibit Z is the "Report of the Engineering Board dated August 15, 1922, and Exhibit X is the Board's resolution adopting the report as its policy. The objection was made on the ground that Exhibit Z shows merely a preliminary consideration of a system of water works and does not show any fixed and determined plan and on the ground that the Blue River Diversion project
2382 described at page 42, Exhibit Z and shown by an attached map, is not the one for which claim is now made, but is more like the 1923 filing,

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2383 Exhibit A. MR. SAUNDERS stated that the step-by-step development of the project had now been shown and that the present project was just an enlargement of the original. THE COURT admitted Exhibits Y and Z.

TESTIMONY OF H. L. POTTS

DIRECT EXAMINATION

2385 My name is H. L. Potts. I am water rights engineer for the Board of Water Commissioners. I had three years of academic training at Colorado A & M. I have been employed by the Board of Water Commissioners for more than 25 years as an engineer.

2386 My work for the Board has been largely connected with the administration of water rights, reservoir regulation and various hydraulic studies.

2387 For the past few years my work has been confined entirely to the field of water supply. As
2388 water rights engineer, I keep track of available water and also the amount of water needed to meet the demands of the water system. Denver Exhibit BB (titled "Water Rights Available for Potable Water Plant of Denver"), is a summary of the flow rights and storage rights owned by the city on the South Platte River, Cherry Creek, Bear Creek and tributaries, and Colorado River tributaries.

2389 THE COURT admitted Denver Exhibit BB in evidence without objection.

2390 MR. POTTS: Exhibit BB under the heading "South Platte River" shows the direct rights out of the South Platte owned by Denver. The list shows each

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right by name, date of priority and amount of second-feet of divertible water. Those rights will not yield the amount shown. Certain of the items are starred. These starred rights are available only from April 15th to August 10th of each year.

2391 There are many persons who have South Platte water rights with a date of priority earlier than the dates of Denver's priorities. Because of these

2392 senior rights the amounts listed for the direct rights are not actually delivered at all times during the year.

2393 On page 1 of Exhibit BB these is a list of storage rights for South Platte water. The stor-

2394 age rights never yield the amount of acre feet listed on the exhibit. The amount shown on the exhibit is the total capacity of the various reservoirs and there is not enough water in the River to enable the reservoirs to be emptied and filled each year.

2395 In practice the first three reservoirs listed, Antero, Eleven Mile Canyon and Cheesman are used for reserve holdover to carry the city through

2396 drought periods. There are periods when the annual flow on the South Platte River is 30% to 40% of its mean flow as shown over a period of years.

2397 I have studied the stream flow records of the South Platte in the office of the State Engineer which are complete from 1910 on. I have also made studies of the annual growth of trees in the area, these studies going back to 1348.

2400 The records in the office of the State Engineer and the tree ring studies indicate that there are dry periods and wet periods which appear from time to time. The periods do not occur with such regularity that they could be considered a cycle.

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2401 A comparison of recorded runoffs to tree ring studies covering exactly the same period of time shows striking similarity. A high run-off reflects itself directly in ring growth. The same relationship exists between known precipitation and tree growth.

2403 To protect the city's water supply it is necessary to maintain sufficient reservoir storage to carry the city through recurring periods of subnormal runoff. The amount of reserve necessary to protect us against periods of low runoff has been under discussion from time to time, and should be sufficient to carry the city through any succession of low runoff years. Roughly speaking, we feel there should be at least a two years' reserve supply in storage in our reservoirs to safe-
2404 guard us to any extent at all. That would be approximately 200,000 acre-feet. Approximately 100,000 acre-feet is considered one year's supply.

2405 Exhibit BB lists 33,000 acre-feet for Antero Reservoir. The decree for Antero is much larger than 33,000 acre-feet but the 33,000 is the stop order on that reservoir imposed by the State En-
2406 gineer because he feels the reservoir would not be safe beyond that point. The dam cannot be safely used to impound more than that much water. We have not fixed the dam because the runoff above Antero is relatively small. Below
2407 Antero we have Cheesman and Eleven Mile Canyon reservoirs which have sufficient storage capacity to more than take care of the runoff from
2408 the cachement area. We are able to take care of all available water with the reservoirs at hand and that condition will remain when the additional water is received from the Blue River diversion project.

2409 Exhibit BB shows Eleven Mile Canyon Reser-

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voir as being undecreed. That reservoir was filled to its full capacity by emptying Antero Reservoir and by exchange of water when available from the
2410 Fraser River. The exchange program works as follows: Referring to Exhibit S, most of the senior water rights on the Platte River are below the mouth of Clear Creek. The call from these rights controls the amount of South Platte water left for city use, which is taken out of the South Platte at the place marked "Intake" on Exhibit S. The
2411 Fraser River water is brought through the Moffat Tunnel and released into South Boulder Creek, brought down South Boulder Creek to Eldorado
2411 Springs and across to Ralston Reservoir. Any additional supply not immediately needed for filteration and direct use in the city is carried over to Clear Creek in a canal and there released. This water is allowed to run down Clear Creek and enters the South Platte River for use of senior appropriators below Denver. By supplying the senior appropriators below Denver with, for ex-
2412 ample, 500 acre-feet of water, it is possible for us to store in Lake Cheesman, Eleven Mile Canyon or in Antero a corresponding amount of South Platte water provided there is that much water at the reservoir and that no senior rights between "Intake" and the City that would be injured by the exchange. We have been able to fill Eleven Mile Canyon Reservoir by exchange, to put some
2413 water in Lake Cheesman, and to put a very small amount of water in Antero.

This plan does not work very well for Antero Reservoir because it is so high on the stream. The runoff into the reservoir is small and the hay land between Antero and the Eleven Mile Reservoir calls for a great deal of the runoff, making it impossible to hold back much water in Antero.

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2414 There are times when the Platte River is in short supply and this exchange program cannot operate. Williams Fork water can be stored by exchange in the same manner as Fraser water is stored by exchange.

2415 I previously stated that Eleven Mile Canyon Reservoir is undecreed. It is located Water District No. 23 and there is no decree in that district for Eleven Mile Canyon Reservoir. It does have a storage decree issued out of Grand County for filling by exchange.

2416 On the first page of Exhibit BB opposite the Platte Canyon Reservoir there is a comment "No normal net yield" and the same comment is made opposite Marston Lake. While these reservoirs have storage decrees in District 8 and District 9, they are not operated as storage reservoirs. They are adjuncts to the filtration plants located at Kassler and at Marston Lake. Water under river rights or water released from storage is taken into these reservoirs and allowed to settle before
2418 being turned into the filter plants. At times of turbulence, chemicals are added and several times through the year when microscopic examination shows it necessary a chemical treatment is given to these reservoirs. If the Platte Canyon Reser-
2419 voir drops 6 or 7 inches in elevation, the superintendent will call for more water for the reservoir in order to keep his filters up to capacity. He must hold the reservoir at a high level. The same thing is true of Marston Lake although it varies
2420 more in elevation due principally to a current lack of sufficient conduits supplying the lake. In
2421 short, the water must be maintained at a fairly constant level because of the filtration process.

2422 The city has two galleries, one called the

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Cherry Creek Gallery and the other one a small one located under the Platte Canyon reservoir. A gallery is used to tap a water table in a sand-bearing strata. It consists of a kind of crib work which permits water to flow into the cribs or pipes and then is carried away from the gallery in a
2423 pipe. The Cherry Creek galleries produce 200 to 300 acre-feet per month. A gallery relies on the
2424 process of natural filtration and cannot remain in operation after population encroaches on it.
2425 This situation is creeping up on the Cherry Creek galleries.

We are also wondering what effect the dam
2426 being built by the army engineers will have on the water table through that section. A tight core of sheet piling is put down across the valley of Cherry Creek to bed rock at the dam and it will stop any
2427 movement of water in the sands above the dam. It will keep that underground flow from travelling on down which would furnish water to these galleries and we do not know just to what extent that will affect the total flow. Some, of course, comes in from the side but we have no way of
2428 telling how much. The purpose of this dam is to control any floods which might occur on the Cherry Creek water shed and to store water from the Blue River after being diverted into the South Platte.

2429 On the second page of Exhibit BB under the heading "Bear Creek and Tributaries" are listed Denver's rights on this stream. The variations on Bear Creek and its tributary Turkey Creek are greater than the Platte itself. The decreed amounts shown are more or less paper decrees. The water simply is not there for any length of time in the amounts stated. Those rights were
2431 acquired by the Denver Union Water Company in

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an early day to make some Bear Creek water available for storage in Marston Lake.

Under the heading "Bear Creek and Its Tributaries" there is listed a storage right for Soda Lakes for 660 acre-feet. That amount is usually available but it is not always suitable for domestic use. The lakes are located on Bear Creek below
2432 the town of Morrison. The lakes are shallow. In many years by the time storage is available in Marston Lake to permit transfer of this 660 acre-feet, Soda Lakes is so grown up with various micro-organisms that the water is not good for use.

2433 On Exhibit "BB", under the heading "Colorado River Tributaries" there is shown a direct right from the Fraser River through the Moffat Tunnel Diversion project for 520 second-feet. That amount of water is not in fact available throughout the year. From 1936, the date when the diversion started, to the present there has been no day when 520 second-feet was diverted through
2434 the tunnel. There is a seasonable variation in the supply of water under this decree. The water shed and the canals, conduits and syphons are all located at a high altitude. Snow and ice conditions ordinarily prevent getting water through the tunnel until after the first of May. Once the
2436 season starts, about 80% of the runoff comes in the months of May, June and July, reaching a peak in June and dropping very rapidly after that.

On page 2 of Exhibit BB under the heading "Colorado River Tributaries" in connection with the Fraser River there a storage right is listed for the Ralston Reservoir of 11,000 acre-feet together with the comment "No normal net yield."
2437 The Ralston Reservoir, like the Marston Lake and Platte Canyon Reservoir, is used in connection

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with a filter plant, Ralston's being the Moffat filters. We fill Ralston as rapidly as possible from the Fraser River diversion and keep it full as long as there is enough water coming through the tunnel to hold it there. The water from the Moffat Tunnel flows down South Boulder Creek and across Rocky Flats into Ralston Creek Reservoir. Ralston holds no water over from year to year for
2439 storage. In order to keep the reservoir from going dry, we have to curtail the rate of flow going through the Moffat filters and begin pumping Platte River water through sections of the city to make up for the shortage from the Moffat filters.

2440 The Williams Fork decree for 214 second-feet is shown on Exhibit BB on the bottom of page 2. The conditions at the Williams Fork tunnel are more severe than at the Moffat tunnel because the Williams Fork tunnel is a little over 1,000 feet higher in elevation. The next item listed is the Williams Fork Reservoir which has storage rights.
2441 It is used to make daily compensation to the Colorado River for diversions through the Moffat Tunnel and Jones Pass Tunnel when senior appropriators on the Colorado River would be entitled to the water diverted through the tunnels. The Williams Fork Reservoir is not shown on Exhibit S. It is located on the Williams Fork River. A pencil circle shows its approximate location.

2445 In a year when the Platte River is in short supply and running 40% of its mean production, the city would take about 40% of its requirements from the Platte River and the remaining 60% would have to come from other sources. In other words, with a 100,000 acre-foot use in the city for a year we would get approximately 40,000 acre-feet from direct rights and 60,000 acre-feet would

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have to come from storage or transmountain di-
2446 version. In such a year the Platte River would not produce any storage for the city.

The Blue, Fraser and Williams Fork Rivers do not fluctuate as much as the South Platte, but I believe that in some years these three rivers have flowed at 60% of normal. In such a 60% year the Fraser River would produce probably 25,000 acre-feet under the present unfinished condition of the
2448 Fraser River project and between 50,000 to 60,000 acre-feet when completed. In a 60% year the Williams Fork project would produce 5,000 or
2449 6,000 acre-feet. In a year of short supply it is not likely that Williams Fork water could be put into the water system. It can be used only by exchange and unless there were enough water in the river at Cheesman or at some other point to make the exchange, no use could be made of it.

2451 At the present time the requirements of the City and County of Denver for filtered water is slightly more than 100,000 acre-feet. It takes approximately 105,000 acre-feet of raw water to produce 100,000 acre-feet of filtered water. In addition, when the city acquired the Antero reservoir, it issued certain water rights to farmers under the canal for their stock in the Antero sup-
2459 plies. It takes approximately 4,000 acre-feet of raw water per year to satisfy these Antero obli-
2460 gations, making normal demand approximately 109,000 acre-feet per year for raw water. This demand fluctuates. In two recent years 124,000
2461 acre-feet of raw water were required; in 1948, 112,000 acre-feet. In years of short water supply the requirements tend to be greater and are gradually increasing from year to year.

The storage reservoirs have a total rated capacity of something over 220,000 acre-feet. How-

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ever, all that would not be available for use due to siltation in some of the reservoirs and our inability to pull each reservoir down to its last gallon of capacity. As a practical matter the Denver Municipal Water System has storage capacity of approximately 200,000 acre-feet or a two-year supply.

2463 In years of short supply when the Platte River is running 40% of normal and the Colorado River resources are running 60% of normal,
2464 50,000 acre-feet would be drawn from storage each year. In four successive years of such conditions the storage reservoirs would be entirely empty. The records of runoff with which I am familiar indicate that such a four-year succession would not be improbable.

2470 A severe drought occurred in 1925 followed by several years of normal conditions. By 1931 Lake Cheesman had been pulled below its spillway and in 1933 it was nearly empty. In 1942, it again went over the spillway. It took seven years and eleven months after falling below the spillway level to bring it up to its full capacity.

2471 Denver Exhibit M is a chart I personally prepared, showing the actual net diversions of raw water made by the city from 1880 to 1947, inclusive, the additional obligations which the city met
2472 during the period from 1918 when the city acquired the system, and the apparent trend of use from 1900 to 2010. The solid line on Exhibit M represents net diversions each year for filtered use. The scale on the righthand margin shows the amount of water available under normal conditions for city use from South Platte rights, Williams Fork rights, the Moffat Tunnel system when completed, and the Blue River diversion. The lefthand scale shows total number of acre-feet,

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2473 these numbers being actually represented by the horizontal lines on the exhibit. The vertical lines on the exhibit correspond to the years from 1880 to 2010. The points of intersection between the vertical year lines and the horizontal water amount lines indicate the actual raw water use by
2475 the Denver Water System for the years indicated on the exhibit. The use of water in future years is indicated by a dotted line which was derived by plotting the annual diversions beginning in
2476 1900 on logarithmic cross-section paper. The values so determined were then plotted on this chart thus showing the estimated future use or the apparent trend in water use in the future. The projection is based on actual use from 1900 to 1948. I consider that the trend indicated by the dotted line on Exhibit M fairly and accurately represents true conditions.

MR. SAUNDERS offered Exhibit M and MR. DELANEY requested time to examine it.

MR. POTTS: Denver Exhibit L, a chart which I prepared, is a forecast of the rate of growth population in the Denver Metropolitan
2481 area. By the Metropolitan area I mean the area which is served by the distribution lines of the Board of Water Commissioners. On the graph the horizontal lines represent the population and the vertical lines represent the year. The dotted line
2482 on the chart shows the yearly estimated popu-
2483 lation of the area served by the Water Board. Beginning with the year 1910 the points shown on the chart for the 10-year periods are based on census figures. The intervening points are based on Water Board estimates based on new taps.
2484 These estimates are checked with the Telephone Company, Public Service Company, Real Estate Exchange, Chamber of Commerce and any other

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agency we know of that might be making a population study.

2485 The dashed line is a line drawn through each of the points plotted for the ten-year census periods and extended. It represents our estimate of popu-
2486 lation trend commencing with 1950 and extending forward from that point. The same method of development was used for this exhibit as was
2487 used for Exhibit M. On Exhibit L there are three dots circled in red on the horizontal line corresponding to a population of one million. These dots are taken from the population chart prepared by the Engineering Board of Review and which is contained in its "Report of Engineering Board of Review to Board of Water Commissioners" dated August 15, 1922 (Exhibit Z), as Plate 1. Denver Exhibit K is a reproduction of that plate on the
2488 same scale as Exhibits M and L for comparison.

MR. SAUNDERS offered Exhibits K and L. THE COURT permitted Mr. Delaney to cross-examine for the purpose of making objections.

CROSS-EXAMINATION

BY MR. DELANEY:

2490 Referring to Exhibit M there appears on the righthand margin the notation South Platte 65,000, Williams Fork 7,000, Moffat 80,000 and Blue River 157,000, the numbers referring to
2493 acre-feet. On Exhibit S in the "Williams Fork Area" there appears the number 25,000 acre-feet. That was an estimate of what could ultimately be realized from that particular diversion. On my chart, Exhibit M, I carry 7,000 acre-feet rather than 25,000 acre-feet shown on Exhibit S.

2494 From 1920 until 1930 there was one year, 1922, when less than 60,000 acre-feet of water

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was diverted from the South Platte River. Most of that time the supply of water was considerably
2496 above 65,000. Around 1930 or 1931 the supply was 90,000 acre-feet and then it dropped in 1935. The average of all the period would show a net diversion about 65,000 acre-feet. In preparing the chart, Exhibit M, I consider the 65,000 as coming from direct rights; that figure does not include withdrawals storage. The 65,000 acre-feet was about the average and the rest would come from storage.

2498 Logarithmic cross-section paper was used to plot the broken line starting with the year 1950 that appears on Exhibit M. I plotted the actual net diversions from 1900 to 1948, laid out the trend during that period and simply extended that trend in a straight line on the logarithmic
2499 paper. This method does not distort. I find it necessary quite often to make forecasts for a five-year period and have used this method and found it to be very satisfactory for my administration of water supply. Logarithmic paper is used to graph an increase at steady percentage. The same method was used in the preparation of Denver Exhibit "L".

2501 Exhibit M was prepared long before I knew Dr. Carmichael. The rate of growth shown on my Exhibit L is 23% Dr. Carmichael's rate of growth was 15.7%. Dr. Carmichael's chart did not consider exactly the same area which I considered. I considered only the area served by our system.

I recall that Dr. Carmichael stated that 96% of an estimated million population was in an area
2506 other than the rural or farm area. My chart shows a million and a half population in the year 2010. Chart L has no bearing or connection with the Chart K taken from the report of the Engi-

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neering Board of Review (Exhibit Z) except that I have placed on L three red dots taken from the Board of Review chart.

2508 The population which I projected for 1950 is about 475,000. The Engineering Board of Review estimated 1950 population at a minimum of 475,000. They also had a maximum or optimistic rate for 1950 of about 560,000. Their mean figure for 1950 would be about 510,000. That estimate was made in 1922. The lower estimate is the one which we now know comes closest to present con-
2510 ditions. It predicts that the population in the year 2002 will reach 1,000,000; however, the present
2511 trend is approaching the mean. I estimated the population in the year 2000 at 1,230,000.

MR. DELANEY then objected to the admission of Exhibits L and M on the ground that use of logarithmic paper was not a recognized
2514 method of forecasting. He made no objection to Exhibit K because it was a reproduction of a portion of Exhibit Z. MR. SAUNDERS then examined the witness further.

REDIRECT EXAMINATION

BY MR. SAUNDERS:

2515 The manner of graph preparation can be illustrated by the following example: Assuming that a city has a population of 10,000 in the year 1900 and a population of 11,000 in the year 1910, the percentage of increase between 1900 and 1910 would be 10% and the population increase would
2516 be 1000 persons. If the same percentage increase occurs between 1910 and 1920, 1100 persons would be added to the population, not 1000.

2518 The example given illustrates the two methods of estimating population increase. One

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method is to use a constant percentage, the other a constant number; that is, the increase in numbers always remains the same. If carried forward far enough, the constant number method causes distortion. A steady increase in numbers appears as a straight line on cross-section paper such as used in Denver Exhibits K and L. A constant percentage increase appears as a straight line on
2520 logarithmic paper and when transferred to cross-section paper will have an upward curve. Denver Exhibit L shows the upward curve and is not a
2521 distorted method of extending future trends.

Referring to Exhibit M, I have penciled in a figure of 65,000 acre-feet per year as applicable to the South Platte River direct rights. I selected 65,000 because that appeared to me to represent a mean figure of available water. The 7,000
2522 acre-feet marked for Williams Fork is the amount of water which could be put to municipal use although it does not reflect the maximum possible
2523 diversion through the tunnel. That tunnel is being built by the City and County of Denver as distinguished from the Board of Water Commissioners. The governing department and the Water Department are co-ordinate and neither is the agency of the other. The 7,000 acre-foot figure is my estimate of the amount of water available to the Board of Water Commis-
2524 sioners. The 80,000 acre-feet marked on Exhibit M for the Moffat Tunnel is my estimate of the average amount of water which will be available for city use after operation and stream losses are
2525 deducted as of today. The Moffat Tunnel is about half completed. The 157,000 acre-feet marked with respect to the Blue River is my estimate of the amount of water available after the Blue River diversion has been completed.

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2526 I did not collaborate with Mr. Carmichael in the making of his population estimates, and he did not collaborate with me in the making of mine. My work was done prior to my meeting Mr. Carmichael.

My estimate for Williams Fork on Exhibit M is 7,000 acre-feet, and the amount shown on Exhibit S is 25,000 acre feet. Most of the Exhibit S estimates in my opinion were too high in the beginning. The Williams Fork diversion project has not been completed up to what may be considered its full capacity. The figures on Exhibit S are gross figures and the figures on Exhibit M are net figures for use.

2532 I personally operate the Williams Fork project for the Department of Improvement and Parks in conjunction with the Fraser River di- on Exhibit L of 7,000 acre-feet is not the entire version. The quantity of water which is shown amount of water diverted through the Williams Fork Tunnel. It is only the water which in my opinion could be converted to city use under present conditions. A few years ago for two years we diverted in excess of 11,000 acre-feet through the Williams Fork Tunnel. Last year our actual diversion was slightly under 2,000 acre-feet, and

2533 7,000 acre-feet shown here is what I would consider available to the City Water System. The reason that all the water cannot be used by the city is that the water is emptied into North Clear Creek and becomes polluted with mill tailings, sewage and other things. The only means we have for use of that water is through the medium of exchange. Exchange is more or less complicated and varies from year to year. In certain years we have no room for exchange water because we have filled our reservoirs from direct rights. Williams Fork has not been completed to its full capacity.

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RECROSS-EXAMINATION

BY MR. BARNARD:

2535 For two years in succession we diverted over 11,000 acre-feet of water that came through Jones Pass Tunnel. None of the water was wasted. Denver got the use of that 11,000 acre-feet in one form or another, either by exchange, storage or otherwise.

REDIRECT EXAMINATION

BY MR. SAUNDERS:

2537 Part of the water that is taken from the Williams Fork project is applied to the use of the Denver Municipal Water System and the re-
2538 mainder is used by the Department of Improvements and Parks of the City and County of Den-
2538 ver at park lakes for recreational purposes or for sale to certain agricultural interests along Clear
2539 Creek. The Department of Improvements and Parks has other water also which it uses for irrigation in Berkeley Park, Rocky Mountain Lake, and Park and for Sloans Lake.

2540 The additional uses of water made by the Department of Improvements and Parks of the city is not included in the calculations shown on Exhibits K, L and M. Those exhibits pertain to water used through the system controlled by the Board of Water Commissioners only. Any other use by the city of water would be in addition to
2541 that shown on the exhibits. I have not included in any of my estimates water required by the De-
2542 partment of Improvements and Parks. The figure given on the righthand margin of Exhibit M for Williams Fork is the net available water to the Board of Water Commissioners for use in its system after deducting water used by the Depart-

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ment of Improvements and Parks, stream losses, losses incurred because of adverse exchange conditions, and loss at the filters.

2543 MR. SAUNDERS, in response to a question by Mr. Delaney, stated that other departments of the city have power to make their own appropriations of water independent of the Board of Water Commissioners and that all testimony presented at the trial related to the use of water by the
2546 Board of Water Commissioners. THE COURT reserved ruling on the Exhibits L and M. They were later admitted (f. 2768).

2547 MR. POTTS: The capacities of various reservoirs follow:

Name of Reservoir	No. of Acre Feet	No. of Cubic Feet
Marston Reservoir	19,800	862,488,000
Antero Reservoir	85,564	3,727,158,168
Grant Reservoir	5,000	217,800,000
Estabrook Reservoir	5,000	217,800,000
Two Forks Reservoir	480,000	20,908,800,000
Strontia Reservoir	25,000	1,089,000,000
Waterton Reservoir	20,000	871,200,000

Antero Reservoir is never carried up to its rated capacity. The State Engineer has put a stop order at 33,000 acre-feet on Antero Reservoir, which for safety purposes we rarely carry over 20,000 acre-feet.

2550 All of the reservoirs above listed are used for regulatory purposes, for storage, for successive fillings as water is available, and for replacement of seepage and evaporation from them. The waters which are subject to this adjudication will be used both for direct and storage purposes.

2552 The water will be used for domestic uses, which include general household use, irrigation

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of lawns and gardens. The water will also be used for such municipal purposes as fire protection and street washing. It will also be used for manufacturing.

2554 No one can tell to what use a particular particle of water in the Denver Water System will
2556 be put. Water is now used through the Denver Municipal Water System for mechanical uses, manufacturing purposes, the generation of electric power, for fire protection, sewage treatment,
2561 watering of parks, maintaining adequate storage reserves, irrigation and adjustment and regulation of various units of the water system. The appropriations which are claimed in this proceeding are for the same purposes just described for which water is now being used. There will
2562 be times when the entire use to be made of the water coming through the Blue River diversion project will be for purposes other than irrigation.

There are 66 and a fraction square miles inside the corporate limits of Denver, that is, or
2563 about 43,000 acres. As shown on Exhibit O, there are approximately 120 sq. miles in the area now served by the Denver Municipal Water System
2565 and an area in pink surrounding Denver which in
2566 my opinion will be served with water by the Denver Municipal Water System eventually if water is
2567 available. The total of the two areas is 260 sq. miles, or approximately 165,000 acres.

2569 Williams Fork water at present can be used for municipal purposes only by exchange. The project when completed will bring the water directly into a city reservoir or directly into the pipeline system. Ultimately the Williams Fork unit will be used to its full capacity.

