WATER UTILIZATION STUDY

Project No. Colorado P-30
Arkansas Valley Region

by

M. M. Skinner

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PROJECT NO. COLORADO P-30/ARKANSAS VALLEY REGION

Prepared for

Colorado Division of Commerce and Development
Denver, Colorado

By

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INTRODUCTION

Purpose

This report represents one part of a comprehensive study of the 15-county area in Southeastern Colorado (Baca, Bent, Chaffee, Crowley, Custer, El Paso, Fremont, Huerfano, Kiowa, Lake, Las Animas, Otero, Prowers, Pueblo and Teller Counties). Other parts of the comprehensive study are being performed by the Colorado Department of Agriculture - (assembly of statistical data on Agriculture); The University of Colorado - (trades and services); and the Denver Research Institute - (economic analysis). The basic information in each of the four reports will serve as a guide to the Colorado Division of Commerce and Development for future planning in the Arkansas Valley Region.

The study is being financed cooperatively with funds from the Federal Housing and Home Finance Agency, the State of Colorado and local organizations.

Scope

This report contains a compilation of basic water resource information pertaining to the 15 county area of Southeastern Colorado. In order to maintain the size of this report to a minimum and in some cases to avoid duplication of reporting in specific areas, an extensive amount of references are cited. Basic water resource information for the area has been placed in the Appendices. Maps, tabulations and reproductions of certain data are included as separate exhibits. Conclusions, and recommendations for improving the overall water supply to the area are included.

Basic Concepts

Both surface-water and ground-water supplies are utilized extensively in the Arkansas Valley Study Area. The majority of the surface water originates in the high mountain area in the form of snow-melt, rainfall or trans-mountain diversions. The Arkansas River and its tributaries carry the surface waters of the study area in an easterly direction The Cimarron River in the Southeast corner of Baca County drains a small portion of that area.

The majority of the ground-water supplies are presently being obtained from the alluvial filled valley of the main stem of the Arkansas River between Canon City and the Colorado-Kansas State Line; in the alluvial filled valley of Fountain Creek between Colorado Springs and Pueblo, in the alluvial filled valleys of Jimmy Camp Creek, Black Squirrel Creek and Big Sandy Creek; and in the Southern High Plains area of Baca and Southern Prowers County. A large part of the study area from Canon City to the Colorado-Kansas State Line is underlain by water bearing consolidated formations capable of yielding adequate supplies to domestic or small irrigation wells. These are primarily artesian waters originating in the Cheyenne Sandstone member of the Purgatoire formation and the Dakota Sandstone, both of early Cretaceous age. These artesian water supplies are presently being developed quite rapidly for irrigation use in the Baca County and Southern Prowers Country area.

Rights to the use of the surface water supplies in the study area were obtained under the Prior Appropriation Doctrine - "first in use, first in right." The use of the surface waters are administered by the State Engineer, Division Engineer, and Water Commissioners. Ground-water supplies, however, have been developed in a more haphazard fashion with no legal right to use established by Colorado Water Law. Considerable controversy between surface-water users and ground-water users has arisen in the last few years in the Arkansas River Valley as well as in other areas in Colorado.

House Bill No. 1066, "providing for the execution and administration of the water laws of the state by the State Engineer; and providing penalties" was signed into law May 17, 1965.

Senate Bill No. 367, "repealing and re-enacting with amendments, Article 18 of Chapter 148, Colorado revised statutes 1963; providing for the appropriation and administration of designated ground water; and providing for the establishment of ground water management districts" was signed into law May 17, 1965.

One aspect of the water cycle in the study area is similar to several other areas in Colorado in that the majority of the water resource originates in the areas as precipitation; little if any water flows naturally into the area either as surface or ground-water flow. Precipitation falling on the area either evaporates directly back into the atmosphere; occurs as surface runoff; infiltrates into the ground to replenish soil moisture or recharge the ground-water reservoir; is transpired back to the atmosphere by natural vegetation; or finds its way back to the atmosphere through consumptive use via irrigation, industrial, municipal or domestic activities. The remaining water flows out of the state as surface water or ground water.

A glossary of water resource terms and a list of common conversion factors applicable to the study area are included in Appendix A.

DESCRIPTION OF AREA

Physiography

Baca County is located in the extreme southeast corner of the study area; with Kansas bordering on the east, Oklahoma and New Mexico to the south, Las Animas County on the west, and Bent and Prowers Counties on the north. The county is rectangular in shape with east-west and north-south dimensions being 57 miles and 44 miles respectively, county area = 2565 square miles. The 1960 population was 6310, urban population 1791, rural population 4519; 1960 population of principal towns in the county is listed: Springfield - 1791, Walsh - 856, Pritchett - 247, Campo - 235, Two Buttes 111, and Vilas - 107. Major highways are U.S. 287 - Colo 59 and U.S. 160 - Colo 100, and Colo 51. The area is served by the Atchison, Topeka and Santa Fe Railroad. The county has one airport with a lighted runway north of Springfield. Principal industries are farming, livestock raising and recreation. The area is noted for broom-corn production.

The majority of the county is relatively flat to slightly rolling with rougher terrain formed by extensive erosion existing in the northwestern and southwestern parts of the county. The surface drainage is generally to the east at about 25 feet per mile with the major, intermittent streams being Two Butte Creek, Wild Horse Creek, Bear Creek, Sand Arroyo, Carrizo Creek and the Cimarron River. Two Buttes Reservoir is located in the north part of the county and is used for wild life habitat and irrigation water storage.

An intensive irrigation well development has been underway in the county since the early 1950's. An estimated 40,000 acres was irrigated during 1964. The majority of the irrigation application was ground-water with a small amount obtained from surface water storage in Two Buttes Reservoir. An average irrigation well in the area is drilled about 300 feet deep, lifts the water about 150 feet, and produces about 900 gallons per minute. The principal aquifers are the Ogallala formation, Dakota Sandstone, and Cheyenne Sandstone member of the Purgatoire formation. The aquifers other than the Ogallala formation are generally found to be artesian. Ground-water levels have been declining in the area and will continue to do so unless the recharge to the aquifers approximates the withdrawal.

The average annual precipitation at two weather bureau stations in the county is listed: Springfield - 14.73 inches, Two Buttes - 13.85 inches. The area is subject to high winds which often cause severe wind erosion of cultivated fields.

Cattle feeding operations, meat processing facilities and fertilizer manufacturing are worth considering for the area. To insure that the county does not return to a dust bowl area the ground-water resource should be used efficiently and methods initiated immediately to increase the recharge to the aquifers.

Bent County is located in the east central part of the study area with Las Animas and Baca Counties to the south, Otero County to the west, Kiowa County on the north and Prowers County on the east. The county is rectangular in shape with the north-south, east-west dimensions being 43 miles and 36 miles respectively, county area 1517square miles. The 1960 population was 7419, urban population 3402, rural population 4017; 1960 population of principal towns in the county is listed: Las Animas - 3402, McClave - 129, and Hasty - 126. Major highways are U.S. 50, Colo 6, Colo 196, Colo 194, Colo 183, and Colo 101. The Atchison, Topeka and Santa Fe railroad serves the area. Las Animas has a small airport that is used by local pilots and for crop dusting operations. Principal industries are farming, livestock raising and recreation. Sizeable bentonite deposits are located south of Las Animas.

The southern part of the county is primarily grazing land dissected by numerous gulleys. The surface drainage is to the north-northeast in the southern part of the county and to the south in the area north of the Arkansas River. The Arkansas River flows in an east-west direction through the upper half of the county; the Purgatoire River , Rule Creek, Caddoa Creek, and Mud Creek flow into the Arkansas River from the south; Horse Creek, Adobe Creek, Gageby Creek, Prowers Arroyo, Limestone Creek and Graveyard Creek flow into the Arkansas River from the north. John Martin Reservoir, Muddy Creek Reservoir, part of Horse Creek Reservoir and part of Adobe Creek Reservoir are located in the county. Several large irrigation canals are found in the county: Ft. Lyon Storage Canal, Ft. Lyon Canal, Kicking Bird Canal, Highland Canal and the Consolidated Extension Ditch. The surface reservoirs furnish wildlife habitat, recreation, irrigation water storage and flood control. Evaporation suppression programs for exposed water surfaces could salvage a sizeable amount of water in this county.

Ground-water supplies are used to supplement surface-water supplies. Irrigation wells derive their supply from the alluvial filled valley near the Arkansas River. These wells are relatively shallow-less than 100 feet deep and generally lift the water less than 50 feet. Deeper wells are drilled into the Dakota Sandstone and/or the Cheyenne Sandstone member of the Purgatoire Formation. These wells may be 300-400 feet deep and generally produce less than 50 gallons per minute.

The U. S. weather bureau station at Las Animas has recorded an average annual precipitation of 12.25 inches.

Water quality problems exist in the area. The municipal water supply for Las Animas is obtained from shallow wells and is very objectionable to the taste. Better quality water for domestic use would be a great boon to the area.

Chaffee County is located in the mountainous area of the upper reaches of the basin. The county is bordered on the north by Lake County, on the west by the Continental Divide, on the south by Saguache and Fremont Counties and on the east by Park County. The county is quite irregular in shape, being about 45 miles long and 30 miles wide, county area - 1039 square miles. The 1960 population was 8298, urban 4560, rural 3738; the 1960 population of principal towns is listed: Salida - 4560, Buena Vista - 1806 and Poncha Springs - 201. Major highways in the area are U.S. 24, Colo 4, U.S. 285, Colo 15, U.S. 50, Colo 6, Colo 291, Colo 162 and Colo 306. The area is served by the Denver and Rio Grande Western Railroad. The county has small airports at Salida and Buena Vista. Principal industries are livestock raising, mining, tourism and recreation. The state reformatory is at Buena Vista. Colorado Game and Fish Department have a sizeable fish hatchery on Chalk Creek.

The county is bordered on the west by the Continental Divide with several peaks over 14,000 feet in elevation. The Arkansas River flows through the central portion of the county in a north-northwest ; south-southeast direction. The Arkansas River falls at the rate of about 30 feet per mile between Buena Vista and Salida. Several mountain streams feed into the Arkansas River from both sides: Lost Canyon Creek, Clear Creek, Pine Creek, Three Elk Creek, Cottonwood Creek, Maxwell Creek, Dry Creek, Chalk Creek, Browns Creek, Three Mile Creek, Four Mile Creek, Sand Creek, Squaw Creek, South Fork of the Arkansas River, Trout Creek, Seven Mile Creek and Four Mile Creek. Clear Creek Reservoir is located near the Arkansas River in the upper end of the county.

Some irrigation is practiced on the narrow valley floors adjacent to the Arkansas River and tributaries. The primary source of water supply for irrigation is surface water diversions. A few irrigation wells are used. Irrigation is principally on meadows and alfalfa. Per acre application rates are excessive, but the return flow help maintain the flow in the streams in the late summer.

U. S. Weather Bureau stations at Buena Vista and Salida recorded an average annual precipitation of 9.60 inches and 10.87 inches respectively.

Summer cottages, lodges, ski resorts, and construction projects (Homestake and Frying Pan, Arkansas) will impose additional requirements on the water supply. The quality of the water is generally very good

Crowley County is located in the north central part of the study area with Lincoln County bordering on the north, Kiowa County on the east, Otero County on the south and Pueblo County on the west. The county is approximately square in shape; the east-west and north-south dimensions are 30 miles and 28 miles respectively, county area - 803 square miles. The 1960 population was 3987, urban 1254, rural 2724; 1960 population of principal towns is listed; Ordway - 1254, Sugar City - 409, Crowley - 265, Olney Springs - 263. Major highways are U.S. 50, Colo 96, Colo 6, Colo 167, Colo 207, and Colo 71. The Missouri-Pacific Railroad serves the area. Ordway has an airport southwest of town. Principal industries are farming, livestock raising and recreation. One of the two sugar beet processing plants in the 15 county area is located at Sugar City. The National Sugar Manufacturing Co. plant uses about 20 tons of water per ton of beets processed. The plant obtains the water supply from Lake Henry and discharges to Lake Meredith.

The surface drainage is generally to the south or southeast. Major drainage ways are Horse Creek, Pond Creek, Breckenridge Creek, and Black Draw. Lake Meredith, Lake Henry, Cudahy Reservoir, Horse Creek and Black Draw Reservoir and numerous small ponds are in the county. The reservoirs provide storage for irrigation and industrial water and wild life habitat - evaporation suppression techniques should be implemented.

Approximately 100 irrigation wells were reported in the county during 1964. Soft water supplies for domestic use are found in the Dakota Sandstone and the Cheyenne Sandstone member of the Purgatoire formation.

The average annual precipitation at the U.S. Weather Bureau station at Ordway is 11.28 inches.

Custer County is located in the west central part of the study area, bordered on the west by the Sangre De Cristo Mountains, on the north by Fremont County, on the east by Pueblo County and on the south by Huerfano County. The county is irregular in shape with the east-west and north-south dimensions being about 35 miles and 25 miles respectively, county area - 737 square miles. The 1960 population was 1305, urban - 306, rural 999; the 1960 population of principal towns is listed: Westcliffe - 306, San Isabel - 204, Silver Cliff - 153. Colo 69, Colo 96 and Colo 277 are the major highways in the area. The county has a small airport south-east of Silver Cliff. Principal industries are livestock raising, tourism, recreation and farming. Remnants of old mining and prospecting operations are quite prevalent in the area.

The county is bordered on the east and west by mountainous terrain. The "wet mountain valley" is oriented in a northwest, southeast direction. Many streams exist in the area with the major ones being Grape Creek, Oak Creek, Hardscrabble Creek and Texas Creek. De Weese Reservoir is located about five miles north of Westcliffe.

Some irrigation wells exist in the area, but the majority of the irrigation water use is diverted from natural streams.

The 1964 annual precipitation at Westcliffe and Wetmore stations was 17.70 inches and 18.70 inches respectively.

The county has potential for increased tourism and recreation use. Renewed mining operations might prove feasible in the future.

El Paso County, the most populous county in the study area, is bounded on the north by Douglas and Elbert Counties, on the east by Lincoln County, on the south by Pueblo, and on the west by Teller and Fremont Counties. The county is approximately 50 miles in the east-west direction and 42 miles in the north-south direction, county area - 2158 square miles. The 1960 population was 143, 742, urban 109,257, rural 34,505; 1960 population of principal towns is listed: Colorado Springs - 70,194, Manitou Springs - 3626, Knob Hill - 3612, Ivywild - 2849, Fountain - 1602, Broadmoor - 1585, Chipita Park - 894, Black Forest - 687, Cascade - 543, Palmer Lake - 542, Roswell - 352, Calhan - 397, Monument - 204, Pikeview - 184, Green Mountain Falls - 179, Peyton - 111, Ramah - 109; Security Village, Ft. Carson, and the U. S. Air Force Academy populations are not listed. Major highways are Interstate 25, U. S. 85, U. S. 87, U. S. 24, Colo. 1, Colo. 4, Colo 83, Colo 122, Colo 94, and Colo 114. The area is served by the Denver and Rio Grande Western Railroad, the Atchison, Topeka and Santa Fe Railroad, and the Chicago, Rock Island and Pacific Railroad. Peterson Field airport is located east of Colorado Springs. Principal industries are tourism, recreation, manufacturing, mining, livestock raising, farming and military operations.

The county is bounded on the west by mountainous terrain. The eastern part of the county is slightly rolling and supports cattle raising operations. The Black Forest area is in the northern part of the county and is considered as the drainage boundary between the South Platte River Basin to the north and the Arkansas River Basin to the South. Irrigated farming operations are underway in the Fountain Valley south of Colorado Springs and in the Black Squirrel and Jimmy Camp Valleys east of Colorado Springs.

Major streams in the county are Fountain Creek, Cherry Creek, Kiowa Creek, Bijou Creek, Big Sandy Creek, Horse Creek, Black Squirrel Creek, Chico Creek and Jimmy Camp Creek. Numerous small reservoirs for irrigation, municipal and industrial water storage are located in the county. El Paso county has more registered wells than any other county in the study area. The major quantities of ground water are pumped from the shallow alluvial filled valleys. The Dawson Arkose, Laramie, Fox Hills and Niobrara formations yield lesser quantities for domestic and industrial uses. Ground-water levels have been declining in several areas of the shallow pumping and depletion could easily occur. The Colorado Springs area represents the most highly urbanized area in the study area, but the outlook for adequate water supply is very encouraging due to the Homestake water development project, and the Frying Pan Arkansas project.

The average annual precipitation at the Colorado Springs Weather Bureau station at Peterson Field airport is 13.19 inches.

Fremont County is located in the western part of the study area. The entire county is in mountainous terrain except for a small portion of the "South Park Area" in the north west part of the county and foothills - plains area south and east of Canon City. The county is approximately rectangular being 58 miles and 30 miles in the east-west and north-south directions respectively, county area - 1562 square miles. The 1960 population was 20,196, urban - 11,794, rural 8402; the 1960 population of principal towns is listed: Canon City - 8973, Florence - 2821, Lincoln Park - 1345, East Canon - 1101, Rockvale - 413, Coal Creek - 206, Brookside - 175, Penrose - 112, Cotopaxi - 108, Portland - 73, Williamsburg - 57, Prospect Heights - 50. Major highways are U.S. 50, Colo 6, Colo 67, Colo 69 and Colo 9. The area is served by the Denver and Rio Grande Western Railroad and the Atchison, Topeka and Santa Fe Railroad. Fremont County airport is located east of Canon City. Principal industries are farming, livestock raising, mining, tourism, recreation and manufacturing. The Colorado State Prison is at Canon City.

The Arkansas River travels in an easterly direction through the central part of the county. Numerous streams discharge into the Arkansas River: Howard Creek, Stout Creek, Hayden Creek, Cottonwood Creek, Coal Creek, Texas Creek, Copper Gulch, Grape Creek, Chandler Creek, Hardscrabble Creek, Eight Mile Creek, Four Mile Creek, Currant Creek, Tallahassee Creek, Bernard Creek and Badger Creek.

Except for local irrigated plats of meadow, grass, alfalfa, or small grains, the majority of the irrigation in the county is practiced in the area south and east of Canon City. The major source of irrigation water is from surface supplies.

The average annual precipitation at the Canon City station is 12.66 inches.

Huerfano County is located in the southwestern part of the study area; bordered on the west by the Sangre De Cristo Mountains, on the south and east by Las Animas County and on the north by Custer and Pueblo Counties. The county is irregular in shape. The east-west and north-south dimensions are approximately 80 miles and 65 miles respectively, county area - 1578 square miles. The 1960 population was 7867, urban - 5071, rural 2796; 1960 population of principal towns is listed: Walsenburg - 5071, La Veta - 672, Cuchara - 200 and Gardner - 155. Major highways are Interstate 25, U.S. 85, U.S. 87, U.S. 160, Colo 1, Colo 69, Colo 10 and Colo 111. The area is served by the Denver and Rio Grande Western Railroad and the Colorado and Southern Railroad. The county has airports north of Walsenburg and north of La Veta. Principal industries are livestock raising, farming, recreation, tourism and mining.

The principal drainages are the Cucharas River and the Huerfano River. Numerous streams empty into the two main rivers. The drainage is generally to the northeast. Several small reservoirs or lakes are located in the county: Cucharas Reservoir, and Lindsey Reservoir are in the eastern part of the county.

The city of Walsenburg needs an improved water supply and sewerage disposal system.

The 1964 precipitation at Walsenburg power plant station was 12.90 inches.

Kiowa County is located in the northeastern part of the study area; bordered on the north by Cheyenne and Lincoln Counties, on the south by Bent, Prowers and Otero Counties, on the west by Crowley County and on the east by the Colorado - Kansas state line. The county is approximately rectangular in shape. The east-west and north-south dimensions are 70 miles and 24 miles respectively, county area - 1792 square miles. The 1960 population was 2425, urban - 929, rural - 1496; 1960 population of principal towns is listed: Eads - 929, Haswell - 169, Towner - 126, and Sheridan - 90. Major highways are U.S. 385, U.S. 287, Colo 59 and Colo 96. The area is served by the Missouri Pacific Railroad. The county has an airport at Eads. Principal industries are livestock raising, farming and recreation.

The county is relatively flat. The surface drainage is generally to the southeast. Major streams are Mustang Creek, Adobe Creek, Rush Creek, Big Sandy Creek, and Wild Horse Creek. Numerous lakes and reservoirs are located in the county: part of Adobe Creek Reservoir, Nee So Pah Reservoir, Nee Noshe Reservoir, Nee Granda Reservoir, and Nee Skah Reservoir are for irrigation water storage. These reservoirs are subject to high evaporation losses.

