The Teton watershed : impact of economically efficient utilization of available irrigation water supply by Leslie E Chalmers

A dissertation submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Agricultural Economics
Montana State University
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Abstract:
This study is concerned with agricultural uses presently being made of the diverted waters of the Teton River in the Choteau, Bynum, Agawam, and Farmington areas. The study indicates how the attitudes, physical activities, and economic responses are affected by the limited availability of this natural resource.

The area referred to in the above paragraph lends itself admirably to the practice of irrigated farming with a minimum of capital outlay, but to maximize economic returns the limited irrigation water supply must be utilized in an efficient manner. Institutional determinants are of great significance and influence how the water is utilized.

Historic research, personal interviews, and questionnaires were used to obtain information which provided the data for determining the forces influencing present land usage and an insight into the psychological factors which have had a marked effect upon development of institutions. Soil Conservation and District Court Records have been resorted to in determining standards to be used for comparison purposes and of establishing rights of use.

The resistance to technical advancement in the area of more efficient utilization of the limiting input factor in the maximization of income can be overcome through educational information made available to the operator. This information should be designed not only to establish the economic benefits that can accrue as a result, but also to enhance personal and psychological improvements as to leadership, prestige, importance, power, and personal satisfaction.

A plan of consolidation and cooperation of existing facilities and rights, based upon a goal of technical and economic efficiency has been set forth. This plan will result in technical and economic improvements that will increase the beneficial use of the diverted waters of the Teton River, due to increased efficiency and returns to scale.

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by

Leslie Edwin Chalmers

A dissertation submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree

of

Doctor of Philosophy
in

Agricultural Economics

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August, 1967

ACKNOWLEDGMENTS

Many people have given inspiration and assistance to the author in writing this dissertation. My family deserves first mention for their continued encouragement and patience over the years spent in research and writing.

Dr. Richard J. McConnen, present committee chairman, and Dr. Helmer C. Holje, past committee chairman, are given special thanks for their help in organization and editing. A special thank you goes to Dr. Melvin Monson for his continued encouragement and interest, and to Dr. Chennat Gopalakrishnan for his assistance. Sincere thanks also to Dr. Clarence W. Jensen, Dr. Clive Harston, and Dr. Layton S. Thompson for their suggestions.

The farmers using diverted water from the Teton River deserve credit for their splendid cooperation and many valuable suggestions. Without their willing help, this dissertation would not have been possible.

My thanks to the Teton County Soil Conservation Service personnel; to Mr. Frank Ferentchak and Mr. Charles L. Walter of the State Conservation Office, Bozeman, Montana; and to personnel of the Teton County Clerk of the Court, the County Clerk and Recorder, Land Reclassification, and County Extension Offices, who willingly gave of their time.

To the secretaries in the Economics department, special thanks for their cheerful and willing assistance in preparing this paper for printing.

To the many others that helped in numerous ways, my sincere thanks.

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ABSTRACT

This study is concerned with agricultural uses presently being made of the diverted waters of the Teton River in the Choteau, Bynum, Agawam, and Farmington areas. The study indicates how the attitudes, physical activities, and economic responses are affected by the limited availability of this natural resource.

The area referred to in the above paragraph lends itself admirably to the practice of irrigated farming with a minimum of capital outlay, but to maximize economic returns the limited irrigation water supply must be utilized in an efficient manner. Institutional determinants are of great significance and influence how the water is utilized.

Historic research, personal interviews, and questionnaires were used to obtain information which provided the data for determining the forces influencing present land usage and an insight into the psychological factors which have had a marked effect upon development of institutions. Soil Conservation and District Court Records have been resorted to in determining standards to be used for comparison purposes and of establishing rights of use.

The resistance to technical advancement in the area of more efficient utilization of the limiting input factor in the maximization of income can be overcome through educational information made available to the operator. This information should be designed not only to establish the economic benefits that can accrue as a result, but also to enhance personal and psychological improvements as to leadership, prestige, importance, power, and personal satisfaction.

A plan of consolidation and cooperation of existing facilities and rights, based upon a goal of technical and economic efficiency has been set forth. This plan will result in technical and economic improvements that will increase the beneficial use of the diverted waters of the Teton River, due to increased efficiency and returns to scale.