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RECROSS-EXAMINATION

BY MR. DELANEY:

2574 I was a witness in Cause No. 657 in the District Court of Grand County wherein Denver obtained its original decrees for the use of waters from the Fraser and the Williams Fork Rivers. In that case I testified that the Williams Fork water would ultimately be used by the City of
2577 Denver or by the Water Board. There has been no change in plan as to the Williams Fork water.
2579 Williams Fork was put in operation in 1942. At
2580 times during the year the entire available flow that could be collected by the present works is taken, and at other times it is not. The available supply is much in excess of 7,000 acre-feet per year, and has been so at all times. Ultimately all of the Williams Fork water will be taken into the mains for municipal use although there is no defi-
2582 nite plan to do so at present. It is a small unit and development to its ultimate and final use will be very expensive.

2585 The Williams Fork decree to Denver is limited
2586 to 620 cu. ft. per second. With that decree went decrees for storage at Williams Fork Reservoir
2587 for 5,120 acre-feet absolute. There was a conditional feature in the decree also. I recall that the Department of Interior only permitted the Department of Improvements and Parks to build a reservoir to a much smaller capacity than had been planned (the Williams Fork Decree, pages 707 to 713, inclusive, plus the supplemental decree and a certificate at page 761, was marked as Protestant's Exhibit 13).

2588 I believe that the total amount of water that we were entitled to divert by direct flow for the Williams Fork reservoir was 750 feet, and that

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2589 the storage had to do with replacement water only. Ordinarily when replacement is due there is practically no flow at the portal of the Williams Fork Tunnel; the runoff has passed and in the operation I nearly always shut down within a very few days of the time I am notified replacement is due. There is always sufficient replacement so that I can take all the water through the tunnel that can be intercepted at the headgate. There is approximately 25,000 acre-feet of water per year
2591 available.

In 1944 and again 1945 the Board of Water Commissioners used 11,000 acre-feet of Williams
2592 Fork water. The 7,000 acre-feet is my estimate of the amount of Williams Fork water generally available for municipal use. The 11,000 acre-feet of water was used for exchange and some was sold to irrigation ditches along Clear Creek prin-
2593 cipally. These sales were not for municipal or city purposes except in so far as the money from the sale was concerned. It will probably be some years before domestic use is made of more than 7,000 acre-feet of Williams Fork water per year.

2594 The plan is to complete the Fraser River diversion project, then to complete the Williams
2595 Fork unit and by the time these supplies were exhausted the Blue River unit would be ready to start delivery of water. It is a long range program and should be considered as such.

2596 The 7,000 acre-feet represents my estimate of the average use of Williams Fork water that will be made under present conditions. Next year we might use as much as 11,000 acre-feet if such were available for exchange purposes. We have not abandoned the idea to finally use the entire divertible amount of water of Williams Fork

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2597 water. Full utilization of Williams Fork water could be accomplished in more than one way. For the greatest beneficial and economical use a reservoir would probably be required on the eastern slope and a pipe line run from that because the duration of flow at altitudes of 10,400 feet only lasts a short time. This is the elevation of the west portal of the Williams Fork Tunnel. Probably by the end of August the flow is down to a very few feet. It is the plan of the Water Board to prosecute the Williams Fork diversion so that it ultimately will beneficially apply and utilize approximately 25,000 acre-feet of water, if available.

2599 We claim for all possible beneficial municipal use within the blue and red areas shown on Exhibit O. There are other areas, for example, where Williams Fork water is beneficially applied, which are not shown on Exhibit O, such as water rented
2600 to farmers. The major and eventual use of the water claimed here will be made in the area shown in red or blue on Denver Exhibit O. Certain uses have been made of outside of that area, as repre-
2601 sented on Exhibit O. Denver parks have their
2602 sources of supply at Berkeley Park, Rocky Mountain Lake and Sloan's Lake and are supplied from direct flow rights from Clear Creek by Rocky Mountain Ditch and Agriculture Ditch. In years when that ditch supply is insufficient to keep up those lakes to their required elevation, the Department of Improvements and Parks tells me that they must have some water delivered from the Williams Fork unit, which I attempt to do.

2604 COUNSEL stipulated that Denver Exhibit BB contained an error. As to Lake Cheesman, the figure 48,300 should have a date 9-24-1893

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and the figure 30,764 should have a date of 6-27-1889.

2605 MR. POTTS: Referring to Exhibit O, there are small areas served by water other than water diverted through the Denver Municipal Water System. A small portion of the southeast corner of the area colored red is served by Lake Cheesman water under supplemental contracts and comes under the Highline Canal. Transmountain water has been put in that canal by exchange a few times. There is a possibility that a
2606 portion of the red area in the northwest corner of the map, Exhibit O, would be served by water sold to the Farmers' Reservoir and Irrigation Company for storage in Stanley Lake. There is a portion of the red area and possibly some of the blue on the west boundary which at times is also served by sale of transmountain diversion
2607 water. Washington Park, City Park, Berkeley Park, Rocky Mountain Lake Park and Sloans Lake and Park are all within the blue area and irrigate through canals rather than with water taken through the municipal system.

2608 There is also some irrigation and use of water in the Rocky Mountain Arsenal area. The United States Government condemned some water rights in the Arsenal area under the Highline Canal
2609 and during the war the Arsenal made large purchases of storage water from Cheesman. In addition to that, we have a large conduit extending to the boundary of the reserve which carries
2610 filtered water to the Arsenal area. The Highline water is used by the Arsenal for manufacturing purposes, and I presume for irrigation purposes on some lawns in the area.

2611 Exhibit BB shows no tabulation as to amount of water for the Highline Canal because that canal

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is operated independently of the municipal water supply. The City Ditch is not tabulated as none of the water goes for direct municipal use. The tabulation of water on Exhibit BB does not include the type of water I have been speaking of; but includes only filtered and treated water.

2614 COUNSEL stipulated that the Denver charter, 1927 compilation, and amendments would be admitted in evidence.

2616 MR. POTTS: The Department of Improvements and Parks built the Williams Fork
2617 Tunnel. After running it for three days they hollered for help and the Water Board took over its operation. No other departments bring water into the city. The Department of Improvements and Parks has water rights not shown on Exhibit BB in the Rocky Mountain Ditch, the Agricultural Ditch, the Highline Ditch, the City Ditch, and they acquire storage credits in Lake Cheesman for water released from the Williams Fork Reservoir for replacement of Moffat Tunnel water. We have a system of interchange between different depart-
2621 ments of the city government. The amount of water involved in this interchange would be the difference between the 7,000 acre-feet which I estimate can be diverted to municipal use from the Williams Fork Tunnel and the 11,000 acre-feet which has been diverted and ultimately will be 25,000 acre-feet.

2622 I do not recall ever having heard the amount of water used by the Department of Improvements and Parks in the area shown on Exhibit O. Wash-
2624 ington Park, City Park, Berkeley Park, Rocky Mountain Lake Park and Sloans Lake Park have their own irrigation. They are also served with water for drinking fountains, concessions and fire hydrants which water is supplied by the Water

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2625 Board. The park area is small in comparison with the area of the city.

2627 The Water Board has 220,000 acre-feet of available storage decreased somewhat by siltation and dead storage. The 220,000 acre storage capacity is made of Antero, Eleven Mile, Cheesman, Marston, Ralston and the Platte Canyon Reser-
2629 voir, which is located two or three miles below "Intake" on Exhibit S. It is the sedimentation basin for the Kassler filter plant which is about
2630 two miles below "Intake" on Exhibit S at approximately the point where I have placed a cross.

2634 The initial means of diversion from the South Platte to the area shown on Exhibit O is accom-
2638 plished by conduits. There are so many conduits and methods by which you can take water from different points that a detailed scale map is required to explain them fully.

2645 The South Platte River has a mean flow which is approximately 285,000 acre-feet to 300,-
2649 000 acre-feet annually. One year the South Platte ran 40% of mean.

2653 From 1936 to 1947 the South Platte, Bear Creek and Cherry Creek together produced a mean supply for Denver of 55,399 acre-feet of
2654 direct water. Over the same 12-year period, an average of 6,712 acre-feet per year was sold for irrigation uses to certain canal owners, including
2655 water drawn from Lake Cheesman for the supplemental contracts under the Highline Canal and water drawn from Lake Cheesman for a 500-acre foot obligation to the Last Chance Ditch.

2656 In 1930, 6,670 acre-feet were used for supplemental water under the Highline Ditch, 8,214
2657 acre-feet for the Henrylynn Irrigation District, and 1,750 acre-feet for Wellington Lake users. In

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1931 the supplemental use on the Antero Reservoir exchange was 4,840 acre-feet; for the Highline Canal, 6,562 acre-feet; for the Evans Canal 1,620 acre-feet; for the Henrylynn District
2658 4,980 acre-feet; for the Burlington Ditch 600 feet. In 1932 there were no sales.

Following is a table showing the water furnished Antero right owners under supplemental contracts:

Year	Acre Feet
1933	2,580
1934	3,900
1935	3,500
1936	3,628
1937	4,048
1938	4,134
1939	4,816

2660 From 1933 on to 1938 the only water sold or leased on the South Platte was under these supplemental rights, which are an annual obligation.
2662 In 1936, 1937, 1938 and 1939 no Moffat Tunnel water was sold or leased. In 1940, 1,632 acre-feet were sold. From the Williams Fork Tunnel in 1940, which was its first year of operation, 4,074 acre-feet were sold.

2667 In 1945 there was sold or leased from transmountain diversion, that is from Williams Fork and Moffat Tunnels, some 4,880 acre-feet. In 1946 the figure was 14,248 acre-feet; in 1947, 3,002
2668 acre-feet. On the South Platte River uses other than strictly municipal diversion amounted to 3,890 acre-feet in 1945; 11,200 acre-feet in 1946,
2669 and 1,150 acre-feet in 1947. At times there is water on the South Platte River that goes over the Cheesman Spillway which could be held back, provided there was storage capacity available.

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2672 Platte Canyon Reservoir and the Marston Reservoir are used as operating reservoirs rather
2673 than storage reservoirs. It is necessary to hold those reservoirs as nearly to the high water mark as possible and consequently there is no available space for storage. The storage rights in those reservoirs are so junior that even if there was storage space available in them there would never be any water available for them.

2676 Protestant's Exhibit 2 is the Map and Statement for Reservoir 22. This is one of the uncompleted parts of the diversion works for that
2677 project. When that capacity is available it will materially increase the holdover storage of Denver. It will also iron out the annual diversion so we can make more efficient use of the project.

2679 Protestant's Exhibit 15 is the Annual Report of the Board of Water Commissioners for the year 1948.

REDIRECT EXAMINATION

BY MR. SAUNDERS:

2682 The other water rights the City is using will not be discontinued after the Blue is brought in,
2683 because the city will need them all. The Blue would in no way displace any other source. The city needs both the Blue and its other water rights.

2686 The water which I have described as being delivered under the Antero Supplemental contracts is not subject to the yearly limitation referred to in the city charter. It is furnished to the same lands that it was furnished to before the
2687 city acquired Antero Reservoir. The use has not been changed in the intervening years.

2689 In round numbers, the net diversions of raw

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water for use through the treated water system controlled by the Board of Water Commissioners is as follows:

Year	Acre Feet
1880	2,000
1890	11,000
1900	40,000
1910	62,000
1920	70,000
1930	90,000
1940	80,000
1948	110,000

2692 For 1949 the amount will exceed 100,000, and possibly may exceed 110,000. The actual use for each year between 1900 and 1948 in addition to the years given could be stated. The past use
2695 and future trend of raw water use through the treated water system controlled by the Board of Water Commissioners is:

Year	Acre Feet
1900	42,000
1910	53,000
1920	63,000
1930	77,000
1940	92,000
1950	112,000
1960	145,000
1970	163,000
1980	199,000
1990	238,000
2000	288,000
2010	350,000

2696 Based on the method described in my previous testimony for developing the trend of population served by the Denver tap water system, the following table shows the population served in the

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past and the population to be served by the Denver tap system in the future:

Year	Population
1910	220,000
1920	260,000
1930	320,000
1940	370,000
1950	470,000
1960	580,000
1970	700,000
1980	840,000
1990	1,000,000
2000	1,230,000
2010	1,500,000

2701 The average annual runoff which might be expected from the diversion system for the Blue River shown on Denver Exhibit A (1923 map and statement of Blue River project showing the trans-mountain tunnel at an elevation of 10,322 feet) would be in the neighborhood of 97,000 acre-feet
2702 per year. The corresponding figure for an elevation of 8,860, the elevation of the tunnel shown on Exhibit S and Exhibit B (1927 map and state-
2703 ment) would be 218,000 acre-feet. There will be times when all of the water taken through the Blue River diversion project will be distributed through the tap water system controlled by the Board of Water Commissioners.

RECROSS-EXAMINATION

BY MR. DELANEY:

2706 The testimony that I just gave concerning an estimated runoff of 97,000 acre-feet at elevation 10,300 was described in a preliminary way in Denver's Exhibit Z at page 42 at the top of the page under VII. That report indicates a probable

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mean annual collectible supply of 100,000 acre-feet. Under sub-paragraph 5 at page 23 of that report the following language appears:

> "The per capita daily consumption of water supplied by the Denver City system has hovered around 200 gallons for the last twenty years, the average for the past ten being 190. Practically no meters are used on domestic service, and there is doubtless much leakage and waste. Long before the end of the century or the time when Denver will have 1,000,000 people, the system will probably be metered and most of the leakage and waste reduced."

2708 I agree with that statement in part only. The
2709 report continues:

> "It is estimated that by the end of this century, the strictly urban demands of Denver will be from 145 m.g.d. to 250 m.g.d. with a probable value of 175 m.g.d."

2710 I do not agree with that statement. My estimate adopts the figure for use which has been more or less uniform since the Department took over.
2711 Some water engineers believe that with increasing population there will be a decrease in the per capita consumption of water. I do not believe this will be the case with Denver.

REDIRECT EXAMINATION

BY MR. SAUNDERS:

2713 On page 66 of Exhibit 15 (1948 Annual Report of Water Board) there is a table showing the per capita consumption of water in Denver from 1918 to 1948. There has been a slight variation in the per capita consumption in those years which

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I attribute to the amount of precipitation received in the various years. The use has been substantially the same.

Denver's case was concluded.

PROTESTANT'S CASE

TESTIMONY OF JOHN R. RITER

DIRECT EXAMINATION

BY MR. DELANEY:

2717 My name is John R. Riter. I have lived in Lakewood, Jefferson County, Colorado, since 1928, with the exception of two breaks for about six months each during which I was away from Denver. I received my degree in civil engineering from the Utah State Agricultural College in 1928, went with the Bureau of Reclamation that year, and have specialized in matters of water supply since.

2720 I started with the Bureau as a Junior Engineer making computations and analyzing water supply for prospective irrigation projects. My responsibilities increased progressively until I became Director of Program Planning and was in charge of all planning work for the Bureau.

2721 Since 1945 I have been Chief of the Hydrology Division. It is my responsibility to review for the Commissioner all water supply studies and to make up all project planning reports. As a part of my duties I received a number of special assignments. In 1947 or 1948 I was assigned to be the

2722 engineering advisor to the Federal representatives on the upper Colorado River Compact Commission. This was the Commission that negotiated the upper Colorado River Compact which was signed in Santa Fe in October, 1948. I was chairman of the Engineering Committee which made

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studies of the uses within the Colorado River basin.

2723 We analyzed the water supply and made a determination of river flow at Lee's Ferry, at the state lines and at the points of use. We made such studies as the Commission directed. Our
2724 studies were of a general nature. Referring to the Blue River, it has been testified here that the Bureau of Reclamation is investigating a possible transmountain diversion project which involves the taking of water from the Blue River to the South Platte Basin. In that connection the Bureau works very closely with the State of Colorado. For the past three years I have been a member of the steering committee composed of the Director of the Colorado River Water Conservation Board, the Regional Director at Salt Lake, whose responsibility covers the western slope of Colorado, and the Director of Region 7 whose responsibility involves transmountain diversions. The purpose
2725 of that Committee is to coordinate the activities in connection with the use of water on those transmountain diversions. In that capacity I have had occasion to review the studies made by the Bureau involving the possible transmountain diversion from the Blue River and have given some attention to the water supply for the city of Denver. I have
2727 made a study personally of the population trend in Denver and have made estimates of its probable future population, because the Blue River-South Platte Diversion involves uses of water for municipal purposes as well as irrigation. I have seen Denver Exhibit BB and the Moffat Tunnel and Williams Fork Diversion Decree, Protestant's Exhibit 13.

2729 One of the questions that the Bureau wishes to answer in connection with the Blue River-

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South Platte Diversion is the amount of water needed by Denver for municipal purposes. In order to arrive at that figure the Bureau has made studies and I personally made studies in order to check the studies made by other officers of the Bureau of the amount of water that Denver will receive for domestic purposes under its existing rights after these rights have been developed to the full extent of their capabilities. The rights I
2730 considered are those listed in Denver Exhibit BB plus the conditional decrees which have been testified to by Mr. Potts on the Fraser River and on the Williams Fork which are listed in Protestant's Exhibit 13. I have taken those decrees into consideration in arriving at my conclusion with respect to Denver's water supply.

2732 PROTESTANT'S Exhibit 13 was received in evidence over objection.

MR. RITER: The method used in my population study was to analyze the population the Board of Water Commissioners served each year for the period 1918 to 1948, inclusive, and to analyze the population of Denver proper from the
2733 year 1860 to the present time. I have made a projection to determine the future growth. In order to guide my judgment as to the manner in which the curve should be extended into the future, I have also made an examination of the growth in other large cities in the United States. In the 1948 report of the Board of Water Commissioners, Protestant's Exhibit 15, page 66, is a table showing the population served by the Denver system from 1918 to 1948, inclusive.

2739 PROTESTANT'S Exhibit 15 was admitted into evidence without objection.

2740 Having arrived at past population, I made

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two projections into the future. My first projection is based on the assumption that the future
2741 growth would be at a uniform rate per year, based on the average rate of growth for the 30-year period, 1918 to 1948. In that 30-year period the population served increased from 268,000 in 1918 to 460,000 in 1948. The average rate of growth is 6,400 persons yearly. Projecting that into the future for the next 52 years, I arrived at a population figure of about 792,000 by the year 2,000 A.D.

2742 My second projection I consider more optimistic. I used the 1938 to 1948 period. In 1938 the population served was 354,000 and in 1948 it was 460,000, indicating an average rate of growth of 10,600 per year. Using that rate of growth per year for the next 52 years I arrived at a figure of 1,011,000 for the year 2,000 A.D.

2743 Using the information contained in Exhibit 15, page 66, for the average daily consumption of
2744 water, I estimate average use at 190 gallons per capita per day of filtered water, and that there
2745 would be a 10% loss from the water diversion before it is filtered and measured. Converting gallons to acre-feet per year I arrived at a figure of .236 acre-feet per capita per year of raw water required. For a population of 100,000 the requirement would be 23,600 acre-feet per year and that can be applied proportionately.

2746 In making further studies I took the period 1930 to 1937 which was a period of short supply in Colorado generally and in the Colorado River Basin and in the South Platte River watershed.
2748 It is the practice in figuring water supply to provide a water supply for the low period on the theory that if a low period is taken care of, in years of high runoff there will be plenty of water.

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I extended my reservoir studies beyond 1937 to make sure the reservoirs would have recovered. In 1938 the reservoirs partially recovered, in 1939 and 1940 they were not too high, but in 1941 and 1942 they were high. Analyzing the operation of the reservoirs, I concluded that if we based our water supply studies on the water that would be available throughout the 8-year period 1930 to
2749 1937 that we could then safely conclude that the water supply would be adequate over a longer period of years.

I did not study the South Platte alone. I studied the water available from the South Platte and Fraser River sources assuming complete development of the Fraser project and also Jones
2750 Tunnel Pass from the Williams Fork. I assumed that Reservoir 22 would be completed to its full capacity of 113,000 acre-feet. I assumed there would be a reservoir on Clear Creek to regulate the diversion through the Jones Pass Tunnel and that Denver would use Lake Cheesman and Antero Reservoir. I assumed that all these reservoirs would be full at the start of this period in 1930 and that they would be completely exhausted in 1937. Denver has a reserve at Eleven Mile Canyon which has a capacity of nearly 82,000
2751 acre-feet. I assumed that this reserve would not be exhausted in 1937, but would be held for some emergency.

I made several other assumptions. Mr. Potts testified Denver had sold or temporarily leased a certain amount of South Platte water in 1930 and 1931. My figures show that these leases and sales would add up to 23,700 acre-feet. That is above the so-called obligation water to be testified to.
2752 I assume that in the face of the recent drouth experience Denver would not sell that water for

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irrigation purposes, but would instead hold it in the reservoirs for municipal purposes. I found in that kind of study there would be a few months in flood or nonirrigating season in most years when Denver could have diverted from the South
2753 Platte River small amounts of water over and above the historical diversions. I assumed that Marston, Platte Canyon and Ralston Reservoirs would be used as they are now being used and counted on no year-to-year storage in them.

2754 I assumed a constant population of 800,000.
2755 I calculated the amount of water available from the full development of the Moffat Tunnel diversion and Jones Pass diversions, the complete utilization of the present sources of supply from the
2756 South Platte. I assumed that Eleven Mile Canyon Reservoir would be held in reserve for emergencies. The firm dependable water supply from the sources which I have mentioned is 183,500 acre-feet annually, based on the average for the eight
2758 years. For a population of 800,000 the demand would be 189,500 acre-feet per year, leaving a deficiency of 6,000 acre-feet per year to supply this population.

2759 My other projection indicated 1,011,000 population by the year 2,000 A.D. I am not prepared to state which projection in my opinion is more nearly correct. I would say that by the year 2,000 the population to be seen by Denver would be somewhere between 800,000 and 1,000,-
2760 000 people. Protestant's Exhibit 16 is a graph which I prepared entitled "Population Served with Municipal Water by Denver Water Board." On the lefthand margin of the graph there are a set of figures running from 0 to 9 and these are labeled "Population in 100,000." For illustration, the figure 9 means 900,000. Running along the

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bottom of the sheet are the years from 1860 by
2762 ten-year periods to 2,000. There is a solid line which is marked "City of Denver." This solid line merely connects points secured from the United States Bureau of Census and shows the population growth of Denver up to the year 1949. The year 1949 was unofficially estimated for me by the Denver officer of the Bureau of Census. The other years I have were published figures from the United States Bureau of Census. I made no attempt to project the population curve of the City of Denver. I merely put its past population on the graph for comparison.

The upper curve is a solid line showing the population served by the Water Board from 1918 to 1948. These figures were taken from the in-
2763 formation contained on page 66 of Exhibit 15. I have two dashed lines extended beyond 1948. One is marked "A average rate of growth, 1918-1948." That curve is based on the assumption that the future rate of growth will be 6,400 persons per year. I projected another dashed curve marked
2764 "B—average rate of growth, 1938-1948." That curve reflects an average rate of growth on the assumption that the rate of growth will be 10,600 per year. Based on curve "A" and assuming full development of the water supply available, I estimate that Denver has a sufficient supply to take
2768 them to the year 1998.

THE COURT admitted Denver Exhibits K, L, and M, and Protestant's Exhibit 16.

2769 MR. RITER: On the basis of the graph line B, average rate of growth 1938-1948, Denver would have an adequate supply of water to the year 1979.

2770 In connection with my study of the past

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growth of Denver I studied the growth of other cities. A number of cities reached their growth
2771 in 1930 and apparently did not grow between 1930 and 1940. I believe that is a typical pattern for large cities. Protestant's Exhibit 17 is a graph which shows the 1840 to 1940 population of Chicago, St. Louis, Los Angeles, Minneapolis, St. Paul, San Francisco, Kansas City, Seattle, Denver and Omaha.

2772 In the preparation of Protestant's Exhibit 16 I did not use a logarithmic scale. I used a natural scale because it is easier for me to visualize re-
2773 lationships on natural scales. Some engineers use the straight line relationships and some use the other. I do not know where the ceiling on Denver's growth is. I have lived in Denver for 20 years, and as near as I can tell from examining its growth it has been a steady growth and I assume that some time and at some population which I am unable to predict, Denver will level off. Exhibit 17 shows the growth of Denver in relation to the other cities named.

2774 THE COURT admitted Protestant's Exhibit 17 in evidence.

2775 MR. RITER: Use of logarithmic lines tends to distort the picture. If you examine the lefthand scale near the top, you will note that a relatively small vertical difference embraces a difference of 1,000,000 population and near the bottom that the same distance embraces only 5,000.

CROSS-EXAMINATION

BY MR. SAUNDERS:

2777 There are no other water resources for supplying Denver that are practicable other than the

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Platte River and its tributaries and the Colorado River tributaries.

2781 On page 71 of Exhibit 15 there is a graph showing fluctuations of the South Platte for the period 1918 to 1948. In the year 1921 the runoff was 610,000 acre-feet, which would be about twice
2782 normal. The year 1934 is probably 50% of normal. The year 1920 is slightly less than 50% of normal, with a runoff of about 35,000 acre-feet. The mean runoff is probably somewhere between 280,000 and 290,000 acre-feet and 1940 would be about 40% of that figure. The table on page 69 shows a direct right diversion for the year 1940 from the South Platte of 45,660 acre-feet. This figure does not include storage. In 1939 the direct
2784 right diversion was 36,365 feet, in a year when the Platte River ran at about two-thirds of normal.

2789 The City of Denver's Fraser River resources
2790 when completed will produce in a year of minimum runoff such as 1934 less than 30,000 acre-
2792 feet. In an extremely low year such as 1934, the South Platte would yield approximately 46,000 acre-feet, Cherry Creek and Bear Creek, 6,000 acre-feet, or a total of 52,000 acre-feet.

2793 I do not know what your policy would be as to which of your various sources of supply you would develop first, or the rapidity with which a particular unit should be pushed, but I assume that you will develop your water supply slightly in
2794 advance of the time needed. Unless there is some stimulation coming in, I feel it would be safe to develop to the high curve on Exhibit 16.

I am acquainted with the fact that the population as a whole is increasing more rapidly in the
2795 west than in the east. When you deal with a subject of population, it is true that one should take

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into consideration all matters that should be given
2796 weight. The general trend of population of the United States influences the population of cities. I can see that there would be a relationship between the trend of population in the United States and the population trend of Denver and other cities. I know some of our engineers in the Bureau
2797 have made studies on that. I have not made any study to find out whether such population trends would affect my judgment on these cities.

2801 The population served by the Denver Water System in 1920 was 272,000 and in 1930 was 326,000. The average rate of growth during that
2802 decade was 5,400 per year. The population in 1940 was 370,000, giving an average rate of growth during the 1930-1940 decade of 4,400 per year. The population in 1948 was 460,000, giving
2803 an average rate of growth during the years 1940-1948 of 11,250. This rate is higher than the 10,600 per year rate which I used for my most
2804 optimistic curve. When the population of Denver reaches 700,000 I am of the opinion that the rate of increase will be between 6,400 per year and 10,600 per year unless the city has leveled off. I do not know when it will level off.