The average annual precipitation at the Eads station is 13.78 inches.

Lake County is located at the head waters of the Arkansas River. The county is irregular in shape. The north-south and east-west dimensions are 22 miles and 17 miles respectively, county area - 380 square miles. The 1960 population was 7101, urban - 4008, rural 3093; 1960 population of principal towns is listed: Leadville - 4008, Climax - 1609, Stringtown - 213, and Twin Lakes - 153. Major highways are U.S. 24, Colo 91, Colo 4, Colo 300, and Colo 82. The area is served by the Denver and Rio Grande Western Railroad and the Colorado and Southern Railroad. The county has an airport at Leadville. Principal industries are mining, livestock raising, recreation and tourism.

The major stream is the Arkansas River with numerous tributaries: Lake Fork Creek, Willow Creek, Halfmoon Creek, Box Creek, Lake Creek, Union Creek, Empire Gulch, Iowa Gulch, California Gulch, and Evans Gulch. Turquoise Lake or Sugar Loaf Reservoir and Twin Lakes Reservoir are used for industrial and irrigation water storage respectively.

The average annual precipitation at Leadville is 18.48 inches.

Las Animas County is located in the southern part of the study area bounded on the south by the New Mexico-Colorado state line, on the west by the Sangre De Cristo Mountains, on the north by Huerfano, Pueblo, Otero and Bent Counties, and on the east by Baca County. The county is irregular in shape. The east-west and north-south dimensions are 115 miles and 56 miles respectively, county area 4794 square miles. The 1960 population was 19,983, urban - 10691, rural - 9292; 1960 population of principal towns is listed: Trinidad - 10,691, Aguilar - 777, Valdez - 447, Jansen - 353, Segundo - 324, Harkville - 261, Kim - 258, Cokedale - 219, Weston - 210, San Juan - 184, Branson - 124 and Hoehne - 108. Major highways are Interstate 25, U.S. 85, U.S. 87, U.S. 160, Colo 12, Colo 350, Colo 239, and Colo 100. The area is served by the Atchison, Topeka and Santa Fe Railroad, the Colorado and Southern Railroad and the Denver and Rio Grande Western Railroad. Trinidad has an airport northeast of town. Principal industries are livestock raising, mining, recreation and tourism. The western part of the county is mountainous, the central part is relatively flat and the eastern part is heavily dissected by streams. The principal streams are the Purgatoire River and the Apishapa River. Numerous intermittent streams are found in the area. Except for a small area in the southeastern part of the county, the drainage is generally to the northeast.

The annual precipitation for 1964 at the Trinidad station was 12.27 inches.

Otero County is located in the central part of the study area, bounded on the north by Crowley and Kiowa Counties, on the east by Bent County, on the south by Las Animas County, and on the west by Pueblo and Las Animas Counties. The county is approximately rectangular in shape. The north-south and east-west dimensions are 43 miles and 36 miles respectively, county area - 1267 square miles. The 1960 population was 24,128, urban - 12,955, rural 11,173; 1960 population of principal towns is listed: La Junta - 8026, Rocky Ford - 4929, Fowler - 1240, La Junta Village - 658, Manzanola - 562, Swink - 348, and Cheraw - 173. Major highways are U.S. 50, Colo 207, Colo 71, Colo 202, Colo 205, Colo 6, Colo 167, Colo 12, U.S. 350 and Colo 194. The area is served by the Atchison, Topeka and Santa Fe

Railroad. Airports are located at La Junta and Rocky Ford. Principal industries are farming livestock raising, tourism and manufacturing. The American Crystal Sugar Company operates a plant at Rocky Ford. Principal use of water is for cooling purposes. "A sugar beet plant slicing 2500 to 4000 tons of beets per day may require as much as 5,000,000 gallons of cooling water per 24 hours." One ton of sugar beets produces about 300 pounds of sugar, 100 pounds of dried pulp and 1600 pounds of water.

Ground water and surface water supplies are used extensively for irrigation primarily in the valley of the Arkansas River. Principal irrigation canals in the county are the Rocky Ford Highline Canal, Oxford Farmers Ditch, Otero Canal, Catlin Canal, Holbrook Canal, Ft. Lyon Storage Canal, Ft. Lyon Canal, and the Colorado Canal. Dye Reservoir, Holbrook Reservoir, and Cheraw Lake store irrigation water. The majority of the ground water pumped for irrigation use is obtained from the relatively shallow alluvial fill. The Dakota Sandstone and the Cheyenne Sandstone member of the Purgatoire Formation provide good quality water to domestic and other small capacity wells.

The 1964 precipitation at the La Junta FAA airport station was 6.68 inches.

Prowers County is located in the east central part of the study area, bordered on the east by the Colorado - Kansas state line, on the south by Baca County, on the west by Bent County and on the north by Kiowa County. The county is rectangular in shape. The north-south and east-west dimensions are 43 miles and 38 miles respectively, county area - 1626 square miles. The 1960 population was 13,296, urban - 7369, rural - 5927; 1960 population of principal towns is listed: Lamar - 7369, Holly - 1108, Granada - 593, Wiley - 383, Bristol - 282 and Hartman - 181. Major highways are U.S. 50, Colo 6, Colo 51, Colo 196, Colo 192, Colo 169, Colo 89, U.S. 287 and U.S. 385. The area is served by the Atchison, Topeka and Santa Fe Railroad. Airports are located at Lamar, Holly and Bristol. Principal industries are farming, livestock raising, tourism and recreation.

Ground-water and surface-water supplies are used extensively for irrigation. Principal irrigation canals are the Amity Canal, Hyde Canal, Buffalo Canal, Fort Bent Canal, Lamar Canal, Manvel Ditch, Sisson Canal, Ft. Lyon Canal, Pawnee Canal, and Two Buttes Canal. The majority of the applied surface water is used in the irrigated acres adjacent to the Arkansas River. Ground-water supplies are used to some extent in this area also. A rapid irrigation well development is occurring in the Southern High Plains area of southern Prowers County. Irrigation wells near the river obtain water from the relatively shallow alluvial fill. Wells in the

southern part of the county are tapping the Ogallala, Dakota Sandstone and the Cheyenne Sandstone member of the Purgatoire Formation.

The average annual precipitation at the Lamar station is 14.20 inches.

Water quality problems exist in the Arkansas River and in the contiguous ground-water reservoir. Excessive mineral content makes the water objectionable to the taste and unsuitable for most uses.

Pueblo County, the second most populous county in the study area is located in the west central part of the region, bounded on the north by El Paso County, on the east by Crowley and Otero Counties, on the south by Huerfano and Las Animas Counties, and on the west by Custer and Fremont Counties. The county is irregular shaped. The north-south and east-west dimensions are 55 miles and 54 miles respectively, county area - 2401 square miles. The 1960 population was 118,707, urban - 103,336, rural - 15,371; 1960 population of principal towns is listed: Pueblo - 91,181, Avondale - 668, Boone - 548, Blende - 500, Beulah - 425, Rye - 179, Pueblo Mountain Park - 168, and Woodland Acres - 168. Major highways are Interstate 25, U.S. 85, U.S. 87, U.S. 50, Colo 1, Colo 76, Colo 96, Colo 6 and Colo 165. The area is served by the Denver and Rio Grande Western Railroad, Atchison, Topeka and Santa Fe Railroad, Colorado Southern Railroad and Missouri Pacific Railroad. Pueblo Memorial Airport is east of town. Principal industries are manufacturing, mining, livestock raising, farming, tourism and recreation.

Principal streams in the area are the Arkansas River, the Huerfano River, the St. Charles River, Fountain Creek, Black Squirrel Creek and Chicosa Creek. Irrigation with both surface water and ground water is used extensively in valley areas adjacent to streams.

The average annual precipitation at the Pueblo Airport Weather Bureau station is 11.84 inches.

Teller County is located in the northwestern part of the study area, bordered on the north by Douglas County, on the east by El Paso County, on the south by Fremont County and on the west by Park County. The county is irregular shaped. The north-south and east-west dimensions are 33 miles and 21 miles respectively, county area - 554 square miles. The 1960 population was 2495, urban 1314, rural 1181; 1960 population of principal towns is listed: Woodland Park - 666, Cripple Creek - 614, Victor - 434, Goldfield - 160 and Divide - 132. Major highways are U.S. 24, Colo 4 and Colo 67. Principal industries are mining, tourism, recreation and livestock raising.

The northern part of the county drains into the South Platte River Basin and the Southern part of the county drains into the Arkansas River Basin.

HYDROLOGY

Average annual precipitation varies from about 45 inches in the mountainous area at the west edge of the region to about 10 inches in the plains areas in the east part of the region. Isohyetal maps are given for each month of the year and for the year in the publication entitled "Normal Monthly and Annual Precipitation for Eastern Colorado" by G. L. Smith and E. F. Schulz. The publication provides isohyetal maps for that area of Colorado east of the Rocky Mountain Foothills. Average maximum annual snow depths for selected mountain stations are listed:

Snow Survey Station	Av. Max. Ann. Water Content (inches)	Calculated Av Max. Ann Snow Depth (inches) (moisture content conv. factor)
Bourbon	7.8	26 (30%)
East Fork	13.4	43 (31%)
Four Mile Park	4.9	18 (27%)
Fremont Pass	19.5	59 (33%)
La Veta Pass	8.3	28 (30%)
Monarch Pass	19.6	58 (34%)
St. Elmo	12.6	42 (30%)
Tennessee Pass	10.9	38 (29%)
Twin Lakes Tunnel	11.6	37 (31%)
West Cliffe	5.2	17 (30%)

The Arkansas River and tributaries drain all of the 15 county study area except for a small area in the southern part of Baca County and southeastern part of Las Animas County which is drained by the Cimarron River. Largest monthly flows occur during April, May, June and July as a result of snowpack melting in the upper reaches of the watershed. Rainfall caused by thunderstorm activity can produce sizeable flows in the intermittent streams for short intervals. Certain weather conditions can produce rainfall that contributes to disastrous flooding in the basin as evidenced by the flood of June 1965. A set of "River Sheets" are found in Exhibit H.

Adjusted Normal Precipitation* for Selected Weather Bureau Stations in the Study Area

Station	Location Latitude	Location Longitude	Adjusted Normal Annual Precipitation (inches)
Eads	38° 29'	102° 47'	13.95
Holly	38° 03'	102° 47'	14.05
Lamar	38° 04'	102° 37'	14.23
Las Animas	38° 04'	103° 13'	10.51
Ordway	38° 13	103° 45'	10 51
Penrose	38° 27'	105° 04'	11.20
Pueblo	38° 17'	104° 31'	12.75
Rocky Ford	38° 02'	103° 42'	14.05
Trinidad	37° 10	104° 29'	11.29
Walsenburg	37° 37'	104° 48'	15.50
Doherty Ranch	37° 12'	103° 53'	13.32
Springfield	37° 24'	102° 36'	14.05
Stonington	37° 17'	102° 11'	16.15
Troy ISE	37° 08'	103° 19'	15.92
Two Buttes	37° 34'	102° 24'	11.81

* "Normal Monthly and Annual Precipitation For Eastern Colorado", G. L. Smith and E. F. Schulz, July 1962.

Major ground-water supplies are obtained from the relatively shallow water table aquifers of the alluvial filled valleys contiguous to the Arkansas River and tributaries Lesser artesian flows are available from deeper formations underlying a good portion of the study area Wells pumping from the alluvial-filled aquifers near perennial streams may reduce the stream flow during certain times of the year For the most efficient use of the total water resource however the wells must be utilized

Selected organizations active in water resource investigations or administration in at least some part of the 15 county study area are listed

1) U S Bureau of Reclamation
2) U. S. Geological Survey
3) Corp of Engineers
4) U. S. Public Health Service
5) Colorado Department of Public Health
6) U S D A Soil Conservation Service
7) Federal Land Bank Wichita Kansas
8) State Engineers Office Denver
9) Division Engineers Office Pueblo
10) Colorado Water Conservation Board Denver
11) Southeastern Colorado Water Conservancy District
    - George Everett Salida Colorado
    - Charles Irwin Buena Vista
    - James Shoun Canon City
    - Frank Dilley Canon City
    - J Selby Young Colorado Springs
    - J. Sid Nichols Manitou Springs
    - Harold H. Christy Pueblo
    - Dave Ciruli Boone
    - Frank Milenski La Junta
    - Wm. Bauserman Jr Manzanola
    - J. Wayne Bennett Ordway
    - Herbert Schroeder Ordway
    - Roy D. Cooper Las Animas
    - Kenneth R Shaw Las Animas
    - James E. Wagner Lamar
    - Charles Beise Denver
    - Charles H Boustead Pueblo
12) Arkansas Valley Task Force Committee
13) Arkansas River Compact Administration
14) Colorado Water Congress
15) Purgatoire River Water Conservancy District
16) Colorado State University

GEOLOGY

Exposed rocks in the study area range in geologic age from the Pre-Cambrian to the Recent. The exposed rocks in the study area east of the Rocky Mountains Foothill Region are generally remnants of the Cretaceous, Tertiary, and Quaternary periods. Primary ground-water producing formations are the alluvium deposits along the perennial streams, the Ogallala in the southeastern part of the study area, the Dakota, and the Cheyenne Sandstone member of the Purgatoire.

Generalized sections of the geologic formations for certain counties in the study area are given in "Colorado Ground Water Basic Data Reports", "Ground Water Series Bulletins", and in "Water Supply Papers"

County	Selected Reference
Baca	"Geology and Ground-water Resources of Baca County, Colordo." Ground-water Series Bulletin No. 2.
Bent	"Colorado Ground-water Basic Data Report No. 14"
Chaffee	"Thermal Springs in the United States," USGS Bulletin No. 679-B.
Crowley	"Water in the Dakota and Purgatoire Formations in Otero County and the Southern Part of Crowley County, Colorado"
Custer	"Preliminary List of Deep Borings in the United States," USGS WSP 149.
El Paso	"Ground Water in Fountain and Jimmy Camp Valleys, El Paso County, Colorado."
Fremont	"Colorado Ground Water Basic Data Release No. 18"
Huerfano	"Colorado Ground Water Basic Report No. 4"
Kiowa	"Geology and Ground-water Resources in Eastern Cheyenne and Kiowa Counties, Colorado," USGS, WSP 1779-N
Lake	"Thermal Springs in the United States", USGS Bulletin 679-B

County	Selected Reference
Las Animas	"Geology of Parts of Las Animas, Otero and Bent Counties," Colorado Geological Survey Bulletin 27
Otero	"Water in the Dakota and Purgatoire Formations in Otero County and the Southern Part of Crowley County, Colorado," USGS, WSP 1669-P
Prowers	"Geology and Ground-water Resources of Prowers County, Colorado," USGS, WSP 1772
Pueblo	"Colorado Ground Water Basic Data Release No. 18"
Teller	"Description of the Colorado Springs Quadrangle, USGS Atlas, Folio 203"

WATER RESOURCES

Surface Water

Gaging station descriptions, historical gaging station records, a master list of decrees from the State Engineers Office, a graphic listing of major decrees, water districts map, and a river mileage index are given in appendices B, C, D, H, I, and J respectively.

A county summary of surface-water supplies, historical annual yields and delivery schedules, limited quality analyses, trends of annual yields, and future supply outlook are given in the following table:

SURFACE-WATER SUPPLY

County	Supply	Av. Ann. Flow (acre feet)	Delivery Schedule	Quality	Trends	Future Supply
Baca	----no record----					
Bent	Arkansas River (at Las Animas)	167, 000	max av. flow occurs in June; min av. flow occurs in September	poor	quantity and quality should improve	Frying Pan Arkansas Project, Trinidad Project
	Purgatoire River (near Las Animas)	97, 000	max. av. flow occurs in August; min. av. flow occurs in Jan.	fair	quality may deteoriate due to increased use upstream.	Trinidad Project
Chaffee	Arkansas River (at Granite)	314, 000	max. av. flow occurs in June min av. flow occurs in February	fair **	quantity and quality should improve	Frying Pan Arkansas Project
	Clear Creek (above Clear Creek Reservoir)	52, 000	max av. flow occurs in June min av flow occurs in February	good		
	Cottonwood Creek (near Buena Vista)	43, 000	max. av flow occurs in June. min av. flow occurs in April	good		
	Arkansas River (at Salida)	451, 000	max. av. flow occurs in June. min. av. flow occurs in February	good	quanity and quality should improve	Frying Pan Arkansas Project
Crowley	-----no record-----					
Custer	Grape Creek (near West Cliffe)	23, 000	max. av. flow occurs in June. min. av. flow occurs in January	good		

SURFACE-WATER SUPPLY cont'd

County	Supply	Av. Ann. Flow (acre feet)	Delivery Schedule	Quality	Trends	Future Supply
Lake	Lake Fork (above Sugar Loaf Reservoir)	30,000	max. av. flow occurs in June, min. av. flow occurs in February	good		
	Halfmoon Creek (near Malta)	21,000	max. av. flow occurs in July, min. av. flow occurs in February	good		
	Lake Creek (above Twin Lakes)	125,000	max. av. flow occurs in June, min. av. flow occurs in March	good		
Las Animas	Purgatoire River (at Trinidad)	65,000	max. av. flow occurs in June, min. av. flow occurs in February	fair	quality may deteriorate due to increased use upstream	Trinidad Project'
	Purgatoire River (near Hoehne)	17,000	max. av. flow occurs in May, min. av. flow occurs in November	fair		
	Frijole Creek (near Alfalfa)	1,600	max. av. flow occurs in May, min. av. flow occurs in January	fair	"	
	San Francisco Creek (near Alfalfa)	6,500	max. av. flow occurs in May, min. av. flow occurs in November	fair	"	
	Purgatoire River (near Alfalfa)	40,000	max. av. flow occurs in May, min. av. flow occurs in January	poor	"	Trinidad Project
Otero	Purgatoire River (near Higbee)	74,000	max. av. flow occurs in May, min. av. flow occurs in December	poor	"	Trinidad Project

SURFACE-WATER SUPPLY cont'd

County	Supply	Av. Ann. Flow (acre feet)	Delivery Schedule	Quality	Trends	Future Supply
El Paso	Fountain Creek (near Colorado Springs)	8,000	max. av. flow occurs in July, min. av. flow occurs in February	Fair	municipal water management in the area will have an effect on quality and quantity	
	West Monument Creek(near Pikeview)	400	max. av. flow occurs in May, min. av. flow occurs in January	poor		
	Templeton Gap Floodway (at Colorado Springs)	75	max. av. flow occurs in July, min av. flow occurs in Oct-Nov.			
Fremont	Arkansas River (near Wellsville)	501,000	max. av. flow occurs in June, min. av. flow occurs in February	good	quantity and quality should improve	Frying Pan Arkansas Project
	Arkansas River (at Canon City)	521,000	max. av. flow occurs in June, min. av. flow occurs in February	good	quantity and quality should improve	Frying Pan Arkansas Project
Huerfano	Huerfano River (near Redwing)	24,000	max. av. flow occurs in June, min. av. flow occurs in February	good		
	Cucharas River (near La Veta)	18,000	max. av. flow occurs in May, min. av. flow occurs in February	good		
Kiowa		-----no record-----				

SURFACE-WATER SUPPLY cont'd

County	Supply	Av. Ann. Flow (acre feet)	Delivery Schedule	Quality	Trends	Future Supply
	Apishapa River (near Fowler)	26,000	max. av. flow occurs in August, min. av. flow occurs in January	fair		
	Arkansas River (at La Junta)	186,000	max. av. flow occurs in June, min. av. flow occurs in February	poor	quantity and quality should improve.	Frying Pan Arkansas Project
Prowers	Arkansas River (at Lamar)	168,000	max. av. flow occurs in June, min. av. flow occurs in March	poor		Frying Pan Arkansas Project
	Arkansas River (Colo.-Kan. State Line)	138,000	max. av. flow occurs in April, min. av. flow occurs in October	poor	"	Frying Pan Arkansas Project
Pueblo	Arkansas River (near Pueblo)	516,000	max. av. flow occurs in June, min. av. flow occurs in March	fair	"	Frying Pan Arkansas Project
	Fountain Creek (at Pueblo)	36,000	max. av. flow occurs in May, min. av. flow occurs in September	fair	"	Frying Pan Arkansas Project Homestake Project
Teller		-----no record-----				

* For surface water quality data see USGS, Water Resources Division, Publication "Quality of Surface Water in Colorado".