PART I

FACTORS AFFECTING ECONOMIC DEVELOPMENT OF IRRIGATION WATER

CHAPTER I

A PROSPECTUS

Introduction

When waters from the Teton River were first diverted to irrigate lands in Teton County, Montana, there was no thought in the minds of the original appropriators that this same water would some day become more valuable than the land to which it was to be applied. The original intent was to use the water to prove up on land settled under the various land development programs instituted by the United States government. Water was available to the individuals in what appeared to them to be quantities far beyond their needs, so that little effort was made either to divert or to lay out the ditch systems so as to obtain the greatest use with the least waste. The path of least cost, least labor, and fastest completion was followed. Often the diversion ditches followed the beds of dry creeks, coulees and sloughs. Due to rugged individualism, lack of necessity for cooperation, and natural waterways tending in the same general direction, numbers of ditches were constructed parallel to each other, even at times crossing, each appropriator of water thus having his own private diversion point and ditch.

With the coming of the railroads and the subsequent influx of homesteaders, spurred on by land development companies, some of the private ditches were converted into canal systems designed to provide water, not

for the proving up of isolated ranches, but for sequential blocks of land laid out in 160 acre tracts, settled under the direction of above mentioned land development companies. Those settlers who were unable to obtain land from the existing companies banded together and built their own canal systems, using the roughest of surveys, designed only with the idea in mind to bring water to the greatest number of quarter sections in the shortest possible time.

Operating in this same area were government engineers, not primarily interested in the existing canal structures, but seeking reservoir sites to be used at some future date for storage of surplus water. (Several of these sites have been developed to date, and are being used to store water.)

Today, after many years of technological development in farming and ranching, with the disappearance of the open range and the advent of scientific farming and ranching, with much of the area being devoted to the production of cereal grains, improved pastures and alfalfa hay, the populace is still depending upon and using the antiquated canal systems of earlier times, originally designed to bring water to the land for the primary purpose of "proving up" on government claims.

Today's demand for water has increased many fold, uses are being made of this natural resource that were not considered by the early settlers. As a result, a serious water shortage has developed for some

of the land being irrigated by the waters of the Teton River, while other areas have more water than they can economically efficiently utilize. 1/

Four independent canal systems, often paralleling each other, and at times crossing each other, together with ten individual users having their own private ditch systems, still following the original survey pattern, along with three off-river storage reservoirs, furnish the irrigation water for the area.

1/ Economic efficiency involves the utilization of a resource in a manner to maximize a particular objective. It is not confined to output of produce, but measured in terms of quantities and prices produced compared to quantities and prices of resources consumed.

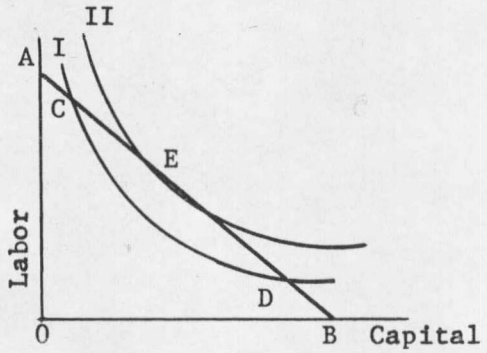


Figure 1. Maximizing Output for a Given Cost

1. AB, isocost curve representing a given level of cost. Any point encompassed by the triangle OAB is attainable.

2. I and II are isoquant curves representing various levels of output.

3. C and D are points where the producer can operate, the required input combinations being available. By a more appropriate combination of inputs, with no additional cost, point E on isoquant II can be reached. Point E is more efficient than points C and D, due to its being on an isoquant curve representing a higher level of output.

This study is undertaken with the intent of finding what use is being made of the waters now being diverted, which areas are shortest of water, and the attitudes of the people involved. It will determine if there is a relationship between shortages of irrigation water and conservation practices being undertaken by the individual farmers and ranchers. Methods to improve efficiency will be considered.

Problem

Economic Inefficiency Plus Institutional Blocks Cause Inefficient Use of Water Resources and Low Disposable Farm Income

Agriculture is a dynamic industry, and in order to keep pace with a growing economy and provide an income that is comparable to other segments of the business world, facing like uncertainties and market structures, it is necessary that it utilize its resources to obtain maximum economic efficiency. 2/

Users of the waters of the Teton River obtained their rights to the use of the waters of the Teton more than half a century ago, when institutions, customs and technology were much different from those of today. The end result has been over-appropriation of the available water, and concentration through subsequent sale of early appropriations into the hands of a few.

2/ When, with given wants, technology and resources, the allocation of resources cannot be reallocated so as to increase total output, maximum economic efficiency has been reached.

Three ditch companies, one reservoir company, and ten individual private users divert water from the Teton for use in Teton County north and northeast of the town of Choteau, for application in an area concentrated in the adjoining communities of Agawam, Bynum and Farmington.

Climatic conditions, soil types, general topographical features, ranching and farming practices are comparable throughout the region. The area is relatively flat, sloping generally in an easterly direction, starting at the foot of the Rocky Mountains and extending through the area covered by the above-mentioned divertees of water.