2808 Denver's 1918 population was 268,000 and its 1948 population was 460,000, the increase being 192,000, or 71.7%. Applying 71.7% to the 1948 population of 460,000, if Denver's population increases the same percentage in the next 30 years that it has increased in the last thirty years, then its population in 1978 would be 790,000.

2813 In connection with my various studies I have analyzed the records and results of the operation of the Denver water systems. During the 8-year
2816 period 1930-1937, Denver diverted, on the average, 48,000 acre-feet from South Platte direct

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flow rights per year. From Cherry Creek and Bear Creek combined, Denver diverted an additional 9,000 acre-feet per year. During the same
2817 period Denver withdrew from storage on the average of 21,000 acre-feet per year from the South Platte reservoirs. At the same time, Denver also sold for irrigation purposes on a lease basis about 3,000 acre-feet per year.

2818 At the end of 1937, Denver had some water left in its South Platte Reservoirs which under the assumption I made on my direct testimony
2820 was completely withdrawn. I have not analyzed the capabilities of the Moffat tunnel system. From 1936 to date Denver has diverted 28,000 acre-feet per year from that source. Mr. Potts testified that the Moffat Tunnel system would yield 80,000 acre-feet when completed. Visually it appears to
2821 be about one-half completed, so 40,000 acre-feet would appear to be its mean present yield.

I have not studied the present Jones Pass tunnel system but if I recall correctly Mr. Potts testified that he can secure 7,000 acre-feet per
2823 year from the present system. In my previous testimony I stated that in a low year it would not be possible to divert more than 30,000 acre-feet through the Moffat Tunnel system when completed. With that project a little more than half completed
2824 a little more than 15,000 acre-feet could be diverted in a low year. In my direct testimony I assumed that there would be a reservoir operated in conjunction with the Moffat Tunnel so that in conjunction with one particular year storage
2827 water would be released. Assuming that 80,000 acre-feet represents production from the completed Moffat Tunnel system at mean flow the production of the tunnel in its present condition in a year such as the 8 low-year period would be 30,000

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2828 acre-feet annually. During the same 8-year period I would use the 7,000 acre-foot figure that Mr. Potts testified to which was about what he could obtain by exchange.

2829 During the low 8-year period it was necessary to release 21,000 acre-feet per year from storage. At the beginning of that period Cheesman was full and at the end it was not quite empty. Antero was substantially full at the beginning of the period and empty at the end. As I recall the
2830 records there were no substantial spills, so this draw down of 21,000 acre-feet per year would include any accretions that were stored in the reservoir. At the end of 1937 we had about 25,000 acre-feet of South Platte water left in the South Platte reservoir after deducting the exchange water from the Moffat Tunnel. My study is based on the assumption that Antero and Cheesman
2831 would be completely exhausted at the end of 1937. I also added 3,000 acre-feet representing that much water leased in 1930 and 1931 for temporary irrigation.

The method I used can be illustrated as follows: If you start out with 120,000 acre-feet in reservoirs and draw out 60,000 acre-feet, there would be a balance remaining in the reservoir of 60,000 acre-feet if there have been no accretions.
2833 If at the end of the period there was actually 80,000 acre-feet, you would know that there had been a gain of 20,000 acre-feet. Applying this
2834 method, at the beginning of the eight-year period, Lake Cheesman had approximately 79,000 acre-feet in storage and Antero had approximately 33,000 acre-feet in storage, the total being 112,000 acre-feet. There was 25,000 acre-feet left in storage in 1937, leaving a net difference of 87,000 acre-feet. Now, if you withdraw an average of

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2835 21,000 acre-feet for eight years, a total of 168,000 acre-feet, and know there was a draw down of 87,000 acre-feet, the accretions during the 8-year period would be 81,000 acre-feet. In other words, approximately 10,000 acre-feet per year were put
2836 into storage during those 8 years. That figure, of course, is exclusive of water stored by exchange. Some 3,000 acre-feet per year were used for temporary leasing or exchange so the figure would be approximately 13,000 acre-feet a year. This 3,000 feet of water, however, would not be available for
2840 Denver's treated water system. The average situation over that 8-year period would be 48,000 acre-feet from the South Platte 9,000 acre-feet
2841 from Cherry Creek and Bear Creek, 30,000 acre-feet from the Moffat Tunnel, 7,000 acre-feet from
2842 Jones Pass and 13,000 acre-feet from reservoirs,
2843 representing accretions not reservoir draw down
2844 of storage water. These figures total 107,000 acre-feet.

The average per capita consumption of water
2845 was .236 acre-feet. Using the figure of 107,000 acre-feet as an average annual yield, taking my rate of .236 acre-feet per capita, there would be sufficient water to serve a population of about 454,000 people.

2846 Periods of low runoff do not occur in predictable cycles. In my testimony I assumed that the reservoirs would be drawn down during dry periods with the exception of Eleven Mile Canyon.
2848 There was a period of low runoff when the storage system of the City was practically empty. Cheesman was empty in '32 and for all practical pur-
2849 poses was empty again at the end of 1934. It partially recovered in '35, '36 and '37, and was drawn down again at the end of '37. I believe it

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was filled in '39 and believe that Antero and Eleven Mile Canyon were filled by 1942.

Reservoir storage was at a minimum at the
2850 end of 1932. 1933 was normal, 1934 and 1935 subnormal, 1936 was above normal, 1937 was subnormal and 1938 was above normal, 1939 and 1940 were below normal, 1941 was normal and
2853 1942 was way above normal. On the basis of past experience and with the conditions which I outlined for 1930 to 1937, I could have met the de-
2854 mands of 1937 because I held back Eleven Mile Canyon Reservoir as a reserve in case of occurrence of the drought cycle for a longer time than what the record showed had occurred.

Assuming completion of the Moffat Tunnel
2855 project, during a period of low runoff the direct supply would be approximately 60,000 acre-feet by adding Reservoir 22 to the system you could boost that to something like 70,000 acre-feet. I doubt if you could get clear up to Mr. Potts' 80,000
2856 acre-feet. For my figure I used a net increase of 6,000 acre-feet, but you might get as much as 14,000 acre-feet a year from it. My calculations would have been different if Reservoir 22 would be built to a capacity of 40,000 acre-feet. No
2858 change in my calculations would be required if its size was 80,000 acre-feet. I did not testify on the point in direct examination but I did assume that there would be some storage held in 22 at the end of this 1937 drought cycle. When Reservoir 22 shall have been built according to my assumption it will have no effect on production of Eleven Mile Canyon reservoir because I did not draw on
2859 Eleven Mile. While Eleven Mile is at present filled by exchange, if No. 22 is built and used completely to regulate importation from Moffat Tunnel there would be no Moffat Tunnel water for ex-

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change. Eleven Mile Reservoir would then fill
2860 more slowly. My records show there was some South Platte water stored in Eleven Mile in 1942. If the Williams Fork unit were brought to completion including the building of Clear Creek Stor-
2861 age that unit would be able to produce 24,000 acre-feet per year.

2863 With the Williams Fork water controlled by a reservoir in Clear Creek and with the Moffat Tunnel water controlled by Reservoir 22, there will not be any diminution of Platte River storage.
2864 If there were sufficient reserve storage to completely regulate the Moffat Tunnel water and the Williams Fork water so that those waters could be used directly into the system, then there would be no water from those two sources available for exchange. I realize in actual operation this is going to be operated as one system and I have not tried to concern myself with the intricacies of water exchange. I have assumed that you have used the water that comes into the system. If the Moffat, Williams Fork and Blue systems were all
2865 completed and the storage necessary to control the Moffat and Williams Fork were constructed part of the Blue River water could be exchanged in Eleven Mile even though the Moffat Tunnel and Williams Fork waters were not available.

2866 In my direct examination I assumed Clear
2867 Creek storage but did not assume construction of the Empire Reservoir on that Creek. It is my opinion that 6,500 acre-feet storage capacity on Clear Creek is not enough for complete regulation there. Other reservoir sites in that vicinity have more than 6,500 acre-feet capacity. I assumed sufficient storage capacity on Clear Creek to make Jones Pass Tunnel water available during this
2868 dry period. I assumed this would be integrated

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into the Denver municipal water system by direct diversion of that water to a filter plant. I recall Mr. Potts' testimony. He testified that ultimately there would be arrangements made with reservoirs and conduits so the Jones Pass water could be taken directly into the Denver system. The
2869 Bureau made some studies of storage on Clear Creek in connection with some of the investigations connected with the Blue River-South Platte project. It is my recollection that the survey parties moved from the Colorado-Big Thompson project to study the Blue River-South Platte project in about 1940.

2870 MR. SAUNDERS asked if, in the course of the studies made with the Bureau, the Bureau had determined the amount of water which should be brought from the Blue River water shed to supply
2871 the Denver Metropolitan area. MR. DELANEY objected on the basis of improper cross-examination, and the objection was sustained. MR.
2872 SAUNDERS offered to prove by the answer to the question that the amount of water planned by the Bureau for the upper Platte valley including the Denver Metropolitan area was 430,000 acre-feet.

2873 MR. RITER: I have testified that available supplies exist in the amount of 107,000 acre-feet, that an additional 30,000 acre-feet could be obtained from the Moffat Tunnel for direct water, plus an additional 6,000 acre-feet by controlling its storage, plus 17,000 acre-feet direct and stor-
2875 age water from Williams Fork. To this there should be added 9,000 acre-feet which could be obtained from South Platte natural flow rights, which, if Denver were larger, could be used direct into its system, making a grand total of 169,000
2876 acre-feet. This figure represents available water during a low runoff period. In actually meeting

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the demands there would be added to that any available storage reserves.

2878 The percentage increase in population for the 10-year period 1918 to 1928 was 20.5, from 1928 to 1938 was 9.6, and from 1938 to 1948 was 29.9. The sum of the percentages is 60% and the average percent per ten-year period is 20%. Applying a 20% increase per decade these figures show the following population: In 1958, 552,000; in 1968, 662,400; in 1978, 794,880.

REDIRECT EXAMINATION

BY MR. DELANEY:

On direct examination I testified that the supply of water over a period which I described as the critical period, which was available to the city of Denver was 183,500 acre-feet. In answer to
2880 counsel's questions on cross-examination, I gave the figures of 169,000 acre-feet which did not in-
2881 clude draw down of storage. In making computations of water for municipal purposes it is necessary to make allowance for storage in order to get the most efficient use of water. Direct flow
2882 rights alone would leave the Denver system woefully inadequate and this statement is true of other systems generally speaking.

2883 In response to questions by Mr. Saunders, I gave him the figures which would result from a percentage method of calculating population. I didn't use that method in arriving at my conclusions because I felt that the method of taking a
2884 straight population increase would more nearly show a true trend. There are some engineers that would even decrease that rate. Since I am not able to predict where Denver will hit its ceiling, it seemed to me the fair method would be a straight

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2885 arithmetic increase. Dr. Carmichael used a percentage increase method. He used 15.7 per decade and the problem which I worked out at the request of counsel used a 20% increase per decade.

Colorado Springs reduced the per capita consumption of water approximately 21% by complete metering. Some 5,471 of Denver's 95,662 taps are metered.

RECROSS-EXAMINATION

BY MR. SAUNDERS:

2893 I assumed that Eleven Mile Reservoir with 81,000 acre-feet storage plus 30,000 or 40,000 acre-feet in Reservoir 22 would be adequate as a reserve to guard against an emergency from a
2894 drought period in excess of the 1930 to 1937 period.

TESTIMONY OF I. A. WINTER

DIRECT EXAMINATION

BY MR. DELANEY:

2896 My name is I. A. Winter. I have lived at 1350 Fillmore Street, Denver, Colorado, for the
2897 past 15 months. I have been employed by the Bureau of Reclamation for the past 16 years. I am a mechanical engineer, and have had the usual professional training.

2898 MR. SAUNDERS admitted the witnesses qualifications.

MR. WINTER: I am acquainted with the Green Mountain Reservoir and the hydro-electric
2899 plant there installed. On May 27, 1943, I tested
2903 the Green Mountain Plant. It has two turbines. The maximum amount of water run through one turbine was 863 cubic feet per second and 1,726 cubic feet per second for both turbines. Each

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2906 generator has a normal rating of 12,000 K.V.A.
2908 During the test one generator put out 12,690 kilo-
2909 watts. The output of both generators would be twice 12,690.

2910 The net head when I tested was 203 feet; the maximum possible net head is 260 feet. With the additional 57 feet of head, the plant would be capable of producing additional electricity.

2911 The plant has been generating electricity since the date of the test, which is delivered to the Public Service Company of Colorado.

2912 MR. SAUNDERS, who had previously reserved his right to object, moved that the entire testimony be stricken as irrelevant and immaterial. MR. DELANEY replied that the evidence was relevant under cases holding that the doctrine of relation applies only in the absence of intervening claims. MR. SAUNDERS replied that the claim with respect to the Green Mountain reservoir filed in this case had been withdrawn and could not be before this court. THE COURT denied the motion.

TESTIMONY OF E. J. NEILSON

DIRECT EXAMINATION

BY MR. DELANEY:

2915 My name is E. J. Neilson. Since September 24, 1945, I have been connected with the Green Mountain Dam and have been in charge for the
2917 last year and a half. We supply the Public
2918 Service with whatever load that Company may require at different times during the day. We have operated both turbines and a good many times at capacity.

2919 MR. SAUNDERS, who had reserved his

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right to object, moved that the testimony of Mr. Winters be stricken. THE COURT denied the motion.

2927 MR. DELANEY offered protestant's Exhibits 1, 2, 3 and 5 in evidence. After hearing objections THE COURT reserved its ruling on Exhibit 1 and admitted Protestant's Exhibits 2, 3 and 5.

TESTIMONY OF F. C. MERRIELL

DIRECT EXAMINATION

BY MR. DELANEY:

2929 I am the same F. C. Merriell who testified that I was connected with the Colorado River Water Conservation District, one of the Protest-
2930 ants in this matter. I am Secretary and Engineer of the District. I served for about two years on the engineering committee in connection with the Upper Colorado River Basin. That work re-
2931 quired water flow studies, utilization studies and investigation of waters of the Colorado River Basin, including the upper reaches of that stream.
2932 I have also heard testimony of different witnesses of the City and County of Denver pertaining to the 1923 filing, Exhibit A and the 1927 filing, Exhibit B. I have also heard testimony with relation to the effect of the Dillon reservoir on the contemplated plan of diversion and have maps to illustrate and show the material differences in the effect of those plans.

2933 Protestant's Exhibit 18 is a map showing the area drained by the 1923 filing. Protestant's Exhibit 19 shows the area drained by the 1927 filing
2934 and the location of the 1,600 second-foot straight line tunnel shown on the 1927 filing. Exhibit 20 embraces the same drainage area as the 1927

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filing, but shows the Dillon reservoir and the new tunnel line.

Exhibit 18 and Denver Exhibit A involve the same drainage area, which, on Exhibit 18 is colored green. The area drained by the 1923 filing (Exhibit A) is 153.55 square miles, and the area drained by the 1927 filing (Exhibit B) is 328.13 square miles. The
2936 1923 filing makes use of a tunnel 4½ miles long with a capacity of 1,200 second-feet out of drainage of the Swan River, at tributary to the Blue River. The 1927 filing drains a greater area and discharges through a tunnel 22.82 miles long with a capacity of 1,600 second-feet into the North fork of the South Platte. The 1923 filing discharged into Jefferson Creek in South Park and its west portal is almost exactly 6 miles due east of Breckenridge in French Gulch. The east portal of the 1927 filing is about half a mile upstream from the confluence of the Blue River and the Snake
2939 River southeast of Dillon. The 1923 filing gets water out of the basins of Ten Mile Creek, Blue River and its tributaries, and the Snake River at elevations, in each case, above 10,300 feet, and takes it to a 4½-mile tunnel which discharges into Jefferson Creek, which runs into the South Fork of the South Platte.

The 1927 filing will take water of Ten Mile and its tributaries, the Blue River and its tributaries and the Snake River at Dillon through a 22-mile tunnel in a straight line, into the North
2941 Fork of the South Platte, below all the storage that Denver had at the time the filing was made and all that it has to date. The West Portal on the 1923 filing is at an elevation of 10,322 feet and on the 1927 filing is at 8,840 feet.

2942 Exhibit 20 represents the filing made on the

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2943 Dillon Reservoir (Exhibit D) to collect water and to enable Denver to avoid the loss of certain water which would have been lost under the 1927 filing, because a 1,600 second-feet tunnel was not big
2944 enough. The tunnel planned on the 1927 filing had a capacity of 1,600 second-feet. In years of a very high runoff the quantity of water which arrives at Dillon from the three sources, Ten Mile Creek, Blue River and Snake River, is greater than 1,600 second-feet, and consequently, part of it would continue on down the river. With the Dillon reservoir there will be sufficient capacity for storage to store all of the water that arrives at Dillon and divert it later through a much smaller tunnel.

2945 The generation of power mentioned in the 1927 filing would have been impossible because you cannot sell electricity if you generate it for only two months in a year. When the Dillon reservoir is added, however, it becomes possible through
2946 a smaller tunnel to divert practically a constant flow which will furnish electricity at all times of the year, and such electricity is salable.

2947 Protestant's Exhibit 21 is a study of the water available for diversion above the 1923 filing, the quantities of water which although available cannot be diverted, the net before losses which can be diverted, and the total divertible. Protestant's Exhibit 22 is the same thing for the 1927 filing.

2948 MR. DELANEY offered Protestant's Exhibits 18, 19, 20, 21 and 22, which were received without objection.

2953 MR. MERRIELL: I made an estimate of the population growth of Denver and also the water supply now existing which

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might be diverted from the Moffat Tunnel and Williams Fork. In estimating the future
2954 population I plotted a curve based upon Census Reports. Population information for 1948 was obtained from Annual Report of the Board of Water Commissioners for that year. I assumed that there would be an addition of about 7,500
2955 population in 1949 and 1950, bringing the 1950 population to 475,000. Starting at that point for 1950, I projected the 1910-1940 rate of growth. I did not apply a percentage method. I used an
2956 average increase method and the population in the year 2000 fell very close to 800,000. I also have shown on the same chart the projected rate of growth which the Bureau of Reclamation adopted in its Blue River-South Platte report.

With respect to water supply, I used the historical record contained in the Annual Report of the Water Board and applied that over a period of years and then repeated it in order to reach the
2957 year 2000. I had a long-time record for the Moffat Tunnel which had been computed in our office and that long-time record consisted of diversions from the Fraser River, Jim Creek, both Vasquez Creeks, the four forks of Ranch Creek. At that time I did not feel it warranted, but I now believe that there is 12,000 to 15,000 acre-feet available in St. Louis and Denver Creeks; however, the result which I will not present does not include any such
2959 water. St. Louis Creek is one of the proposed sources of supply for the Fraser River project as it is shown in the decree introduced in evidence.

Exhibit 26 is a water supply operational study. It represents graphically the various
2960 sources of water, the various quantities of water contained in storage and also the raw water demand for the city of Denver. The scales on the

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left and righthand side of the sheet represent acre-feet, and the scale of years from 1950 to 2000 appears at the top and also at the bottom of the sheet. There are sketched on this Exhibit lines which go across the years which represent the amount of diversions from various sources.

2961 These are also shown by cross-hatching the various reservoirs and their contents each year and then below the zero line are a number of boxes colored black which represent water which Denver could not use because it had no immediate use for it and no place to store it. The present reservoirs, of Denver, Cheesman, Marston, Platte Canyon, and Eleven Mile are indicated on the chart and the reservoirs to be built, Reservoir 22 on South Boulder Creek, the Empire Reservoir on Clear Creek and the Two Forks Reservoir on the South Platte are also represented. I have also projected the demand for water on the Exhibit and it is represented by the heavy black line which crosses the exhibit in an ascending direction. It was derived by multiplying the population shown in the second column of Exhibit 27, by the figure of .225

2963 acre-feet per year which is equal to 200 gallons per capita per day.

2964 In 1950 the estimated population is 475,000 and in the year 2,000 it is 800,000. The population is increased at a uniform rate for the intervening years.

2967 THE COURT received Protestant's Exhibits 26 and 27.

MR. MERRIELL: The study shows that by the year 2000 the direct supply of water had not been equivalent to the demand for several years prior to that date and that there had been a considerable draft on storage, but at the end of the

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year 2000 Denver had supplied all its needs and
2968 had in storage a year and a half's supply. The Exhibit is prepared by taking the known water supplies and projecting them into the future with the assumption of increasing population. First you supply the demand, then increase the storage whenever you can or decrease it if you have to supply the demand and carry all those tabulations ahead from year to year.

2969 Protestant's Exhibit 28 was prepared in my office under my supervision from the records at
2970 the Green Mountain Reservoir. It shows the amounts of the water released from storage in Green Mountain Reservoir used either at Shoshone or Grand Valley from 1943 through 1948.

THE COURT admitted Protestant's Exhibit
2973 28 over objection. By agreement of counsel, all material other than tabular material on Protestant's Exhibit 27 was to be eliminated by use of
2974 scissors. Protestant's Exhibit 23, a certified copy of the Shoshone decree, was offered in evidence
2975 and admitted over objection. Protestant's Ex-
2979 hibits 24 and 25 were offered and ruling reserved
2981 thereon. It was stipulated by counsel that the decrees entered in causes 1709 and 1710 in this court were the official decrees in those two cases, that said decrees would be considered as being in evidence and that there was nothing in those decrees pertaining to Denver's plans except the parts offered previously in evidence.

2983 MR. MERRIELL: Referring to Exhibit 27, I started in with a population of 475,000 people for 1950 and ended up with a population of 800,000 for 2000 and assumed that it took 200 gallons per day which was the average raw water use from 1932 to 1948 as shown by Protestant's Exhibit 15.
2984 In addition I assumed the construction of three

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other reservoirs, namely, Reservoir 22 with a capacity of 113,000 acre-feet; and Empire Reservoir located at Lawson on Clear Creek having a capacity of 77,000 acre-feet and Two Forks with a capacity of 422,000 acre-feet. All storage for the Two Forks Reservoir in my studies was to be
2986 accumulated from Moffat Tunnel and Williams Fork exchange. In projecting the table I assume the construction of Reservoir 22 very shortly and that it would be put into operation in 1954. Between 1950 and 1954 there would be 85,800 acre-feet of Moffat Tunnel water which could not be diverted because there would be no place to store it. It would then take six full years to fill Reser-
2987 voir 22 and it would remain full for 3 or 4 years after that. But in the period 1959 to 1962, there would be 108,900 acre-feet of Moffat Tunnel water which could not be diverted because Reservoir 22 would be full.

CROSS-EXAMINATION

BY MR. SAUNDERS:

2988 In my home town of Fruita I ran the municipal water system for 7 years. Fruita is a town of about 1,000. I have had no other experience running a municipal water system.

2989 With Reservoir 22 completed and South Boulder Creek storage completed, there would be some storage for Two Forks by exchange. If Two
2990 Forks and Eleven Mile were emptied and no exchange water was available because of the completion of Reservoir 22 and the South Boulder Creek storage, I think there would still be a possibility of filling Eleven Mile Reservoir. Eleven Mile was emptied at the beginning of 1937 and was filled partly by exchange and partly by free water. In fact, the greater part of water which

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is stored in Eleven Mile was that free water to which no one had a claim. This condition of free
2991 water occurred often enough between 1937 and 1942 to store about 50,000 acre-feet in Eleven Mile Reservoir. It is true that this condition occurs only occasionally. But in the better years on the South Platte there is at least a few days of free water.

2992 I long ago learned that the people who operate the Denver Municipal system are of the opinion that two years' reserve storage is the proper amount. I personally would place the figure
2993 higher. Reserve storage at reservoirs like Cheesman should not be emptied out every year to meet operating demands. Reserve storage should be handled as Eleven Mile Canyon is handled, that
2994 is, once full, kept full. If a large reserve storage is not provided, with all the uncertainties that surround direct rights, it is necessary to have more direct water to meet requirements. Any municipality of any size requires three kinds of storage. Reserve storage which is never touched, large operational storage, of which Cheesman is an example, for you may draw 40,000 feet out of Cheesman when necessary, and then the purely nominal type of storage which affords regulation on a daily basis. The balance between these various types of storage and direct water available is largely a matter of the exercise of one's judgment.

2995 Turning now to Exhibit 18, the map based on the 1923 filing, the area to which the diversion works of 1923 filing would drain is 153 square miles. There would be available 117,420 acre-feet for diversion. The average altitude of that area is 11,620 feet and the runoff per square mile is 910 acre-feet annually.

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2996 Exhibit 19, the map of the 1927 filing, shows an area of 328 square miles of which a portion was below the 153 square miles shown on Exhibit 18. The average altitude for the whole area covered by Exhibit 19 is 10,958 feet and the average runoff for the entire area is 736 acre-feet per square mile.

3001 I do not know how much unused water flows out of the State of Colorado at the state line on the Colorado River.

MR. DELANEY offered Protestants' Exhibit 12. THE COURT reserved ruling. MR. DELANEY offered Protestants' Exhibit 14 and it was admitted.

3005 PROTESTANTS rested.

DENVER'S REBUTTAL

TESTIMONY OF H. L. POTTS

DIRECT EXAMINATION

BY MR. SAUNDERS:

3006 Both Mr. Merrill and Mr. Ritter referred to population figures shown on page 66 of Exhibit 15, the Annual Report of the Board of Water Commissioners. I prepared the figures appearing on that page. Deriving a figure for 1949 on the same basis as the other population figures shown on page 66 of Exhibit 15 would indicate a 1949 population for Denver of 481,000 people.

3008 Assuming that the Moffat Tunnel and Williams Fork diversions are controlled by reservoirs such as described by Mr. Merrill and Mr. Ritter it is very improbable that exchange water would be available from either of those sources for filling Eleven Mile Canyon Reservoir or Two Forks Reservoir.

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3009 For the year 1911 to 1935, the mean flow of the Colorado River for the period April 1 to October 1 each year was 4,162,100 acre-feet.

3012 In my opinion the mean available supply from the Blue River diversion project when completed to a capacity of 1,600 cubic feet per second of direct flow available at the East Portal will be 150,000 acre-feet of diversion taken through the East Portal of the tunnel annually.