** Mining operations in the Leadville area have contributed to severe stream pollution in the upper stretches of the Arkansas River.

GROUND WATER

Well locations and locations of selected observation wells, and Annual summaries of well development are given in Appendicies K and L respectively. Area-wide ground-water availability are illustrated in Exhibits I and J.

Colorado Ground-Water Law requires a "permit to use ground water", and a "permit to construct a well". A sample application form and approval sheet are attached. A sample "log and History of Well" sheet to be filled out by the driller is also attached. A summary of county ground-water supplies is included.

Imported Water

Several trans-mountain diversions serve to import water into the Arkansas River Basin from the Colorado River Basin: (1) Hoosier Pass Tunnel, (2) Fremont Pass Tunnel, (3) Columbine Ditch, (4) Ewing Ditch, (5) Wurtz Ditch, (6) Twin Lakes Tunnel, (7) Busk-Ivanhoe Tunnel, and (8) Larkspur Ditch. Details on these trans-mountain diversions are described in Appendix B. Historical diversion quantities through the several systems are given in Appendix C.

New trans-mountain diversion projects presently under construction include the Frying Pan Arkansas Project and the Homestake Development Project. The Frying Pan Arkansas Project is intended to provide supplemental water (about 70,000 acre-feet annually)to the Arkansas Valley area for irrigation, domestic use, fish and wildlife, and recreation. The Frying Pan project should provide an average annual supply of 20,500 acre-feet for municipal and industrial use and about 190,000 acre-feet of new and return flow to supplement irrigation. The Homestake Development Project will provide supplemental domestic supplies to Colorado Springs and to Aurora (South Platte River Basin). This project is designed to provide about 37,000 acre-feet annually to each of the two cities. Delivery of the first water is scheduled for the spring of 1966. A descriptive map of the Homestake Development Project is shown in Appendix N.

The Climax Molybdenum Company at Climax, Colorado diverts water from the Ten-Mile Creek watershed in the Colorado River Basin, but returns the water back to the same basin.* Average daily water requirements for the Climax operation have been reported to be 20,000,000 gallons.

*Horace B. Ham, Chief Engineer, Climax Molybdenum, Climax, Colorado.

Form C Rev.
9-62/10M

STATE OF COLORADO

APPLICATION FOR: ☐ A PERMIT TO USE GROUND WATER
☐ A PERMIT TO CONSTRUCT A WELL

Applicant _____

P.O. Address _____

Quantity applied for _____ gpm or
_____ AF Storage

Used for _____ Purposes

on/at _____
(legal description of land site)

_____
Total acreage irrigated and other rts.

ESTIMATED DATA OF WELL

Hole size: ____ in. to ____ ft.
____ in. to ____ ft.

Casing Plain ____ in. from ____ to ____ ft.
____ in. from ____ to ____ ft.
Open or Perf. ____ in. from ____ to ____ ft.
____ in. from ____ to ____ ft.

PUMP Outlet
DATA: Type _____ HP ____ Size ____

Use initiation date _____ 19____.
(Use Supplemental pages for additional data)

Driller to furnish Log and History (Form E) within 30 days after completion of well.

THIS APPLICATION APPROVED

PERMIT NO. _____
ISSUED:
DATE _____ 19____

LOCATION OF WELL

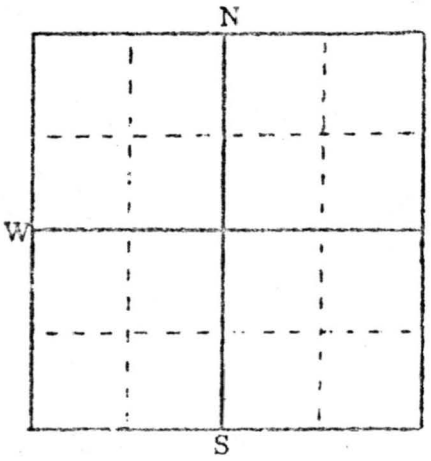
County _____

____ ¼ of ____ ¼ of Sect. ____, Twp. ____,

Rge. ____, ____ P.M. OR

_____
Street Address or Lot & Block No.

_____
Town or Subdivision



Locate well in 40 acre (small) square as near as possible.
Large square is one section.

$25.00 fee required for uses other than Domestic or Livestock.

Applicant _____
Agent or
Driller _____ No. ____

Address _____

NOTE — SATISFACTORY COMPLETION REQUIRED FOR APPROVAL OF APPLICATION

STATE OF COLORADO
DIVISION OF WATER RESOURCES
OFFICE OF THE STATE ENGINEER
GROUND WATER SECTION

Index No. .....
DWD .....
Use .....
Registered .....

(For State Engineer's Use)

LOG AND HISTORY OF WELL

PERMIT NO. _____

Driller _____ Lic. No. _____

Owner _____

Street _____ City _____

Tenant _____

Use of Water _____

On or By _____ No. Acres _____
(description of site or land)

Date Started _____, 19____

Date Completed _____, 19____

Yield _____ GPM or _____ CFS

WELL DESCRIPTION:

Depth to Water _____ ft. Total Depth _____ ft.
(measured from ground surface)

Hole Diameter
- in. _____ from _____ ft. to _____ ft.
- in. _____ from _____ ft. to _____ ft.
- in. _____ from _____ ft. to _____ ft.

TEST DATA:

How Tested _____ Pump or _____ Bailed

Date Tested _____, 19____ Length _____ hrs.

Rate _____ GPM Drawn Down _____ ft.

PUMP DATA:

Pump Type _____ Outlet Size _____ in.

Driven by _____ HP _____

CASING RECORD:

Plain Casing

Size _____, Kind _____ from _____ ft. to _____ ft.

Size _____, Kind _____ from _____ ft. to _____ ft.

Size _____, Kind _____ from _____ ft. to _____ ft.

Perforated Casing

Size _____, Kind _____ from _____ ft. to _____ ft.

Size _____, Kind _____ from _____ ft. to _____ ft.

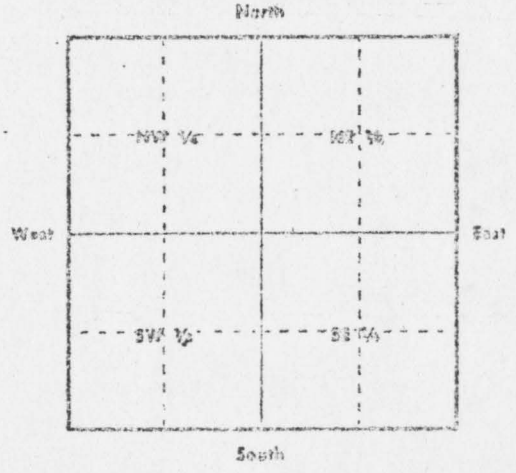
Size _____, Kind _____ from _____ ft. to _____ ft.

WELL LOCATION

_____ County

_____ ¼ of _____ ¼ of Sec. _____

Twp. _____, Rge _____, _____ PM



ABOVE DIAGRAM REPRESENTS ONE FULL SECTION. LOCATE WELL ACCURATELY IN SMALL SQUARE REPRESENTING 40 ACRES.

or

If the above is not applicable fill in:

_____
No. Street

_____
City or Town

or

Lot _____, Block _____

_____ Subdivision
(include filing or number)

TO BE MADE OUT IN QUADRUPLICATE:

Original Blue (both sides) and Duplicate Green Copy must be filed with the State Engineer within 30 days after well is completed. White copy is for the Owner and Yellow copy for the Driller. SIGN BLUE COPY

FOR WELL LOG USE REVERSE SIDE

GROUND-WATER SUPPLY

County	Source (Formation)	Average Reported Well Yields* (gallons/minute)	Quality	Trends	Future supply Outlook
Baca	Ogallala, Dakota, and Cheyenne	D=19, S=15, D and S = 16, C= 1, IND=61, I=900, I and S=230, M=262	good	see Appendix M	fair
Bent	Alluvium, Ft. Hays Limestone, Bridge Creek Limestone, Dakota, Cheyenne, and Entrada Sandstones	D=74, S=12, D and S=31, C=26, I=894, I and S=653, M=354	fair	see Appendix M	fair
Chaffee	Alluvium	D=18, S=4, C=46, IND=185, I=439, I and S=169, M=348	good	Supply should be adequate for present development	good
Crowley	Alluvium, Niobrara, Codell Limestone, Bridge Creek Limestone, Lincoln Limestone, Dakota, and Cheyenne	D=11, S=14, D and S=10 IND=150, I=546, I and S=190	fair	water levels have been steady (limited observations)	fair
Custer	Alluvium	D=16, S=14, I=252, I and S=542	good	supply should be adequate for present development.	good

* D = Domestic, S = stock, D and S = domestic and stock, C = Commercial, IND = Industry, I = Irrigation, I and S = Irrigation and stock, and M = Municipal

GROUND-WATER SUPPLY cont'd

County	Source (Formation)	Average Reported Well Yields (gallons/minute)	Quality	Trends	Future Supply Outlook
El Paso	Alluvium, Dawson Arkose, Laramie, Fox Hills, and Niobrara	D=12, S=15, D and S = 41, C=120, IND=82, I=860, I and S = 236, M = 800	fair	see Appendix M	fair
Fremont	Alluvium	D=18, S=19, D and S = 9 C = 43, IND = 133, I = 448, I and S = 206, M = 250	good	supply should be adequate for present development	good
Huerfano	Alluvium, Devils Hole, Farasita conglomerate, Intrusive rocks, Huerfano, Cuchara, Poison Canyon, Raton, Vermejo, Trinidad, Smoky Hill Marl, Ft. Hays Limestone, Codell Limestone, Greenhorn Limestone, Dakota, Cheyenne, Sangre De Cristo, and marine rocks	D = 15, S = 8, D and S = 11, C = 12, IND = 987, I = 543, I and S = 400, M = 63	good	"	good
Kiowa	Alluvium, and Ogallala	D = 6, S = 9, D and S = 7, I = 591, I and S = 800, M = 129	good	"	fair
Lake	Alluvium	D = 12, C = 31, IND = 180, M = 300	good	"	good

County	Source (Formation)	Average Reported Well Yields (gallons/minute)	Quality	Trends	Future Supply Outlook
Las Animas	Alluvium, Dakota and Cheyenne and Entrada Sandstone	D = 6, S = 76, D and S = 17, IND = 75, I = 247, I and S = 222 M = 83	fair	"	fair
Otero	Alluvium, Niobrara Codell Limestone, Bridge Creek Limestone, Lincoln Limestone, Dakota and Cheyenne sandstone	D = 24, S = 17, D and S = 83, C = 253, IND = 331, I = 528, I and S = 319, M = 380	fair	--	quality may continue to deteriorate
Prowers	Alluvium, Ogallala, Ft. Hays Limestone, Codell Sandstone, Blue Hill Shale, Fairport Chalky Shale, Dakota Sandstone, and Cheyenne sandstone	D = 30, S = 15, D and S = 12, C = 458, IND = 55, I = 1255, I and S = 1513, M = 556	fair	see Appendix M	quality may continue to deteriorate and supply may be reduced in Southern part of county
Pueblo	Alluvium	D = 21, S = 21, D and S = 57, C = 201, I = 446, I and S = 250, M = 136	fair	see Appendix M	good
Teller	Alluvium	D = 9, S = 9, D and S = 6, IND = 20, I = 74, M = 64	good	supply should be adequate for present development	good

WATER UTILIZATION

Agriculture

Maps illustrating the location of the majority of the irrigation wells in the Arkansas River Valley, irrigated acreage maps, historical diversion records for the major irrigation companies; surface-water diversion records for the 1963 irrigation season, and a list of irrigation companies in the study area are shown in Exhibit D, Exhibits E and K, Appendix G, Appendix E, and Appendix F respectively.

The following table represents the quantity of water that could be pumped if all the wells in the study area in 1964 were operated at the reported discharges for 1/3 of the time. The 1/3 ratio (or 8 hours per day) is probably an upper limit of the amount of pumpage from Domestic, Stock, Domestic and Stock, Commercial, Industrial, Irrigation and Stock, and Municipal Wells. The 1/3 ratio (or 4 months per year) is probably excessive for irrigation wells. In the case of irrigation pumpage for Baca and Bent Counties, the estimates were made from natural gas consumption and electrical power consumption data respectively.

It is interesting to note that the 1/3 potential discharge for irrigation wells approximates the average volume of water diverted from natural streams for irrigation use during 1963 and that the 1/3 potential discharge for all ground water uses approaches the average volume of water diverted for all uses from natural streams:

	Diversions From Natural Streams (acre-feet)	1964 - 33 - 1/3% Potential Pumpage (acre-feet)
All uses	1,578,384 (average 1955-63)	1,117,050
Irrigation	919,929 (1963)	992,200

Baca County has been experiencing a very rapid irrigation well development. Irrigation wells in the county have increased in number from 48 in 1954 to 448 in 1964. In 1964 an estimated 150,000 acre-feet were pumped and applied to about 40,000 acres. Colorado's new legislation will undoubtedly limit additional well development in the area, but the underlying ground-water reservoir appears to be over-developed at the present time. Ground-water level measurements in the area the last 3 years indicates general water table declines of about 4 feet per year. Artificial

33-1/3o/o Potential Reported Discharge Table
(acre-feet)
1964

County	Domestic	Stock	Domestic Stock	Commercial	Industrial	Irrigation	Irrigation Stock	Municipal
Baca	400	900	100	---	300	150,000*	300	1600
Bent	1000	500	200	100	---	66,000**	2000	1500
Chaffe	2300	---	---	500	400	5,500	500	1100
Crowley	100	200	100	---	100	10,000**	500	[illegible]
Custer	400	200	---	---	---	4,000	3900	500
El Paso	9000	1900	1200	1800	500	134,000	1500	16000
Fremont	1000	100	---	---	800	7,300	200	500
Huerfano	400	300	100	---	---	3,500	---	100
Kiowa	---	100	---	---	---	8;000	400	800
Lake	700	---	---	100	100	----	---	200
Las Animas	100	800	100	---	500	4,700	1200	200
Otero	1300	500	500	3100	4100	147,000	4500	7000
Prowers	700	700	---	1200	100	270,000	3300	14000
Pueblo	7800	1000	1200	4000	2500	182,000	4900	2000
Teller	500	---	---	---	---	200	---	150
	25,700	7,200	3,500	10,800	9,400	992,200	22,300	45,950

Total 1,117,050

* Pumpages calculated from natural gas consumption data.

** Pumpages calculated from electrical power consumption data - 100 KWH/acre foot.

--- = less than 100 acre feet.

ground-water recharge, improved irrigation efficiency, and water re-use programs need to be initiated immediately.

Power companies supplying electricity to irrigation pumping plants in the area are listed with respective rate schedules; in some instances, historical power use data are attached.

Southern Colorado Power Co.

E. G. Schiesl, Supervisor New Business

Pueblo, Colorado

		no. of plants	KWH	Conncected H. P.
1932	Pueblo Dist.	87		918-1/2
	Rocky Ford Dist.	45		559
	La Junta Dist.	17		76
	Ordway Dist.	10		171
1935	Pueblo	87	581, 725	
	Rocky Ford	39 (19)*	168, 180	
	Ordway	4 (1)	116, 221	
1936	Pueblo	89	480, 195	
	Rocky Ford	37 (17)	154, 533	
	Ordway	4 (1)	115, 249	
1937	Pueblo	100	807, 193	861-1/2
	Rocky Ford	31	164, 689	376
	Ordway	3	37, 344	52-1/2
1938	Pueblo	96	635, 297	869-1/2
	Rocky Ford	27	116, 068	308
	Ordway	4	81, 276	120
1939	Pueblo	100	673, 001	856-1/2
1940	Pueblo	108	891, 903	864-1/2

*Number of plants pumping from surface supplies.

SOUTHERN COLORADO POWER COMPANY

BI-MONTHLY AGRICULTURAL SERVICE — RATE

Effective in: All territory served.

Classification: Irrigation customers only.

Availability: Customers using electricity for irrigation power purposes at the voltage, phase and frequency of the Company's distribution system and having no less than three (3) HP connected. No lighting or power service other than irrigation permitted. No resale, breakdown or auxiliary service permitted.

Rate:

First 200 Kwh. used per contract year, per contract HP, per Kwh. net	$.04
Next 400 Kwh. used per contract year, per contract HP, per Kwh. net	.02
Next 600 Kwh. used per contract year, per contract HP, per Kwh. net	.015
All additional Kwh. used per contract year, per Kwh. net.	.0125

Bills for energy used shall be rendered on the regular bi-monthly billing dates adopted by the Company except that one bill will be rendered for energy used during the period from October reading to February 28th. In calculating these bills the contract year character of the rate will be reflected by billing all 4¢ energy first, 2¢ energy second, 1.5¢ energy next, and 1.25¢ energy only after the full 1200 hours' use of contract horsepower has been used. "C"

Discount: Bills for service under this schedule will be computed at the net rates shown above and there will be added to the total net bill a sum equivalent to 5% thereof which amount will constitute the discount if payment is made within the discount period of approximately ten days as indicated on each bill.

"C" Indicates change.

SOUTHERN COLORADO POWER COMPANY

BI-MONTHLY AGRICULTURAL SERVICE		RATE
Minimum Charge:	Contract Year	
	Net minimum charge per contract year per horsepower of maximum contract horsepower.	$10.00 "R"
Contract Year:	All contracts under this schedule shall be for a period of 12 months beginning March 1st except that on contracts becoming effective subsequent to March 1st, and on additional horsepower added subsequent to March 1st, hours of use under the energy rate and the minimum charge will be adjusted on a pro-rated basis.	"C"
	Note: The above minimum charge and contract year clauses are subject to the Company's filed Connection and Line Extension Policy.	
Rules and Regulations:	The above provisions of this schedule are subject to the definitions, terms and conditions of the General Rules and Regulations made a part thereof by reference thereto.	
	Company reserves the right to restrict the use of service between the hours of 4 P.M. and 10 P.M. during the months of November, December, January and February	"C"
Determinations of Contract Horsepower:	Contract horsepower which in no event shall be taken as less than 100% of the manufacturer's rating of largest motor connected nor less than 3 HP. shall be determined on the basis of a percentage of the connected load, as follows:	
	"R" Indicates reduction. "C" Inducates change.	

SOUTHERN COLORADO POWER COMPANY

Determination of Contract Horsepower: Continued

For installations of:

(a) One motor	100%
(b) Two motors	90%
(c) Three motors	80%
(d) Four motors	70%
(e) Five or more motors	60%

Provided that motors of less than one horsepower rating shall not be counted as motors in the determination of the above percentages but shall be considered as part of the total connected load.

		no. of plants	KWH	Connected H. P.
1956	Pueblo	440	3, 539, 836	
1957	Pueblo	448	1, 950, 923	3236
1958	All districts	639 (19)	3, 813, 215	5111
1959	All districts	646 (19)	5, 670, 331	5151
1960	All districts	660 (20)	5, 511, 873	
1961		662 (20)	4, 187, 307	

Offices at Canon City, Rocky Ford, Fowler, Ordway and Pueblo

1962		666 (20)	4, 567, 771	

(40 percent of total in Pueblo area)

1963		680 (20)	8, 411, 585	
1964	Pueblo Canon City Rocky Ford	842 (42)	8, 458, 711	

San Isabel Electric Assoc., Inc.

316 West 15th St.

Pueblo, Colorado

John Foute, Director of Consumer Services

1963	31	126, 162	
1964	31	248, 415	

SAN ISABEL ELECTRIC ASSOCIATION, INC.

CLASSIFICATION OF SERVICE

KIND OF SERVICE (OR USE)	RATE Assn. No. 11

IRRIGATION

Electric Water Pumping for Irrigation Purposes

AVAILABILITY

Available to all consumers served by the Association. The use of energy under this Schedule and conditions of service shall be regulated by individual contract.

TYPE OF SERVICE

Single phase or three phase at available secondary voltage.

ENERGY CHARGE

First 250 KWH per horsepower per year per KWH	4.0¢
Next 200 KWH per horsepower per year per KWH	3.0¢
Next 200 KWH per horsepower per year per KWH	2.0¢
Over 650 KWH per horsepower per year per KWH	1.75¢

MINIMUM CHARGE

The minimum annual charge shall be $10.00 per connected horsepower and shall be determined by individual contract.