Storage facilities consist of three small off-stream sites of less than 6,000 acre feet capacity each, owned by two of the ditch companies, plus one larger off-stream site owned by the reservoir company, with a present capacity in excess of 90,000 acre feet. Total storage capacity is 100,000 acre feet.

The third ditch company, having adequate early prior appropriations, deems it unnecessary to maintain storage facilities.

The form of development of land ownership and the present irrigation facilities serving the area under study was not left completely to chance, but followed a pattern influenced by land and water laws of the past. These resulted in canal systems whose direction and turnings were influenced by ease of construction and the desirability of making water available to as many individual plots of ground as possible. The outcome was duplication and paralleling of facilities. At the time of construction, due to custom, institutional factors, and population, this was not thought of as

inefficient use of water, since its purpose was not the same as under present customs, institutions, and population growth. 3/

Shortages of water for irrigation purposes have also been aggravated by changed methods of farming and new cropping practices.

Due to the institutional restraints and customs which have evolved during the developing years of irrigation in this area, the local farm economy finds itself operating at less than maximum economic efficiency, aggravating the farm cost-price squeeze.

Being bound by custom, and institutional blocks perpetuated through the present organizational pattern of numerous independent water companies and their appropriated water rights for beneficial use, and the practice of owning shares for use on total acres in contrast to acre feet of water per acre, the area is faced with the problem of inefficient usage of the available water supply.

Uneconomically utilized and unused resources can be channeled into the most beneficial use to assist in alleviating the cost-price squeeze and to aid the area in attaining an overall increase in economic well-being. Average cost per unit of output can be reduced.

3/ Subject matter relating to institutional factors and their forces in shaping present water and land policy is covered in Chapter II. Land and water policy, a result of institutions and customs, as established in the area served by diverted water of the Teton River, contributes to the economic problems now being faced as regards equity and efficiency. Many of the answers to the questions relating to the allocation of resources between farmers and between segments of the farm population can be found by utilizing historical analysis.

In short run equilibrium, some farms make money, some break even, and some lose money. Those losing money may continue to operate in the short run if variable costs are covered. It is reasonable to conclude from personal interviews with a sampling of 50 percent of the operators chosen at random that examples of all these conditions can be found to exist among farms of this area, due to inequality of availability of water to the individual operators.

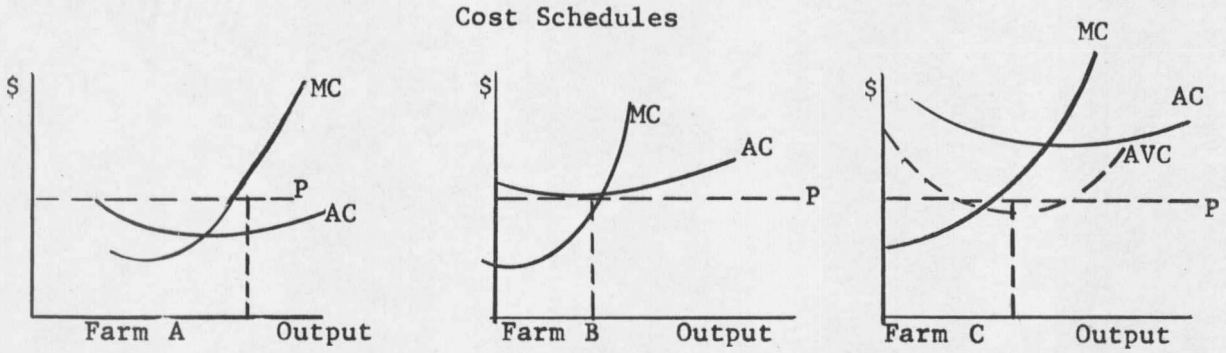


Figure 2. Illustrating Results of Water Resource Inequalities, Assuming All Other Factors Are Efficiently Used and Price Covers Cost of Production

Farm A is making a profit and will capitalize this profit into the price of the land. It may or may not be wasting resources.

Farm B is in long run equilibrium.

Farm C is operating at a loss and will continue to operate only by valuing its labor at less than market value and return to investment at less than average for the area. Technological changes that will shift the average cost curve downward may allow farm C to break even.

It is possible, if the economic and institutional blocks can be mitigated, to shift resources among the various commodities within agriculture as practiced in this area and thereby improve the overall efficiency of all resources. 4/

With increased efficiency the marginal cost curve will shift to the right, and may shift downward.