CROSS-EXAMINATION

BY MR. DELANEY:

3017 I have not made any observations to determine whether or not there is any appreciable quantity of water in the Colorado River below the main diversion canals at the head of the Grand Valley during the months of July, August, September and October. I do know that in the tunnel operation there have been times when I have been called on for replacement water as early as the first of August. Some years it has not occurred at all and in other years during the latter part of August or in September, which would indicate a shortage at the Glenwood Springs station.

3018 I testified on direct examination that for the purpose of computation of further population I took a population of the area served by the Denver water system in 1950 as 475,000. The actual population estimate was far in excess and above this projection line. The figure 475,000 was used because it was in the trend. The proper population for 1950 would be 481,000. My charts were prepared more than a year ago before the 1950 figure could be known.

3022 When the Blue River project is completed, it

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will be possible to divert annually a mean amount of 150,000 acre-feet per year. There is about twice the amount of flow at Green Mountain Reservoir than there is now at Dillon from the combined flow of Ten Mile, Blue River and Snake River. The figure I remember for the three streams from earlier studies is 450,000 acre-feet.

DENVER rested.

PROCEEDINGS RELATING TO STIPULATION

4008 MR. SAUNDERS presented a stipulation by Denver and The Colorado River Water Conservation District dated January 26, 1950. He stated that attached to the stipulation was Denver Exhibit YY consisting of one page summarizing by years its monetary expenditures on the Blue River unit followed by some 46 pages of work orders itemizing such expenditures, and that attached to the stipulation was Denver Exhibit ZZ showing annual charges to the Blue River Diver-
4010 sion project on a separate sheet. He also pointed out that Exhibits YY and ZZ gave complete detail as to the items appearing on Exhibit G which had not as yet been admitted.

4012 MR. DELANEY stated that the work orders appearing in Exhibit YY showed the nature of the expenditures and that no objection was being made on account of the failure to produce original
4013 records. He further stated that in connection with the stipulation it was the understanding that Protestant's Exhibits 31, 32, 33 and 34 relating to the Two Forks reservoir would be admitted. There being no objection, THE COURT admitted the Protestant's Exhibits 31, 32, 33 and 34.

4014 MR. DELANEY then objected to the ad-

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mission of the work orders for all expenditures made on the Two Forks Reservoir or in connection therewith, or made on the South Platte River because such expenditures were not related to the diversion of water from the Blue River. Mr. Delaney also made specific objections to a number of
4049 particular work orders. MR. SAUNDERS re-
4050 offered Exhibit G and THE COURT, over objection admitted the Exhibit.

PROCEEDINGS RELATING TO DENVER'S AMENDED STATEMENT OF CLAIM

4297 MR. SAUNDERS filed an amendment to Denver's Statement of Claim. (Amendment at folios 499-503, original record.) In general, the amendment claims that the Green Mountain Reservoir, which is a portion of the Colorado-Big Thompson project, by reason of the provisions of Senate Document 80 (a pamphlet entitled "Colorado-Big Thompson Project, Synopsis of Report", District Exhibit A) should be so regulated and restricted that the use of water and storage of water therein would not interfere with the operation of any portion of Denver's Trans-Mountain Diversion system, and so that any waters impounded in said reservoir would be released at such time and in such quantity as to supply the requirements of appropriators senior to Denver at times when the Colorado River and its tributaries are so diminished in flow that said senior rights could require discontinuance of diversion by Denver under its junior water rights.

4320 MR. SAUNDERS also stated that he personally, as an attorney, believed that Denver's position heretofore taken (that no one could make a claim out of the Green Mountain Reservoir except the United States Government) was sound, but that he did not have the right to jeopardize

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the interests of his client by assuming that he was infallible, that Mr. Delaney might be correct in the position that the individual beneficiaries of the Green Mountain reservoir could obtain a decree for some use and benefit from it, and, therefore, in order to protect Denver's interests, he had offered an amendment to his claims, said Amendment taking a position for Denver similar to the position taken by Mr. Delaney in his statement
4323 of claim for his clients. MR. SAUNDERS further stated that he had contended that Senate Document 80 had no place in the case but that if it did, then Denver was entitled to its benefits as
4324 well as other parties, and pointed out that under the provisions of Senate Document 80, the Green Mountain reservoir was for "* * * the primary purpose of preserving insofar as possible the rights and interests dependent on this water, which exist on both sides of the Continental Divide in Colorado."

4334 MR. DELANEY stated that the Colorado-Big Thompson project was created for the purpose of benefiting the people on the Western Slope and the people on the St. Vrain, not others on the East-
4339 ern Slope, that 50,000 acre-feet of water put through Adams Tunnel to the St. Vrain must be replaced and this water comes from the Green Mountain reservoir, that after deducting the 50,000 acre-feet from the fill each year there are 100,000 acre-feet left for future irrigation on the Western Slope. (The District's Statement of claim and that of the United States both asked for an annual fill of approximately 152,000 acre-feet at Green Mountain reservoir.)

MR. SAUNDERS stated that Senate Document 80 was the law of the land, if it applied to the Eastern Slope as well as the Western Slope;

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that the language of the Document is perfectly plain; that if there were some ulterior intention of injuring Denver, Congressman Lewis of Denver would not have supported the project.

TESTIMONY OF H. L. POTTS

DIRECT EXAMINATION

BY MR. SAUNDERS:

4365 I am the H. L. Potts who previously testified in this case.

4370 I operate the Williams Fork diversion and Moffat Tunnel through which that water is taken for the Board of Water Commissioners. The Board also operates the Williams Fork Reservoir which is near Parshall. The Public Service Com-
4371 pany has a power plant at Shoshone which has a senior right to the rights of the Moffat and Jones Pass Tunnels. Whenever there is insufficient water in the Colorado River to supply the 1,250 second-foot right that the Public Service Company has at Shoshone, it becomes necessary for us to furnish replacement water from the Williams Fork Reservoir or shut down the tunnels. Any operation on the Colorado River or its tributaries above Shoshone which would create a shortage on the Colorado River would put an additional burden
4372 on our diversion. Likewise, any addition to the flow of the Colorado River above Shoshone would be a benefit to our diversion. The reservoir which we built on the Williams Fork is of small capacity because of restrictions placed on the City by the Department of the Interior. We have had sufficient water for all the replacement claims to date, but with the completion of the Williams Fork and Blue River diversions, we will not have sufficient replacement to cover diversions from those
4373 sources. Releases from the Green Mountain Reser-

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voir would accomplish the same purpose as releases from the Williams Fork Reservoir.

4374 The 1,250 second-foot water right at Shoshone is senior to Denver's water rights which are shown on Exhibit CC. There are other water rights which are also senior to Denver's, however,
4375 during 15 years of operation, it appears that the 1,250 second-foot river right at Shoshone will supply senior rights in the Grand Valley. Whenever the river falls below that point there is some short-
4376 age of irrigation water.

4377 If Denver's Blue River diversion project was in operation there would be substantial certainty of filling the Green Mountain Reservoir with the 152,000 acre-feet each year that it claims. If the Blue River Diversion project were not in operation, there would be an absolute certainty.

CROSS-EXAMINATION

BY MR. DELANEY:

4381 Williams Fork Reservoir is operated under a plan approved by the State Engineer for replacement of Williams Fork and Fraser River water. When a call comes on a diversion through either or both tunnels (Jones Pass and Moffat), we theoretically replace the diverted flow with an equal amount of water from storage in this reservoir. Practically, we do not operate in this manner. Some years ago an agreement was made with the people in the Grand Valley under which we keep on diverting and the people in the Valley built up
4382 a debit against the water in the Reservoir. When they are in need of irrigation, we release water in sufficient amounts to make it of some practical value. If we released water daily in small amounts it would be of little benefit to the lower valley.

4383 The capacity of the Williams Fork Reservoir

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4384 is 6,623 acre-feet. A filing was made a number of years ago for an enlargement of that reservoir to create greater storage capacity, but we could not obtain a right-of-way or permit from the Department of the Interior to build to that capacity.

4389 When the Moffat project is completed Denver would need greater replacement capacity at Wil-
4391 liams Fork. I testified that water released from the Green Mountain Reservoir could take the place of water diverted from the Western Slope. Den-
4392 ver has no agreement with the United States or the Bureau of Reclamation to that effect.

4394 The 152,000 acre-feet at Green Mountain is sufficient water to provide for power generation at Green Mountain at full capacity for something less than a month. To operate at capacity continuously at Green Mountain would require the entire direct flow of 4 or 5 Blue Rivers. There is
4396 ample water in the Blue River and its tributaries above the Green Mountain Reservoir to fill that reservoir to its capacity of 152,000 acre-feet each year and also to supply the amount of water claimed by Denver in its Blue River diversion.
4397 However, if you required water for the power plant at the Green Mountain Reservoir at its full
4398 capacity for say, two months, there wouldn't be sufficient water. The capacity at Green Mountain is very much overbuilt for the size of the river.

4399 Senate Document 80 (District Exhibit A) states on page 3:

> "(a) The Green Mountain Reservoir, or similar facilities, shall be constructed and maintained on the Colorado River above the present site of the diversion dam of the Shoshone power plant, above Glenwood Springs, Colo., with a capacity of 152,000 acre-feet of water, with a reasonable expectancy that it

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will fill annually. Of said capacity, 52,000 acre-feet of water stored therein shall be available as replacement in western Colorado, of the water which would be usable there if not withheld or diverted by said project; 100,000 acre-feet shall be used for power purposes; * * *"

4404 The 100,000 acre-feet could serve as replacement water for Denver.

MR. SAUNDERS offered Exhibit CC, which was admitted.

DENVER rested its case with respect to its amended claim.

PROTESTANTS CASE RELATING TO DENVER'S AMENDED CLAIM

TESTIMONY OF JOHN R. RITER

DIRECT EXAMINATION

BY MR. DELANEY:

4420 My name is John R. Riter and I have previously been sworn and have testified in this case.
4421 I have made studies relative to the effect of the
4422 claimed diversion by Denver on the Green Mountain Reservoir.

Mr. Potts stated that the proposed diversion and impoundment of water by the City of Denver through the facilities described in its claim would not interfere with the filling of Green Mountain Reservoir. To determine the effect of Denver's Blue River facilities on the Green Mountain Reservoir, I made two studies, both covering the 11-year
4423 period, 1938 to 1948, inclusive. The first study was based on the assumption that the Green Mountain Reservoir would have available the entire recorded flow of the Blue River. We have records

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on the flow below the Green Mountain Dam cover-
4424 ing this period. I also assumed that the Green Mountain Reservoir would be empty at the beginning of the filling period each year and that it would be necessary to release about 25,000 acre-feet to the power plant to keep it operating. This
4425 study showed that the Green Mountain Reservoir would have filled every year.

The second study assumed that the water available to the Green Mountain Reservoir would be all of the water left in the stream after deducting the entire combined flow of the Blue River, Snake River and Ten Mile River as shown at the Dillon gauges. I assumed that the Green Mountain Reservoir would be empty at the beginning of the storage season and that there would be a minimum by-pass of 25,000 acre-feet of water per year for the power plant. This study showed that
4426 in none of the 11 years would the Green Mountain Reservoir have filled.

Protestant's Exhibit 50 is a tabulation which I have made which shows in the first column the maximum live storage at the Green Mountain Reservoir each year assuming no diversion or storage at Dillon. The second column shows the maximum live storage content under the assumption that all flows at Dillon were withheld. The third column shows the reduction in Green Mountain storage by reason of diverting all water passing Dillon.

The best year shows that the Green Mountain Reservoir would have been 6,200 acre-feet short and in the worst year it would have lacked 85,000 acre-feet.

4427 MR. DELANEY offered Protestant's Exhibit 50 and after hearing objections THE COURT admitted the Exhibit.

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4428 In my second study I assumed that the water at the Dillon gauges from the Ten Mile, Blue and Snake would not be available to fill the Green
4429 Mountain Reservoir. I assumed that this amount of water would be either diverted or withheld under the Denver claim. The Dillon Reservoir site is below the junction of those three streams. If Denver built that Dillon Reservoir the entire flow of those three streams would be impounded and taken. This was the basis of the assumptions upon which I made my computations.

TESTIMONY OF FRANK C. MERRIELL

DIRECT EXAMINATION

BY MR. DELANEY:

4441 My name is Frank C. Merriell and I was
4442 previously sworn and testified. I have made studies relative to the amount of water which would be available at the Green Mountain Reservoir if the proposed Dillon reservoir and other works claimed by the City and County of Denver
4443 were constructed. Protestant's Exhibit 51 is a tabulation of numerical values by months for the years 1911 to 1948 of the water that would remain in the Blue River below Dillon and above the Green Mountain Reservoir if the City and County of Denver built the Dillon Reservoir and diverted all the water from the Blue River, Ten Mile River and Snake River. It differs from Mr. Riter's study in that a diversion out of the Snake River by the Summit County Power Company is added back in. Mr. Riter took simply the record of the three gauging stations at Dillon on the Blue River, Ten Mile River and Snake River. This diversion by-passes the Snake River gauging station, goes to Summit County Power Plant and then goes back into the Blue River. I added those figures

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4445 back in. I also made no assumption that 25,000 acre-feet would necessarily be by-passed to keep the power plant in operation. Protestant's Exhibit 52 is a graphic representation of the totals shown on Exhibit 51.

4446 In the period from 1911 to 1948, 38 years, the amount of water available below Dillon to flow into the Green Mountain Reservoir would not be sufficient in 13 out of 38 years to fill that reservoir.

Mr. Riter's study was confined to the years 1938 to 1948, and under his assumptions the reser-
4447 voir would not fill in any year. In the same period, my work shows the reservoir would not fill in 5 of the 11 years. The reason for the difference between Mr. Riter's results and mine are the 18 or 20 thousand feet diverted above Dillon by the Summit County Power Company and returned to the river below Dillon.

4448 Protestant's Exhibit 52 shows total amount of flow for the particular year involved by blocks marked "Annual Inflow—Dillon to Green Mountain Reservoir." There is also marked across the chart a dashed line labeled "Active Storage, 146,900 Acre-Feet." Any time the annual flow was above that dashed line, the Green Mountain
4449 Reservoir would fill; any time the annual flow is below the dashed line, the Green Mountain Reservoir would not fill. The figure, 146,900 acre-feet is used despite the fact the Green Mountain Reservoir claims 156,475 acre-feet because some 7,000 acre feet is dead storage.

4450 MR. DELANEY offered Protestant's Exhibit 51 and 52, and after hearing objections, THE COURT admitted the Exhibits.

PROTESTANTS rested.

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STIPULATION

Ordered filed February 2, 1950

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364 It is hereby stipulated and agreed by and between the City and County of Denver, a municipal corporation, one of the claimants herein, and the Colorado River Water Conservation District, Clayton Hill and Olga Hill, protestants herein, by their respective attorneys of record, that the items of disbursement set forth in Exhibit G of the City and County of Denver are based upon work orders which are accurately summarized as shown in Exhibit YY, pages 2 to 47 inclusive, with explanatory material as to work order 3350, and appropriate catchlines showing purpose of expenditures in each work order; that all of said work orders are based upon and supported by vouchers and warrants in the files of the Board of Water Commissioners of the City and County of Denver, which vouchers and warrants show that the amounts listed in said Exhibit YY, pages 2 to 47, as aforesaid, were expended for the purposes specified and described in said work orders.

365 That Exhibit ZZ attached hereto is a summary by calendar years of the same expenditures shown by said work orders included in Exhibit YY. That sheet 1 of Exhibit YY is a tabulation showing expenditures by year in the first column and the accumulated totals in the second column. That there are two sheets of work order 3350, both of which pertain to the same expenses. That in addition to
366 the work order pertaining to the work done on the West Portal of the Blue River Diversion Tunnel there are other sheets which show the itemized expenses pertaining thereto, and give a breakdown of the amounts set forth in the work order.

It is stipulated and agreed that all of the expenditures listed in said work sheets were carried

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in the books of the Board of Water Commissioners of the City and County of Denver under various "suspense accounts" until December 31, 1943, at which time said "suspense accounts" in the amount of $188,812.06 were transferred from "suspense accounts" and were charged to the Blue River Diversion, and have since been carried as expenditures under the Blue River Diversion.

367 It is admitted that the original supporting vouchers and warrants show that the expenditures listed in Exhibit YY were made at the times and for the purposes therein stated. It is further stipulated that Exhibit ZZ attached hereto is a summary by calendar years of the same expenditures shown by said work orders, copies of which are set forth in Exhibit YY.

The protestants waive the necessity of producing the original vouchers, warrants and work orders, and agree that the copies included in Exhibit YY attached hereto may be offered in evidence
368 in lieu of the originals of said records, with the same force and effect as if the originals were produced in court. It is stipulated and agreed that the protestants reserve the right, and shall be entitled, to object to said exhibits and records on the grounds that the same, or any one or more of them, are not competent, material or relevant, or on account of any other ground of objections except want of foundation or failure to produce the originals; if the court holds that said records are competent, material or relevant for any purpose, appropriate pages of Exhibit YY may be admitted in evidence, subject to objection and exception on the part of the protestants, in lieu of the original records.

369 Dated January 26, 1950.

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THE CITY AND COUNTY OF DENVER
By GLENN G. SAUNDERS
Its Attorney

THE COLORADO RIVER WATER CONSERVATION DISTRICT
By FRANK DELANEY
Its Attorney

CLAYTON HILL
OLGA HILL
By FRANK DELANEY
Their Attorney

DENVER EXHIBIT YY

WORK ORDERS

INCURRED COSTS—BY YEARS AND CUMULATIVE

Year	Yearly Cost	Cumulative Cost
1921	163.85	163.85
1922	7029.17	7193.02
1923	2988.43	10181.45
1924	1402.67	11584.12
1925	21221.38	32805.50
1926	5331.46	38136.96
1927	2152.52	40289.48
1928	772.69	41062.17
1929	2999.86	44062.03
1930	17984.93	62046.96
1931	8222.31	70269.27
1932	12760.80	83030.07
1933	934.39	83964.46
1934	395.07	84359.53
1935	434.78	84794.31
1936	334.91	85129.22
1937	942.31	86071.53
1938	1276.88	87348.41
1939	2216.92	89565.33
1940	2119.57	91684.90
1941	11976.85	103661.75
1942	17934.00	121595.75
1943	72049.85	193645.60
1944	58124.19	251769.79
1945	31756.84	283526.63
1946	58528.23	342054.86
1947	61840.44	403895.30
1948	136002.09	539897.39
1949 (10 mos.)	46510.16	586407.55
	586407.55	

WORK ORDERS

No. 2805 C

Date: March 24, 1921

Description:

A. Summary: Investigation Water Supply Western Slope—Blue River

B. Work Order: Cost of preparing filings for diverting water from the Western Slope, including salaries and expenditures.

Cost Incurred:

1921	$ 163.85	
1922	7029.17	
1923	2988.43	
1924		
1925	13.67	
1926	182.56	
1927	239.81	
1928	60.00	
1929	21.20	
1930	93.48	
1931	85.80	
1932	65.16	
1933	223.93	
1934	30.20	$11,197.26*

* #2805C Cost is combined on summary with #9425 ($2747.31) to make combined cost of $13,944.57—see June 6, 1935.

WORK ORDERS

No. 4121

Date: November 1, 1924

Description:

A. Summary: Cost of investigation for Dam Site on South Platte River at Two Forks

B. Work Order: Same

Cost Incurred:

1924	$1402.67	
1925	6004.12	
1928	79.15	
1929	497.79	
1931	60.00	$8043.73

WORK ORDERS

No. 4334

Date: June 10, 1925

Description:

A. Summary: Cost of reservoir surveys and diamond drill investigations of Dam Site on South Platte River near South Platte.

B. Work Order: Same plus "subsequent to June 1st, 1925."

Cost Incurred:

1925	$15,203.59	
1926	428.13 (Credit)	
1927	19.83	$14,795.29

WORK ORDERS

No. 4604

Date: February 6, 1926

Description:

A. Summary: Water supply of Eastern Slope, South

Platte storage developments, prepare filing maps for enlargement of Two Forks Reservoir

B. Work Order: Same

Cost Incurred:

1926	$2026.72	
1927	90.40	
1928	487.04	
1929	1473.45	
1930	324.65	$4402.26

WORK ORDERS

No. 4842
Date: July 21, 1926
Description:

A. Summary: Cost of making surveys and filing maps for diversion of water from Blue River to Webster Creek.

B. Work Order: Cost of making survey and filing maps for diversion of water from the Blue River to Webster Creek, a branch of the North Fork of the South Platte River. (A previous survey and filing have been made on the Blue River for diversion into Jefferson Creek, a branch of the South Fork of the South Platte River.)

Cost Incurred:

1926	$3550.31	
1927	1802.48	
1928	146.50	
1929	300.00	
1930	18.45	$5817.74

WORK ORDERS

No. 6585
Date: October 17, 1929
Description:

Summary: Make investigation and do work on Strontia Springs Reservoir Site as required by Federal Power Permit No. 720.

Work Order: Make investigation and do work at Strontia Springs Reservoir site as required by Federal Power Commission, Preliminary Permit No. 720—Colorado—City and County of Denver. Cost to be subdivided as follows:

6585—A—Stream Gauging

6585—B—Running levels and traverse and establishing bench marks from intake reservoir site to Strontia Springs Reservoir.

6585—C—Survey to establish project boundaries and capacity of reservoir in addition to work done under Acct. Nos. 4121 and 4334.

6585—D—Test pits and borings to determine nature of foundations in addition to work done under Acct. Nos. 4121 and 4334.

6585—E—Design and cost estimates of dam, power house ad. and other structures.

Cost Estimates:

A. Insufficient data for estimate. Probably no work required.
B. $ 100
C. $5,000
D. $5,000
E. $8,000

Total estimated cost: $18,100

Incurred Cost:

1930	$770.46	
1931	38.90	
1932	14.55	
1943	81.29	$905.20

WORK ORDERS

No. 6586
Date: October 17, 1929
Description:

A. Summary: Make investigation and do work at Two Forks Reservoir site as required by Federal Power Permit No. 720

B. Work Order: Same as 6585 but for Two Forks Reservoir, and revised estimates:

A.	Insufficient data for estimate.
B.	$ 100
C.	$ 6,000
D.	$ 7,000
E.	$10,000
Total	$23,100

Cost Incurred:

1929	$ 100.00	
1930	11,808.68	
1931	99.25	
1932	305.29	
1933	105.88	
1934	46.05	
1943	1,229.87	$13,695.02

WORK ORDERS

No. 6594
Date: October 18, 1929
Description:

A. Summary: Install gauging station on Ten Mile Creek near Dillon and maintain same for 3-year period as required under Federal Power Permit No. 720

B. Work Order: Same as above followed by "Colorado —City and County of Denver."

	Estimate
8594—A—Cost of installation	$ 700
8594—B—Cost of maintenance	$ 500
Total estimated cost	$1200

Cost Incurred:

1929	$385.17	
1930	88.51	
1931	6.90	
1932	71.85	
1933	110.50	
1934	67.50	$730.43

WORK ORDERS

No. 6599

Date: October 24, 1929

Description:

A. Summary: Install gauging station on Snake River near Dillon and maintain same for 3-year period as required under Federal Power Permit No. 720

B. Work Order: Same as 6594 but for Snake River

Cost Incurred:

1929	$222.25	
1930	88.51	
1931	171.95	
1932	73.00	
1933	110.50	
1934	67.50	$733.71

WORK ORDER

No. 6610

Date: November 1, 1929

Description:

A. Summary: Run traverse and levels on North Fork of South Platte River from Two Forks to Grant

B. Work Order: Same—total cost estimate $1,000

Cost Incurred:

1930	$4,215.69	
1931	642.70	
1932	61.30	$4,919.69

WORK ORDERS

No. 8046

Date: November 25, 1930

Description:

A. Summary: Cost of adjudicating the City's Water Rights on the Blue River.

B. Work Order: Same—no cost estimate.

Cost Incurred:

1930	$576.50	
1931	930.80	
1932	28.90	
1934	19.47	$1555.67

WORK ORDERS

No. 8256

Date: June 25, 1931

Description:

A. Summary: Make survey required for location of 22.8 mile tunnel for diversion of Blue River water into North Fork of South Platte River.

Survey and monument center line of tunnel as located.

B. Work Order: Same—Cost estimate $7,500.

Cost Incurred:

1931	$ 6,186.01	
1932	11,898.86	
1933	129.35	$18,527.30

WORK ORDERS

No. 8654
Date: August 8, 1932
Description:

A. Summary: Maintain and operate gauging station on Blue River near Dillon as required under Federal Power Comm. Permit No. 720

B. Work Order: Same—also "insufficient data for cost estimate."

Cost Incurred:

1932	$241.89	
1933	70.50	
1934	35.00	$347.39

WORK ORDERS

No. 9425
Date: June 6, 1935
Description:

A. Summary: Investigation water supply Western Slope—Blue River

B. Work Order: This account number, from January 1, 1935, supersedes account numbers covering the several projects for diversion of Blue River water for use on Eastern Slope.
Future work on this project must be authorized as new work. At the time such work is ap-

proved a new account number will be taken out and if the work covered by any former work order is continued, the charge against the old work order will be incorporated in the new account number.

The account numbers, with charges to December 31, 1934, and which charges are made a part of the costs of this account, are as follows:

No. 2805 C—Investigation Water Supply Western Slope—Blue River	$11,197.26
No. 4842—Blue River Diversion	5,817.74
No. 8046—Adjudication water rights, Blue River	1,555.67
No. 8256—Survey for tunnel—Blue River	18,527.30
No. 6506—Preliminary permit No. 720—FPC (6594, 6599, 8654, 6610)	6,731.22
Total	$43,829.19

Cost Incurred:

1935	$ 374.58	
1936	334.91	
1937	414.07	
1938	277.16	
1939	126.92	
1940	1,079.57	
1941	7,255.52	
1943	7,115.42	(Credit—Trade-in equipment)
Net total	$2,747.31*	

*Combined with No. 2805 C (3/24/21) on summary

WORK ORDERS

No. 9427
Date: June 6, 1935
Description:

A. Summary: Covers several projects in connection with determining the feasibility of construction of dam on Two Forks on the South Platte River.

B. Work Order: Same as above, plus:

Future work on this project will be authorized as new work. At the time such work is approved a new account number will be taken out and if the work covered by any former work order is continued, the charges against the old work order will be incorporated in the new account number.