TERMS OF PAYMENT

The above rates are net, the gross rates being 10% higher. In the event the current bill is not paid within ten (10) days from statement, the gross rates shall apply.

Southeast Colorado Power Company
Mr. R. P. Murphy, Office Manager
901 West 3rd Street
La Junta, Colorado 81050

	no. of plants	KWH	Connected H. P.
1956	390-413	5, 349, 279	
1957	405-426	2, 459, 998	
1958	428	2, 472, 221	

Average size pumps 11.3 HP
71 are lift pumps and 357 well pumps

1959	430 (426 av)	4, 038, 986	

Average size = 11.3 HP.

(Est. 10 percent or 43 are lift pumps)

(68 lift pumps counted early summer of 1960)

1960	444	4, 856, 110	

(59 were lift pumps)

1961	485	4, 237, 269	

(58 lift pumps)

most pumps located in Valley in Otero, Bent and Prowers Counties.

1962	494 (58)	5, 204, 859	
1963	536 (60)	9, 358, 460	
1964	608 (60)	10, 231, 044	

SOUTHEAST COLORADO POWER ASSOCIATION

I. IRRIGATION RATE:

First 200 kwh used per year per HP connected at $.04 per kwh
Next 300 kwh used per year per HP connected at $.025 per kwh
Over 500 kwh used per year per HP connected at $.017 per kwh
(By special contract)

The minimum charge for service during any year shall be $15.00 per horsepower for the first 10 HP of connected load and $12.50 per HP for each additional HP of connected load.

Smaller than 5 HP shall be computed on 5 HP basis for rate and minimum.

Mountain View Electric Assoc.
Floyd Guilliams, Office Manager
Limon, Colorado 80828

		no. of plants	KWH
1954	Fountain Valley	99	1,174,941
	Big Sandy	20	235,451
	Horse Creek	30	440,583
	Other	11	102,000
1955	Fountain Valley	106	1,339,078
	Big Sandy	24	227,537
	Horse Creek	30	406,610
	Other	15	131,693
1956	Fountain Valley	107	1,640,230
	Big Sandy	29	319,531
	Horse Creek	34	485,059
	Black Squirrel Creek	12	237,470
	Bijou	6	46,166
	Other	4	56,800
1957	Fountain Valley	120	419,636
	Big Sandy	29	104,816
	Horse Creek	31	204,478
	Black Squirrel Creek	16	123,512
	Middle Bijou	8	19,923
	Rush Creek	6	32,364
1958	Fountain Valley	113	666,491
	Big Sandy	21	131,584
	Horse Creek	41	325,894
	Black Squirrel Creek	8	116,760
	Middle Bijou	8	19,714
	Rush Creek	2	21,620
1959	Fountain Valley	117	897,157
	Horse Creek	41	446,858
	Big Sandy	20	188,919
	Black Squirrel Creek	9	139,370
	Middle Bijou	9	64,580
1960	Fountain Valley	119	1,082,640
	Horse Creek	42	474,273
	Big Sandy	22	226,727
	Black Squirrel	9	168,080
	Middle Bijou	11	114,274

Mountain View Electric Assoc. (cont'd)

		no. of plants	KWH
1961	Fountain Valley	122	642,386
	Horse Creek	49	520,948
	Big Sandy	23	175,392
	Black Squirrel	10	156,590
	Middle Bijou	12	77,372
1962	Fountain Valley	115	1,173,807
	Horse Creek	52	656,628
	Big Sandy	20	215,878
	Black Squirrel	10	271,940
	Middle Bijou	13	137,619
1963	Fountain Valley	121	1,319,805
	Horse Creek	54	725,120
	Big Sandy	22	223,920
	Black Squirrel	16	427,210
	Middle Bijou	12	99,521
1964	Fountain Valley	125	1,471,790
	Horse Creek	62	5,951,046
	Big Sandy	28	411,480
	Black Squirrel Creek	19	434,310
	Middle Bijou	13	152,841

(this includes 8 wells - Cherokee Water District pumping water to Colorado Springs, and 6 wells for Clear Springs Water District pumping water to Fountain)

MOUNTAIN VIEW ELECTRIC ASSN., INC.
LIMON, REA COLORADO
IRRIGATION POWER CONTRACT

SCHEDULE I

IRRIGATION SERVICE

AVAILABILITY

Available to the consumers of the Association located adjacent to lines of the Association for irrigation service.

CHARACTER OF SERVICE

Alternating current, 1-phase, 60 cycles, 230 volts--7-1/2 H.P. motors or smaller.

Alternating current, 3-phase, 60 cycles, 230 volts--10 H.P. or larger motors.

RATE

First 100 KWH per H.P. of Maximum Seasonal Contract H.P. per KWH	$.05
Next 100 " " " " " " " " " "	.03.
Next 100 " " " " " " " " " "	.02
Excess KWH " " " " " " " " " "	.0175

DETERMINATION OF CONTRACT H.P.

The contract horsepower shall be the name plate rating of the installed motor.

IRRIGATION SEASON

The irrigation season shall be the period from January 1 to December 31 of each year.

MINIMUM ANNUAL CHARGE

The minimum annual charge shall be $12.00 per contract horsepower per year but in no event shall it be less than $60.00.

The minimum annual charge shall be payable on or before January 10th of each year and the payment of the minimum charge shall entitle the consumer to the use of electric energy at the above rate.

Superintendent, Las Animas Light and Power Co.
Box 271
Las Animas, Colorado
(Computed by USGS)

	No. of Pumps	KWH	A. F.
1955	31	779,171	6446
1956	30	1,036,923	8388
1957	32	251,158	2111
1958	33	397,233	3218
1959	34	964,050	7963
1960	34	832,942	6882
1961	43	696,897	5767

Bent County

1962	37(1)	676,470	
Surrounding city, mostly N. E. of Las Animas, Colo.			
1963	38(1)	1,472,582	
1964	44	1,383,102	

LAS ANIMAS MUNICIPAL LIGHT AND POWER

City of Las Animas, Colorado

Irrigation Pumping
(Permanent Service)

AVAILABILITY

1. This rate is applicable under the Rules and Regulations of the City to irrigation installations at a fixed location in excess of five (5) H.P. Service to be three (3) phase

2. Available for irrigation service from existing rural distribution lines of 13,200 volts or less, in excess of (5) H.P. during the Agricultural season. (January 1st to December 31st) where customer uses service every day.

RATE

First 200 KWH per year, per H.P. of connected load,	$ .04
	.02

MINIMUM CHARGE*

For the first 20 H.P. of connected load, per year per H.P.	10.00
For all additional connected load, per year, per H.P.	5.00
The minimum charge each year is payable in advance	5.00

*The minimum charge is subject to the provisions of the Department's line extension policy.

City of Lamar
Mr. L. K. Christolear, Supt.
Lamar, Colorado

Bent and Prowers Counties
(Big Bend, May Valley, Wiley, Lamar, Bristol and Granada)

	No. of Pumps	KWH	
1950	1	21,350	
1951	1	77,703	
1952	2	86,336	
1953	4	181,822	
1954	7	301,871	
1955	6	422,970	
1956	12	577,363	
1957	10	343,143	
1958	20	342,313	
1959	22	531,674	2 were pumping from drainage ditch and used 19,990 KWH of total
1960	23 (2)	533,769	(2)
1961	22 (2)	505,187	(2)
1962	21 (2)	621,333	(2)
1963	48	1,714,657	
1964	85	2,892,230	

Plateau Natural Gas Co.
Springfield, Colorado
Mr. Duane F. Ply

	Baca County No. of pumps	Cubic feet of natural gas
1964	379	1,057,964,000
1963	281	854,440,000
1962	203	371,137,000

UTILITIES BOARD OF THE CITY OF LAMAR

IRRIGATION

I (Rate Title or Number)	Company Rate Code
APPLICABILITY: Applicable throughout territory served.	442C
	RATE
AVAILABILITY: Available for irrigation pumping purposes of not less than 5 H.P.	
RATE:	
First 50 KWH used per month per H.P. connected	.02
Next 100 KWH used per month per H.P. connected	.015
All additional KWH	.0125

MINIMUM:

Minimum per season shall be $10.00 per H.P. connected.

At the option of the City, the minimum shall be payable in advance and will be credited on the monthly bills until used up.

RULES AND REGULATIONS:

The unit of H.P. demand shall be based on manufacturer's rating of the motor. If the motor name plate is lost or destroyed, the Electric Department reserves the right to establish the H.P. rating by suitable tests. Service for each meter installed shall be computed separately. The irrigation season shall be from April 1 to April 1.

Motors in excess of 5 H.P. must be 3 phase, 230 or 460 volts-60 cycles.

PUBLIC SERVICE COMPANY OF COLORADO

ELECTRIC RATES

IRRIGATION POWER SERVICE

Company Rate Code

SCHEDULE IP-1

Territory	Rate No.
Urban	16
Fringe	41
Rural	66

AVAILABILITY

Available within the Boulder, Brighton, Denver, Fort Collins, Idaho Springs, Leadville, and Sterling Divisions of the Company

APPLICABILITY

Applicable only to service for irrigation pumping power at the voltage and phase of Company's established secondary distribution system. No applicable to standby, auxiliary, or resale service

RATE

YEARLY RATE

First 100 kwh used per year, per HP of billing demand, per kwh	$.056
Next 200 kwh used per year, per HP of billing demand, per kwh	.034
Next 200 kwh used per year, per HP of billing demand, per kwh	.0235
All additional kwh used per year, per kwh	.0105

1. Irrigation Season (March 1 to November 15):
2. Winter Season (November 15 to March 1):

The use of service to irrigation pumps, for fire protection or stock watering purposes, during the aforesaid Winter Season is permitted provided that stock watering service is used only between the hours of 10:00 P.M. to 4:00 P.M.

GENERAL FARM POWER SERVICE

For farm power service other than irrigation, fire protection and stock watering, the rate and charges of the applicable secondary power rate or General Farm Service rate schedules shall apply.

DETERMINATION OF BILLING DEMAND

The billing demand, which in no event will be less than the manufacturer's rating of the largest motor nor less than three horsepower, will be determined on the basis of a percentage of the maximum connected motor load in horsepower as follows:

a. One motor 100%
b. Two motors 80%
c. Three or more motors 70%

Motors of less than one horsepower will not be counted in the determination of the above percentages but their rating will be a part of the total connected horsepower.

PUBLIC SERVICE COMPANY OF COLORADO

SCHEDULE IF-1

Territory	Rate No.
Urban	16
Fringe	41
Rural	66

RATE

YEARLY MINIMUM

Per HP of maximum billing demand $5.30

(General Farm and Irrigation Power Service
The monthly minimum charge of the applicable rate.)

PAYMENT

Bills for electric service are due and payable within ten (10) days from date of bill.

CONTRACT PERIOD

All irrigation contracts under this rate will be for a yearly period from March 1 to March 1, automatically renewed for like periods unless terminated by written notice.

RULES AND REGULATIONS

Service supplied under this schedule is subject to the terms and conditions set forth in the Company's Rules and Regulations on file with The Public Utilities Commission of the State of Colorado and the following special conditions:

1. In the event Customer desires General Farm Power Service through the irrigation power meter during the Winter Season, such service may be obtained under terms of the applicable secondary power or General Farm Service schedules, by notifying Company of such desire. Such notice will automatically suspend the contract for Irrigation Power Service for the period during which General Farm Power service is supplied. At the time when customer advises Company that General Farm Power service is no longer required, the contract for Irrigation Power service may be automatically reinstated.
2. Bills for General Farm and Irrigation Power service during the Winter Season will be prorated for billing periods less than a month, unless service is discontinued and later resumed during the same Winter Season.
3. If the Customer desires to use service during the Winter Season on the same premises but at a different location than during the Irrigation Season, the Company will, at the Customer's request and upon payment of the total cost thereof, move said transformer installation to the new location for the Winter Season and reinstall the same for the Irrigation Season.

PUBLIC SERVICE COMPANY OF COLORADO

SCHEDULE IP-2

Territory	Rate No.
Urban	16
Fringe	41
Rural	66

AVAILABILITY

Available within the Grand Junction, Salida, and San Luis Valley Divisions of the Company.

APPLICABILITY

Applicable only to service for irrigation pumping power service at the voltage and phase of Company's established secondary distribution system. Not applicable to standby, auxiliary, or resale service.

RATE

YEARLY RATE

First 100 kwh used per year, per HP of billing demand, per kwh	$.053
Next 200 kwh used per year, per HP of billing demand, per kwh	.031
Next 200 kwh used per year, per HP of billing demand, per kwh	.023
Next 1000 kwh used per year, per HP of billing demand, per kwh	.016
All additional kwh used per year, per kwh	.0105

1. Irrigation Season (March 1 to November 15):
2. Winter Season (November 15 to March 1):

The use of service to irrigation pumps, for fire protection or stock watering purposes, during the aforesaid Winter Season is permitted provided that stock watering service is used only between the hours of 10:00 P.M. to 4:00 P.M.

GENERAL FARM POWER SERVICE

For Farm Power service other than irrigation, fire protection and stock watering, the rate and charges of the applicable secondary power rate or General Farm Service rate schedules shall apply.

DETERMINATION OF BILLING DEMAND

The billing demand, which in no event will be less than the manufacturer's rating of the largest motor nor less than three horsepower, will be determined on the basis of a percentage of the maximum connected motor load in horsepower as follows:

a. One motor 100%
b. Two motors 80%
c. Three or more motors . . . 70%

Motors of less than one horsepower will not be counted in the determination of the above percentages but their rating will be a part of the total connected horsepower.

PUBLIC SERVICE COMPANY OF COLORADO

SCHEDULE IP-2

Territory	Rate No.
Urban	16
Fringe	41
Rural	56

	RATE
YEARLY MINIMUM	
Per HP of maximum billing demand	$5.30
(General Farm and Irrigation Power service	
The monthly minimum charge of the applicable rate.)	

PAYMENT

Bills for electric service are due and payable within ten (10) days from date of bills.

CONTRACT PERIOD

All irrigation contracts under this rate will be for a yearly period from March 1 to March 1, automatically renewed for like periods unless terminated by written notice.

RULES AND REGULATIONS

Service supplied under this schedule is subject to the terms and conditions set forth in the Company's Rules and Regulations on file with The Public Utilities Commission of the State of Colorado and the following special conditions.

1. In the event Customer desires General Farm Power Service through the irrigation power meter during the Winter Season, such service may be obtained under terms of the applicable secondary power or General Farm Service schedules, by notifying Company of such desire. Such notice will automatically suspend the contract for Irrigation Power Service for the period during which General Farm Power service is supplied. At the time when Customer advises Company that General Farm Power service is no longer required, the contract for Irrigation Power service may be automatically reinstated.
2. Bills for General Farm and Irrigation Power service during the Winter Season will be prorated for billing periods less than a month, unless service is discontinued and later resumed during the same Winter Season.
3. If the Customer desires to use service during the Winter Season on the same premises but at a different location than during the Irrigation Season, the Company will, at the Customer's request and upon payment of the total cost thereof, move said transformer installation to the new location for the Winter Season and re-install the same for the Irrigation Season.

Average annual diversions for each of 12 water districts located in the study area are summarized below.

Water District	Counties	Period of Record Considered	Average Annual Diversion*(acre-feet)
10	El Paso	1955-1964	42,837
11	Chaffee and Lake	1955-1964	146,578
12	Fremont	1955-1964	343,303
13	Custer	1955-1964	35,349
14	Pueblo and El Paso	1955-1964	234,516
15	Pueblo	1955-1964	23,426
16	Huerfano	1955-1964	17,427
17	Crowley and Otero	1955-1964	465,770
18	Las Animas	1955-1964	9,680
19	Las Animas	1955-1964	86,623
66	Las Animas and Baca	1955-1964	1,521
67	Bent, Prowers, Baca and Kiowa	1955-1964	171,354
		Total	1,578,384

*Includes amount diverted for agriculture, industry and municipal use.

Annual ditch and reservoir diversions are given.

Diversions - Water District 10 *

El Paso and Teller Counties

	Ditch (Acres) a	c	e	Reservoir (Acres) b		
1964	48661	(12585)	3.9	401	(-)	
1963	49051	(11515)	4.3	700	(-)	
1962	59147	(11965)	4.9	5204	(-)	
1961	63432	(12412)	5.1	3806	(-)	
1960	49570	(11385)	4.4	4565	(-)	
1959	37279	(10669)	3.5	4973	(-)	
1958	35404	(11120)	3.2	1268	(-)	
1957	42594	(10491)	4.1	4011	(-)	
1956	21447	(10840)	2.0	55	(-)	
1955	21785	(10789)	2.0	64	(-)	
1954	23509	(10489)	2.2	3758	(-)	d
1953	31476	(6225)	5.1	4749	(5533)	0.9
1952	25304	(5590)	4.5	9882	(6583)	1.5
1951	22551	(21401)	1.1	3947	(6598)	0.6
1950						

* Source of Data: Water Commissioner's annual Ditch and Reservoir Report Nov. 1 - Oct. 31

(a) Ditch-No. of A.F. used by canal for season from natural stream for all uses

(b) Reservoir-No. of A.F. of reservoir water carried during season for all uses

(c) Irrigated acreage (ditch water)

(d) Irrigated acreage (reservoir water)

(e) "Water use index", $\frac{a}{c}$ (note: not per acre irrigation application rate)

Diversions - Water District 11

Chaffee Lake and Saguache Counties

	Ditch (Acres)	Reservoir (Acres)
1964	123796 (25525) 4.9	108 (100) 1.1
1963	132149 (25771) 5.1	0 ( )
1962	165307 (26610) 6.2	0 ( )
1961	159341 (26042) 6.1	712 (1900) 0.4
1960	155965 (27093) 5.8	0 ( )
1959	129729 (24893) 5.2	453 (-)
1958	152089 (26028) 5.8	346 (-)
1957	178988 (25615) 7.0	0 ( )
1956	128075 (23587) 5.4	685 (-)
1955	140344 (24942) 5.6	1482 (-)
1954	100816 (22296) 4.5	0 ( )
1953	165356 (30519) 5.4	820 (-)
1952	190163 (37707) 5.0	96132 (-)
1951	161720 (37513) 4.3	88017 (-)
1950	137410 (36604) 3.8	0 (-)

Diversions - Water District 12

Fremont, Teller, El Paso, Custer, Pueblo and Park Counties

1964	361813 (19232) 18.8	10223 (-)
1963	359480 (18302) 19.6	10548 (-)
1962	355775 (22744) 15.6	27041 (-)
1961	358322 (22071) 16.2	13043 (-)
1960	347026 (21299) 16.3	14296 (-)
1959	347425 (21832) 15.9	15383 (-)
1958	361450 (21922) 16.5	15902 (-)
1957	332861 (20903) 15.9	9354 (-)
1956	292951 (18904) 15.5	2205 (-)
1955	315929 (20030) 15.8	1146 (-)
1954	227145 (13464) 16.9	--- (-)
1953	344422 (17971) 19.2	4955 (-)
1952	240193 (20582) 11.7	--- (-)
1951	340319 (19187) 17.7	473 (-)
1950	144301 (16895) 8.5	--- (-)

Diversions - Water District 13
Custer and Fremont Counties

	Ditch (Acres)	Reservoir (Acres)
1964	30341 (35194) 0.9	---- (-)
1963	9428 (6016) 1.6	4092 (-)
1962	33917 (19209) 1.8	9391 (-)
1961	46938 (19870) 2.4	565 (-)
1960	40729 (19909) 2.1	14673 (-)
1595	31272 (19370) 1.6	16749 (-)
1958	36957 (19988) 1.9	9601 (-)
1957	72475 (21268) 3.4	7025 (-)
1956	18355 (16527) 1.1	725 (-)
1955	33080 (18934) 1.8	1520 (-)
1954	16658 (9800) 1.7	---- (-)
1953	32963 (23776) 1.4	5859 (-)
1952	50123 (24691) 2.0	9708 (-)
1951	19343 (13645) 1.5	---- (-)
1950	7803 (8397) 0.9	---- (-)