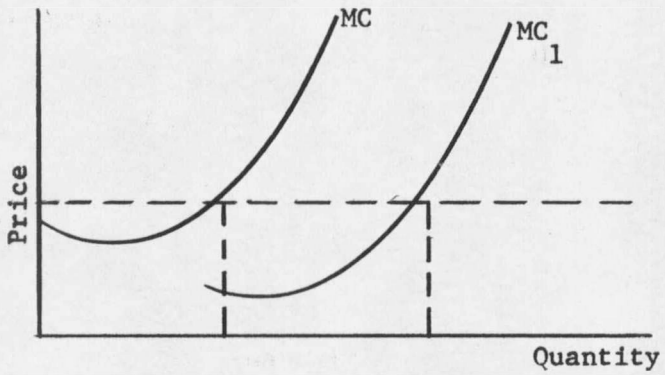


Figure 3. Effect of Change of Supply on Marginal Cost

4/ It is more difficult to shift from cereal grain to apples than to shift from cereal grain to alfalfa, or from alfalfa to pasture. Due to the similarity of products produced, the capital investment required to shift from production of cereal grain to alfalfa or pasture (the three most important outputs of agricultural production on the Teton) is low, and the length of time involved to make the shift, short, resulting in high elasticity of supply for individual commodities. This condition tends to promote greater efficiency in use of input factors.

Due to the shift in the marginal cost curve the aggregate supply curve will shift to the right, generating more aggregate production for the area.

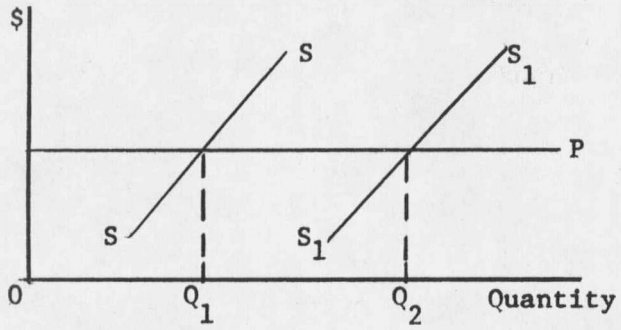


Figure 4. Supply Curve Shift in a Perfectly Competitive Market

The curve labeled MC corresponds to the supply indicated by the curve labeled S in Figure 3, and the curve labeled MC_1 corresponds to the supply indicated by the curve labeled S_1 in Figure 3, which all indicates that if the producers in question can, through better utilization of water resources, modify their production function to increase output, total disposable income for the area will increase.

Hypothesis

(1) Altered crop patterns would result in a more efficient use of the scarce resource of water.

(2) Three individually operated ditch companies, one reservoir company, and ten individual users, with duplication of structures serving various portions of the same general area, are not conducive to efficient utilization of the waters of the Teton.

Propositions

(1) Methods of obtaining water rights and subsequent privilege of sale of water rights have led to the concentration of early appropriations into the hands of a few landowners whose prime interest may not be in accord with community economics.

(2) Past customs of diverting water and running it all season for the specified purpose of having running stock water through their pastures is still practiced by a large enough representation of the water users of the appropriated water of the Teton to aggravate the shortage to other users.

(3) Stock water is not considered an economic use of diverted water in an area that is underlain with an abundance of underground water at relatively shallow depths.

Procedures

Since the Teton River is an adjudicated stream, it is possible to obtain verifiable records of water diverted from the Teton. These records are used to determine the average yearly diversion for each of the three ditch companies, the reservoir company, and the ten individual users. Using this data, tables are constructed to provide a means for making meaningful comparisons among the various companies, individual users, and the irrigation district.

Bureau of Reclamation records and studies are used to determine loss due to evaporation and seepage in the storage and distribution systems. This method is resorted to, as there are no measuring devices on any of

the ditches being studied after they leave the Teton River. Data used are selected from studies made by the Bureau of Reclamation in comparable areas. These data are used to make comparisons relating to efficiency of operation as has been computed by the use of soils maps for the area under study.

Data relating to field trials are used to compute field efficiencies relating to irrigation practices and to determine maximum efficiency obtainable.

A questionnaire was constructed relating to farm size, use of water, and personal opinions concerning questions pertinent to this study. Through a random sample comprising 40 percent of those receiving water through the distribution systems, chosen by drawing names from a container holding all the stockholders' names, information was obtained from which to make a judgment concerning the questions vital to the study.

Teton County Soil Conservation records provide the data concerning water and soil conservation practices carried out by the water users of the several groups. This data is used in statistical analysis to determine if there is a relationship between amount of water available to the operator and conservation practices followed.