The account numbers, with charges to December 31, 1934, and which charges are made a part of the costs of this account number are as follows:

4121—Two Forks Reservoir Site, cost of dam site at Two Forks on the South Platte River		$ 8,043.73
4334—Cost of reservoir surveys and diamond drill investigations of dam site on South Platte River near South Platte		$14,795.29
6506—Preliminary permit No. 720 FPC	$33,071.41	
Less charges allocated to Blue River Project	6,731.22	$26,340.19
4604—South Platte River Storage Development		4,402.26
Total		$53,581.47

Cost Incurred:

1935	$ 60.20	
1939	2,090.00	
1940	1,040.00	
1942	14.29	$3,204.49

WORK ORDERS

No. 1213
Date: August 30, 1937
Description:

A. Summary: Make investigations and surveys of canal system tunnel for diversion of water from the Snake River, a tributary of the Blue River into Geneva Creek, a tributary of the South Platte River.

B. Work Order: Same except Snake River instead of Snake, and plus the Following:
Authorized by the Board of Water Commissioners. Estimated cost $1,000.

Cost Incurred:

1937	$528.24	
1938	999.72	$1,527.96

WORK ORDER

No. 2986
Date: September 25, 1941
Description:

A. Summary: Investigations of storage possibilities on Western Slope for use of proposed Blue River Project, inc. survey of Dillon Reservoir Site.

B. Work Order: Same as above and the following:
Authorized by Board of Water Commissioners Dec. 2, 1941. Budget Items S 3 and C 38 A.
½ to ourselves
½ to City and County of Denver, Special Water Rights Fund
Cost to January 1, 1944—$5,914.91

Cost Incurred:

1941	$4,721.33	
1942	2,456.44	$7,177.77

WORK ORDERS

No. 3301
Date: July 24, 1942
Description:

Summary: Make further investigation for development of additional water supply from the Western Slope including geological costs.

Work Order: Same as above plus:
Authorized by Board of Water Commissioners July 21, 1942
½ to ourselves
½ to City and County of Denver, Special Water Rights Fund
Total estimated cost—$8,000.
Following memorandum, crossed out with pencil:

Meeting of August 18, 1942

Cooperative agreement with U. S. Reclamation Bureau. Detailed plans and specifications for Two Forks Reservoir Dam. Board to pay 50% of costs incurred by the Bureau for core drilling and estimating costs of both gravity type and arch type dam at Two Forks, the contribution on account of drilling to be limited to $5000 and

on account of drawings and estimated to $3000. The City's share of the cost to be provided one-half from the Mayor's Special Water Rights Fund and one-half out of the Water Works Fund.

Also, attached to the Work Order was the following letter:

March 2, 1944

On August 4, 1942, the Board authorized an expenditure of $10,000 for core drilling work by the Bureau of Reclamation at Two Forks Reservoir Dam Site.

On the strength of this authorization, Work Order No. 3424, dated December 31, 1942, was originated.

At the meeting held August 18, 1942, the authorization of August 4 was modified. This last act provided for participation in the costs by the Reclamation Bureau for core drilling to be limited to $5000 and on account of drawings and estimates to $3000, one-half of all costs to be paid from the City's Special Water Rights Fund.

The Core drilling under this phase of the work has been completed, and payment is now to be made in accordance with an invoice just received in the amount of $5000.

On January 4, 1944, the Board authorized an expenditure limited to $5000 for cooperative core drilling for the Two Forks at a new site known as the "Point of Rocks Site."

It is our understanding that work is now in progress on the second phase of the core drilling, the work of designing the dam by the Bureau of Reclamation is to be carried out under Work

Order No. 3424, the payment of which is limited to $3000.

On December 7, 1943, the Board authorized the Engineering Division to prepare plans and specifications for the Two Forks Reservoir Dam without a specified authorization as to cost. The work is being carried out under Work Order No. 3653, dated December 24, 1943, which provides for one-half of the cost being paid from the Special Water Rights Fund.
On January 18, 1944, the Board authorized Chief Engineer Gross to employ extra help in the Engineering Division if and when needed in making a study of the different routes for transmountain diversion of Blue River Water. The cost of preparing these plans if being charged to Work Order No. 3301, dated July 24, 1942, and Work Order No. 3680, dated January 28, 1944. The latter work order provides for investigations of power possibilities on the North Fork of the South Platte River.

Therefore, the cost of the work is actually being divided on the basis of the Eastern and Western Slope activities. If the work is extended beyond the scope of these two work orders, it is our understanding with Mr. J. Burgess, Office Engineer, that additional accounting mediums will be furnished in the form of work orders.

(Signed) HMW

Office Manager

Cost Incurred:

1942	$4,211.22	
1943	8,799.68	
1944	7,815.19	$20,826.09

WORK ORDERS

No. 3350
Date: September 17, 1942
Description:

Summary: Clearing and excavation for approach to Blue River tunnel at Dillon.

Work Order: Same, plus:

Usual split, as before, of charge.
Estimated cost:

Clearing	$ 2,000
Excavation	12,970
Engineering and contingencies	1,497
Total	$16,487

GENERAL OFFICE LOADING 5%
(in red pencil)

Cost Incurred:

1942	$4,833.54	
1943	7,812.22	$12,645.76

AUDIT OF SPECIFIC WORK ORDER COST

No. 3350—dated September 17, 1942—Clearing and excavation for approach to Blue River Tunnel at Dillon.

General notes re audit coverage:

1. Principal items only were subjected to detail audit (as indicated below). The aggregate of unimportant items not subjected to audit was $1,487.17 out of a total Work Order cost of $12,645.76, or about 9%.
2. Outside purchases of services, supplies, etc., were charged to Work Order on the basis of so-called Purchase Orders—really confirmation of audited vendors' invoices, the actual purchase having been made previously through the medium of Purchase

Requisitions. This is the uniform practice of the City of Denver and is not irregular.

3. Your auditor was not content with checking of Purchase Orders to the Work Order Ledger, on the basis of which the "Summary, etc." (Evidence Exhibit G) was prepared. Vouchering, issuing of warrants, and posting of Treasurer's checks covering vouchers, were checked. However, since the foregoing examination was deemed adequate, Treasurer's cancelled checks were not examined.

4. Audit of salaries and wages charged to the Work Order:

   a. Test checks were made of entries in the Work Order Ledger by comparison with entries in Monthly Payroll Distribution.

   b. Tabulating Machine runs supporting the Monthly Payroll Distribution could not be checked, since they had been destroyed under the provisions of the City's record-destruction policy, which calls for destruction of these run sheets after seven years. This is quite normal practice.

   c. As a further test, spot checks were made of semi-monthly time sheets covering crews of workmen, showing allocation of time to the work covered by the Work Order. These showed substantial allocation to jobs other than the one under audit, and gave evidence of being reasonable and regular.

Class of Expenditure	Audited	Not Audited (small items)	Total
Salaries and Wages	$ 3583.25		$ 3583.25
Materials and Supplies		$ 17.63	17.63
Motor Vehicle Expense (based on mileage and hours used on job)	238.32	498.50	736.82
Denver Storehouse and Yard Expense		3.08	3.08
West Denver Shop Expense		95.48	95.48
General Office Expense	100.40	455.62	556.02
General Utility Equipment Expense (based on time used on job)	3548.97	3.75	3552.72
Service Not Otherwise Classified	3687.65	413.11	4100.76
Totals	$11158.59	$1487.17	$12645.76

Details of audited costs:

1. Salaries and Wages—Note: See General Note No. 4, above

1942:	September	$248.15	
	October	431.30	
	November	367.90	
	December	96.85	
1943:	July	234.95	
	August	528.45	
	September	403.20	
	October	768.25	
	November	201.05	
	December	303.15	$3583.25

2. Motor Vehicle Expense—based on mileage operated on the job

		Total Journal Entry		Allocated to Job	
1942:	October	$3025.72		$131.20	
1943:	November	2507.18	$5632.90	107.12	$238.32

	Total Journal Entry	Allocated to Job
3. General Office Expense—allocated to job	$ 490.00	$ 100.40

4. General Utility Equipment Expense—based on actual hours equipment used on job:

1942:	October	1588.38		582.88	
	November	1148.75		265.75	
1943:	July	700.50		210.00	
	August	1185.38		671.75	
	September	1061.19		600.69	
	October	1272.75		1051.50	
	November	579.15	$7536.10	166.40	$3548.97

AUDIT OF SPECIFIC WORK ORDER COST—P. 4

5. Service not otherwise classified:

1942:	Total Voucher		To Job	
Sept. 30—Gallagher Transport Co. Hauling link belt from Eldorado Springs to Dillon	$403.20		$403.20	
Oct. 3—H. H. Hooker—clearing timber, etc., at approach to Blue River Tunnel, Dillon	330.75		330.75	
Oct. 17—H. H. Hooker—same	526.50		526.50	
Nov. 7—Ethel James, Wildwood Lodge, Dillon—meals, lodging for H. R. Oliver (Superintendent BRDS), and party	163.00		146.00	
Nov. 7—H. H. Hooker Clearing timber, etc., at approach cut to Blue River Tunnel, Dillon	$285.75		$285.75	
Dec. 11—Weicker Transfer & Storage Co.—Hauling link belt from Dillon to Denver	406.60		406.60	
1943:				
July 30—Gallagher Transportation Co. Lorrain dragline and shovel boom and bucket from Winter Park to Dillon	568.00		568.00	
Sept. 11—Ethel James, Wildwood Lodge—meals and lodging for H. R. Oliver and party for August	397.14		175.75	
Sept. 30—A. D. James—same for September	242.50		137.50	
Nov. 3—Mrs. K. G. Chamberlain—meals for H. R. Oliver and party from September 30 to November 11	225.75		161.60	
Nov. 20—Weicker Transfer & Storage Co. moving Lorrain shovel M55 from Dillon to Winter Park	546.00	$4095.79	546.00	$3687.65
Total of audited costs				$11158.59

WORK ORDERS

No. 3356

Date: September 28, 1942

Description:

Summary: Purchase of Louis Kinkel property in Douglas and Jefferson Counties for Two Forks Reservoir Site.

Work Order: Same, plus:

Detailed description of property
Usual split of charge
Purchase price: $9,000
Split of price:
Land $8,500
Buildings 500
General Office loading 1%

Cost Incurred:

1942 $9,091.26

WORK ORDERS

No. 3367

Date: October 5, 1942

Description:

Summary: Repair roofs of buildings and do cleanup work as desirable at Strontia Springs

Work Orders: Same as above plus:

Usual split
Est. cost $100
General Office Loading 5%

Cost Incurred:

1942 $198.30

WORK ORDERS

No. 3375

Date: October 10, 1942

Description:

Summary: Purchase land known as the Sayre Tract at Dillon, about 460 acres for use of Blue River Tunnel.

Work Order: Same as above, plus:
Usual split of charge
Estimated cost $5,200
General Office Loading 1%

Cost Incurred:

1942	$3,015.34	
1943	360.78	
1945	677.82	
1946	1,446.29	$5,500.23

WORK ORDERS

No. 3393

Date: November 5, 1942

Description:

Summary: Make filing maps for enlarged Blue River Diversion Project and do similar engineering work in cooperation with South Platte Water Users Association.

Work Order: Same as above plus:
Usual Charge split
Limitation on cost $1000

Cost Incurred:

1942	$110.32	
1943	5.52	$115.84

WORK ORDERS

No. 3420
Date: December 16, 1942
Description:

Summary: Reroof South Platte Hotel on South Platte property purchased from Louis Kinkel.

Work Order: Same as above, plus:
Usual charge split
Estimated cost $198.45

Incurred cost:

1942	$199.05

WORK ORDERS

No. 3424
Date: December 31, 1942
Description:

Summary: Complete diamond core drilling and design dam for Two Forks Reservoir Work by U. S. Bureau of Reclamation, cost not to exceed $20,000.

Work Order: Complete diamond core drilling and design dam for Two Forks Reservoir, as outlined in letter to Mr. S. O. Harper, Chief Engineer, Bureau of Reclamation, signed by Ben F. Stapleton, Mayor, dated August 5, 1942.

Usual charge split.
"Work to be done by the Bureau of Reclamation for actual cost but not to exceed $10,000."

Incurred Cost:

1943	$ 5.04	
1944	12,275.66	
1945	7,366.46	
1946	1,041.82	
1947	3.43	$20,692.41

WORK ORDERS

No. 3646

Date: December 7, 1943

Description:

Summary: Purchase property at Long View for use of Two Forks Reservoir site from Frank D. Thompson et al.

Work Order: Same as above, plus:

Usual charge split
Est. cost $4,606
General Office Loading 1%

Cost Incurred:			
1943	$4,637.26		
1944	56.60		
1945	46.07		
1946	9.90	(credit)	$4,730.03

WORK ORDERS

No. 3653

Date: December 27, 1943

Description:

Summary: Prepare plans and specifications for Two Forks Reservoir Dam

Work Order: Same as above, plus:

Usual charge split
No estimate

Cost Incurred:		
1943	$192.67	
1944	915.58	
1945	225.79	$1,334.04

WORK ORDERS

No. 3680
Date: January 28, 1944
Description:

Summary: Investigate power possibilities in connection with the development of additional water supply for Western Slope

Work Orders: Same as above, plus:

Usual charge split
No estimate

Cost Incurred:

1944 $5,053.41

WORK ORDERS

No. 3752
Date: May 10, 1944
Description:

Summary: Make surveys of property in Two Forks Reservoir Site for purchase of land or rights of way

Work Order: Same as above, plus:

Usual charge split
No estimate

Cost Incurred:

1944 $73.23

WORK ORDERS

No. 3813
Date: July 17, 1944
Description:

Summary: Drive 6½' x 7½' pilot tunnel through cemented gravel to bed rock about 400 feet at west portal of Blue River Tunnel at Dillon.

Work Order: Same as above, plus:
Usual charge split
Cost details, totaling $11,796.75, including General Office Loading of 5%.

Cost Incurred:

1944	$9,262.37	
1945	6,383.73	
1946	850.20 (credit)	$14,795.90

WORK ORDERS

No. 3840
Date: August 26, 1944
Description:

Summary: Do geological work along proposed Blue River Tunnel—work by Ernest Walstrum; cost not to exceed $3,000.

Work Order: Same as above, plus:
Usual charge split
Top limit on cost—$3,000

Cost Incurred:

1944	$1,967.07	
1945	34.35	$2,001.42

WORK ORDERS

No. 3841
Date: August 26, 1944
Description:

Summary: Do geological work at Two Forks Reservoir Dam Site

Work Order: Same, plus:
Usual charge split
Total estimated cost $500

Cost Incurred:

1944	$ 46.98	
1945	471.65	$518.63

WORK ORDERS

No. 3842

Date: August 26, 1944

Description:

Summary: Do geological work at Dillon Reservoir Dam Site

Work Order: Same, plus:

Usual split in charge
Estimated cost $500

Cost Incurred:

1944	$ 9.63	
1945	318.83	$328.46

WORK ORDERS

No. 3846

Date: September 9, 1944

Description:

Summary: Cooperation with U. S. Geological Survey in topographic mapping along North Fork of South Platte River for use in connection with Blue River Project.

Work Order: Same as above, plus:

Usual charge split
Total amount of payment to U. S. Geological Survey: $12,750

Cost Incurred:

1944	$1,393.73	
1945	8,593.51	
1946	3,731.26	
1947	1,259.45	$14,977.95

WORK ORDERS

No. 4448

Date: June 13, 1946

Description:

Summary: Purchase land and interest in land at east portal of Montezuma Tunnel, Blue River Project, from Neil G. Seeley, approximately 175 acres.

Work Orders: Same as above, plus:

Detailed description of property
Usual charge split
Purchase price $6,000

Cost Incurred:

1946	$6,064.04	

WORK ORDERS

No. 3249

Date: June 1, 1942

Description:

Summary: Purchase land in connection with development of Western Slope water supply.

Work Order: Same plus:

½ to ourselves
½ to City and County of Denver, Special water rights fund.

Cost Incurred:

1943	$1,416.73	
1944	15.15)	
1945	53.53) Credits	
1946	9.90)	
1948	202.00	$1,540.15

WORK ORDERS

No. 3384
Date: October 27, 1942
Description:
Summary: Purchase land for Two Forks Reservoir Site as approved from time to time.
Work Order: Same as above plus:
Usual charge split
No estimate of cost
General Office Loading 1%

Cost Incurred:

1942	$ 404.00	
1943	4,327.94	
1944	4,357.33	
1945	454.92	
1946	2,523.49	
1947	1,287.03	
1948	2.17	$13,356.88

WORK ORDERS

No. 3417
Date: December 14, 1942
Description:
Summary: Cost of adjudicating City's Water Rights on the Blue River—Water District No. 36.
Work Order: Same as above, plus:
Usual charge split
No estimate of cost

Cost Incurred:

1942	$ 515.66	
1943	1,020.73	
1944	266.34	
1945	191.41	
1946	318.51	
1947	190.54	
1948	542.83	
1949 (10 mos.)	240.28	$3,286.30

WORK ORDERS

No. 3462
Date: February 18, 1943
Description:

Summary: Purchase land for Dillon Reservoir Site during the year 1943, as authorized from time to time.

Work Order: Same as above, plus:

Usual charge split
Estimated cost $10,000
General Office Loading 1%

Cost Incurred:

1943	$9,916.98	
1944	88.39	
1946	117.95	
1947	160.96	
1949	121.29	$10,405.57

WORK ORDERS

No. 3574
Date: July 24, 1943
Description:

Summary: Do diamond core drilling along proposed Blue River tunnel site (24 mile Montezuma Route) to determine nature of ground traversed.

Work Order: Same as above, plus:

Usual charge split
Drilling by U. S. Bureau of Reclamation—3750 lineal feet of holes at $6 ..... $22,500
Inspected by ourselves 2,500
Total $25,000

Cost Incurred:

1943	$16,419.10	
1944	15,313.02	$31,732.12

WORK ORDERS

No. 3590
Date: August 30, 1943
Description:
Summary: Acquirement of real estate and rights of way for Montezuma Tunnel of Blue River Project, as authorized from time to time.
Work Order: Same as above, plus:
Usual charge split
No estimate
General Office Loading 1%

Cost Incurred:

1943	$141.09	
1944	40.22	
1945	50.21	
1946	188.87	
1949	14.71	$435.10

WORK ORDERS

Description:
Date: October 15, 1943
No. 3627
Summary: Purchase of the Parley Roach property at Foxton for use of Two Forks Reservoir Site.
Work Order: Same as above, plus:
Detailed description of property
Usual split of charge
Estimate: Real estate, including quiet title suit $15,000
Personal property 500
Legal & administrative 200

Total Est. Direct Cost $15,000
Est. Indirect cost 157

Grand Total Est. Cost $15,857

Cost Incurred:

1943	$15,247.77	
1944	1,594.06 (credit)	
1945	571.82	$14,225.53

WORK ORDERS

No. 3855
Date: September 25, 1944
Description:

Summary: Furnish assistance to expedite investigation of relative merits of alternate routes for Blue River, South Platte Project as proposed by U. S. Bureau of Reclamation.

Work Order: Same as above, plus:
Usual Charge split
Total estimated cost $3,500

Cost Incurred:

1944	$1,233.83	
1945	256.71	$1,490.54

WORK ORDERS

No. 3913
Date: January 1, 1945
Description:

Summary: Make further investigations of and do engineering work on Blue River Tunnel with special attention to Montezuma Route.

Work Order: Same as above, plus:
Usual charge split
"Insufficient data for estimate" (This is a portion of the work for which the Board approved expenditure of $7,000 for the period from Jan. 1 to June 30, 1945, $3,500 of which is to be paid by the Board.)

Cost Incurred:

1945	$6,167.09	
1946	2,678.50	
1947	371.75	$9,217.34

WORK ORDERS

No. 4457
Date: June 24, 1946
Description:

Summary: Drive Montezuma Tunnel, Blue River Project full size starting at East Portal

Work Order: Same as above, plus:

Usual charge split

"Total appropriation, after deducting right of way cost $44,000."

Cost Incurred:

1946	$41,287.50	
1947	58,567.28	
1948	56,871.72	
1949 (10 mo.)	39,267.72	$195,994.23

WORK ORDERS

No. 5148
Date: February 6, 1948
Description:

Summary: Build trestle across highway at Blue River Tunnel above Grant, Colorado

Work Order: Same as above, plus:

Following memorandum:

"See letter from Board of Water Commissioners to Mayor Quigg Newton, dated February 4, 1948, signed by John Burgess, Asst. Secretary and returned with Mayor Newton's approval relative to charges on cost of work."

Usual charge split

Total estimated cost $4,500

Cost Incurred:

1948	$9,001.38

WORK ORDERS

No. 5197
Date: March 29, 1948
Description:

Summary: Make further investigation and do engineering work on the Blue River Project with special attention to the Montezuma Tunnel (supersedes work order No. 3913).

Work Order: Same as above, plus:
Usual charge split

Note: This work order supersedes work order 3913, which was closed November 30, 1947.

"Insufficient data for estimating."

Cost Incurred:

1948	$ 478.46	
1949 (10 mo.)	1688.65	$2,167.11

WORK ORDERS

No. 5392
Date: July 31, 1948
Description:

Summary: Purchase equipment for driving Montezuma Tunnel of the Blue River Project.

Work Order: Same as above, plus:

Charge to ourselves
Total estimated cost-purchase price of new machinery $55,000.
"No General Office Loading"

Cost Incurred:

1948	$68,903.53	
1949 (10 Mo.)	5,177.50	$74,081.03

DENVER EXHIBIT E

UNITED STATES
DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

CONTRACT BETWEEN THE UNITED STATES AND THE CITY OF DENVER PROVIDING FOR COOPERATIVE INVESTIGATIONS.

This contract made December 31, 1941, between the United States of America, herein styled the United States, acting for this purpose through S. O. Harper, Chief Engineer, Bureau of Reclamation, under the provisions of the Act of June 17, 1902 (32 Stat. 388), and acts amendatory thereof or supplementary thereto, and the City of Denver, herein styled the City, and acting for this purpose through B. F. Stapleton, Mayor of the City of Denver.

WITNESSETH:

2. Whereas, the United States and the City desire to arrange for further investigations for the utilization of the waters of Colorado River, and particularly the waters of Blue River and neighboring streams which investigations would be delayed or not conducted at all in the absence of the cooperation of the City and other interests within the State, by means of the contribution of funds or services,

3. Now, Therefore, in consideration of the premises and mutual covenants and agreements here contained, it is agreed as follows:

4. The United States and the City will proceed with investigations, surveys and studies to develop the best possible feasible plans for the comprehensive utilization on the eastern slope of the Rocky Mountains of the waters of the watersheds involved to the extent that such waters are or may be made available without impairing the

ultimate irrigation development on the western slope, and with the aid of adequate replacement storage.

5. The United States and the City contemplate an expenditure of one hundred thousand dollars ($100,000) each on the investigations referred to in this agreement, but neither party should be obligated to expend any specific amount thereon. The City may, with the approval of the United States, make available for the use of the United States in connection with these investigations such funds and the services of such men or equipment as the United States can utilize on the proposed investigation.

6. Representatives of the United States and the City, in charge of such investigations, will at all times coordinate their activities to the end that the investigations be comprehensive and be conducted without duplication, and that the plans developed be the most satisfactory adapted to the situation. The United States and the City shall at all times make available to each other, for use in connection with the investigations and the preparation of reports thereon, all applicable factual and other data, but the release of such data or its utilization for other purposes shall, prior to the completion of the investigation, and issuance of reports thereon, be limited to factual information, such as stream flow records, and maps of surveys, and drill cores, except as the release of other data may be authorized by the party that has developed or prepared such data.

7. Upon completion of the investigations, a report thereon shall be prepared by the United States. Prior to the issuance of such report for public inspection, the United States will extend to the City an opportunity to review and comment on said report and will give consideration to said comments before issuance of the report. Prior to the release of any report by the City containing data secured from the United States, the City will ex-

tend to the United States an opportunity to review and comment on such report.

8. Field notes, original plans, calculations, or other data acquired or prepared by the United States in pursuance of this agreement will, upon completion of the investigations, be placed on file with the Bureau of Reclamation, and copies of such records will be furnished the City upon request, if funds are available for making such copies; provided, however, that if funds are not available for this purpose, the City shall be privileged to examine such records at the office of the Bureau of Reclamation in Denver, Colorado, and shall have the right to secure copies thereof at its own expense.

9. The United States reserves the right, at any time to make further agreements, similar to this agreement, with such other parties or interests, as may evince a desire to participate in the investigations contemplated; provided, however, that such other parties shall not be entitled to access to data furnished by the City except with the assent of City representatives.

10. From time to time, public meetings may be arranged to present the general results at that time of the investigations, and to provide an opportunity for the presentation of plans and ideas for consideration by the United States, the City, and others, interested in the investigations.

11. Neither this agreement nor any activities or reports resulting therefrom shall in any way be deemed, construed, or operate to affect the rights of the parties hereto in the waters of the streams involved.

12. No member of or delegate to Congress or resident commissioner shall be admitted to any share or part of this contract or to any benefit that may arise therefrom. Nothing, however, herein contained shall be construed to extend to this contract if made with a corporation for its general benefit.

13. Where the operations of this contract extend beyond the current fiscal year, the contract is made contingent upon Congress making the necessary appropriation for expenditures by the United States hereunder after such current year shall have expired. In case such appropriation as may be necessary to carry out this contract is not made, the City hereby releases the United States from all liability due to the failure of Congress to make such appropriation.

IN WITNESS WHEREOF, the parties hereto have signed their names the day and year first above written.

THE UNITED STATES
OF AMERICA,
By /s/ S. O. Harper
Chief Engineer,
Bureau of Reclamation.

Form approved:
Malcolm Lindsey, Attorney,
City and County of Denver,
By Glenn G. Saunders,
Asst. City Attorney.
Registered and countersigned:
W. H. McNichols, Auditor.

(SEAL)
Attest:
/s/ Paul F. Persk e,
Clerk & Recorder, Ex-officio
City Clerk,
By Siewers Fincher, Deputy.

CITY OF DENVER,

By /s/ Ben F. Stapleton,
Mayor.