Diversions - Water District 14
Teller, Pueblo, Fremont and El Paso Counties

1964	207788 (83225) 2.5	250 (275) 0.9
1963	138019 (83640) 1.7	
1962	291927 (110060) 2.7	
1961	211905 (108585) 2.0	
1960	246269 (127823) 1.9	
1959	198541 (104178) 1.9	
1958	313159 (105772) 3.0	
1957	354657 (104382) 3.4	
1956	175191 (105524) 1.7	
1955	207706 (108374) 1.9	
1954	142352 (106811) 1.3	
1953	231337 (107275) 2.2	
1952	250668 (106831) 2.3	
1951	269927 (107078) 2.5	
1950	194208 (106403) 1.8	760 (270) 2.8

Diversions - Water District 15
Pueblo, Custer and Huerfano Counties

	Ditch (Acres)	Reservoir (Acres)
1964	21793 (4250) 5.1	
1963	9723 (2615) 3.7	
1962	21204 (4701) 4.5	
1961	40768 (5039) 8.1	
1960	30238 (4280) 7.1	
1959	21489 (3537) 6.1	
1958	18914 (3552) 5.3	
1957	32884 (5249) 6.3	
1956	13305 (2669) 5.0	
1955	23947 (5377) 4.5	
1954	55797 (3628) 1.6	
1953	16779 (5470) 3.1	
1952	14016 (5852) 2.4	
1951	15638 (3367) 4.6	
1950	7796 (3940) 2.0	

Diversions - Water District 16
Huerfano and Pueblo Counties

1964	38392 (21485) 1.8	2151 (1270) 1.7
1963	23661 (13372) 1.8	1540 (975) 1.6
1962	1375 (1435) 1.0	12569 (7895) 1.6
1961	2730 (1810) 1.5	1613 (1915) 0.8
1960	2130 (2215) 1.0	5346 (7700) 0.7
1959	5315 (10995) 0.5	8099 (11125) 0.7
1958	7385 (3860) 1.9	10550 (9725) 1.1
1957	2462 (1510) 1.6	
1956	17629 (54315) 0.3	
1955	73199 (50847) 1.4	
1954	31372 (56493) 0.6	
1953	62566 (41021) 1.5	
1952	76309 (40051) 1.9	
1951	26894 (39910) 0.7	
1950	18632 (47649) 0.4	

Diversions - Water District 17

Crowley, El Paso, Lincoln, Huerfano, Pueblo, Las Animas, Otero, Kiowa and Bent

	Ditch (Acres)	Reservoir (Acres)
1964	300778 (157115) 1.9	
1963	328520 (154230) 2.1	4836 (-)
1962	602210 (154770) 3.9	22976 (-)
1961	525918 (155700) 3.4	6757 (-)
1960	421136 (157227) 2.7	9114 (-)
1959	410432 (154591) 2.7	27071 (-)
1958	578942 (158211) 3.7	47943 (-)
1957	831839 (158161) 5.3	1537 (-)
1956	323686 (157901) 2.1	0 (-)
1955	334240 (158231) 2.1	7387 (-)
1954	264960 (158491) 1.7	986 (-)
1953	397462 (252852) 1.6	1490 (-)
1952	503493 (250452) 2.0	0 (-)
1951	461769 (251552) 1.8	18893 (-)
1950	461243 (250655) 1.8	28044 (-)

Diversions - Water District 18

Las Animas County

1964	5656 (3455) 1.6	640 (-)
1963	1206 (1025) 1.2	(-)
1962	6880 (4875) 1.4	792 (-)
1961	15784 (4980) 3.2	1122 (400) 2.8
1960	9186 (4905) 1.9	0 ( )
1959	10124 (4805) 2.1	279 (300) 0.9
1958	14165 (4755) 3.0	1452 (300) 4.8
1957	18069 (5590) 3.2	1569 (300) 5.2
1956	1195 (1585) 0.8	1122 (-)
1955	14535 (6425) 2.3	1828 (660) 2.8
1954	1056 (965) 1.1	422 (600) 0.7
1953	2970 (3950) 0.8	0 ( )
1952	11011 (6950) 1.6	0 ( )
1951	----- (2570)	818 (200) 4.1

Diversions - Water District 19

Las Animas County

	Ditch (Acres)	Reservoir (Acres)
1964	55372 (21014) 2.6	1698 (860) 2.0
1963	38310 (7099) 5.4	6611 (1973) 3.4
1962	80374 (26909) 3.0	5088 (593) 8.6
1961	150874 (29960) 5.0	9799 (8164) 1.2
1960	97036 (19025) 5.1	2234 (2515) 0.9
1959	76067 (22941) 3.3	6897 (2300) 3.0
1958	111662 (32786) 3.4	13195 (2665) 5.0
1957	114769 (31956) 3 6	13460 (2160) 6 2
1956	53110 (20091) 2.6	6691 (1650) 4.1
1955	88663 (28761) 3.1	17965 (1250)14.4
1954	61077 (26407) 2.3	
1953	69790 (11216) 6.2	
1952	(10336)	
1951	(10336)	5500 (1080) 5.1
1950	(11403)	2610 (940) 2.8

Diversions - Water District 49

Lincoln, Kit Carson and Cheyenne Counties

1964	5311 (1776) 3.0	
1963	5507 (1916) 2.9	
1962	5722 (1986) 2.9	
1961	4949 (2140) 2.3	
1960	4994 (2196) 2.3	
1959	2568 (1240) 2.1	2680 (1000) 2.7(Bonny Dam)
1958	3060 (1560) 2.0	0 ( )
1957	3114(2245) 1.4	0 ( )
1956	5634 (1790) 3.2	4254 (1335) 3.2
1955	8240 (2985) 2.8	820 (1335) 0.6
1954	9117 (1450) 6.3	689 (1410) 0.5
1953	8095 (2760) 2.9	149 (800) 0.2
1952	8888 (2310) 3.9	3561 (1250) 2.8
1951	6806 (4780) 1.4	2546 (765) 3.3

Diversions - Water District 66

Las Animas and Baca Counties

	Ditch (Acres)	Reservoir (Acres)
1964	1958 (293) 6.6	
1963	1530 (490) 3.1	
1962	1815 (465) 3.9	
1961	1153 (433) 2.7	
1960	1054 (590) 1.8	
1959	1704 (721) 2.4	
1958	1873 (575) 3.3	
1957	1916 (560) 3.4	
1956	1373 (440) 3.1	
1955	841 (294) 2.9	
1954	802 (365) 2.2	
1953	680 (230) 3.0	
1952	411 (180) 2.3	
1951		
1950		

Diversions - Water District 67

El Paso, Elbert, Lincoln, Cheyenne, Kiowa, Bent, Prowers, Baca, Las Animas, Kit Carson Counties

1964	69430 (63609) 1.1	28152 (68127) 0.4
1963	117364 (73602) 1.6	35871 (103621) 0.3
1962	177800 (70024) 2.5	91133 (100254) 0.9
1961	176816 (68482) 2.6	46975 (100247) 0.5
1960	131581 (76884) 1.7	90261 (108006) 0.8
1959	237503 (69629) 3.4	278617 (100542) 2.8
1958	225702 (72395) 3.1	217207 (67501) 3.2
1957	216698 (71882) 3.0	259585 (67796) 3.8
1956	139657 (70033) 2.0	91033 (66652) 1.4
1955	220991 (71481) 3.1	276038 (66374) 4.2
1954	113615 (71007) 1.6	96354 (-)
1953	169368 (105770) 1.6	11944 (-)
1952	205838 (88270) 2.3	143528 (-)
1951	213739 (72612) 2.9	209765 (-)
1950	(71555)	227289 (-)

The total of the average irrigated acreage [(a)] in each of the water districts listed above amounted to about 458,000 acres. Per acre water application data for agriculture from natural streams during the 1963 water year* are listed below:

Water District	Headgate Diversion for Agriculture (1963) (acre-feet)	Irrigated Acreage (1963) (acres)	Headgate Duty (acre feet per acre) (1963)
10	31,179	11,515	2.7
11	125,794	25,771	4.9
12	119,133	18,302	6.5
13	9,428	6,016	1.6
14	130,090	83,640	1.6
15	4,894	2,615	1.9
16	20,321	13,372	1.5
17	325,228	154,230	2.1
18	1,206	1,025	1.2
19	34,362	7,099	4.8
66	1,530	490	3.1
67	116,764	73,602	1.6
	919,929	397,677	2.3

(a) 1955-1964

* November 1 - October 1

Industry

One of the principal water using industries in the Arkansas Valley is the Colorado Fuel and Iron Plant at Pueblo. The "American Iron and Steel Institute" reports that an average of 46,000 gallons of water are required per ton of finished product (many types of products). Re-use is a necessity in water short areas and/or where economics warrant. Colorado Fuel and Iron Corporation reportedly returns 35 percent of the diverted water supply back to the stream.

Sugar beet processing plants, canning factories, soft drink manufacturing, miscellaneous light manufacturing and railroads are other industries in the study area that use relatively large quantities of water. Estimated ground-water pumpage from industrial wells is given on page 31 .

Municipal and Domestic

Municipal water supply and sewage facilities are described in Exhibits A and B respectively. These data were obtained from the files of the Colorado Department of Public Health, Denver, Colorado. A more concise summary is presented in Exhibit C. Estimated ground-water pumpage for 1964 is given in the table on page 31.

Some of the larger municipalities were visited and more complete water use and sewage data obtained (Appendices N, O, P, Q, R, S and T) The following section presents a brief resume of water and sewage data for selected cities in the study area: Colorado Springs, Pueblo, Leadville, Buena Vista, Salida, Security, Widefield Estates, Fountain, Rocky Ford, La Junta, Lamar, Las Animas, Trinidad, and Walsenburg.

Colorado Springs: The city receives water supply from The Pikes Peak watershed, The Blue River, wells in the Fountain Valley and wells in the Black Squirrel Valley. Future additional supplies will come from the Homestake Project and The Frying Pan Arkansas Project.

Colorado Springs is 100% metered and encourages only low-water use industry in the area. Per capita use during 1963 was about 200 gallons per day. A schedule of water charges is shown:

Colorado Springs has initiated a re-use program. Treated sewage water is used for irrigation use in city parks, etc.

City of Colorado Springs
Dept. of Public Utilities

An Ordinance amending Section 2-59 of Article 6, Chapter 11 of the Code of Colorado Springs, 1950, pertaining to the Charges for Water.

2-59 ---- CHARGE FOR WATER

The monthly charge for water shall be as follows:

RATE 1 - Urban Territory (City of Colorado Springs)
General residential and commercial service.

First 500 cubic feet or less use per month	2.25
All use in excess of 500 cubic feet per month per 100 cubic feet	.24

RATE 2 - Suburban, Fringe Territory (Lying immediately adjacent to and outside the City Limits of the City of Colorado Springs.)
General residential and commercial service.

First 500 cubic feet or less use per month	3.50
All use in excess of 500 cubic feet per month per 100 cubic feet	.30

RATE 3 - Small Manufacturing and Industrial Service (Applicable to industrial and processing non-residential uses and available on contract for not less than one year.)

First 8,000 cubic feet or less per month, minimum charge	22.50
All use in excess of 8,000 cubic feet per month per 100 cubic feet	.225

RATE 4 - Large Industrial and Institution Service. (Applicable to industrial and industrial and institutional use, including military establishments, and available on contract for not less than one year.)

For all water used during the months of October through March, and for all water used during the months of April through September not in excess of average use October through March per 100 cubic feet per month	.195
For all water used during the months of April through September in excess of the average use of the months of October through March per 100 cubic feet per month	.24
Minimum Charge	37.50

RATE 5 - Water for Cooling.
A surcharge of 40.00 per ton year. (Service conditions on application.)

RATE 3 - Water for Cooling. (continued)

Main extensions necessary for service under this rate shall be at the consumer's expense and service shall be limited to available distribution line capacities as determined by the Department.

The rates and charges in this Ordinance provided and set forth shall be effective with the meter readings for the Month of April, 1957, based upon water uses indicated by said April 1957 meter readings.

Service under these rates is to be given only in accordance with the provisions of Ordinance 1535, passed on July 13, 1937.

Charges for water billed by the Public Utilities Department, Division of Water and Water Works, for a monthly period or a fraction thereof shall be due and payable at the office of the Public Utilities of the City of Colorado Springs before the 15th day after such billing.

Approved by Colorado Springs City Council
Effective April, 1957

Pueblo: The city obtains water supply from the Arkansas River. The former District No. 1 (northside waterworks) and District No. 2 (southside waterworks) have been combined to form the Consolidated water works. The system presently serves about 100, 000 population. Per capita water consumption for the period 1944-1952 averaged 340 and 400 gallons per day for District No. 1 and District No. 2 respectively. 1960 and 1964 per capita water consumption were about 236 and 207 respectively. The marked reduction in water consumption is due in part to increased metering.

Pueblo has a combined sewer system (storm sewer and domestic sewer). Sewage is treated before being discharged into the Arkansas River. Sewage pumping records are listed:

Leadville: The city obtains water supply from Big Evans Reservoir, Mountain Lake No. 1 and 2, Iowa Gulch, and Canterbury Tunnel; and is in the process of drilling 2 wells in the Arkansas River alluvium. Average daily consumption is about 1, 650, 000 gallons and 2, 000, 000 gallons for the winter and summer months respectively. The system serves about 7000 population (1550 taps). There are about 350 house meters and about 100 commercial meters. A $7.00 minimum meter rate per month and a $19.75 minimum house rate per 3 months are current rates. Most homes are sewered.

Buena Vista: The city obtains water supply from Cottonwood Creek and infiltration galleries near Cottonwood Creek. The city has experienced a sudden increase in population during the 1950-1960 period. Present population is estimated to be around 2000.

Salida: Water use and sewage flow estimates were obtained from Mr. R.J. Brazil, Water Superintendent:

Water Use

Nov., Dec., Jan., Feb. and Mar.	± 1, 000, 000 gallons per day
Apr., May, Sept., and Oct.	± 2, 500, 000 gallons per day
June, July, and Aug.	± 5, 000, 000 gallons per day

Sewage

(mechanical plant including primary and secondary treatment)

winter	± 850, 000 gallons per day
summer	± 950, 000 gallons per day

PUEBLO, COLORADO - SEWAGE PUMPING RECORDS

THOUSANDS OF GALLONS TREATED

	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
JAN.	429,580 (13,857)	414,250 (13,363)	623,270 (20,105)	455,040 (14,680)	442,970 (14,289)	545,770 (17,605)	419,235 (13,524)	460,767 (14,863)	542,286 (17,493)	497,546 (16,050)
FEB.	400,920 (14,319)	374,210 (13,365)	353,360 (12,185)	432,796 (15,457)	426,390 (15,228)	550,870 (19,674)	393,374 (13,565)	414,550 (14,805)	440,860 (15,745)	443,508 (15,840)
MAR.	436,260 (14,084)	401,420 (12,949)	383,270 (12,364)	485,398 (15,658)	471,770 (15,218)	417,974 (13,483)	411,941 (13,288)	459,065 (14,809)	501,415 (16,175)	480,655 (15,505)
APR.	435,510 (14,517)	381,650 (12,722)	385,670 (12,856)	469,980 (15,666)	428,500 (14,283)	342,521 (11,417)	375,701 (12,523)	438,831 (14,628)	483,999 (16,133)	458,241 (15,275)
MAY	454,290 (14,645)	449,660 (14,505)	450,500 (14,532)	576,445 (18,595)	506,260 (16,331)	376,610 (12,149)	423,782 (13,670)	459,259 (14,815)	505,744 (16,314)	471,614 (15,213)
JUN.	476,830 (15,894)	488,030 (16,268)	494,980 (16,499)	622,050 (20,735)	517,810 (17,260)	384,230 (12,808)	423,157 (14,105)	511,655 (17,055)	497,414 (16,580)	458,221 (15,274)
JUL.	537,750 (17,347)	561,070 (18,099)	541,190 (17,458)	644,738 (20,798)	545,570 (17,599)	375,729 (12,120)	514,823 (16,607)	521,959 (16,837)	545,074 (17,583)	485,774 (15,670)
AUG.	476,210 (15,361)	589,320 (19,010)	561,610 (18,116)	676,358 (21,818)	553,940 (17,869)	345,804 (11,155)	502,891 (16,222)	558,775 (18,025)	529,308 (17,074)	508,384 (16,399)
SEP.	461,660 (15,389)	617,570 (20,586)	583,840 (19,461)	587,670 (19,589)	539,430 (17,981)	352,564 (11,752)	452,554 (15,085)	504,483 (16,816)	464,541 (15,485)	494,506 (16,484)
OCT.	453,410 (14,626)	598,770 (19,315)	585,460 (18,886)	538,191 (17,361)	542,490 (17,500)	428,826 (13,833)	452,654 (14,602)	517,527 (16,694)	456,966 (14,741)	481,124 (15,520)
NOV.	423,550 (14,118)	592,400 (19,747)	493,000 (16,433)	487,860 (16,262)	499,740 (16,658)	413,359 (13,779)	423,273 (14,109)	463,067 (15,436)	450,815 (15,027)	430,420 (14,347)
DEC.	414,540 (13,372)	650,870 (20,996)	528,630 (17,052)	480,810 (15,150)	546,850 (17,640)	429,710 (13,862)	462,781 (14,928)	472,959 (15,257)	460,190 (14,845)	453,162 (14,618)
TOTAL	5,400,510	6,119,220	5,984,780	6,457,376	6,021,740	4,963,967	5,256,166	5,782,897	5,878,612	5,663,155
MONTHLY AVERAGE	450,043	509,935	498,732	538,115	501,812	413,664	438,014	481,908	489,884	471,930
DAILY AVERAGE	14,794	16,765	16,352	17,691	16,498	13,600	14,361	15,844	16,106	15,515

Security. The city has a total of 12 wells, 10 of which were in use as of February 1965. Security pays $40.00 per acre foot and $50.00 per acre foot for water from the "Spraul Wells" and "Clear Springs Wells" respectively. In addition the city bears the pumping costs. Security paid Widefield $40.00 per acre foot for water during a water shortage in 1964. An estimated population of 11,352 (4.4 persons per tap) was being served in January 1965.

Water rates and policy are listed:

Widefield Estates: The city went on meters January 1963. Prior to that date, excessive water use was quite common. One family was reported to have used about 300,000 gallons during one month.

A flat rate of $3.50 per month is charged for use up to 10,000 gallons; use over 10,000 gallons per month is $0.35 per 1000 gallons.

Fountain: The estimated population served in 1964 was 2500; there were 452 water meters. 59,517,078 gallons and 65,173,464 gallons were used during 1963 and 1964 respectively.

Residential rate: $7.00 minimum per meter
$0.30 per 1000 gallons over 7000 gallons

Commercial rate: $7.00 minimum per meter
$0.30 per 1000 gallons over 14,000 gallons

Double rate outside city limits.

Rocky Ford: Total water supply has been metered since January 1964. (Before January 1964 swimming pool, park watering, golf course and high school - built in 1963 and possibly others were not metered.) 1670 taps in use as of 10-14-64 include light industry such as sugar factory, frozen food processing plant, wool processing plant, meat packing plant, concrete plant, soft drink bottling co., and 5 schools - use patterns for these various units are available in terms of monthly gallonages from ledger sheets in city office.

La Junta: Water taps in service during 1963

Residential	2327
Commercial	206
Total	2533

1963 population within city limits - 8500

Security Water and Sanitation Districts

356 Main Street 392-3475

SECURITY, COLORADO

63

1) All billings are payable in advance, eliminating the need for service deposits. To keep billing costs to a minimum, billings are prepared and mailed on a calendar quarter basis. Payment is due in full within 30 days after the billing date. A Late Charge of $2.00 is assessed against all accounts unpaid 30 days after the quarterly billing date. Further delinquency can result in discontinuance of water service. We realize the $2.00 charge may seem excessive. However, the added expense in processing these delinquent accounts substantiates this charge and places the financial burden on those responsible.

2) All charges for services are against the property itself, and the owner of the property is responsible for the arrangements for payment of these charges. It is, therefore, very important that each new occupant sign for service in order to make our records accurate. When transfer of service is made, because of sale or rental, it is important for the seller and buyer or landlord and tenant, at the time of the sale or rental transaction, to prorate between themselves, any charges already paid or unpaid charges. We cannot overemphasize the importance that we attach to this policy, since deviation from it results in unnecessary costs.

3) Beginning July 1, 1963 our rates are as follows:

Water: 3 months @ $3.50 per month	$10.50
Sewer: 3 months @ $1.25 per month	3.75
Construction Account: 3 months @ $1.25 per month	3.75
Your total quarterly billing amounts to	$18.00

The "Construction Account" charge is for the purpose of paying for construction costs of bringing water from Clear Springs Ranch into our lines. This charge is a temporary one and will be moved when such construction is paid in full.