Tables are constructed to show the relationship between economic returns to the area with irrigation as now practiced, as possible if an economically efficient system of production and distribution were to be attained, and as it would be without any irrigation. Cost figures relating to the production function were obtained by personally contacting a random

sample of 35 percent of the total operators in the area. This sample was chosen by drawing names from a box containing all names of operators on the projects.

The Brady Irrigation Company is not included in this study for the following reasons:

1. Only 195 acres of their project lie within the boundaries of Teton County.

2. Out of a total of 1,000 shares of water in the Teton Cooperative Reservoir, they own only 196, one share being the equivalent of 30 to 40 acre feet.

3. In 1936 the Brady Irrigation Company completed construction of Brady Lake on Farmers Coulee. This additional storage has made it possible for them to provide water for their stockholders without the use of all their shares in the Teton Cooperative Reservoir.

4. Thus, the 195 acres of their project lying within the bounds of Teton County, using Teton River diverted water, becomes small.

Using the data and information obtained from the questionnaires, the Soil Conservation Office in Teton County, and the Bureau of Reclamation, the standing of each individual group in the following major areas of study will be determined.

Areas of Study

1. Soil and water conservation practices completed on each farm.

2. Number of acres of land actually irrigated.

3. Number of acres which the operator estimated could feasibly be irrigated.

4. Opinion regarding consolidation of the independent units into one company for the overall control of waters diverted from the Teton.

5. Estimated acre feet of water used per acre.

6. Cost per acre foot.

7. Return per acre foot.

Relationship between land and water conservation practices and available water is determined for each group and for the entire irrigated area as a whole.

A plan for increasing the economic returns to the area through improved economic and technical efficiency will be proposed.

Teton County

The area now comprising Teton County, located in northwestern Montana east of the Rocky Mountains, includes approximately 1,468,160 acres of land used predominantly for grazing and farming.

The climate of the county is influenced to a considerable degree by its topography, which ranges in elevation from approximately 9,000 feet along the mountainous western edge to a low of near 3,400 feet on its eastern border. Due to the location east of the continental divide, its climate is classified as "Continental." One variation makes the area unique. Foehn winds, that often blow from the southwest during the winter months, have the effect of cutting short the duration of cold spells,

melting the snow and producing clear, sunny winter weather. It is not uncommon for temperatures to rise 40 degrees or more in a short period of time, due to these winds. Winter temperatures have been known to drop to a minus 50 degrees Fahrenheit, but the below zero readings seldom last more than a few days.

Extreme warm summer temperatures seldom occur. Daytime highs average in the 80's, cooling to an average of 45 degrees during the night. An average of approximately 63 degrees in a normal year.

Frost free days for the county, excluding the mountainous western border area, are approximately 105, taken over a period of years.

Precipitation throughout the county varies to some degree, probably being affected by the proximity of the mountains on the west and varying elevations. The average annual precipitation at Choteau and Bynum is 11.5 inches; at higher elevations nearest the mountains it is closer to 15 inches. It is believed that some of the higher mountains have an annual precipitation of 60 inches or more.

In the mountainous areas more than half of this precipitation falls in the form of snow and contributes to the stream run-off during the months of April to September.

A high percentage of the measured annual precipitation occurs during the April to September growing season. In the agriculture areas, approximately 82 percent of the yearly normal precipitation comes between April 1 and September 30, May and June being the wettest months over the lower elevations.

The county experiences considerable clear, sunny weather, interspersed with summer thunderstorms, especially during July and August. Fog is not common, seldom occurring during the summer months.

Drainage system of Teton County consists primarily of the Teton River and its tributaries, Deep Creek and Muddy Creek. This drainage system has its source in the high mountains that border the western edge of the county. High precipitation, in the form of snow, contributes to the value of this drainage as a source of irrigation water during the growing season.

The majority of the soils comprising the area are well suited to agriculture. This fact has been established through soil surveys carried out by the Teton County Soil Conservation Office located at Choteau, Montana.

CHAPTER II

MONTANA WATER LAWS: A RESULT OF THE METHODS OF DISPOSAL OF THE PUBLIC DOMAIN

Introduction

The environment of the semi-arid West, of which Teton County, Montana, is a part, has been a powerful force in changing old, and building new, institutions. These have left their characteristic imprints upon all that exists within the area.

Land and water, together with air, provide the fundamental elements necessary for human existence. The laws governing them should be, of necessity, closely related to the welfare of the people. It is impossible to discuss the role of water in Montana without being concerned with the land, since Montana is a predominantly agricultural area. In addition, the growth and prosperity of the agriculture of an arid region depend to a large extent upon the land system and the water rights as they pertain to the land. Political forces, accommodating themselves to the thinking of the times, and knowledge derived from the areas from which such thoughts came have, to a considerable extent, aided in determining Montana's present water laws. As a result it will be necessary to review some of the history pertinent to land and water.