DENVER EXHIBIT G

SUMMARY OF CHARGES TO BLUE RIVER DIVERSION SYSTEM

OCTOBER 1, 1920 to OCTOBER 31, 1949

SCHEDULE 1

No.	Description of Work	Total October 31, 1949
4121	Cost of investigation for Dam Site on South Platte River at Two Forks	8,043.73
4334	Cost of reservoir surveys and diamond drill investigations of Dam Site on South Platte River near South Platte	14,795.29
4604	Water Supply of Eastern Slope, South Platte storage developments, prepare filing maps for enlargement of Two Forks Reservoir	4,402.26
4842	Cost of making surveys and filing maps for diversion of water from the Blue River to Webster Creek	5,817.74
6585	Make investigations and do work at Strontia Springs Reservoir Site as required by Federal Power Permit No. 720	905.20
6586	Make investigations and do work at Two Forks Reservoir Site as required by Federal Power Permit No. 720	13,695.02
6594	Install gaging station on Ten Mile Creek near Dillon and maintain same for 3-year period as required under Federal Power Permit No. 720	730.43
6599	Install gaging station on Snake River near Dillon and maintain same for 3-year period as required under Federal Power Permit No. 720	733.71
6610	Run traverse and levels of North Fork of South Platte River from Two Forks to Grant	4,919.69
8046	Cost of adjudicating the City's water rights on the Blue River	1,555.67
8256	Make surveys required for location of 22.8 mile tunnel for diversion of Blue River water into North Fork of South	

No.	Description of Work	Total October 31, 1949
	Platte River—Survey and Monument center line of tunnel as located	18,527.30
8654	Maintain and operate gaging station on Blue River near Dillon as required under Federal Power Comm. Permit No. 720	347.39
9425 (2805)	Investigation water supply Western Slope—Blue River	13,944.57
9427 (6506) (3424)	Covers several projects in connection with determining the feasibility of construction of dam on Two Forks on the South Platte River	3,204.49
1213	Make investigations and surveys of canal system tunnel for diversion of water from the Snake River, a tributary of the Blue River, into Geneva Creek, a tributary of the South Platte River	1,527.96
2986	Investigations of storage possibilities on Western Slope for use of proposed Blue River Project including survey of Dillon Reservoir Site	7,177.77
3301	Make further investigations of development of additional water supply from the Western Slope including geologizing costs	20,826.09
3350	Clearing and excavation for approach to Blue River Tunnel at Dillon	12,645.76
3356	Purchase of Louis Kinkel property in Douglas and Jefferson Counties for Two Forks Reservoir Site	9,091.26
3367	Repair roofs of buildings and do clean up work as desirable at Strontia Springs	198.30
3375	Purchase land known as the Sayre Tract at Dillon, about 460 acres for use of Blue River Tunnel	5,500.23
3393	Make filing maps for enlarged Blue River Diversion Project and do similar engineering work in cooperation with South Platte Water Users Association	115.84

No.	Description of Work	Total October 31, 1949
3420	Reroof South Platte Hotel on South Platte property purchased from Louis Kinkel	199.05
3574	Do diamond core drilling along proposed Blue River Tunnel Site (24 mile Montezuma Route) to determine nature of ground traversed	31,732.12
3627	Purchase of the Parley Roach property at Foxton for use of Two Forks Reservoir Site	14,225.53
3646	Purchase property at Longview for use of Two Forks Reservoir site from Frank D. Thompson et al	4,730.03
3680	Investigate Power Possibilities in connection with the development of additional water supply from Western Slope	5,053.41
3752	Make surveys of property in Two Forks Reservoir site for purchase of land or rights of way	73.23
3813	Drive 6½′ x 7½′ pilot tunnel through cemented gravel to bed rock about 400 feet at west portal of Blue River Tunnel at Dillon	14,795.90
3840	Do geological work along proposed Blue River Tunnel—work by Ernest Walstrum; cost not to exceed $3,000	2,001.42
3841	Do geological work at Two Forks Reservoir Dam Site	518.63
3842	Do geological work at Dillon Reservoir Dam Site	328.46
4448	Purchase land and interest in land at east portal of Montezuma Tunnel, Blue River Project, from Neil G. Seeley, Approx. 175 acres	6,064.04
3249	Purchase land in connection with development of Western Slope water supply	1,540.15
3384	Purchase land for Two Forks Reservoir Site as approved from time to time	13,356.88
3417	Cost of adjudicating City's water	

No.	Description of Work	Total October 31, 1949
	rights on the Blue River—Water District No. 36	3,286.30
3424	Complete diamond core drilling and design dam for Two Forks Reservoir work by U. S. Bureau of Reclamation, cost not to exceed $20,000	20,692.41
3462	Purchase land for Dillon Reservoir site during the year 1943, as authorized from time to time	10,405.57
3590	Acquirement of real estate and rights of way for Montezuma Tunnel of Blue River Project, as authorized from time to time	435.10
3653	Prepare plans and specifications for Two Forks Reservoir Dam	1,334.04
3846	Cooperation with U. S. Geological Survey in topographic mapping along North Fork of South Platte River for use in connection with Blue River Project	14,977.95
3855	Furnish assistance to expedite investigation of relative merits of alternate routes for Blue River, South Platte Project as proposed by U. S. Bureau of Reclamation	1,490.54
3913	Make further investigations of and do engineering work on Blue River Tunnel with special attention to the Montezuma Route	9,217.34
4457	Drive Montezuma Tunnel, Blue River Project full size starting at East Portal	195,994.23
5148	Build trestle across highway at Blue River Tunnel above Grant, Colorado	9,001.38
5197	Make further investigations and do engineering work on the Blue River Project with special attention to the Montezuma Tunnel (Supersedes work order No. 3913)	2,167.11
5392	Purchase equipment for driving Montezuma Tunnel of the Blue River Project	74,081.03
	Total	$586,407.55

DENVER EXHIBIT H

COSTS INCURRED IN CONNECTION WITH DRIVING MONTEZUMA TUNNEL EAST AND WEST PORTALS INCLUDING PURCHASE OF EQUIPMENT FOR THE PERIOD SEPTEMBER 1st, 1942 to OCTOBER 31, 1949, INCLUSIVE.

Year	Month	Total By Months	Total By Years	Number Men Employed
1942	September	$ 715.80		5
	October	2,086.21		6
	November	1,395.56		5
	December	635.97	$ 4,833.54	5
1943	June	3.24		—
	July	1,112.86		5
	August	1,352.59		5
	September	1,483.87		5
	October	2,079.03		6
	November	1,351.95		5
	December	428.68	7,812.22	—
1944	July	298.47		—
	August	1,589.84		6
	September	2,535.56		7
	October	1,817.71		6
	November	1,237.77		6
	December	1,783.02	9,262.37	6
1945	January	98.54		—
	February	28.93		—
	March	15.20		—
	April	23.42		—
	May	1,088.34		6
	June	1,573.51		7
	July	2,273.15		7
	August	1,384.51		7
	September	85.89		—
	October	359.48 CR.		—
	November	162.68		—
	December	9.04	6,383.73	
1946	July	7,424.69		7
	August	5,430.32		10
	September	9,385.35		10
	October	3,935.79		9
	November	4,358.56		8
	December	9,902.59	40,437.30	8

Year	Month	Total By Months	Total By Years	Number Men Employed
1947	January	4,078.46		9
	February	2,971.95		9
	March	3,293.35		9
	April	5,232.30		10
	May	3,741.34		9
	June	3,947.35		9
	July	9,379.12		10
	August	6,856.88		10
	September	4,453.60		10
	October	5,389.71		10
	November	4,657.64		11
	December	4,565.58	58,567.28	11
1948	January	5,139.97		11
	February	3,716.01		11
	March	7,737.63		12
	April	11,517.28		14
	May	8,833.10		13
	June	6,488.00		13
	July	4,359.58		13
	August	17,189.69		12
	September	13,759.20		15
	October	16,255.81		15
	November	8,018.12		13
	December	31,762.24	134,776.63	11
1949	January	4,210.69		12
	February	5,226.81		11
	March	9,041.02 CR.		12
	April	5,634.73		11
	May	10,182.81		11
	June	4,482.21		12
	July	3,853.79		12
	August	5,867.82		12
	September	7,681.17		12
	October	6,346.22	44,445.23	12
		Total	$306,518.30	

Note: Credit item in March 1949 represents excess of credits over debits as follows:

Total Expenditures	$ 5,768.61
Credit for Equipment Removed on account replaced with new equipment in year 1948	14,809.63
Difference	$ 9,041.02

DENVER EXHIBIT I
BOARD OF WATER COMMISSIONERS
City and County of Denver
Capital Investments
Years 1935-1949

Classification	1935	1936	1937	1938	1939	1940	1941	1942
Pumping Stations	$ 85,103.07	3,022.61	87.44	—	34,965.52	32,851.95	1,701.87	19,140.91
Lakes & Reservoirs	26,192.75	27,403.02	1,787.08	1,773,703.79	98,560.92	4,472.44	21,778.69	13,069.20
Conduits	30,159.74	55,176.09	26,845.23	2,322,787.00	339,798.58	131,576.03	68,908.81	43,593.40
Filtration & Sterilization Plants	8,191.73	6,638.71	6,915.63	1,009,421.49	33,636.98	5,341.52	17,801.55	5,912.15
City Distribution System	33,281.34	74,267.13	122,404.60	393,320.69	318,024.83	510,180.86	632,904.46	374,609.30
West Denver Storehouse & Yard	3,357.70	6,555.51	3,973.28	759.69	156.91	6,060.24	4,430.53	610.74
Office Garage	—	—	—	—	27,481.96	—	—	—
Littleton Mill	277.10	—	—	—	26,510.46	—	—	—
Ditches & Canals	57,536.54	77,054.48	363,152.58	71,917.78	8,147.83	6,249.18	1,557.49	3,807.17
Ranch Structures	—	—	—	3,903.56	6,012.15	569.85	—	—
Western Slope Collection System	—	—	—	1,191,881.41	10,562.46	10,394.21	1,114.13	—
Moffat Water Tunnel	—	—	—	2,876,378.48	3,098.25	951.41	110.44	7,101.33
South Boulder Creek Diversion System	—	—	—	1,700,598.62	13,677.20	9,540.75	44,720.25	7,327.30
Ralston—Clear Creek Diversion System	—	—	—	337,170.90	7,384.21	299.23	1,037.34	498.51
Land & Rights of Way	12,182.68	8,825.38	6,736.79	169,979.61	13,916.40	64,073.22	39.05	12,909.30
Water Rights	7,459.28	2,427.03	—	2,000.00	—	—	—	—
Total	$263,741.93	261,369.96	531,903.18	11,853,823.02	941,934.66	782,560.89	796,104.61	488,579.31

Classification	1943	1944	1945	1946	1947	1948	10-Mos. 1949	Grand Total
Pumping Stations	$ 778.74	—	171.92	286.18	5,939.12	8,765.46	17,618.14	$ 210,432.93
Lakes & Reservoirs	1,782.29	3,835.92	5,322.29	682.05	35,001.17	780,656.23	42,910.41	2,837,158.80
Conduits	6,673.32	4,745.36	5,626.23	11,876.52	19,676.90	415,074.84	2,002,563.38	5,485,081.43
Filtration & Sterilization Plants	1,461.76	402.14	1,709.65	2,681.91	2,278.75	168,656.39	65,688.00	1,336,738.36
City Distribution System	26,475.48	61,408.20	139,770.95	355,356.60	309,961.68	553,634.33	1,277,470.28	5,183,070.73
West Denver Storehouse & Yard	3,231.45	—	315.68	636.14	1,202.24	410.65	15,596.85	47,297.61
Office Garage	—	—	—	—	—	—	—	27,481.96
Littleton Mill	—	—	—	—	—	—	—	26,787.56
Ditches & Canals	14,518.21	6,359.58	672.01	21,251.91	11,538.93	2,758.32	7,716.32	654,238.33
Ranch Structures	—	—	—	25.00	—	221.28	—	10,731.84
Western Slope Collection System	272.78	81,754.54	51,051.53	20,659.69	4,535.61	44,192.18	45,713.34	1,462,131.88
Moffat Water Tunnel	478.99	—	149.98	—	744.99	791.69	1,065.66	2,890,871.22
South Boulder Creek Diversion System	485.78	5,083.80	33,527.78	134.37	4,918.84	2,186.08	3,152.71	1,825,353.48
Ralston-Clear Creek Diversion System	—	—	13,059.49	—	128.89	—	—	359,578.57
Land & Rights of Way	—	—	—	8,564.11	27,622.75	2,293.35	20,474.78	347,617.42
Water Rights	21,535.43	—	—	37.50	—	—	—	33,459.24
Total	$ 77,694.23	163,589.54	251,377.51	422,191.98	423,549.87	1,979,640.80	3,499,969.87	22,738,031.36

Figures for 1938 include original cost of Moffat Tunnel Diversion Projects.
Expenditures in 1949 represent construction in progress.

DENVER EXHIBIT P

EXCERPT FROM MINUTE BOOK III, Page 5-A, BOARD OF WATER COMMISSIONERS

Denver, Colorado, June 16, 1921

Mr. W. F. R. Mills,
Gen. Mgr., Board of Water Commissioners,
Denver, Colo.

Dear Sir:

IN RE. SURVEY WORK IN CONNECTION WITH WESTERN SLOPE DEVELOPMENT

The matter of appropriation of water from the Western Slope has progressed as follows:

Complete studies have been made as to the need of this additional water for Denver and the Platte Valley. These studies have also included a general summary of the sources and volume of supply available, the possible conflicts with the present Colorado State users of Grand River water for irrigation and power and also the possible adverse uses outside of Colorado, present and future.

All reports and studies from every source that have been made, up to the present time, regarding the possible diversions, have been collected, reviewed and compiled in a bound volume for future use.

The initial step has been taken to present the city's claim to this water before the Colorado River Commission by the submission to the State Engineer of Colorado by the General Manager of the Water Commission, of a memorandum stating the City's needs and outlining in a general way what is proposed to do. This memorandum also presents the general data as to the effect of this appropriation by the City on other users of water from the Grand River.

There are four endeavors that must be consummated before the actual completion of the development of Western slope waters.

1st—Filings must be made with the State Government to actually appropriate the water.

2nd—Filings for rights-of-way must be made with the Federal Government and the same must be granted in order that diversion structures can be built on government land.

3rd—The structures to be built must be planned and specifications drawn before the various items of work can be submitted to contractors and detailed estimates of cost made.

4th—The development must be financed and constructed.

Regarding the work that must now be done to appropriate the water from Fraser River, Williams Fork and Blue River, and to secure right-of-way from the Federal Government, preliminary surveys and maps must be made which show the location and length of all tunnels, canals land conduits for each of these schemes, the streams from and to which the waters will be diverted, the ownership of various tracts of land upon which structures will be built, together with general estimates of cost.

Surveys necessary for the collection of such data and for mapping the same, will also be the preliminary survey from which the actual location survey for the design of the finished structure would be made. This is the immediate work that must be taken in hand during the coming summer.

Had the City the necessary funds, and, if it were urgent, a party could be placed on each of these three schemes of the proposed development.

The necessary unit of field organization for this survey will consist of a Chief of Party, transit man, three chairmen or rodmen, one field draftsman, an axman accustomed to work in the mountains and a cook. Depending upon the location of the camp, it might be found that an additional boy for incidental work would be economical, but the party started out should consist of eight men.

The present status of the three developments in regard to preliminary work, is as follows: On Fraser River all filings that have been made in the past have been for diverting water from Fraser to South Boulder Creek. An equally feasible scheme is to divert the waters to the head-waters of Clear Creek above Empire where the same would enter the Platte River at the head of District No. 2 and be available in a practical amount for storage above Platte Canon by exchange. Your Engineering force has obtained from the Highway Bureau of the U. S. Department of Agriculture surveys covering the terri-

tory from Empire to Fraser, both as to location and elevation, and have completed all office work required in adapting that survey for use in connection with filings for diversion of water. They also have done practically all of the field work in connection with this survey necessary to locate the outlet of the diversion tunnel on the Eastern slope. The additional work of making this filing will consist in picking up the highway survey near Fraser, the location of the intake end of the tunnel, and preliminary survey of the canals leading from this intake to the various streams to be diverted. This is logically the first field work to be taken up in connection with filings as the work is now under way and can be completed rapidly.

In connection with the making of appropriation filings for the Williams Fork, your attention is called to the fact that the survey and filings that have been made by Mr. Wolff in conjunction with the Henrylyn Irrigation District, will be practically the same survey and the same map that would be prepared should a new filing be made. Before this work is undertaken, it might be well to find out the attitude of that Company in regard to the turning over of this filing to the City with its prior date and such data as has been collected. In this matter, however, it should be borne in mind that this tunnel site and canal line would have to be re-surveyed and located before definite estimates could be made as to construction cost, so that the only saving that would be made in utilizing the present filing would be the date of appropriation, time required in making the filing, and in the saving of immediate expenditure.

In regard to the appropriation of water from the Blue River, there exists the filing made by George Bancroft and his associates, who claim that something like $40,000 were spent on surveys. This not only includes the survey of the tunnel site and canals from Blue River, but a large number of reservoirs and conduits on the Eastern slope. The survey on the Western slope being only an incident in the entire scheme of development. The diversion of water from the Blue River does not represent as simple a scheme of development as that of either the Fraser River or the Williams Fork. In either of these latter schemes, once the elevation of the in-let end of the tunnel is determined, all that is required is the

survey of the traverse line following the contour of the country until the various streams diverted are reached. There is practically no choice location for either tunnel site or canal, except as to elevation of tunnel intake. On the Blue River, it is not certain that the Bancroft survey locates the tunnel through the Continental Divide at the best location, and the topography of the country provides many alternate locations for the canal diverting system for any elevation of the intake of the tunnel that may be determined upon. This system would have to be surveyed in considerable detail before even a preliminary line that was most economical for future construction would be determined. While the Bancroft surveys furnish valuable data that would aid in these preliminary surveys, new surveys would have to be made before anything like a detailed estimate of cost could be made.

During the making of the preliminary survey for filing maps of the Fraser River Project, a reconnaissance should be made of the Blue River project in order that the survey for filing purposes could be economically made following the completion of the Fraser River survey, the purpose of this reconnaissance being to determine the principal tunnel sites to be investigated in detail, locations from which survey parties could most readily work, and similar details.

On the completion of these preliminary surveys and filing maps, more definite knowledge will be at hand as to the scope of the projects under consideration. At that time a conference should be had as to what additional details should be developed, such as future measurements of water supply available, detailed surveys, plans, etc., and a program should be formulated to care for all other matters that might be necessary in shaping up the projects for financing and construction.

Respectfully submitted,

Signed Geo. M. Bull

Excerpt from Minute Book III, Board of Water Commissioners, Pages No. 5-a, 5-b and 5-c.

DENVER EXHIBIT T

DENVER, COLORADO

February 16, 1946

Report of the Engineering Board of Review Blue River-South Platte River Project	Subject: Selection of Route for Blue River-South Platte Transmountain Diversion Project

To Director, Region 7, U. S. Bureau of Reclamation
Director, Colorado Water Conservation Board
President, Board of Water Commissioners, City and County of Denver
President, South Platte Water Users Association

Gentlemen:

This Board was provided, by the Bureau of Reclamation, with copies of preliminary draft of proposed report on the Blue River-South Platte Project, Colorado, Appendix D, dated January 17, 1946. This report deals with alternate routes for the diversion of Western Slope water, i.e.: (1) The Moffat; (2) the Empire; and (3) the Montezuma. Previously the Board was provided with one copy of Chapters I, II and III, Appendix B (Water Supplies) of a report on the proposed Blue River-South Platte Diversion Project.

The general over-all results that would be accomplished by the three routes are similar. Cost data shown for each route were prepared on a comparative basis. Practically the same water will be diverted from the Western Slope by each route with the exception that Fraser River water, decreed to the City and County of Denver, can be included for diversion through the Moffat route for power purposes only.

The construction costs, operating costs and annual revenues of the three routes under consideration result in a ratio of annual returns to total construction costs so nearly the same that they provide no clear cut basis for a selection of route. Furthermore, the project benefited area will be essentially unaffected by the choice of diversion route.

The Board finds that there are very definite engineering, construction, operation and administration advantages

in the Montezuma route which far outweigh similar features occurring in either of the other two routes, and for these reasons, the more pertinent of which are enumerated below, recommends the adoption of the Montezuma route:

1) It is the most direct route and water from the Montezuma tunnel discharges into a natural water course. After the tunnel is completed, the further development of the project can be made on a step-by-step program under which, as various units of the plant are completed, they can be put to beneficial use in advance of the completion of the whole project. All power plants are supplied by individual conduits, independent of the system as a whole, and neither conduit or power plant need be constructed until required; and they can be operated independent of all the other power plants within the project.

2) Since all power plants are supplied by individual conduits, independent of the system as a whole, the failure of a power conduit will cause an outage of only the plant supplied by it; while with either of the other two routes the failure of a power conduit would cause an outage of the entire system.

3) The failure of a power conduit would cause little or no property damage by flooding, while with either of the other two routes considerable property damage might result from a power conduit failure.

4) It requires less mileage of diversion conduits which in this mountainous area are attended by hazards and high operation and maintenance costs.

5) On this route better utilization can be made of the reservoir sites.

6) The project water can be controlled by a reservoir at the entrance portal of the Montezuma tunnel and after passing through the tunnel can either flow down the North Fork of the South Platte River or be diverted through conduit lines supplying power plants, but in any event all imported water passes through and is controlled by the Two Forks and Waterton reservoirs.

7) The administration of the operation of the Montezuma route will be less difficult than the Moffat

tunnel route, since the Fraser River water will not be mixed in with project water.

IT IS RECOMMENDED:

1. That a detailed project report of the Montezuma route be prepared.

2. That project water supply determination be based on the equated supply that will be made possible by the proposed reservoirs during the critical water supply period 1931-1940, and in other respects be in full accord with the Benson-Erickson-Honnold memorandum of November 29, 1945.

3. That the operation of the proposed Eastern Slope reservoirs, over the period 1911-1944 be further studied in order to determine the capacity and type of operation necessary to bring the imported water supply into phase with Eastern Slope water requirements.

4. That co-operation of the Denver Municipal Water Board be sought to fully study the possibility for exchanging Fraser Basin water for project water in order that Fraser water may be used for irrigation purposes in the Boulder and South Boulder Creek areas, thereby eliminating the long Boulder supply canal otherwise required by the Montezuma route.

Respectfully submitted

ENGINEERING BOARD OF REVIEW

J. H. KNIGHTS
U. S. Bureau of Reclamation

C. L. PATTERSON
Colorado Water Conservation Board

D. D. GROSS
Board of Water Commissioners
City and County of Denver

R. J. TIPTON
South Platte Water Users
Association

DENVER EXHIBIT AA

December 13, 1949

RIGHTS OF WAY ACQUIRED BY DENVER BOARD OF WATER COMMISSIONERS

Name of Grantor	Book	Page	County	Date	Acres	Consideration
DILLON RESERVOIR						
1. San Juan Exploration Co. (Warranty Deed)	120	407	Summit	3- 2-43	298.53	$ 4,000.00
2. Kinney Investment Co. (Warranty Deed)	131	384	Summit	9-30-43	100.00	500.00
3. Arthur W. Caywood and Marie R. Caywood (Warranty Deed)	131	467	Summit	12-22-43	160*	5,000.00
4. Robert H. & Ethel Sayre (Quitclaim Deed)	132	419	Summit	1-23-46	304*	3,938.63
5. James Giberson (Quitclaim Deed)	136	91	Summit	8-28-46	2 city lots	16.05
6. Denver & Rio Grande Western Railroad Co. (Trustee's Deed)	136	340	Summit	5- 9-47	12.2	150.00
MONTEZUMA TUNNEL						
1. Glenn G. Saunders (Quitclaim Deed)	120	466	Summit	6-18-45	Blight Placer	164.92
2. Neil G. Seeley (Warranty Deed)	134	370	Park	6-17-46	26.2	100.00
3. Elizabeth Fritzinger. etc. (Quitclaim Deed)	133	195	Park	11-21-46	25.00	10.00
E. I. Grenfell, Atty. in fact (Quitclaim Deed)	133	173	Park	10- 3-46		10.00
4. Neil G. Seeley (Warranty Deed)	143	35	Park	12- 1-49	40.00	1,200.00
STRONTIA SPRINGS						
1. John Burgess (Quitclaim Deed)	62	543	Douglas	2-24-43	80.00*	10.00
W. C. Danks (Quitclaim Deed)	62	545	Douglas	2-24-43		10.00
Delilah M. Thompson (Warranty Deed)	94	193	Douglas	2-24-43	160.00	500.00
2. Denver & Rio Grande Western Railroad Co. (Quitclaim Deed)	652	41	Jefferson	10-24-49	7.90	10.00

* Part of same property bought from Delilah M. Thompson.

NOTE: Consideration figure takes into account only the amount paid to Grantor and does not include any additional costs such as taxes, etc.

	Name of Grantor	Book	Page	County	Date	Acres	Consideration
TWO FORKS RESERVOIR							
1.	Denver Power and Irrigation Co. (Deed)	75	256	Douglas	7-25-24	?	$75,000.00
2.	C. P. Allen and J. E. Maloney (Quitclaim Deed)	27	311	Douglas	7-15-14	?	500.00
3.	Louis Kinkel (Warranty Deed)	462	576	Jefferson	9-29-42	280.00	10.00 plus
4.	Carl R. Smith (Warranty Deed)	464	259	Jefferson	11- 6-42	160.00	400.00
5.	Parley Preston Roach (Warranty Deed)	478	558	Jefferson	10-20-43	1100 (Approx.)	14,500.00
6.	Carl R. Smith (Quitclaim Deed)	62	578	Douglas	1-26-44	140	275.00
7.	Anna L. Pierce McAneny (Warranty Deed)	100	460	Douglas	4-29-48	36	4,400.00
8.	Joseph D. Pender (Spec. Warranty Deed)	494	464	Jefferson	9-16-44	144 (Approx.)	3,200.00
9.	Frank D. Thompson, et al (Warranty Deed)	481	356	Jefferson	12-22-43	280 (Approx.)	4,606.00
10.	Otto Linnet and Margaret Linnet	494	189	Jefferson	9- 9-44	6 Lots	75.00
11.	Joe N. Comstock and Ada D. Comstock	488	431	Jefferson	5-13-44	.14	10.00 plus
12.	Sara Eleanor Burch and Edith Burch Frye (Deed)	497	368	Jefferson	11-10-44	.17*	250.00
13.	Ina Ewing (Deed)	497	370	Jefferson	11-10-44	.16	200.00
14.	William S. Kirkbride and Ono W. Kirkbride (Warranty Deed)	540	494	Jefferson	7-20-46	70.00	2,500.00
15.	Charles R. Beers (Deed)	563	204	Jefferson	4-14-47	.088	25.00
16.	Anton Chryst (Warranty Deed)	568	195	Jefferson	6- 7-47	?	25.00
17.	Lawrence Hinkley (Warranty Deed)	568	210	Jefferson	6- 7-47	80.00	1,200.00
18.	Carl R. Smith (Quitclaim Deed)	603	594	Jefferson	6-12-48	80.00	200.00

NOTE: Consideration figure takes into account only the amount paid to Grantor and does not include any additional costs such as taxes, etc.