Lamar: The city obtains water supply from 10 wells in the Clay Creek collection unit, 8 wells in the north collection unit, and from the Clay Creek infiltration gallery. The reported capacity of the well systems is 7.2 million gallon per day; the reported capacity of the infiltration gallery is 300-400 gallons per minute.

La Animas: Four shallow wells are reported to produce about 2400 gallons per minute. Pumpage data are included:

Trinidad: The city obtains water supply from the Purgatoire River and stores in North Lake and Monument Lake about 38 miles west of the city. In 1964 approximately 12,500 population was served (3700 meters). Daily maximum water demands in the summer approach 8,200,000 gallons (± 660 gallons per day per capita). Water restrictions are imposed every year.

1963 and 1964 monthly use data are included: Rate schedules are shown.

Total Used

	1963	1964
Jan	78,362,444	76,725,411
Feb	57,966,501	75,199,355
Mar	65,971,948	77,149,974
Apr	119,426,040	94,330,399
May	96,851,061	140,062,960
June	99,152,583	120,802,475
July	102,168,000	133,052,318
Aug	105,052,948	124,123,968
Sept	89,909,906	97,715,416
Oct	92,656,781	100,132,832
Nov	76,101,272	73,679,138
Dec	73,838,566	76,242,965
	1,057,358,050 gal.	1,188,617,211 gal.
	3244.9 A F.	3647.7 A F.

Residential Flat Rate

Residences - 1-4 rooms - per year	$14.00
Each additional room over 4 - per year	2.00
Bath or shower - per year	6.60
Water closet - per year	6.60
Additional bath or shower - per year	4.00
Lawn sprinkling - per year	2.20
Per 1000 sq. ft. - per year	
Laundry or basement - per year	2.20

City of Las Animas Pumpage (Valley-Fill Aquifer)

Estimated Consumption

1953 -		521, 972, 500	gallons
1954 -		521, 972, 500	
1955 -		696, 972, 500	
1956 -		714, 862, 300	
1957 -		765, 923, 540	
1961 -	July	41, 499, 700	
	Aug.	31, 565, 800	
	Sept.	25, 286, 700	
	Oct.	19, 398, 600	
	Nov.	10, 431, 600	
	Dec.	10, 939, 100	
1962 -	Jan.	10, 875, 400	
	Feb.	10, 055, 500	
	Mar.	15, 698, 300	
	Apr.	26, 494, 700	
	May	34, 916, 600	
1963 -	Apr.	34, 409, 500	
	May	40, 958, 900	
	June	50, 126, 000	
	July	49, 789, 700	
	Aug.	42, 593, 800	
	Sept.	29, 777, 900	
	Oct.	30, 126, 700	
	Nov.	9, 246, 200*	
	Dec.	11, 556, 900	
1964 -	Jan.	11, 872, 000	
	Feb.	13, 755, 200	
	Mar.	16, 993, 100	
	TOTAL	341, 205, 900	gallons

* Meter not in operation part of the month of November, 1963

City of Trinidad, Trinidad, Colo.

Meter Size	W-2 Rate Minimum Charge	W-2 Rate Minimum Water Quantity	W-3 Rate Minimum Charge	W-3 Rate Minimum Water Quantity
5/8 inch	2.00	668 cu. ft.	3.50	700 cu. ft.
3/4 "	2.50	833 " "	4.00	800 " "
1 "	3.00	1,000 " "	5.00	1,000 " "
1-1/4 "	4.00	1,417 " "	7.00	1,500 " "
1-1/2 "	5.00	1,833 " "	9.00	2,000 " "
2 "	8.00	3,083 " "	14.00	3,250 " "
3 "	15.00	6,333 " "	25.00	6,333 " "
4 "	25.00	11,889 " "	45.00	13,000 " "
6 "	50.00	31,167 " "	85.00	32,000 " "
8 "	85.00	60,333 " "	145.00	62,000 " "

W-2 Commercial Metered Rate - Urban

Applicability - Applicable for water service within the corporate limits of the City of Trinidad to commercial, industrial and multi-family uses and optional to single or two family uses.

First	1,000 cubic feet of water used per month, per 100 cubic feet	$..30
Next	4,000 cubic feet of water used per month, per 100 cubic feet	..24
Next	10,000 cubic feet of water used per month, per 100 cubic feet	..18
Additional	cubic feet of water used per month, per 100 cubic feet	..12

W-3 Metered Rate - Rural

Applicability - Applicable for water service outside the corporate limits of the City of Trinidad to all residential, commercial and industrial uses.

First	1,000 cubic feet of water used per month, per 100 cubic feet	$..50
Next	4,000 cubic feet of water used per month, per 100 cubic feet	..40
Next	10,000 cubic feet of water used per month, per 100 cubic feet	..30
Additional	cubic feet of water used per month, per 100 cubic feet	..20

Residential Flat Rate

Residences - 1-4 room	per year	$14.00
Each additional room over 4	"	2.00
Bath or shower	"	6.60
Water closet	"	6.60
Additional bath or shower	"	4.00
Lawn sprinkling per 1000 sq. ft.	"	2.20
Laundry or basement	"	2.20

Walsenburg: The city obtains water supply from the Cucharas River. The system serves an estimated 6000 population (1700 water accounts)(240 meters are located on business establishments only. Water policy and rates are shown:

WATER METER RATES

1/4" METER

MIN.	7,000 Gallons			3.50	
Next	18,000 "	@.30	5.40		8.90
Next	25,000 "	@.20	5.00		13.90
All over	50,000 "	@.15			

Outside City Limits - plus 25 per cent

3/4" METER

MIN.	9,000 Gallons			4.50	
Next	16,000 "	@.30	4.80		9.30
Next	25,000 "	@.20	5.00		14.30
All over	50,000 "	@.15			

Outside City Limits - plus 25 per cent

1" METER

MIN.	10,000 Gallons			5.00	
Next	15,000 "	@.30	4.50		9.50
Next	25,000 "	@.20	5.00		14.50
All over	50,000 "	@.15			

Outside City Limits - plus 25 per cent

SERVICE CHARGES

To 10,000 Gallons	$1.00
10,000 to 25,000	1.50
Over 25,000	2.00

Domestic per capita water consumption in selected cities in the study area varies from about 75 gallons per day to 350 gallons per day.

City	Period	Per Capita Consumption (gallons per day per capita)
Colorado Springs	1963	200
Security, Colo.	Jan. 1964-Dec. 1964	206
Pueblo, Colo.	Oct. 1963-Sept. 1964	207
Fountain, Colo.	Jan. 1964-Dec. 1964	76
Rocky Ford	Feb. 1964-Sept. 1.	290
La Junta	Oct. 1963-Sept. 1964	348
Springfield	Jan. 1963-Dec. 1963	203
Las Animas	Apr. 1963-Mar. 1964	275
Lamar	Jan. 1963-Dec. 1963	210
Leadville	1964	236
	1964 (summer)	286
Trinidad	1964	261

Phreatophytes

A phreatophyte has been defined by the Task Force of the Phreatophyte Subcommittee of the Pacific Southwest Inter-Agency Committee as 'a plant that habitually obtains its water supply from the zone of saturation, either directly or through the capillary fringe'. The water use by these plants is generally considered as non-beneficial consumptive use. In the Arkansas Valley area these plants include cottonwood, salt cedar, willows, reeds, cattails, salt grass and weeds. In a study by Bittinger and Stringham in 1962 approximately 3660 acres of phreatophytes were found to be growing in the bottomland area of the Arkansas River Valley between La Junta and Las Animas and consuming an estimated 15, 000 acre-feet of water annually. The study further indicated that the growth in the study area had been increasing about 50 acres per year during the period 1936-1957. Extension of estimates from the study area indicates that approximately 66, 000 acre-feet of water annually are being consumed by the phreatophytes adjacent to the main stem of the Arkansas River between Pueblo and the Colorado-Kansas State Line. It should be noted that additional phreatophyte growths also exist in several tributary area of the valley. Phreatophyte management is receiving considerable attention in many areas of the water-short west. A glossary of terms pertaining to phreatophytes as developed by the Phreatophyte Subcommittee PSIAC is given in Appendix U.

Other Water Uses

Recreation, fish and game habitat, and pollution abatement are justifiable uses of water and are continuing to receive more and more prestige in Water Resource management plans. In the semi-arid climate of the Arkansas Valley Regional study area, the scarcity of available water supply and surface water storage facilities requires that the above water uses be integrated with irrigation, municipal, and industrial water uses.

"America's pleasure boat fleet has nearly tripled in the last 10 years and there is now 1 pleasure boat in use for every 24 Americans."

Fishing and duck and goose hunting are becoming important economic assets in the study area.

In some areas of the study area, untreated municipal sewage is being discharged directly into natural water courses. Additional supplies of good quality water are needed to dilute the flows to acceptable quality levels for downstream users. In spite of advanced technology and the ability to return sewage plant effluent to near pure conditions, economics will probably dictate that some use of water supply for pollution abatement in natural water courses will be necessary. The old conviction that all natural streams should be full of pure sparkling water at all times will succumb to the existence of a modern riparian population.

TRENDS

Water Supply

The water supply for the Arkansas Valley Regional study area is obtained from precipitation, stream flow, ground water, and trans-mountain diversions. Since precipitation is the original source of the total water supply, trends of both surface and ground-water supplies are related either directly or indirectly to "wet" and "dry" periods. From the standpoint of a long time interval and assuming that an average precipitation value is established for the basin, increase or decrease in water supply at a certain location depends upon importation of more or less new water, change in consumptive use, and/or change in location of use.

Average Annual Discharge at Selected Gaging Stations is given below:

Station	Period of Record	Average Annual Discharge (acre-feet)
Arkansas River at Granite, Colorado	1910-1963	254,800
Arkansas River at Salida, Colorado	1898-1899, 1901-1903, 1909-1963	450,300
Arkansas River at Canon City, Colo.	1888-1963	520,500
Arkansas River near Pueblo, Colorado	1886-87, 1894-1963	515,500
Arkansas River near Nepesta, Colorado	1913-1963	501,700
Arkansas River at La Junta, Colorado	1912-1963	186,100
Arkansas River at Las Animas, Colorado	1939-1963	167,200
Arkansas River below John Martin Reservoir Colorado	1938-1963	250,500
Arkansas River at Lamar, Colorado	1913-1955, 1959-1963	168,700
Arkansas River near Coolidge, Kansas	1950-1963	129,600
Fountain Creek near Colorado Springs, Colo.	1958-1963	7,890
Fountain Creek at Pueblo, Colorado	1922-1925, 1940-1963	36,780
Huerfano River at Manzanares Crossing, near Redwing, Colo.	1923-1963	23,820
Huerfano River below Huerfano Valley Dam, Near Undercliffe, Colo.	1939-1963	28,160

Station	Period of Record	Average Annual Discharge (acre feet)
Cucharas River at Boyd Ranch near LaVeta, Colo.	1934-1963	18,100
Apishapa River near Fowler, Colo.	1922-1925, 1939-1963	25,700
Purgatoire River at Trinidad, Colo.	1895-1899, 1907-1908, 1909-1912, 1915-1960, 1962-1963	64,720
Purgatoire River near Hoehne, Colo.	1954-1963	20,340
Purgatoire River near Alfalfa, Colo.	1905-1907, 1924-1928, 1951-1963	40,400
Purgatoire River at Nine Mile Dam, near	1924-1963	73,840
Purgatoire River near Las Animas, Colo.	1922-1931, 1948-1963	97,010
Grape Creek Near Westcliffe, Colo.	1924-1961, 1962-1963	22,950

Trans-Mountain Diversions

Trans-Mountain Diversion	Owner	Period of Record	Average Annual Flow (acre-feet)
Hoosier Pass Tunnel at Hoosier Pass, Colo.	City of Colorado Springs	1951-1963	7,020
Fremont Pass Ditch at Fremont Pass, Colo.	American Metal, Climax	1928-1963	530
Columbine Ditch near Fremont Pass, Colo.	City of Pueblo	1930-1963	1,020
Ewing Ditch at Tennessee Pass, Colo.	City of Pueblo	1907-1963	1,210
Wurtz Ditch near Tennessee Pass, Colorado	City of Pueblo	1931-1963	2,060
Twin Lakes Tunnel Near Twin Lakes, Colo.	Twin Lakes Reservoir and Canal Co., Ordway	1934-1963	35,830
Busk-Ivanhoe Tunnel near Malta, Colo.	Highline Canal Co. Rocky Ford	1924-1963	4,440
Larkspur Ditch at Marshall Pass, Colo.	Catlin Canal Manzanola	1934-1963	130
			52,240

New trans-mountain diversion projects will increase the water supply to the area; increased utilization of ground water and/or surface water increases the consumptive use and decreases the water supply in the area; transferring a diversion location upstream may allow more complete fullfillment of a decree, cause more consumptive use and consequently reduce the water supply in the area.

A complete review of "Gaging Station Records" - Appendix C and "Major Canal Diversion Records" - Appendix G may indicate long term changes in annual water supply. With increased use in the basin, one can expect that less water remains in the area. The major increase in water use in the last few years has been due to wells. The use by wells has undoubtedly reduced the water supply that had historically been available to junior surface-water decrees. At certain times the well development may be affecting senior surface-water decrees. The effect on surface-water decrees by operation of wells in the alluvial-filled valley of the streams was one of the major reasons for Colorado's "new" ground-water law.

Ground-water use has generally been increasing in the area with El Paso, Pueblo, Otero, Baca, Prowers, and Bent Counties having the more extensive ground-water development. The majority of the pumped ground water is used for agriculture . In most of the irrigated counties, ground water is used to supplement surface-water supplies. A summary of wells by type for each county is shown.

Historical ground-water level hydrographs for selected observation wells are illustrated in Appendix M. "Dry" periods may impose heavy ground-water pumping conditions on the ground-water reservoir and correspondingly cause declines in water-table levels. During "wet" periods the increased stream flow and precipitation penetration to the water table correspondingly causes the water table to rise. Long term trends in water table level changes indicate either over development of the ground-water reservoir or changing physical conditions. Ground-water levels in Baca County are beginning to decline at the rate of about 4 feet per year. Under present conditions of recharge and withdrawal, certain areas of Baca County can be considered as overdeveloped. Ground-water levels in an area on the north side of the Arkansas River between Boone and Nepesta (see well C21-61-23 dac Pueblo County) are actually rising. The rise may be attributed to aggradation of the River channel in the area.

Summary of No. of Wells by Type for Each County - 1964

County	Domestic	Stock	Domestic Stock	Commercial	Industrial	Irrigation	Irrigation Stock	Municipal	Total
Baca	40	109	16	1	8	448	2	11	635
Bent	26	79	12	10	0	194	6	8	335
Chaffee	236	5	0	18	4	23	5	6	297
Crowley	19	31	12	0	1	102	5	5	175
Custer	47	20	6	0	0	31	10	3	117
El Paso	1348	235	54	27	11	289	12	37	2013
Fremont	106	14	8	5	11	30	2	4	180
Huerfano	53	62	8	2	21	12	1	2	161
Kiowa	5	29	4	0	0	25	1	11	75
Lake	108	0	0	6	1	0	0	1	116
Las Animas	27	191	13	0	12	35	10	4	292
Otero	95	58	21	23	23	515	26	34	795
Prowers	45	91	6	5	3	399	4	45	598
Pueblo	675	89	38	36	30	758	36	27	1689
Teller	106	9	1	0	1	4	0	4	125

Water Demand

A Chronologic listing of well development, and well development graphs are given in Exhibits F and G respectively. In general the utilization of ground water for all use has been increasing quite rapidly since the early 1950's. The majority of the potential quantity of use increase is due to irrigation wells. In Chaffee, Custer, El Paso, Fremont, Huerfano, Pueblo, Teller and Lake counties the greatest increase of ground-water use has been for domestic use. The use of ground-water for stock use has increased sharply in Kiowa and Las Animas counties.

Considering the period of 1950 - 1964, water commissioners annual reports indicate an increase in surface water diversion in water district 10; little change in water district 11; little change in water district 12; little change in water district 13; little change in water district 14; slight increase in water district 15; decrease in water district 16; little change in water district 17; slight decrease in water district 18; little change in water district 19; decrease in water district 49; increase in water district 66; and slight decrease in water district 67. Average annual diversions for selected canals are given in the following table:

Quality

Quality sampling stations presently being maintained in the Arkansas Valley by the U. S. Geological Survey, Water Resources Division, (Quality of Water) are listed. Quality data are reportedly to be made available in the near future.

The sources of limited quality data are given for certain counties:

Baca: "Geology and Ground Water Resources of Baca County, Colorado, T. G. McLaughlin, Ground Water Series Bulletin No. 2, pp 67-81.

Bent: "Colorado Ground Water Basic Data Report No. 14", M. E. Broom and J. H. Irwin, pp 38-40.

"Quality of Surface Waters In Colorado, October 1962 to September 1963", Data Release No. 1, USGS, Water Resources Division, pp 28-30.

Chaffee: "Public Water Supplies of Colorado", D. O. Gregg, E. L. Meyer, M. M. Targy, and E. A. Moulder, General Series 757, USGS and C.S.U. pp 102.

Crowley: "Water In the Dakota and Purgatoire Formations In Otero County and the Southern Part of Crowley County, Colorado.", W.S.P. 1669-P, pp 13-16

AVERAGE ANNUAL DIVERSIONS FOR SELECTED CANALS

Canal	Period of Record	Av. Ann. Diversion (acre-feet)
Pickett Ditch	1940-1963	300
Pleasant Valley Ditch	1940-1963	2400
Porter-Woodriff-Tells Ditch	1940-1963	400
Canon City Ditch	1946-1963	3900
South Canon City Ditch	1940-1963	14500
Union Ditch	1940-1963	9500
Canon City Hydraulic and Irrigation Co. Ditch	1939-1963	24800
Canon City and Oil Creek Ditch	1939-1963	10100
Fremont County Ditch	1940-1963	6900
Minnequa Ditch	1943-1963	70500
Hannenkratt Ditch	1940-1963	500
Lester and Atterberry Ditch	1940-1963	1000
Hobson Ditch	1940-1963	1000
Bessemer Ditch	1910-1963	62600
Booth Orchard Grove Ditch	1910-1963	7800
Excelsior Ditch	1910-1963	4900
Collier Ditch	1956-1963	1200
Colorado Canal	1910-1963	79200
Rocky Ford Highline	1910-1963	73300
Oxford Farmers Ditch	1910-1963	24600
Otero Canal	1910-1963	12000
Catlin Canal	1910-1963	80900
Holbrook Canal	1910-1963	34000
Rocky Ford Ditch	1910-1963	47000
Ft. Lyon Storage Canal	1910-1963	31700
Ft. Lyon Canal	1910-1963	221900
Las Animas Consolidated Ditch	1910-1963	24000
Las Animas Town Ditch	1910-1963	10200
Fort Bent Canal	1910-1963	16500
Keesee Ditch	1910-1963	3800
Amity Canal	1910-1963	81300
Lamar Canal	1910-1963	34800
Hyde Ditch	1910-1963	1900
Manvel Ditch	1910-1963	3700
XY and Graham Canals	1910-1963	7200
Buffalo Canal	1910-1963	12100
Sisson Ditch	1910-1963	1300
Ninemile Canal	1923-1963	5000
Highland Canal	1924-1963	6400

Arkansas Valley Surface Water Quality Sampling Stations

I Continuous Conductivity Records
1. Arkansas River at Nepesta
2. Arkansas River at Fort Lyon Canal Diversion near La Junta
3. Arkansas River at Las Animas

II Daily Conductivity Records
1. Arkansas River at Pueblo
2. Arkansas River below John Martin Dam
3. Arkansas River at Coolidge, Kansas

III Weekly Chemical Quality Records
1. Arkansas River at Coolidge, Kansas

IV Monthly Chemical Quality Records
1. Arkansas River at Canon City
2. Arkansas River at Pueblo
3. Fountain Creek at Pueblo
4. Arkansas River at Nepesta
5. Apishapa River near Fowler
6. Arkansas River at Fort Lyon Canal Diversion, near La Junta
7. Arkansas River at Las Animas
8. Purgatoire River near Las Animas
9. Arkansas River below John Martin Dam
10. Arkansas River near Lamar
11. Arkansas River near Granada
12. Arkansas River at Coolidge, Kansas