There is almost always conflict between custom and necessity. This conflict became very pronounced when settlers moved into the arid West.

Due to necessity they became innovators and spoke a different language from the areas of the humid eastern half of the United States, where the political power was vested. Customs and laws which had proved to be adequate and desirable for the Easterners were inadequate and undesirable for the settlers of the arid West.

Institutional Factors: An Historical Perspective

Land policy which had been followed by the United States in disposing of public domain from 1789 until the passage of the Homestead Act in 1862 had two notable characteristics which were to influence political thinking in later years and exert a profound influence upon the size of farm units and the form of the water laws in Montana. First, there was the reduction in size of the tracts offered for sale. In the beginning the maximum size was 640 acres. This was reduced to 300 acres in 1800, 160 acres in 1804, 80 acres in 1820, and 40 acres in 1832. Second, there was a reduction in price from $2.00 per acre to $1.25 per acre. It is interesting to speculate as to the reasons behind this reduction in size and price. One must conclude that the American farmer wanted to purchase only the amount of land that he could utilize to his best advantage at a price he could afford to pay. Because of the heavy forest cover, humid climate, and type of soil, as well as primitive tools for farming, during this period 40 acres seems to be the size that he felt he could adequately take care of and get along on.

There is little doubt that these factors made an impression on politicians of the day, and had a bearing upon the size of unit established in

the Homestead Act of 1862. The fact that land under the Homestead Act of 1862 was to be free was a result of continued agitation for free land. The 160 acre limit must have seemed reasonable to the lawmakers when compared to the average size of farms in the East. Had there been any thought but political expediency the size would have been much larger, because even at this early date enough exploration of the West had been carried out to make the politicians well aware of the nature of the area which would be settled under the Homestead Act. In history books and atlases published before 1850 one can find maps and numerous references to the Great American Desert, an area comprising a strip of land east of the Rocky Mountains and extending eastward for several hundreds of miles. In 1806 Zebulon Montgomery Pike had been detailed by the United States government to explore a portion of the area east of the Rocky Mountains. Upon the return of the expedition it was declared that the area was wholly unfit for agriculture as carried out east of the Mississippi. Both expeditions asserted that the land was suitable only for grazing. Why, then, did the politicians, with this information at hand, stipulate 160 acres in setting up the Homestead Act of 1862? They were well aware that this acreage was much too small for cattle ranching. Thus, the stage was set for unlawful use of the public domain by cattle and sheep ranchers, and the resultant strife between homesteaders and stockmen. More important, no thought had been given to the role water was to play in this struggle. In an arid region, he who controls the water controls the land.

The old English common law concerning water was used in the eastern part of the United States, and proved to be adequate for that region, where streams and rainfall were abundant. For the arid regions of the West it was completely inadequate. This law, known as riparian doctrine, states that every owner of land on the banks of a river has natural and equal rights to use of the water.

As a result of lack of foresight on the part of the government, there grew up in the West customs and usages that became necessary for survival of the people settling the area. Common laws, as related to the arid land of the West, were inadequate to prevent land and water rights from becoming separated. The necessity of the area required change, and other practices grew up that obtained legal rights from state and territorial legislation, and to some extent from national legislation.

> In all the country the natural channels of the streams cannot be made to govern water rights without great injury to its agriculture and mining industry. For the great purpose of irrigation and hydraulic mining the water has no value in its natural channel. . . .All the waters of all the arid lands will eventually be taken from their natural channels, and they can be utilized only to the extent to which they are thus removed, and water rights must of necessity be severed from the natural channels. . . .The water when used for irrigation is absorbed by the soil and re-evaporated to the heavens. It cannot be taken from its natural channel, used, and returned again. 1/

1/ Powell, John Wesley, Report on the Lands of the Arid Region of the United States, (Cambridge, Massachusetts: The Belknap Press of Harvard University Press, 1962), p. 54.

The common law of riparian rights as applied to the lands east of the Mississippi River would have a retarding influence upon the growth of Montana. There came into being appropriation by prior usage, which will be discussed later.

In an attempt to correct some of the glaring land law defects, the Timber Culture Act of 1873 was passed. This allowed a settler to acquire an additional 160 acres, provided he planted 40 acres of trees, later reduced to 10 acres of tree planting.