DENVER EXHIBIT BB

November 22, 1949

WATER RIGHTS AVAILABLE FOR POTABLE-WATER PLANT OF DENVER

South Platte River

Direct Rights:

Name	Date	Amount Sec. Ft.
Platte Canon Ditch	7-30-1861	4.70
Nevada Ditch	8-30-1861	6.19
Platte Canon Ditch	12-30-1863	24.50
Platte Canon Ditch	12-30-1864	17.30
Nevada Ditch	12-30-1865	7.58
*Borden Ditch	5- 1-1866	8.70
City Right	12-20-1870	3.00
City Right	12-31-1874	3.78
*Weed Ditch #42	5- 1-1875	2.31
City Right	9-10-1878	13.22
**High Line Canal	1-18-1879	——
*½ Weed Ditch #102	6- 1-1879	3.65
City Right	6-30-1880	10.00
*Love & Rayner Ditch	5- 8-1881	1.71
*½ Little Channel Ditch	5- 1-1882	.48
*Island Ditch	5-20-1885	2.04
City Right	10- 1-1889	12.38
City Right	9- 1-1892	25.33
City Right	5- 1-1899	38.08
City Right	12- 6-1910	42.72

*Divertible only from April 15 to August 10, inclusive.

**City Right in High Line Canal is variable and intermittent.

Storage Rights:

Name	Date	Amount Acre Feet
Antero Reservoir	10- 8-1907	33,000
11-Mile Canon Reservoir	Undecreed	81,917

WATER RIGHTS AVAILABLE FOR POTABLE-WATER PLANT OF DENVER

Lake Cheesman	6-27-1889	30,764)	
	9-24-1893	48,300)	79,064
Platte Canon Reservoir	9-5 -1902	920	(No normal net yield.)
Marston Lake	4- 1-1911	19,800	(No normal net yield.)

Cherry Creek

Direct Rights:

Name	Date	Amount Sec. Ft.
Cherry Creek Galleries	5- 1-1887	14.2

Bear Creek and Tributaries

Direct Rights:

Name	Date	Amount Sec. Ft.
Harriman Ditch:		
Undivided one-half:		
Turkey Creek	4-16-1868	10.75
Bear Creek	3-16-1869	7.94
Bear Creek	5- 1-1871	25.54
Bear Creek	3- 1-1882	12.87
Entire:		
Bear Creek	12- 5-1889	25.5
Bear Creek	12- 5-1889	148.35
Turkey Creek	2- 1-1890	4.805
Turkey Creek	2- 1-1890	29.97
Bear Creek	8-15-1892	19.16
Bear Creek	8-15-1892	76.65
Turkey Creek	8-15-1892	4.50
Turkey Creek	8-15-1892	18.03

Storage Rights:

Name	Date	Amount Acre Ft.
Soda Lakes	2-11-1893	660

COLORADO RIVER TRIBUTARIES

Fraser River

Direct Rights:

Name	Date	Amount Sec. Ft.
Moffat Tunnel Diversion Project	7- 4-1921	520

Storage Rights:

Name	Date	Amount Acre Feet	
Ralston Reservoir		11,000	(No normal net yield.)

Also storage by exchange in Platte River reservoirs.

Williams Fork River

Direct Rights:

Name	Date	Amount Sec. Ft.
Williams Fork Diversion Project	7- 4-1921	214

Storage Rights:

Name	Date	Amount Acre Ft.
Williams Fork Reservoir	11-10-1935	6,623

Also storage by exchange in Platte River reservoirs.

Blue River

Under construction

DENVER EXHIBIT A
SHEET 1

LEADVILLE NAT'L. FOREST

Swan River

Tunnel

Webster Pass

DIVIDE

CONTINENTAL

T. 6 S.

TIGER

NORTH CANAL LINE

Fork Swan Cr.

North Fork Swan

Middle Fork Swan

Georgia Gulch

American Gl.

Lincoln Gl.

Farncomb Hill Tunnel

French Gulch

South Fork Swan

ELEV. 10322'

R. 76 W.

SOUTH CANAL LINE

TRANSMOUNTAIN TUNNEL SITE

4.54 Miles

Mon "B"

Mt. Guyot Monument

Georgia Pass

Mt. Hamilton (Baldy)

Dam

INDIANA RESERVOIR SITE

T. 7 S.

Michigan Creek

Jefferson Creek

Webster Creek

NORTH

Accepted for filing in the office of the State Engineer of Colorado on the 31st day of May, A.D. 1923.
Addison J. McClure
State Engineer

MAP OF THE
BLUE RIVER DIVERSION PROJECT
SUMMIT COUNTY, COLO.

IRRIGATION DIV. No. V., WATER DISTRICT No. 36

Courses Referred to True Meridian

0 2000 feet 1 mile 9000 12000

Denver Municipal Water Works
Geo. M. Bull – Consulting Engineer
C. A. Betts – Resident Engineer
1923

This Map is in 7 sheets →

Blue River Project Sheet 1

-13758-

DENVER EXHIBIT A
SHEET 2

Loveland Pass

L 221

L 200

L 104

L 150

L 50

S 7°34 W 12773'

S 46°03 W 17787'

North Fork Snake River

18

17

L1 S 50°26 W 3433'

Siphon 1.04 Mi.

Chihuahua Creek

Torrey's Peak

Gray's Peak

NORTH

Argentine Pass

Argentine Peak

T. 5 S.

SNAKE RIVER

19

Jones Creek

N 740

N 1050

Peru Creek

ARGENTINE

N 1043

N 600

N 650

N 800

N 1000

N 850

N 700

13856

13863

DIVIDE

25

30

Tip Top Mt. Monument

COLLIER MOUNTAIN TUNNEL 4.7 Mi.

Keystone Creek

N 550

Cut

11364

N 637 W

MONTEZUMA

N 886

St. John's Creek

N 900

N 950

S 17°40 W

S 29°35 W

36

Sante Fe Peak

Geneva Gulch

N 930

S 64°59 E 1272

N 411

N 500

N 450

Deer Cr.

Snake R.

R. 76 W.

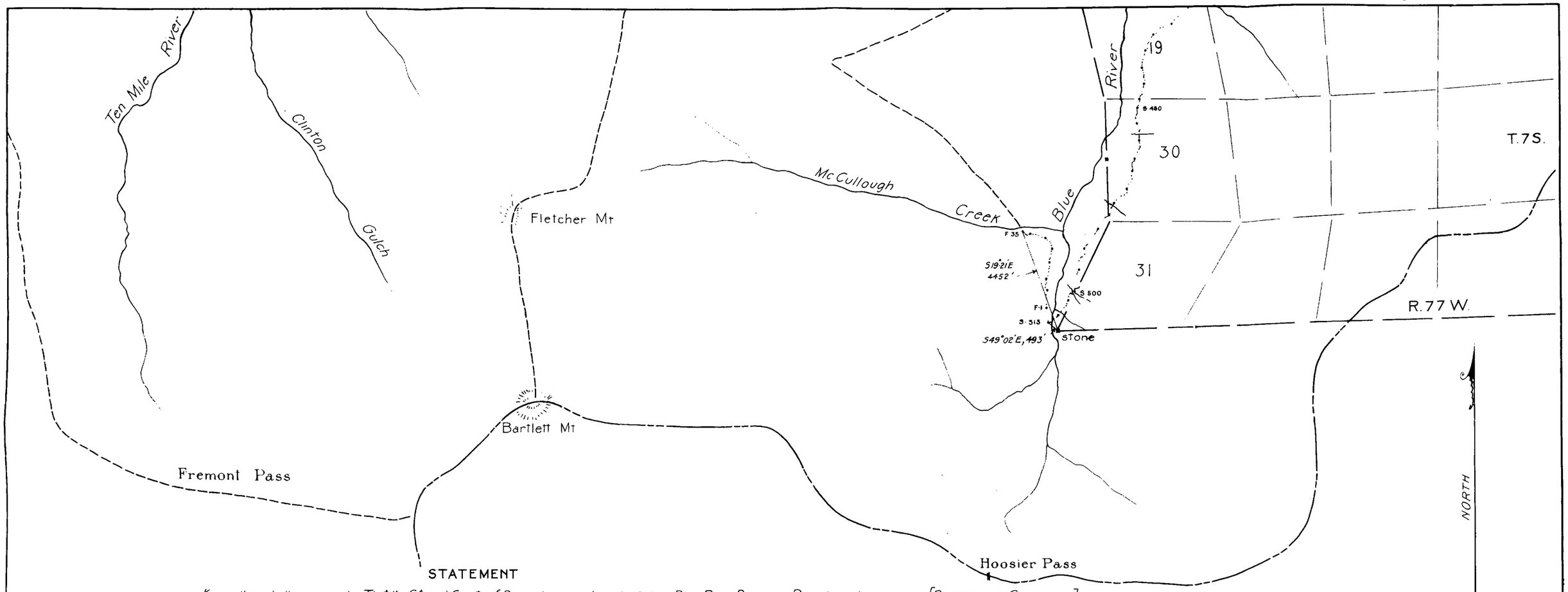
Accepted for filing in the office of the State Engineer of Colorado on the 31st day of May, A.D 1923.

Addison J. McClure
State Engineer

Blue River Project
Sheet 2

-13758-

DENVER EXHIBIT A
SHEET 3



STATEMENT

Know all men by these presents: That the City and County of Denver has caused to be located the Blue River Diversion Project canals, siphons, tunnels, reservoirs and appurtenances as hereinafter mentioned, has made several statements relative thereto and filed the same in compliance with the laws of the State of Colorado. The accompanying map (in 7 sheets) which shows the location of said conduit system forms a part of this filing.

BLUE RIVER COLLECTING SYSTEM - S LINE - The headgate (S-513) is located at a point whence the S.W. corner of Section 31, T.7S., R.77W. of the 6th P.M. bears S49°02'E, 493 ft. *

Section 1	from Transmountain Tunnel (S-1) to S-64,	Depth 9.0 feet,	top width 12.0 ft.,	bottom width 11.0 ft.,	grade 1 ft. per 1000 ft.,	length 1.86 miles,	carrying capacity 675 cu. ft. per sec. of time
2	(Farncomb Hill Tunnel) from S-64 to S-111,	" 8.5 " "	" 8.5 " "	" 8.5 " "	4 " " " "	0.97 " "	" 675 " " " " "
2-A	(Flume) from S-111 to Lincoln Cr. (S-93),	2.5	2.0	2.0	3	0.9	20
3	from French Cr. (S-111) to Illinois Cr (S-223),	9.3	11.5	10.6	1	3.9	650
4	from S-223 to Siphon (S-256),	9.0	11.2	10.4	1	1.16	625
5	from S-256 to Indiana Cr (S-333),	6.5	8.2	7.5	1	2.57	275
6	from S-333 to Blue River Intake (S-513),	5.7	7.2	6.5	1	6.42	190
6-A	(Flume) from S-513 to Mc Cullough Cr. (F 35),	3.5	3.5	3.5	1.5	1.12	40

TEN MILE RIVER COLLECTING SYSTEM - T LINE - The headgate (T-500) bears S24°01'W, 28170 ft. from the W¼ cor of Sec 29, T.6S., R.78W. of 6th P.M. The est cost is $2,760,100.

Section 1	(Blue River Siphon) from S-256 to T-100,	(66" dia steel pipe)				1.5	350
2	from T-100 to E. Portal Tunnel (T-156),	7.0	8.7	8.0	1	2.45	330
3	(Peak 8 Tunnel) from T-156 to T-387,	7.0	6.0	6.4	4	2.61	280
4	from T-387 to Ten Mile River Intake (T-500)	6.0	7.6	7.0	1	4.6	230
2-A	(Flume) from T-156 to Middle Barton Cr. (T-298)	3.5	3.5	3.5	2	4.32	50
1-A	(Flume) from T-100 to Spruce Cr. (T-55)	3.5	3.5	3.5	1.5	1.54	40

SNAKE RIVER COLLECTING SYSTEM - N LINE - The headgate (N-1043) bears N29°35'E, 13863 ft. from S E cor of Sec 35, T.5S., R.76W of 6th P.M. The est cost is $4,227,000.

1	from Transmountain Tunnel (S-1) to N-105	8.1	10.3	9.5	1	3.0	525
2	(Tunnel) from Middle Swan (N-105) to N-192	8.0	7.0	7.0	40	0.7	500
3	from N-192 to N Fork Swan Cr. (N-229)	8.0	9.9	9.2	1	1.28	475
4	from N 229 to NW " " " (N-264)	7.5	9.6	8.8	1	1.31	425
5	from N 264 to N-348	7.3	9.3	8.5	1	2.95	400
6	(Tunnel) from N 348 to Keystone Cr. (N 450)	8.0	7.0	7.0	4	0.97	400
7	from N-450 to Snake River Siphon (N 740)	7.0	8.7	8.0	1	8.67	325
8	from N 740 to St. Jones Cr (N 886)	6.0	7.0	6.5	1	3.42	200
9	from N 886 to Snake River (N 930)	5.7	7.0	6.5	1	1.25	180
10	from N-930 to Peru Cr. (N 1043)	4.5	5.4	5.0	1	4.0	100
11	(Flume) from N 1043 to Chihuahua Cr. (N 1050)	3.5	3.5	3.5	1.5	0.57	40

NORTH FORK SNAKE RIVER - L LINE - The headgate (L 104) bears N48°03'E, 17787 ft. from S W Cor of Sec 17, T.5S., R.76W of 6th P.M. The estimated cost is $471,000.

12	(Siphon) from N 740 to L-1	(48" dia. steel pipe)				1.04	100
13	(Flume) from L-1 to North Fork Snake R. (L-104)	4.7	5.0	5.0	1.5	2.98	80
14	(Flume) from L-104 to L 221	3.3 " " "	3.5 " " "	3.5 " "	1.5 " " " "	3.33 " " "	32 " " " " " "

[STATEMENT CONTINUED]

ALTERNATE SNAKE RIVER COLLECTING SYSTEM Estimated cost, including Collier Mt. tunnel, = $3,216,600.

Collier Mt. Tunnel from Peru Cr. (N-1043) to Geneva Cr., Depth 7.0 ft., top width 6.0 ft., bottom width 6.0 ft., grade .004, length 4.7 miles, capacity 350 cu. ft. per sec.

Section 1,	from N-1043 to Snake River (N-930),	6.5	8.0	7.4	.001	4.0	260
2,	N 930 to St Johns Cr. (N 886)	5.7	7.0	6.5	.001	1.25	180
3,	N-886 to Siphon (N-740)	5.3	6.4	6.0	.001	3.42	150
4	N-740 to Jones Cr. (N-698)	3.5	3.5	3.5	.0015	1.22	40

Sections 11, 12, 13 and 14 as described above Note: If Snake River is diverted thru Collier Mt. Tunnel the capacity of Sections 1, 2 and 3 carrying Swan Creeks to Transmountain Tunnel is 120 cu. ft. per second.

Transmountain Tunnel from So. Swan to Jefferson Cr, Depth 12.0 ft., top width 11.0, bottom width 11.0 ft., grade .004, length 4.5 miles, capacity 1200 cu. ft. per sec. for which claim is hereby made for domestic, irrigation and power purposes.
The intake portal bears S 68°47'E, 2548.6 ft. from E ¼ cor. of Sec. 36, T.6S., R.77W. of the 6th P.M.

* Estimated cost of Blue River Collecting System = $5,178,500. ; Est. cost of temporary conduit to divert Blue River only = $3,775,600.
Est. cost of the combined Blue, Ten Mile and Snake River diversions thru Transmountain Tunnel to Jefferson Creek = $12,636,600.
The sources of supply are the Blue, Ten Mile, Swan and Snake Rivers, their branches and all tributary drainage above the conduits.

INDIANA CR. RESERVOIR SITE: 1. Height of dam 40 ft, 2. Initial point (W end of dam) bears S 32°15'E, 13504 ft. from S.E. cor. Sec 6, T.7S., R.77W. 3. Area is 18 acres; 4. Total capacity is 9,600,000 cu. ft. 5. Source of supply = Indiana Cr. and conduit system; Estimated cost = $18,000.

Work on the entire Blue River Project was commenced by survey on the 21st day of March A.D. 1914.

THE BOARD OF WATER COMMISSIONERS
of the City and County of Denver, Colo. Frank E. Woodward President.

Subscribed and sworn to before me this 23rd day of May A.D. 1923.
My commission expires July 20th, 1925.
Thomas E. Gargan
Notary Public

Accepted for filing in the office of the State Engineer
of Colorado on the 31st day of May, A.D. 1923
Addison J. McClure
State Engineer

Blue River Project Sheet 3

-13758-

STATE OF COLORADO }
City and County of Denver } ss

[signature] being duly sworn on his oath, deposes and says that he is the engineer employed by the Board of Water Commissioners of the City and County of Denver to make the surveys of the Blue River Diversion Project, that the survey of the same and the map thereof was made under his direction and that such survey is accurately represented upon this map; that he has read the statements thereon and that the same are true of his own Knowledge.

[signature] Licensed Engineer

Subscribed and sworn to before me this 23rd day of May A.D. 1923
My commission expires July 20th, 1925.

[signature]
Notary Public

This is to certify that this map and the statements hereon have been prepared to be filed with the State Engineer of Colorado by authority of the City and County of Denver acting by and thru the Board of Water Commissioners.

THE BOARD OF WATER COMMISSIONERS
of the City and County of Denver, Colo.

Frank L. Woodward
President

Attest [signature]
Secretary

Accepted for filing in the office of the State Engineer of Colorado on the 31st day of May A.D. 1923.

Addison J. McCune
State Engineer

By
Deputy

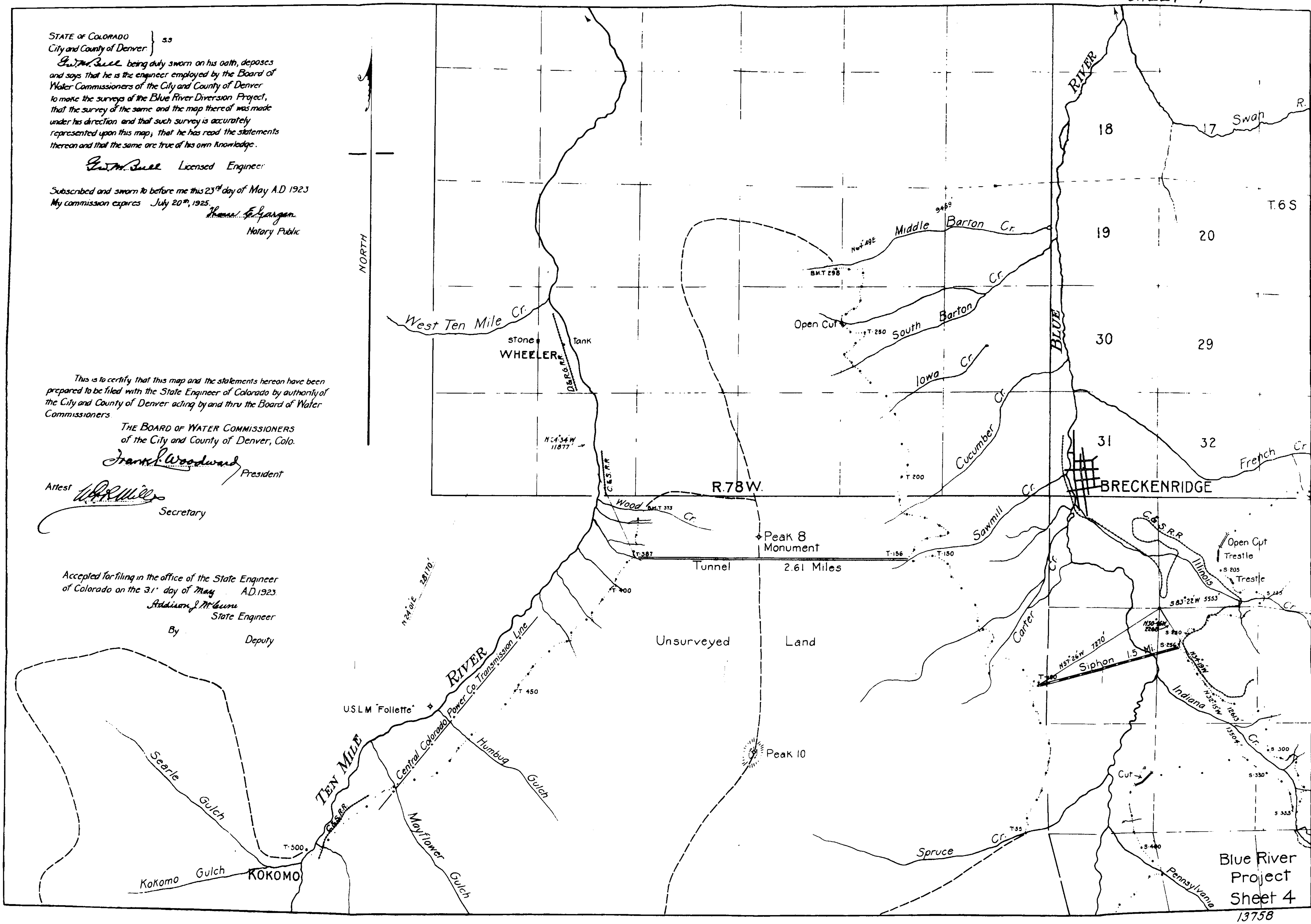
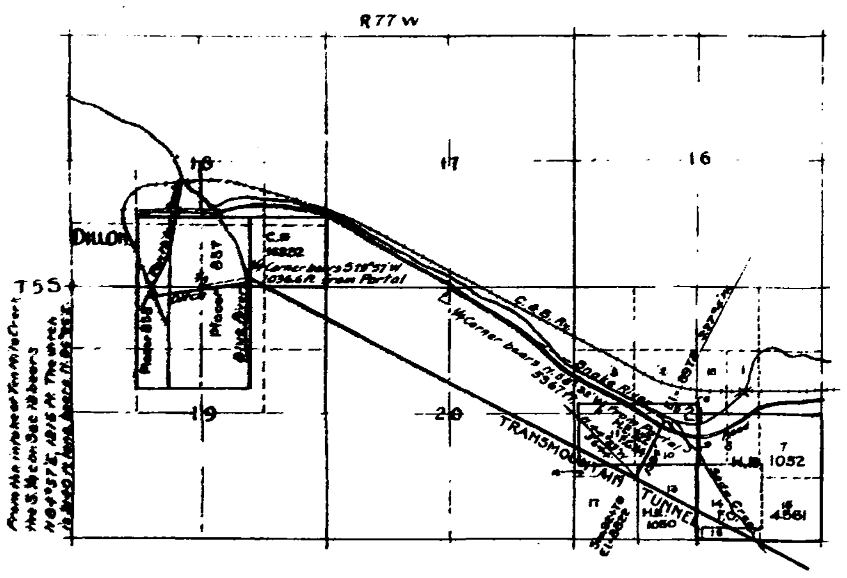
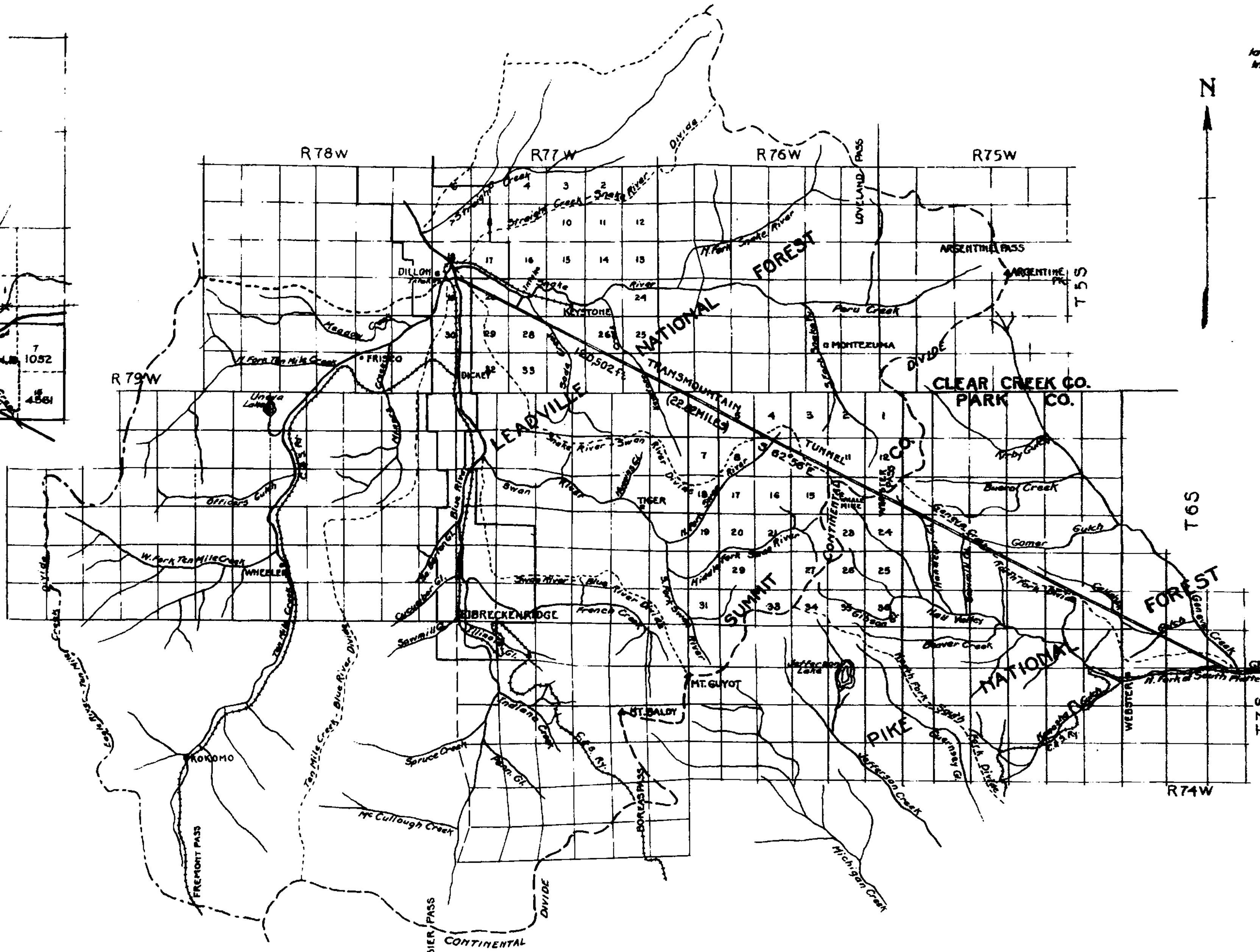


EXHIBIT B





Unless otherwise shown all land affected is government land, except the following mining and mill site claims:

In T. 6 S., R. 76 W. of the Sixth P.M.