Locations of Wells for Which Chemical Quality Data has Been Collected

23-43-21	abc Kansas
23-41-29	bbc
22-42-26	bda
23-42- 2	bcd
4	bcb
8	cbb
14	bcc
32	bdc
22-43- 9	dcd
23-43- 4	ddd
6	cbc
14	acd
24	adc
22-44-19	aba
21	dda
32	adc
23-44- 3	bdc
22	bbb
22-45- 4	ba
13	dcd
22	caa
23	bbb
22-52-25	abb
26	bac
31	cbc
33	bcb
35	ccc
23-52- 3	dca
4	dac
6	bbd
10	bbc
22-45-23	cdc
30	ccc
32	aad
23-45- 1	bbb
22-46-15	bcc
30	ddd
23-46- 3	cbd
10	cdd
22	bab
22-47-23	aba
30	cdc
21-48-14	add
25	bbb
22-48-34	ada
35	dbc
23-48- 6	dab
22-49-28	bca
23-49-12	baa
22-51-21	bca
31	ccc
32	aaa
23-51- 4	bbb
18	abb
18	daa

Continued

Continued

22-54-20	bbd
29	bbb
23-54-13	bbd
16	ddd
24	bbc
27	bcc
28	cbb
23-55-31	abc
32	aab
11	dac
15	ddc
16	ccb
18	abb
22-53-24	bcb
26	acc
28	ccb
32	ddc
35	aad
23-53- 2	abc
2	cac
4	cbb
9	bba
10	ddd
12	acc
22-57-28	cbb
30	cdd
23-57- 3	bda
11	dca
21-58-15	dbb
22	dcd
27	dcd

22-58- 3	ccb
5	ccc
15	cbd
18	cbd
21	cbb
22	cbc
25	ccc
21-59-21	ccc
22-59- 1	dab
9	c
15	abb
16	bcc
24	bbb
25	bdd
32	dca
34	dca
36	dcc
24-55- 2	bca
21-56- 2	cab
23-56- 2	cda
5	dcc
6	baa
15	bda
17	aba
23	aab
23	ccc
21-57-21	ccb
22-57-27	adb
28	aba

Continued

Continued

22-60- 3	baa
11	bda
31	a
20-61-31	bcb
21-61- 7	aaa
7	dcb
9	dbd
17	abc
24	cdd
22-61-26	bbb
20-62-22	cda
21-62- 2	ccc
4	bab
7	bdbc
13	bcb
16	bcb
22-62- 9	dbd
20-63-33	aba
36	cba
21-63- 3	bac
5	acc
26	c
28	b
19-64-36	dcb
20-64-18	cba
33	cba
34	bac
36	bcd
21-64- 1	bcc
3	acbc
5	abb
6	aaa
9	bcd
10	dbcb
14	aaa
19-65-36	bdd
20-65-31	ddc
33	dca
34	adb
36	acc
36	baa
21-65- 5	bab
20-66-34	dca
20-67-14	cdd
19-68-20	aab
7	dcc
9	ccc
13	add
15	acd
19-69- 7	cda
13	dad
17	abd
21	baa
19-70- 4	aad

Custer: "Public Water Supplies of Colorado", General Series 757, USGS - CSU, pp 106.

El Paso: "Ground-Water in Fountain and Jimmy Camp Valleys, El Paso County Colorado," WSP 1583, pp 46-52.

Fremont: "Colorado Ground Water Basic Data Release No. 18," pp 26-27.

Huerfano: "Colorado Ground Water Basic Data Report No. 4" pp 17-21.

Kiowa: "Geology and Ground-Water Resources in Eastern Cheyenne and Kiowa Counties, Colorado," 1779-N, pp 17-30.

Lake: "Public Water Supplies of Colorado", General Series 757, USGS, CSU, pp 105.

Las Animas: "Public Water Supplies of Colorado", General Series 757, USGS, CSU, pp 107.

Otero: "Water in the Dakota and Purgatoire Fountions in Otero County and the Southern Part of Crowley County, Colorado", WSP 1669-P, pp 13-16.

Prowers: "Colorado Ground Water Basic Data Report No. 1", P. T. Vogeli and L. A. Hershey, pp 50-52.

Pueblo: "Colorado Ground-Water Basic Data Release No. 18", H. E. McGovern, D. O. Gregg, and R. Brennan. pp 26-27.

Teller: "Public Water Supplies of Colorado", General Series 757, USGS, CSU, pp 103

An excellent publication on "Water Quality Criteria", by McKee and Wolf, should be consulted for water quality considerations.

A list of Sewage Treatment Plants discharging to natural streams and a list of cities obtaining water from natural streams are listed:

SEWAGE TREATMENT PLANTS DISCHARGING TO STREAMS

CITY	STREAM
Las Animas	Arkansas
Buena Vista	Cottonwood Creek
Salida	Arkansas
Ordway	Lake Meredith
Sugar City	Lake Meredith
Air Force Academy	Monument Creek
Colorado Springs	Fountain Creek
Deer Creek Estates	Dirty Woman Creek to Fountain Creek
Fort Carson	Fountain Creek
Fountain	Fountain Creek
North Suburban	Monument Creek
Ramah	Big Sandy Creek
Security	Fountain Creek
Widefield Homes	Fountain Creek
Canon City District	Arkansas
East Canon	Arkansas River
Florence	Arkansas
Portland	Arkansas
LaVeta	Cucharas River
Walsenburg	Cucharas River
Leadville	California Gulch (to Arkansas)
Trinidad	Purgatoire River
LaJunta	Arkansas
Manzanola	Arkansas
Rocky Ford	Arkansas
Swink	Arkansas
Granada	Wolf Creek
Holly	Arkansas
Lamar	Arkansas
Blende	Arkansas
C.F. and I	Salt Creek to Arkansas
Pueblo	Arkansas
Pueblo Army Air Base	Arkansas
Cripple Creek	Cripple Creek to Arkansas
Victor	Cripple Creek to Arkansas
Woodland Park	Fountain Creek

* Sewage treatment ranges from no treatment to adequate treatment

CITIES OBTAINING WATER FROM STREAMS

City	Stream
Salida	Harrington Ditch
Broadmoor	Rosemont - Fisher Canon
Chipita Park	Crystal Lake
Fountain	Little Fountain Creek
Green Mt. Falls	Crystal Creek (Catamount)
Manitou Springs	French Creek - Ruxton Creek
Palmer Lake	Ice Cave Creek and Monument Creek
Rock Creek Mesa	Greenhorn Creek
South Suburban	N and S Cheyenne Creeks
Canon City	Arkansas River
Coal Creek	Coal Creek
Florence	Newlin Creek, Adobe Creek, Mineral Creek, Arkansas River
Penrose	Beaver Creek
Portland	Arkansas River
Royal Gorge Bridge Co.	Arkansas River
Cuchara	Dodgeston Creek
LaVeta	Cucharas River
Walsenburg	Cucharas River
Climax	Buffers Lake
Leadville	Big Evans Creek
Rocky Ford	Arkansas River
Starkville	Clear Creek
Trinidad	Monument and North Lakes
Buelah	Middle Creek
Pueblo	Arkansas River
Pueblo Mt. Park System	So. Creek
Cripple Creek	Pikes Peak, W. Fork of West Beaver Creek
Victor	Pikes Peak, E. Branch of West Beaver Creek
Woodland Park	Lay Creek

Summary of Potential Municipal Users That Could Benefit From Frying Pan Arkansas Project Water in a Valley Pipeline From the Proposed Pueblo Reservoir

Estimated Population Served
Total Annual Need (acre feet)

Community	1960	1970	1980	1990	2000
Pueblo	90,000 (24,000) 230*	120,000 (30,000) 222*	160,000 (38,500) 215*	200,000 (46,000) 207*	240,000 (54,000) 200*
Avondale	700 (160) 200*	875 (185) 188*	1,050 (206) 175*	1,225 (220) 162*	1,400 (235) 150*
Blende	1,000 (225) 200*	1,250 (260) 187*	1,500 (294) 175*	1,750 (320) 162*	2,000 (340) 150*
Boone	600 (135) 200*	750 (160) 187*	900 (176) 175*	1,050 (191) 162*	1,200 (200) 150*
Pueblo Army Depo	4,000 (450) 100*	4,000 (450) 100*	4,000 (450) 100*	4,000 (450) 100*	4,000 (450) 100*
Ordway	1,250 (280) 200*	1,560 (327) 187*	1,870 (367) 175*	2,180 (396) 162*	2,500 (420) 150*
Sugar City	400 (90) 200*	500 (105) 187*	600 (118) 175*	700 (127) 162*	800 (135) 150*
Crowley	300 (70) 200*	375 (79) 187*	450 (88) 175*	525 (95) 162*	600 (100) 150*

* estimated per capita per day use in gallons

(continued)

Community	1960	1970	1980	1990	2000
Olney Springs	260 (60) 200*	325 (68) 187*	390 (76) 175*	455 (83) 162*	520 (90) 150*
Fowler	2,000 (450) 200*	2,500 (524) 187*	3,000 (588) 175*	3,500 (635) 162*	4,000 (672) 150*
La Junta	10,000 (4,000) 350*	12,500 (4,383) 313*	15,000 (4,621) 275*	17,500 (4,665) 238*	20,000 (4,500) 200*
Rocky Ford	6,000 (2,000) 290*	7,500 (2,260) 269*	9,000 (2,470) 245*	10,500 (2,623) 223*	12,000 (2,700) 200*
Manzanola	700 (160) 200*	875 (183) 187*	1,050 (206) 175*	1,225 (222) 162*	1,400 (235) 150*
Swink	500 (110) 200*	625 (131) 187*	750 (147) 175*	875 (159) 162*	1,000 (170) 150*
Cheraw	170 (40) 200*	215 (45) 187*	255 (50) 175*	300 (54) 162*	340 (60) 150*
Las Animas	3,000 (920) 275*	3,750 (1,080) 257*	4,500 (1,200) 238*	5,250 (1,288) 219*	6,000 (1,350) 200*
Fort Lyons	1,200 (200) 150*	1,500 (252) 150*	1,800 (302) 150*	2,100 (353) 150*	2,400 (400) 150*
Hasty	100 (20) 200*	125 (26) 187*	150 (29) 175*	175 (32) 162*	200 (35) 150*
Lamar	8,000 (1,900) 210*	10,000 (2,330) 208*	12,000 (2,756) 205*	14,000 (3,168) 202*	16,000 (3,600) 200*

(continued)

Community	1960	1970	1980	1990	2000
Holly	1,250	1,560	1,875	2,185	2,500
	(280)	(327)	(368)	(396)	(420)
	200*	187*	175*	162*	150*
Granada	700	875	1,050	1,225	1,400
	(160)	(183	(206)	(222)	(235)
	200*	187*	175*	162*	150*
Wiley	400	500	600	700	800
	(90)	(105)	(118)	(127)	(135)
	200*	187*	175*	162*	150*
Bristol	200	250	300	350	400
	(45)	(52)	(59)	(64)	(70)
	200*	187*	175*	162*	150*
Hartman	165	205	250	290	330
	(40)	(43)	(49)	(53)	(55)
	200*	187*	175*	162*	150*

Due to existing quality problems, inadequate and/or undependable water supply, Las Animas, La Junta and Fowler, should consider using Frying Pan Arkansas water as soon as it can be made available.

Other municipalities below the Pueblo Reservoir, should phase project water into their system as quality considerations or water supply system obsolescence dictates. Colorado Springs, Fountain, and Security could certainly benefit from supplemental supplies of project water.

Comparison of Benefits For Alternate Uses of Frying Pan Arkansas Project Water

Supplemental water supply at the right time can mean the difference between a good crop and no crop at all. The value of available water of suitable quality at such times is great. Domestic and industrial water demand is for a relatively constant supply of good quality water. Maximum utilization and benefit of new water to the study area can be achieved by integrating domestic, industrial, and agricultural uses. Return flows from domestic and/or industrial use can be used for irrigation purposes. The order of priority of use of domestic, industrial, and agricultural is logical from the standpoint of quality requirements, pricing and general public sentiment.

Integrated use should begin at the upper end of the watershed to achieve as many re-use cycles of the supply as practical. Correspondingly, since the water quality generally deteriorates in the down-stream direction, domestic, industrial and agriculture uses **should ideally be** located geographically to use the water supplies in that order.

Summary of the Adequacy of Present Water Supplies And Estimated Future Supply Needs

Present water use from natural streams and ground-water reservoirs in the study area is estimated to average 2,600,000 acre feet per year. Irrigation use is estimated to account for the majority of the present use or about 1,800,000 acre-feet annually; ground water sources supply approximately 850,000 acre-feet annually for irrigation use. Domestic, stock, commercial, industrial and municipal supplies utilize approximately 800,000 acre-feet annually; ground-water supplies furnish about 150,000 acre-feet and natural streams furnish about 650,000 acre-feet annually. Severe water shortages frequently exist in the area, especially for agriculture, during dry periods.

Future Water Requirements

Municipal Use

Assuming a per capita use from municipal water systems (including domestic, industrial and public use) for the study area by the year 2000 of 200* gallons per day and an urban population of 1,350,000 the annual water requirement would be about 99 x 10^9 gallons per year or about 302,000 acre-feet per year.

Non-Urban Domestic Use

Assuming a per capita use for domestic purposes by population living in non-urban areas of the study area by the year 2000 of 120 gallons per day and an estimated non-urban population of 135,000, the water requirement would be about 6 x 10^9 gallons per year or about 18,000 acre-feet per year.

Agricultural Use

Estimated total per acre application (surface water and ground water) for irrigated lands in the study area by the year 2000 is 4.4** acre feet per acre. Assuming an irrigated acreage of 600,000 acres, the annual irrigation water requirement would be about 2,640,000 acre-feet.

The total estimated future water supply use by the year 2000 for municipal, non-urban, domestic and agriculture purposes is 3,000,000 acre-feet annually or about 400,000 acre-feet more than the amount presently being utilized on an annual basis. Unless water quality improvement management practices are initiated, additional shortages will exist, expecially in the lower end of the study area.

The future Frying Pan Arkansas Project water and the Homestake Project water will help alleviate water deficiencies in the study area. The expected urban growth pattern, however, might impose some new requirements on the available water supply Due to the intense water supply requirement for an urban population that might be concentrated near the western edge of the study area, the historically available water supply in the newly urbanized areas could be easily depleted. This delivery problem would require radical changes in the present water resources management of the area and would undoubtedly further increase the area-wide water supply deficiency.

The possibility for getting additional water supplies from outside the study area for future needs is becoming more remote with each passing day. Additional available water supplies will have to come from within the area. Initially, urban water supply deficiencies will probably be supplied from internally purchased irrigation water supplies. ~~By the year 2000, available water supply will probably support only about 300,000 acres of irrigated~~

~~* gallons per capita per day~~

As the market value for additional water supply increases, municipal re-use and overall water use efficiency will prove economical. Additional water supply can be made available within the study through phreatophyte management, evaporation suppression, seepage reduction in canal systems, weather modification, watershed modification (above and below timber line), public water conservation indoctrination programs, improved sewage disposal systems, substitution of low water crops and low water use industry, possible water metering for all uses and improved water resource management programs for the entire study area as a unit.

Recommendations

Under the sponsorship of the Colorado Water Conservation Board, Colorado State University has developed a mathematical model for evaluating the interrelationship between surface water and ground water in the Arkansas River Valley. Appropriate equations and data are programmed for a "high speed digital computer" (IBM-7094). The U.S. Geological Survey have constructed an electric analog model for the Arkansas River Valley to evaluate the interrelationship between surface water and ground water. Colorado State University's mathematical model can be easily adapted to other areas in Colorado and has the added capability of doing quality studies. Either one or both of the above models could be utilized in trial water resource plans.

Weather modification studies by the Atmospheric Science Department, Colorado State University, and snow fence installations on the watershed above timberline and their effect on snowfall accumulation, by the U.S. Forest Service, are being made in the upper Arkansas River basin.

These studies are getting underway and may point up the possibility of new management programs for increasing the water supply to the basin.

New concepts of water management for more efficient use of the available water supply are needed for the study area. Development and acceptance of new programs will need to start at the local level in the area. The Colorado State University Extension Service can materially assist in this phase. A list of the State Staff and professional employees of the Colorado State University Extension Service and the Colorado Agricultural Experiment Station are attached.

COLORADO STATE UNIVERSITY
EXTENSION SERVICE
Fort Collins, Colorado 80521

State Staff

January 1, 1965

Administrative		Building	Phone No.
Lowell H. Watts	Director of Agricultural Programs & Director of Extension	Admin.	491-6281
S. Avery Bice	Associate Director	Admin.	491-6285
Frank C. Taylor	Assistant Director	Admin.	491-6283
Sherman S. Hoar	Staff Assistant	Admin.	491-6522
Program Leaders			
Carl W. Herman	Agricultural Programs	Admin.	491-6522
Mrs. Clara Anderson	Home Economics Programs	Admin.	491-6247
Cecil G. Staver	4-H Club & Youth Programs	Admin.	491-6421
Carl J. Hoffman	Education & Training	Admin.	491-6289
George E. Bevard	Information	Student Serv.	491-6432
District Agents			
Ronald P. Brady	District I, Northcentral	Admin.	491-6521
Donald K. Chadwick	District II, Eastern	Admin.	491-6287
Charles E. Nelson	District III, Southcentral	Admin.	491-6521
Gordon T. Mickle	District IV, Western	Admin.	491-6287
Program Specialists			
Bert L. Bohnont	Agricultural Chemicals	Agriculture	491-6353
*Thomas B. Borden	Forestry	Student Serv.	491-6304
Raleigh E. Brooks	4-H Club Work	Admin.	491-6421
Floyd E. Brown	Irrigation	Engineering	491-6172
William W. Brown, Jr.	Veterinary	Vet. Med.	491-6186
Stewart G. Case	Community Development	Economics	491-6229
Harry E. Crim	Farm Management	Economics	491-6156
William R. Culbertson	Animal Husbandry	Animal Sci.	491-6393
*Don J. Dallas, Jr.	Radio and TV	Student Serv.	491-6433
*N. Preston Davis	Visual Aids	Student Serv.	491-6331
Lester E. Dickens	Plant Pathology	Plant Sci.	491-6470
Charles M. Drage	Horticulture	Plant Sci.	491-6481
James W. Echols	Seed Certification	Plant Sci.	491-6201
*Melvin L. Eckard	In-service Training	Admin.	491-6289
*James E. Ells	Canning Crops	Plant Sci.	491-6572
*Howard L. Enos	Poultry Husbandry	Animal Sci.	491-6233
*Roy H. Follett	Soil Testing	Old Soils	491-5061
William A. Greer	Rural Civil Defense	Economics	491-5248
Henry P. Tronemoller	Farm Management	Economics	491-6156
William Hantsbarger	Entomology	Agriculture	491-6345
Theodore E. Hartung	Poultry Marketing	Animal Sci.	491-6340
P. Eugene Heikes	Weeds	Weed Lab.	491-6537
Marvin W. Heeney	Livestock Nutrition	Animal Sci.	491-6805
Daniel Hilleman	Extension Editor	Student Serv.	491-6433

State Staff (continued) January 1, 1966

Mrs. Ann Jackson	Clothing	South Hall	491-6241
Dawson C. Jordan	Dairying	Animal Sci.	491-6392
Fred B. Kaehler	4-H Club Work	Admin.	491-6421
Kenneth W. Knutson	Potato Improvement	Plant Sci.	491-6372
Ralph J. Kotich	Soil and Water Conservation	Student Serv.	491-6305
Mrs. Jeannette Lynch	Consumer Marketing	Economics	491-6167
Mrs. Mildred Masterson	Home Economics	Admin.	491-6287
John K. Matsushima	Livestock Nutrition	Animal Sci.	491-6394
*Lawrence McMillan	Conference Services	Admin.	491-6222
Mrs. Madeline Moos	Home Management	South Hall	491-6241
S. Kenneth Oakleaf	Agricultural Economics	Economics	491-6229
Donald K. Olsen	Fiscal	Admin.	491-6248
Paul S. Pattengale	Animal Husbandry	Animal Sci.	491-6393
*John O. Reuss	Agronomy - Soils	Plant Sci.	491-6408
Audrey M. Sandstead	4-H Club Work	Admin.	491-6421
George E. Scott	Sheep and Wool	Animal Sci.	491-6191
Mrs. Mary G. Shaffer	Home Furnishings	South Hall	491-6241
*Theodore N. Sherman	Publications	Printing	491-6622
Mrs. Leslie W. Smith	Foods and Nutrition	South Hall	491-6241
William G. Stewart	Agronomy	Plant Sci.	491-6201
Orville J. Trenary	Agricultural Engineering	Engineering	491-6172
*John A. Wallize	Agricultural Information	Student Serv.	491-6433
J. Hugh Winn	Livestock Marketing	Economics	491-6493
*Mrs. Marcile Wood	Home Economics Information	Student Serv.	491-6433
Vacancy	Wheat Marketing	Economics	491-6493