In 1877 the Desert Land Act was passed by Congress. Note the use of the word "desert." Herein, Congressional attitude toward the area was made apparent. Entry of 640 acres was possible under this Act, a certain portion to be irrigated within three years. The settler was not to receive the land free, but was to pay $1.25 per acre. Note the discrepancies and inconsistencies. The government was giving free 160 acres of the best land in the area, and was charging $1.25 per acre for desert land that was to be acquired for irrigation. In addition, it is general practice, where irrigation is possible, to reduce the acreage in the unit. Due to the impossible conditions set up by the government, the settler in Montana found methods of evading the irrigation requirement in order to obtain the needed land to add to his all too small holdings.

One such incident, as related to the writer, involved the construction of a ditch by the claimant. No source of water being readily available other than rain showers, said claimant had himself observed riding down the ditch in a boat, the boat being pulled by a horse, thus proving that

water was upon the stipulated area of land to fulfill the irrigation requirement. The witness duly testifying to the fact that he had seen the claimant riding down the ditch in a boat, this fact enabled the settler to obtain his desert claim. 2/

Congress, in passing the Desert Land Act, revealed two lines of thought: (1) that the land in the West was extremely dry, natural rainfall being inadequate to provide enough moisture to assure growth of normal vegetation; and (2) that water which could be used for irrigation was of value to the West.

In 1909 the enlarged Homestead Act was passed. It was shortly after the passage of this act that the final rush of homesteaders into Montana became evident.

Realization that the land units were too small to be economically feasible is evidenced by the passage in 1916 of the Grazing Homestead Act. This Act allowed 640 acres to be taken up if it was to be used for grazing purposes.

As a result of the original Homestead Act and its various modifications made with the passage of time, a man and his wife could, at one time in Montana (other Western states as well), obtain between 1,000 and 1,800 acres of land under the various Acts. 3/

2/ McCormack, Daniel V., early day sheep rancher, as related to writer.

3/ The Great Falls Tribune, 30 March, 1886.

Early activities of the Federal Government as regards administration of public lands were for the purpose of deriving revenue from the sale thereof and as a bonus to soldiers being mustered out of the army. This view slowly changed, and by 1862 it was evident that the Federal Government recognized the greater importance of added productive forces which settlement would bring into action. That subsequent decisions were affected by this mode of thinking is evidenced by the Desert Land Act, which definitely relates water to the well-being of the arid West.

When one traces early developments of land and water policy it becomes evident that past decisions and actions have had a significant effect upon the nature of present water laws in Montana. The stage had been set for disputes among the three major segments of Montana economy, the ranching, farming and mining interests. These disputes, too, have had a significant bearing upon present day Montana water law.

It should be noted that the land laws of the United States had to be modified to make allowance for differences presented by the arid West. In the same manner water laws were modified and changed. In numerous instances the riparian doctrine was set aside, in others merely modified.

This change was neither simple nor quick to come about. Previous land laws had created a situation which caused cattle and sheep ranchers in Montana to become squatters upon public domain if they were to retain enough range to warrant continuation in the livestock business.

All land laws for disposal of the public domain had been made in favor of the farmer and none to help the livestock industry, which was predominant

in early Montana history. The livestock man had to hold his own by evading the law and making use of what Nature had provided. In order to survive, he was not above breaking the law or stretching it beyond its intent and purpose. It was common practice for a rancher to homestead a "string of 40's" taking in both banks of a stream, thereby controlling the watercourse for considerable distances of its natural length. For every 160 acres homesteaded, one mile of watercourse was controlled. Cowboys, herders, and drifters were paid by livestock men to take up additional homesteads with the understanding that they would in turn be signed over to the rancher, the end result being that several miles of streams thus remained completely under the control of one individual. 4/ This method was used to assure continued use of the range lying on either side of the water thus controlled. Both of the foregoing practices brought on direct conflict between the homesteaders and the livestock men, a direct outgrowth of the land and water laws that were in operation at the time. This feeling prevailed, and had a bearing upon the direction that Montana took in establishing a set of water codes for the state.

Early ranchers were familiar with the water rights known as the doctrine of riparian rights, which accords to each owner of land contiguous to a stream the right to make whatever use of the water he requires for domestic purposes and the watering of livestock, and to make use of the

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4/ Chalmers, William, pioneer sheep rancher, as narrated to the writer.

waters for irrigation or other purposes as is reasonable with regard to like reasonable uses by all other owners of land riparian to the same stream. 5/

Because Montana's early days were dominated by two industries, livestock and mining, both of which were acquainted with the foregoing common law of England, the Bannack Assembly meeting on January 11, 1965, adopted the riparian doctrine. 6/

This law, though suited to these two industries, mining and livestock, was inappropriate for agricultural purposes. First, it restricted the use of water to riparian owners, and, as was stated by John Wesley Powell in his report of 1878, for the purpose of irrigation the water had no value in its natural channel. 7/ Secondly, it provided for equality of use. This, in Montana, is an impossibility, there being more land requiring irrigation than there is water to provide for it. Thirdly, and most important, the law required that the stream remain in its accustomed channel, undiminished in quantity. This last point, if followed, would preclude irrigation as it is known in Montana.