Section 5
5004 Lost Strike
1178 Erikson

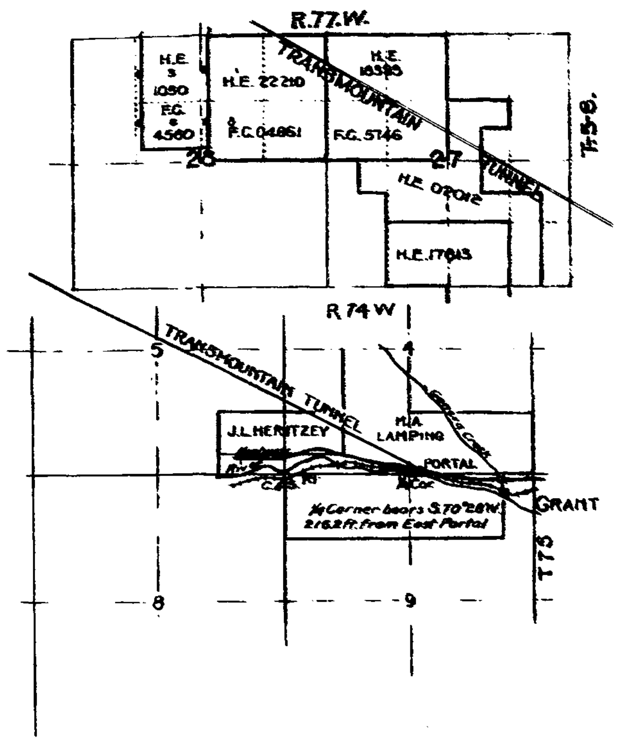
Section 10
1916 A Baltic
15049 Earickson
265 A Erie
267 A "
677 B mill site
1917 B " "

Section 11
4721 A Bertha
244 Venus
2185 Whale Extension

Section 13
2182 Doon
2178 Titania Placer

Section 14
16923 A Golden
" Gyvert
" Ohio
4492 Dolphin
2184 Silver Medal

In T. 6 S., R. 75 W.
Section 18
2178 Titania Placer



Know all men by these presents: That the City and County of Denver, by its undersigned Board of Water Commissioners, claimant, whose postoffice address is Denver, Colorado, has caused to be located the Blue River Diversion Project as hereinafter mentioned, has made these several statements relative thereto, and filed the same in compliance with the laws of the State of Colorado. The accompanying map (consisting of one sheet) shows the location of said project and forms a part of this filing.

First. The project contemplates three points of diversion, as follows:

(1) The main point of diversion is located on the right or east bank of the Blue River, from which the said project derives a part of its supply of water, whence the south quarter corner of Section 18, Township 5 South, Range 77 West of the Sixth Principal Meridian, bears south 79°57' west 1036.6 ft.

(2) The second point of diversion is located on the right or east bank of Ten Mile Creek, a tributary of the Blue River, from which tributary the said project derives a part of its supply of water, whence the south quarter corner of Section 18, township and range aforesaid, bears north 84° 57' east 1216 feet.

(3) The third point of diversion is located on the left or south bank of Snake River, a tributary of the Blue River, from which tributary the said project derives a part of its supply of water, whence the south quarter corner of Section 17, Township 5 South, Range 77 West of the Sixth P.M. bears north 58°32' west 5367 feet.

Second.

(1) The size of the main tunnel, when completed, will be:

Area	140 square feet
Grade	10 feet per mile
Length from portal to portal	22.82 miles

The detailed dimensions are shown on the accompanying drawing.

(2) The size of the ditch from Ten Mile Creek to the Blue River with extension to the tunnel intake, when completed, will be:

Depth	8 feet
Width on top	110 feet
Width on bottom	78 feet
Grade	26 feet per mile
Length	0.405 miles

(3) The size of the feeder tunnel from the Snake River to the main tunnel, when completed, will be:

Area	80 square feet.
Grade	16 feet per mile.
Length from portal to portal	0.26 miles.
Shaft	146 feet

The detailed dimensions are shown on the accompanying drawing.

Third.

The capacity of the main tunnel from portal to portal will be 1600 second feet.

The capacity of the diversion canal from Ten Mile Creek to Blue River will be 1600 second feet.

The intake from Blue River to the tunnel will have a capacity of 1600 second feet.

The diversion tunnel from Snake River to the main tunnel will have a capacity of 800 second feet.

Claim is hereby made to divert 1600 second feet for municipal uses or other beneficial purposes. Claim is made for this entire supply from either Ten Mile Creek, or Blue River; from Snake River to the full capacity of its intake; or such combination of these supplies as is most beneficial or convenient.

Fourth.

The estimated cost is $19,850,000 and is divided as follows:

Main tunnel	$ 19,530,000
Ten Mile Creek feeder ditch	$ 140,000
Snake River feeder tunnel	$ 180,000
Total	$ 19,850,000

Fifth.

Work was commenced by survey on the 21st day of March 1914, as stated in filing No. 13758 made by this claimant in the office of the State Engineer of Colorado for the Blue River Diversion Project. After said filing No. 13,758 was made, investigations were continued and it was determined that it would be more economical to locate said Project at a lower elevation and accordingly this amended map, with statement is filed to show the relocation of the Project at such lower elevation.

Sixth.

The method of construction contemplated is to first drive a heading of economic dimensions and then to enlarge and line the tunnel to its full size.

Seventh.

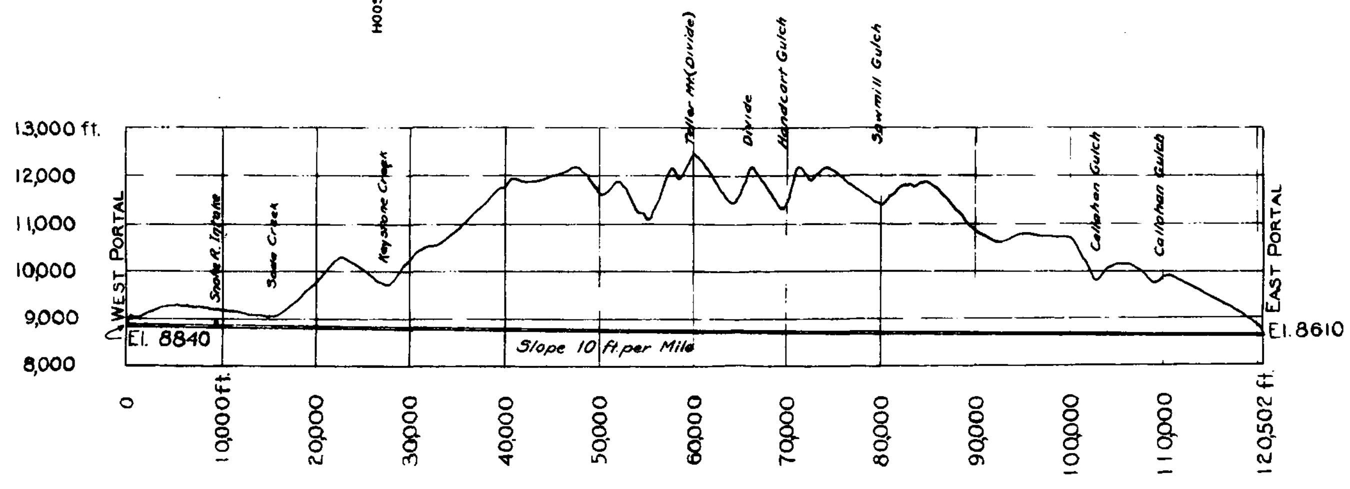
The Blue River Diversion Project is a part of a system of reservoirs, canals and other works all of which constitute one entire project for furnishing the City and County of Denver and vicinity with water for municipal uses and other purposes.

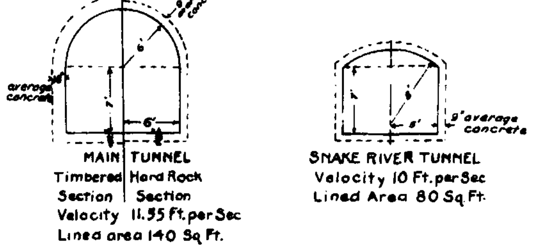
The said waters of the Blue River and its tributaries to be diverted through the said main tunnel will be turned into the North Fork of the South Platte River and will flow down the channel of said South Platte River to, and be impounded in, the Two Forks Reservoir, which is the principal storage reservoir of said system, an amended map, with statement, of which reservoir was filed November 3, 1926 in the office of the State Engineer of Colorado, as No. 14,618. The claimant contemplates the filing of an index map of the entire system as soon as certain of its details have been worked out.

The Board of Water Commissioners
of the City and County of Denver

By C. G. Schaffleman [signature]
President

Attest Hiram E. Heitz [signature]
Secretary





State of Colorado
City and County of Denver } S.S.

George M. Bull, being duly sworn on his oath, deposes and says that he is the engineer of the Blue River Diversion Project; that the survey of the same and the map thereof were made under his instructions and that such survey is accurately represented upon this map; that he has read the statements thereon, and that the same are true of his own knowledge.

Geo. M. Bull [signature]
Engineer.

Subscribed and sworn to before me this 17th day of October A.D. 1927.

My commission expires July 8 1929

Thomas E. [signature]
Notary Public

0 2000 ft. 4000 1 mile 12,000 ft

Accepted for filing in the office of the State Engineer of Colorado on the 19th day of Oct A.D. 1927.

M. C. Hinderlider [signature]
State Engineer

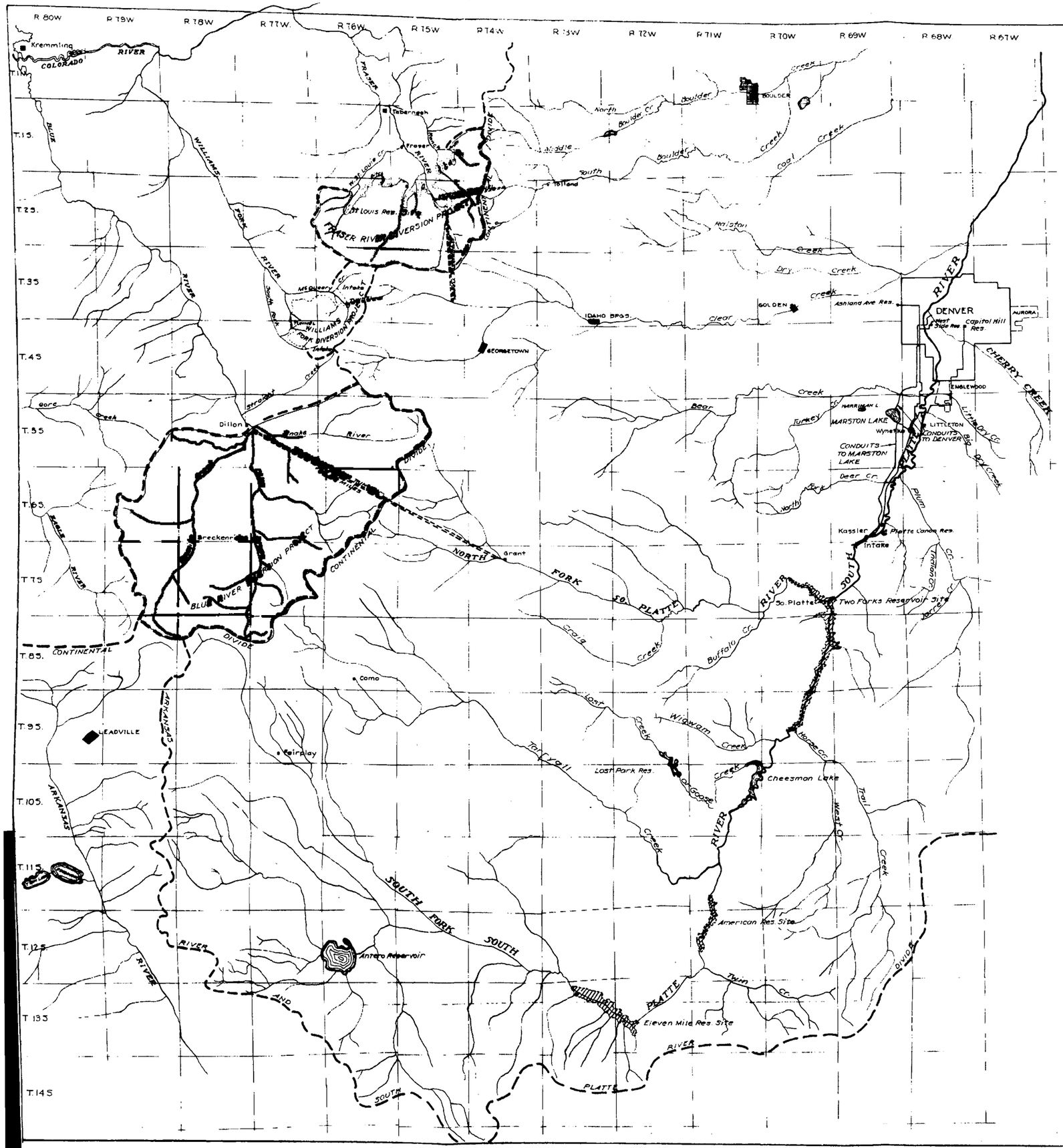
By G. G. [signature]
Deputy

AMENDED MAP OF THE
BLUE RIVER DIVERSION PROJECT
SUMMIT COUNTY, COLORADO

IRRIGATION DIVISION No. 5 WATER DISTRICT No. 36
Courses Referred to True Meridian, Public Land Survey.
Scale of detailed drawings 1 inch = 2,000 feet.
Scale of general map 1 inch = 10,000 feet
In one sheet.

14837

EXHIBIT C
SHEET 1



Accepted for filing in the office of the State Engineer of Colorado on the 19th day of January A.D. 1928.

M. C. Hinderlider
State Engineer
By G. G. Stapleton
Deputy

AMENDED AND COMPOSITE MAP OF THE ~~DENVER MUNICIPAL~~ WATER SYSTEM

PARK, SUMMIT, GRAND, JEFFERSON AND DOUGLAS COUNTIES, COLORADO.

IRRIGATION DIVISIONS No. 1 AND No. 5

WATER DISTRICTS Nos 8, 23, 36, AND 51

COURSES REFERRED TO TRUE MERIDIAN

SCALE 1-IN = 4 MILES

THIS MAP IS IN TWO SHEETS - SHEET No. 1

Know all men by these presents That the City and County of Denver, by its undersigned Board of Water Commissioners, claimant, whose postoffice address is Denver, Colorado, has caused to be located the Denver Municipal Water System, consisting of the following reservoirs and other works

(a) Two Forks Reservoir
(b) American Reservoir
(c) Eleven Mile Canon Reservoir
(d) Blue River Diversion Project.
(e) Williams Fork Diversion Project
(f) Fraser River Diversion Project.

as hereinafter mentioned, has made these several statements relative thereto, and filed the same in compliance with the laws of the State of Colorado. The accompanying map (consisting of two sheets) shows the location of the said Denver Municipal Water System and forms a part of this filing.

First: this claimant, and its predecessors in interest, have been engaged for many years in the construction of a system of water works for supplying the City and County of Denver, and its inhabitants and others residing in its vicinity with water. This system of water works includes the uncompleted reservoirs and other works hereinbefore named and also those certain reservoirs shown on the accompanying map and known respectively as Cheesman, Antero, Lost Park and Marston, all of which have adjudicated water rights or are now being adjudicated, together with numerous ditches, pipe lines and other works, all of which also have adjudicated water rights or are now being adjudicated, together with treatment and distribution systems, including filter plants, regulating reservoirs (like Ashland and Capitol Hill shown on the accompanying map), pipe lines and other works.

Second: from time to time maps and statements of said uncompleted reservoirs and other works have been filed in the office of the State Engineer of Colorado, and approved by him, the respective numbers of which prior filings are as follows:

(a) Two Forks Reservoir, 1963, 4007, 4600, 13263 and 14615.
(b) American Reservoir, 14412 and 14521.
(c) Eleven Mile Canon Reservoir, 14609
(d) Blue River Diversion Project, 13758 and 14837
(e) Williams Fork Diversion Project, 13456
(f) Fraser River Diversion Project, 13455

Third: the height of dam, initial point of survey, area and capacity, total capacity and estimated cost of each of the reservoirs, and the location of the headgate, dimensions, character, carrying capacity and cost of each of the ditches, canals, pipe lines and tunnels comprising the said Denver Municipal Water System are fully set out in the respective statements above mentioned for the several reservoirs and other works, and in like manner the maps accompanying such statements show the details required by the rules of the State Engineer of Colorado, to which respective statements and maps reference is now made for such data, this amended and composite map and statement being filed for the purpose of showing the relation of the several reservoirs and other works to each other

Fourth: the sources of supply for the said Denver Municipal Water System are as follows:

(a) For the Two Forks Reservoir, the South Platte River, including both the North and South Forks thereof, with such augmentation of the natural flow of said river as the claimant may make by bringing to said river water from other sources and particularly from the Blue River and its tributaries by means of the Blue River Diversion Project. This reservoir will also be used as the chief storage reservoir of said Denver Municipal Water System and will be used not only to store the waters of said South Platte and Blue Rivers; but also by a system of exchanges to store the waters of the Williams Fork and Fraser Rivers to be brought into the South Platte watershed by means of the Williams Fork Diversion Project and Fraser River Diversion Project, respectively.

(b) For the American Reservoir, the South Fork of the South Platte River.

(c) For the Eleven Mile Canon Reservoir, the South Fork of the South Platte River.

(d) For the Blue River Diversion Project, the Blue River and its tributaries Ten Mile Creek and Snake River.

(e) For the Williams Fork Diversion Project, South Fork, Bull Creek, Allen Creek, Middle Fork, Steelman Creek, Bobtail Creek and McQueary Creek, all tributaries of Williams Fork and smaller tributaries intersected by the gathering ditches.

(f) For the Fraser River Diversion Project, the Fraser River and its tributaries West St. Louis, Byers, St. Louis, East St. Louis, Fool, King, East King, West Elk, Elk, Vasquez, Little Vasquez, Jim, Faun, South Ranch, Ranch and North Ranch Creeks and smaller tributaries intersected by the gathering ditches.

Fifth: claim is hereby made for municipal uses and other beneficial purposes, including especially the generation of electric power, for the following quantities of water:

(a) By means of said Two Forks Reservoir for the storage of 145,133 acre feet of water by original construction and 191,236 acre feet by enlargement, making a total of 336,369 acre feet.

(b) By means of said American Reservoir for the storage of 56,624.29 acre feet of water.

(c) By means of said Eleven Mile Canon Reservoir for the storage of 80,253.3 acre feet of water.

(d) By means of said Blue River Diversion Project [illegible] cubic feet of water per second of time (but only 300 cubic feet of water per second of time from the Snake River).

(e) By means of said Williams Fork Diversion Project 1,000 cubic feet of water per second of time (but only the following amounts from the several tributaries of Williams Fork:

South Fork and Bull Creek,	200 second feet
Allen Creek,	250 "
Middle Fork,	350 " "
Steelman Creek,	600 "
Bobtail Creek,	800 " "
McQueary Creek,	200 " ")

(f) By means of said Fraser River Diversion Project for the storage of 50,000,000 cubic feet of water in the St Louis Reservoir and 12,000,000 cubic feet in the Vasquez Reservoir, and for 1,500 cubic feet of water per second of time to be diverted through the transmountain tunnel (but only the following amounts from the Fraser River and its several tributaries:

West St. Louis and Byers Creeks	112 second feet.
St. Louis, East St. Louis, Fool, King, East King, West Elk and Elk Creeks	700 " "
Vasquez Creek	860 " "
Little Vasquez Creek	1050 " "
Fraser River	1500 " "
North Ranch and Ranch Creeks	112 " "
South Ranch Creek	180 "
Faun Creek	280 "
Jim Creek	300 ")

Sixth. work was commenced by survey on the several reservoirs and other works composing said Denver Municipal Water System as follows:

(a) On the Two Forks Reservoir, original construction January 18, 1905 and on the enlargement May 1, 1926.
(b) On the American Reservoir, March 1, 1926.
(c) On the Eleven Mile Canon Reservoir, July 10, 1926.
(d) On the Blue River Diversion Project, March 21, 1914.
(e) On the Williams Fork Diversion Project, March 21, 1914
(f) On the Fraser River Diversion Project, March 21, 1914

Seventh: all of said reservoirs and other works are parts of the said Denver Municipal Water System, and, by interchange of water and otherwise, will be operated together, and same constitute (with the additional reservoirs and other works hereinbefore mentioned now already constructed and adjudicated) a single system for supplying the City and County of Denver and its inhabitants and others residing in its vicinity with water; and it is the intention of the City and County of Denver to prosecute the construction of the said entire system with diligence; and in the prosecution of such construction to finish the individual reservoirs and other works in such order of construction as seems most desirable and advantageous.

The Board of Water Commissioners
of the City and County of Denver,

By [illegible]
President.

Attest: [illegible]
Secretary.

STATE OF COLORADO,
CITY AND COUNTY OF DENVER } S.S.

George M. Bull being duly sworn on his oath deposes and says that he is the engineer of the Denver Municipal Water System; that the survey of the same and the map thereof were made under his instructions and that such survey is accurately represented upon this map; that he has read the statements thereon, and that the same are true of his own knowledge.

Geo M Bull
Engineer

Subscribed and sworn to before me this 17th day of January, A.D. 1928.
My commission expires March 8, 1930.
Stella C. Enlow
Notary Public.

Accepted for filing in the office of the State Engineer of Colorado on the 19th day of January A.D. 1928.

M. C. Hinderlider
State Engineer.
By. [illegible]
Deputy.

AMENDED AND COMPOSITE MAP
OF THE
DENVER MUNICIPAL WATER SYSTEM

PARK, SUMMIT, GRAND, JEFFERSON AND DOUGLAS COUNTIES, COLORADO.

IRRIGATION DIVISIONS No. 1 AND No. 5

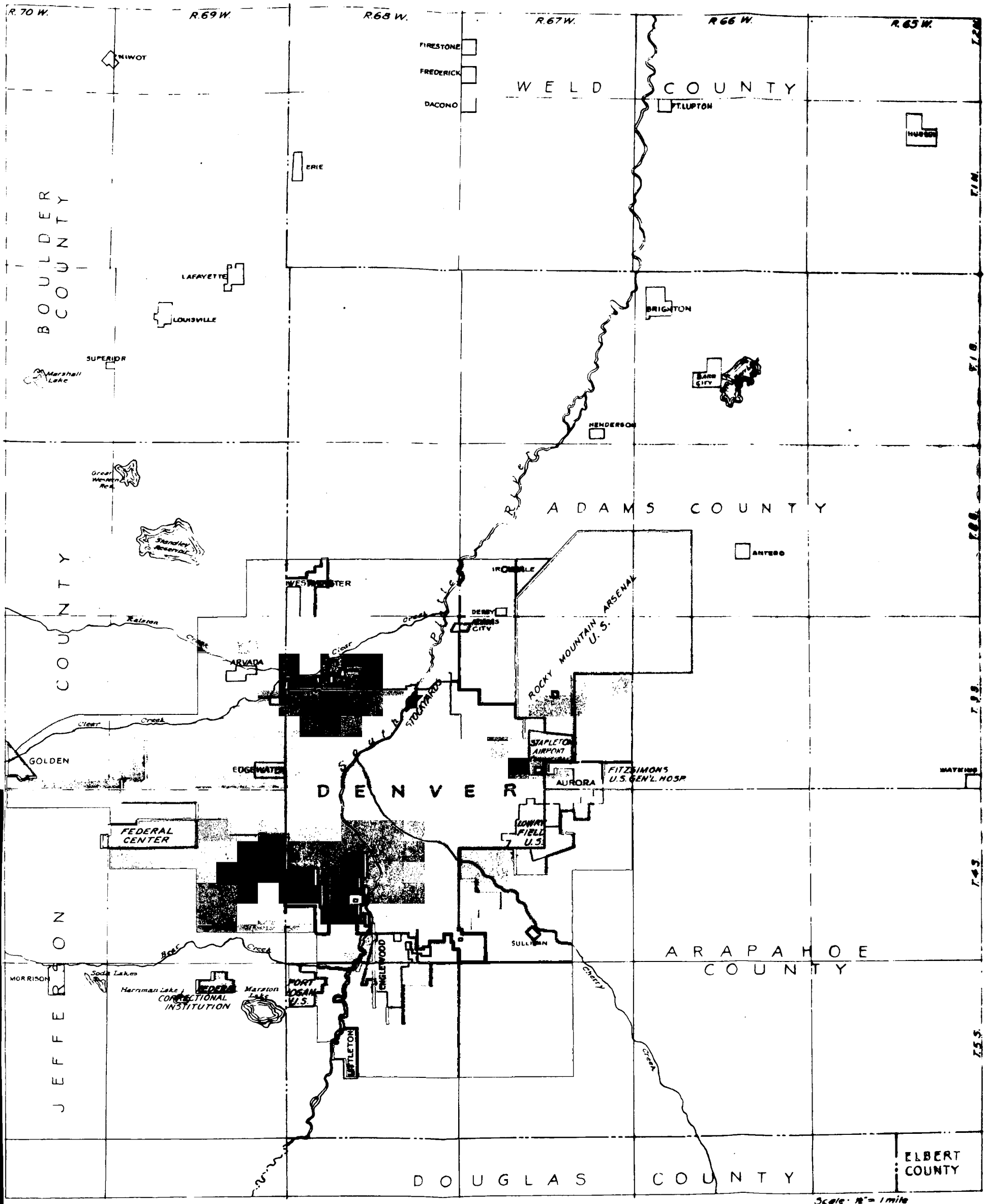
WATER DISTRICTS Nos. 8, 23, 36, AND 51

COURSES REFERRED TO TRUE MERIDIAN

SCALE 1 IN. = 4 MILES

THIS MAP IS IN TWO SHEETS - SHEET No. 2.

EXHIBIT O



DRAWER B2-NO. 115