*Part time Extension

COLORADO STATE UNIVERSITY
EXTENSION SERVICE PERSONNEL

Extension Agents

January 1, 1966

Dist.	County	Agent	Headquarters	Phone No.
I	Adams	Alvin L. Lesser	County Courthouse, Brighton 80601	659-2120
I	Arapahoe	Charles F. Lane	County Courthouse, Littleton 80120	798-3533
IV	Archuleta	Robert L. Seaton	P.O. Box 457, Pagosa Springs 81147	968-5931
II	Baca	Thomas J. Doherty	County Courthouse, Springfld 81073	523-5971
II	Bent	Dale W. Kesterson	708 Carson Ave.,Las Animas 81054	456-0764
I	Boulder	Charles W. Bliss	S.C.S. Building, Longmont 80501	776-4865
III	Chaffee	Leon S. Stanton	213 E. Third, Salida 81201	539-6447
II	Cheyenne	Quentin E. Vance	P.O. Box 536, Cheyenne Wells 80810	767-5716
III	Conejos	Leslie S. Porter	P.O. Box 250, La Jara 81140	274-5200
III	Costilla	Roxy A. Romine	P.O. Box 25, San Luis 81152	672-4861
II	Crowley	Arnold C. Wilshusen	P.O. Box 58, Ordway 81063	7741
I	Denver	Herbert C. Gundell	1300 E. Virginia Ave., Denver 80209	297-2715
IV	Dolores	Loren W. Alexander	P.O. Box 527, Dove Creek 81324	677-2283
III	Douglas	Charles E. Kirk	P.O. Box G, Castle Rock 80104	688-3096
IV	Eagle	Samuel O. Kuntz	P.O. Box 713, Eagle 81631	328-2670
II	Elbert	Raymond E. Peterson	P.O. Box 128, Simla 80835	541-2361
III	El Paso	Forest T. McWilliams	County Office Building 27 E. Vermijo, Colo. Springs 80903	632-5611
III	Fremont	Donald L. Svedman	P.O. Box 590, Canon City 81212	275-5976
IV	Garfield	Ray D. Cogburn	P.O. Box 447, Glenwood Sprgs. 81601	945-6330
IV	Grand	Robert M. Teegarden	R.F.A. Building, Kremmling 80459	724-3438
III	Gunnison	George H. Ellicott	County Courthouse, Gunnison 81230	641-0858
III	Huerfano	Angelo A. Blase	County Courthouse, Walsenburg 81089	738-2170
I	Jefferson	John L. Fuqua	15200 W. 6th Ave., Golden 80401	279-4811
II	Kiowa	Bruce G. Whitmore	County Courthouse, Eads 81036	438-5321
II	Kit Carson	Robert L. Croissant	County Courthouse, Burlington 80807	346-8577
IV	La Plata	Ivan L. Lorenz	P. O. Box 261, Durango 81300	247-4355
IV	La Plata	Leon L. Hopkins	Indian Affairs Bldg., Ignacio 81137	3221
I	Larimer	Donald L. McMillen	P. O. Box 543, Fort Collins 80521	482-4722
III	Las Animas	Roy D. Pattison	County Courthouse, Trinidad 81082	846-5861
II	Lincoln	Robert L. Wardell	County Courthouse, Hugo 80821	743-2442
I	Logan	James W. Read	P. O. Box 950, Sterling 80751	522-3205
IV	Moffat	Walter J. Gregory	County Courthouse, Craig 81625	824-5673
IV	Montezuma	Glenn E. Wilson	County Courthouse, Cortez 81321	565-3123
I	Morgan	Chester R. Fithian	County Courthouse, Ft. Morgan 80701	867-2403
II	Otero	Charles D. Bird	P. O. Box 190, Rocky Ford 81067	254-3721
III	Park	Thomas H. Knight	P. O. Box 247, Fairplay 80440	836-2441
II	Phillips	Darrel L. Schafer	County Courthouse, Holyoke 80734	854-2030
II	Prowers	Fred A. Fitzsimmons	P. O. Box 511, Lamar 81052	336-2631
III	Pueblo	Melvin V. Haines	County Courthouse, Pueblo 81005	543-3550
IV	Rio Blanco	William S. Ball	County Courthouse, Meeker 81641	41
IV	Routt	Charles Miller	County Courthouse, Steamboat Sprgs. 80477	879-0825
IV	San Miguel	Samuel P. Haslem	Norwood City Hall, Norwood 81423	327-4383
II	Sedgwick	Dale K. Pfau	P. O. Box 289, Julesburg 80737	474-3479
III	Teller	Clyde Richardson	P. O. Box 368, Cripple Creek 80813	689-2552
II	Washington	Donald L. Figurski	County Courthouse, Akron 80720	345-6668
I	Weld	George L. Jones	Co. Services Bldg. Greeley 80631	353-2212
II	Yuma	Thomas A. LaOuey	County Courthouse, Wray 80758	241-J

COLORADO STATE UNIVERSITY
EXTENSION SERVICE

Area Agents

San Luis Valley Area

January 1, 1965

Dist.	Agent	Headquarters	Phone No.
III	Bernie A. Williams Area Extension Agent	P. O. Box 329, Alamosa 81101	589-2771
III	Mrs. Connie Gamble Area Extension Home Agent	P. O. Box 150, Monte Vista 81144	852-2841
III	John C. Hansen Area Horticulturist	P. O. Box 150, Monte Vista 81144	852-2841
III	Oliver C. Hill Area 4-H Club Agent	P. O. Box 329, Alamosa 81101	589-2771
III	Abram J. Relyea Area Agronomist	P. O. Box 329, Alamosa 81101	589-2771
III	James M. Sachse Area Animal Husbandman	P. O. Box 150, Monte Vista 81144	852-2841
III	~~Janice S. Schneider~~ Area Home Agent	P. O. Box 329, Alamosa 81101	589-2771

Iri River Extension Area

IV	James H. Doyle Area Extension Agent	P. O. Box 98, Delta 85716	874-3519
IV	Theodore G. Collin Area 4-H Club Agent	P. O. Box 449, Montrose 81401	249-3935
IV	Vernon P. Cornforth Area Animal Husbandman	P. O. Box 449, Montrose 81401	249-3935
IV	John W. Freziores Area 4-H Club Agent	P. O. Box 628, Grand Junction 81501	242-9542
IV	~~Carl K. Kendall~~ Area Horticulturist	P. O. Box 98, Delta 85716	874-3519
IV	James W. Swartz Area Agronomist	P. O. Box 628, Grand Junction 81501	242-9542
IV	Nadine F. Thompson Area Extension Home Agent	P. O. Box 628, Grand Junction 81501	242-9542
IV	Vacancy Area Extension Home Agent	P. O. Box 449, Montrose 81401	249-3935

Western Slope Branch Station

IV	C. R. Ure Area Horticulturist	3174 B 1/2 Road, Grand Junction 81501	243-2613

COLORADO STATE UNIVERSITY
EXTENSION SERVICE PERSONNEL

Assistant Agents

January 1, 1965

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I	Adams	James L. Adams	County Courthouse, Brighton 80601	659-2120
I	Adams	James W. Davidson	County Courthouse, Brighton 80601	659-2120
I	Arapahoe	W. Floyd Shoemaker	County Courthouse, Littleton 80120	798-8533
II	Baca	Leland R. Barden	County Courthouse, Springfld 81073	523-4971
I	Boulder	Charles Sylvester, Jr.	S.C.S. Building, Longmont 80501	776-4865
I	Denver	Elmer E. Rothman	1300 E. Virginia, Denver 80209	297-2716
I	Denver	Robert D. Buck	1300 E. Virginia, Denver 80209	297-2716
II	Elbert	E. Wayne Anderson	P. O. Box 126, Simla 80835	541-2361
III	El Paso	Nathaniel E. Fine	27 E. Vermijo, Colo. Sprgs. 80903	632-9511
III	Fremont	Larry L. Wagner	P. O. Box 590, Canon City 81212	275-8576
IV	Garfield	Norvin H. Frerichs	P. O. Box 447, Glenwood Sprgs 81601	945-6333
I	Jefferson	Dwight H. Paca	15200 W. 6th Ave., Golden 80401	279-4611
II	Kit Carson	Carl E. Sciacca	County Courthouse, Burlington 80807	346-8672
I	Larimer	Robert L. Davidson	P. O. Box 583, Fort Collins 80521	482-4822
III	Las Animas	A. Bruce Johnson	County Courthouse, Trinidad 81082	846-8881
I	Logan	Richard E. Scott	P. O. Box 950, Sterling 80751	522-3305
I	Morgan	William B. Walek	County Courthouse, Ft Morgan 80701	867-2933
I	Morgan	E. Wayne Colette	County Courthouse, Ft Morgan 80701	867-2933
II	Otero	William L. Wilson	P. O. Box 190, Rocky Ford 81067	254-3721
III	Pueblo	Vacancy	County Courthouse, Pueblo 81005	543-3550
II	Washington	Richard L. Travis	County Courthouse, Akron 80720	345-2363
I	Weld	Alvie W. Rothe	Co. Services Bldg. Greeley 80631	353-2212
I	Weld	Robert H. Wardlaw	Co. Services Bldg. Greeley 80631	353-2212
I	Weld	Charles Y. Urano	Co. Services Bldg. Greeley 80631	353-2212
I	Weld	Stanley L. Boyes	Co. Services Bldg. Greeley 80631	353-2212
I	Weld	~~W. Arden Colette~~	Co. Services Bldg. Greeley 80631	353-2212
II	Yuma	Clifford A. Leonard	County Courthouse, Wray 80758	241-3

PROFESSIONAL EMPLOYEES
Colorado Agricultural Experiment Station
Colorado State University
July 1, 1965

MAIN STATION

SECTION	TITLE
DIRECTOR:	
Hervey, D. F.	Acting Director
Hamilton, G. W.	Administrative Assistant
Eldin, F. E.	Junior Programmer
INFORMATION SERVICE:	
Wallize, J. A.	Experiment Station Editor
Butterff, E. L.	Publications Distributions Supv.
Dallas, D. J., Jr.	Radio and TV Specialist
Pearce, J. B.	Assistant Experiment Station Ed.
Siple, L. C.	Publications Editor
Wood, Marcile N.	Home Economics Editor
BIOMETRICS UNIT:	
Williams, J. S.	Associate Statistician In Charge
Boes, D. C.	Assistant Statistician
Craswell, J. K.	Assistant Statistician
Mielke, P. W.	Assistant Statistician
AGRONOMY:	
Whitney, R. S.	Chief Agronomist (Soils)
Brengle, K. G.	Associate Agronomist (Soils)
Crumpacker, D. W.	Associate Agronomist (Crops)
Curtis, B. C.	Associate Agronomist (Crops)
Danielson, R. E.	Agronomist (Soils)
Dotzenko, A. D.	Associate Agronomist (Crops)
Doxtader, K. G.	Assistant Agronomist (Soils)
Franklin, W. T.	Assistant Agronomist (Soils)
Haus, T. E.	Agronomist (Crops)
Heil, R. D.	Assistant Agronomist (Soils)
Johnson, D. D.	Agronomist (Soils)
Kemper, W. D.	Agronomist (Soils)
Leonard, W. H.	Agronomist (Crops)
Lindsay, W. L.	Associate Agronomist (Soils)
Phipps, R. L.	Junior Agronomist (Soils)
Reeves, D. L.	Junior Agronomist (Crops)
Robertson, D. W.	Agronomist (Crops)
Romine, D. S.	Associate Agronomist (Soils)
Romsdal, S. D.	Assistant Agronomist (Soils)
Schmehl, W. R.	Agronomist (Soils)
Wood, D. R.	Agronomist (Crops)

Professional Employees
Colorado Agricultural Experiment Station — July 1, 1965

ANIMAL SCIENCE:

Story, C. D.	Chief Animal Scientist
Bullis, D. D.	Assistant Dairy Scientist
Connell, W. E.	Animal Scientist
Cramer, D. A.	Associate Animal Scientist
Daugherty, F. C.	Animal Scientist
Eaplin, A. L.	Animal Scientist
Heeney, M. W.	Assistant Animal Scientist
Johnson, H. R.	Junior Animal Scientist
Johnson, J. E.	Junior Animal Scientist
Knox, K. L.	Assistant Animal Scientist
Matsushima, J. K.	Animal Scientist
Nagy, J. G.	Junior Animal Scientist
Richardson, G. L.	Junior Animal Scientist
Snyder, W. E.	Associate Dairy Scientist
Stonaker, H. H.	Animal Scientist
Sutherland, T. M.	Associate Animal Scientist
Swanson, V. B.	Assistant Animal Scientist
Ward, G. M.	Dairy Scientist
Washburn, L. E.	Animal Scientist
Wilson, D. W.	Junior Animal Scientist

ANIMAL DISEASE:

Jensen, Rue	Chief Pathologist
Boyd, W. L.	Associate Microbiologist
Breen, H.	Associate Pathologist
Chow, F. H.	Assistant Chemist
Chow, T. L.	Associate Virologist
Collier, J. R.	Pathologist
Homar, D.	Assistant Chemist
Hibler, C. P.	Associate Parasitologist
Hoerlein, A. B.	Pathologist
Lueker, D. C.	Assistant Microbiologist
Miller, V. A.	Pathologist
Rubin, R.	Parasitologist
Young, S.	Associate Pathologist

ANIMAL REPRODUCTION (Subsection):

Faulkner, L. C.	Associate Physiologist
Homan, N. R.	Assistant Dairy Husbandman

Professional Employees
Colorado Agricultural Experiment Station — July 1, 1965

BOTANY AND PLANT PATHOLOGY:

Fulks, J. L.	Chief Botanist
Aitman, Jack	Associate Plant Pathologist
Baker, R. R.	Plant Pathologist
Harrington, H. D.	Plant Taxonomist
Harrison, M. B.	Associate Plant Pathologist
Hepworth, H. M.	Junior Plant Physiologist
Klinger, B.	Botanist
Kreutzer, W. A.	Plant Pathologist
Livingston, C. H.	Associate Plant Pathologist
Oshima, M.	Assistant Plant Pathologist
Phillips, D. J.	Junior Plant Pathologist
Ross, M. A.	Junior Plant Physiologist
Smith, D. W.	Assistant Plant Physiologist
Thornton, M. L.	Assistant Botanist

CHEMISTRY:

Mang, D. D.	Chief Biochemist
Churkey, L. W.	Biochemist
Johnson, D. K.	Assistant Biochemist
Johnson, G.	Biochemist
Kano, A. K.	Assistant Biochemist
Payne, M. G.	Biochemist

ENDOCRINOLOGY (Subsection):

Hopwood, M. L.	Biochemist
Masken, J. F.	Assistant Physiologist

ECONOMICS:

Smith, S. C.	Chief Economist
Creek, C. R.	Associate Agricultural Economist
Hartman, L. M.	Associate Agricultural Economist
Hildebrand, P. E.	Assistant Agricultural Economist
Lewis, J. H.	Associate Agricultural Economist
Madsen, A. G.	Assistant Agricultural Economist
Rehnberg, R. D.	Agricultural Economist
Seastone, D. A.	Associate Agricultural Economist
Seckler, D. W.	Assistant Agricultural Economist
Tung, T. H.	Assistant Agricultural Economist
Vernon, T. T.	Junior Agricultural Economist

Professional Employees
Colorado Agricultural Experiment Station — July 1, 1965

ENGINEERING:

Simons, D. B.	Chief, Engineering Section (Civil Engineer)
Baer, Ferdinand	Associate Meteorologist
Barmington, R. D.	Associate Agricultural Engineer
Bell, J. M.	Associate Civil Engineer
Bittinger, M. W. (On Leave)	Associate Civil Engineer
Clark, S. J.	Assistant Agricultural Engineer
Dirmeyer, R. D.	Assistant Civil Engineer
Duke, Harold	Junior Civil Engineer
Evans, N. A.	Agricultural Engineer
Grant, L. O.	Associate Meteorologist
Hansen, R. W.	Associate Agricultural Engineer
Heermann, D. F., Jr.	Junior Agricultural Engineer
Karaki, S.	Associate Civil Engineer
Koloseus, H. J.	Associate Civil Engineer
Longenbaugh, R. A.	Assistant Civil Engineer
Marlatt, W. E.	Associate Meteorologist
Reich, B. M.	Assistant Civil Engineer
Ruff, James	Junior Civil Engineer
Skinner, M. M.	Assistant Civil Engineer
Smith, G. L.	Assistant Civil Engineer
Sunada, D. K.	Assistant Civil Engineer
Ward, J. C.	Associate Civil Engineer
Yevdjevich, V. M.	Civil Engineer

ENTOMOLOGY:

Daniels, L. B.	Chief Entomologist
Jenkins, L. E.	Assistant Entomologist
Johnson, Richard	Assistant Entomologist
Kamal, A. S. (On Leave)	Associate Entomologist
Simpson, R. G.	Assistant Entomologist
Thatcher, T. O.	Entomologist
Wellso, S. G.	Assistant Entomologist
Wilson, W. T. (On Leave)	Assistant Entomologist

FORESTRY AND RANGE MANAGEMENT:

Norris, J. J.	Chief Range Conservationist
Bodig, Jozsef	Assistant Wood Technologist
Everson, A. C.	Associate Range Conservationist
Fechner, G. H.	Associate Forester
Hansen, R. M.	Associate Range Biologist
Huey, B. M.	Associate Forester
Meiman, J. R.	Assistant Watershed Manager
Miller, R. V.	Junior Range Conservationist
Terwilliger, C.	Associate Range Conservationist
Troxell, H. E.	Wood Technologist
Vaughan, T. A.	Associate Range Biologist

Professional Employees
Colorado Agricultural Experiment Station — July 1, 1965

HOME ECONOMICS:

Gifford, E. D.	Chief Home Economist
Bowman, F.	Food Scientist
Combs, M. E.	Assoc. Home Management Scientist
Harvill, L. K.	Associate Nutrition Scientist
Page, E.	Associate Food Scientist
Vance, L. A.	Junior Textile and Clothing Scientist
Weis, A. E.	Associate Nutrition Scientist
Woolrich, A. M.	Assoc. Home Management Scientist

HORTICULTURE:

Foskett, R. L.	Chief Horticulturist
Basham, C. W.	Assistant Horticulturist
Beach, G. C. (Retires 10-1-65)	Horticulturist
Denna, D. W.	Assistant Horticulturist
Ells, J. E.	Assistant Horticulturist
Goldsberry, K. L.	Assistant Floriculturist
Hansen, J. J.	Assistant Floriculturist
Holley, W. D.	Floriculturist
Mackeam, W. C.	Associate Horticulturist
Workman, M.	Associate Horticulturist

POULTRY SCIENCE:

Morsng, R. E.	Chief Poultry Scientist
Enos, H. L.	Assistant Poultry Scientist
Kierhols, E. W.	Assistant Poultry Scientist
Miller, B. F.	Assistant Poultry Scientist
Nockels, C. F.	Junior Poultry Scientist

PHYSIOLOGY:

Booth, N. H.	Chief Physiologist

Professional Employees
Colorado Agricultural Experiment Station — July 1, 1965

BRANCH EXPERIMENT STATIONS

ARKANSAS VALLEY BRANCH STATION, Rocky Ford, Colorado - Phone: 254-6312

Swink, J. F.	Superintendent & Assistant Horticulturist
Dickie, C. W.	Assistant Pathologist
Schweissing, F.	Assistant Entomologist

EASTERN COLORADO RANGE STATION, Waitley Star Route - Phone: 345-6402
Akron, Colorado

Denham, A. H.	Superintendent & Assistant Animal Scientist
Dahl, B. E.	Assistant Range Conservationist

SAN JUAN BASIN BRANCH STATION, Hesperus, Colorado - Phone: 385-4574

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Marquiss, R. W.	Assistant Range Conservationist
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