5/ Hutchins, Wells Aleck, Outlines of Water Law Doctrine in the Seventeen Western States, (Washington: U. S. Department of Agriculture, SCS, 1941), p. 49.

6/ Montana Territory, Session Laws, 1864-1865, p. 356.

7/ Powell, op. cit.

Development of the Appropriation Doctrine in Montana

At this same period of time, the miners in the gold mining areas of Montana were, by custom, developing a different kind of water right, one that some of them had first seen used in the gold mining areas of California, the doctrine of appropriation--first in time, first in right. Miners, through mutual agreement, were allowed to divert waters for use on their claims even though they were non-riparian, these diverted waters to be of the amount that could be used beneficially.

The appropriation doctrine gives to the first user of water from a stream the right to continue his use so long as it is beneficial, and to use the entire supply if it is necessary to satisfy the right which he has established by beneficial use. As we have seen, it grew out of the occupancy of the public domain, and is not accepted outside the western irrigation states. 8/

The Bannack legislators, in January of 1865, authorized the diversion of water and its application to non-riparian lands. If there was not enough water, three commissioners were to divide the waters in just and equitable proportions, with due regard to the legal rights of all. 9/

Later the legislature clarified the law to a greater extent by repealing the apportionment section and stating that the right should be deter-

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8/ Chandler, A. E., Elements of Western Water Law, (San Francisco: Technical Publishing Company, 1913), p. 1.

9/ Montana Territory, Session Laws, 1865, pp. 67-69.

mined by the date of the appropriation. Furthermore, an act of Congress in 1866 made legal the right of trespassers upon the public domain to use water:

> Whenever by precocity of possession, right to use of water for mining, agriculture, manufacturing, or other purposes have vested and accrued, and same are recognized and acknowledged by local customs, laws and decisions of courts, the possessors and owners of such vested rights shall be protected and maintained. 10/

Lack of an appropriate land law had forced the early settlers to become squatters and trespassers upon the public domain; lack of the realization of the importance of water to the well-being of an arid region had caused these early settlers to appropriate the water for their use without benefit of legal status. Thus, through custom borne of necessity, prior appropriation became the water law for public lands.

It now becomes evident that Montana has two water laws, one of riparian rights, established by the Bannack Assembly in 1865, and prior appropriations, established by Congressional Act in 1866.

With such attitudes concerning water rights, how was it possible to develop water uses that would provide for the necessities of agriculture? If riparian owners demanded their rights it would be impossible to divert the water for irrigation purposes upon lands at a distance from the stream. In addition, points of necessary diversion were often found only upon the property of some established livestock ranch.

10/ Chandler, op. cit., p. 5.

Much of the early irrigation was by private individuals, who were often prevented from proceeding due to lack of ability to acquire a right-of-way across private property, this resulting in lengthy court litigation, the final outcome many times leading to changes in procedure. 11/

One factor leading to a modification in the water laws was brought about by changing views in regard to disposal of public domain. Judicial interpretation in the West, where irrigation is a necessity for the production of crops, came to look upon water use from the standpoint of beneficial and reasonable use. The Desert Land Act of 1877 made this change in decision necessary.

The riparian owner no longer had the right to demand the full and undiminished flow of the stream, so long as his interests were not damaged by diversion of water: "The character and extent of the use must be considered in relation to the size of the stream and the custom of the country, and the necessities of the user must be taken into account." 12/ In addition, where only one location proved feasible for a canal or other irrigation structure where public use was involved, sales could be forced through a legal procedure known as condemnation or the exercise of the right of eminent domain; but if the use was for private purposes the owner could not be forced to sell. 13/

11/ Prentice v. McKay, 38 Mont. 114, 98 Pac. Rep. 1081, p. 1736; also Great Falls Co. v. Great Northern Rry. Co., 21 Mont. 487, 54 Pac. Rep. 963, p. 1739, Kinney on Irrigation and Water Rights, Vol. I (San Francisco: Bender Moss Co., Second Ed., 1912).

12/ Ibid., Section 487.

13/ Harding, S. T., Water Rights for Irrigation (Stanford University: Stanford University Press, 1936), p. 125.

In regard to water rights, the Montana Constitution has the following to say:

> The use of all water now appropriated, or that may hereafter be appropriated for sale, rental, distribution, or other beneficial use, and the right of way over the lands of others, for all ditches, drains, flumes, canals, and aqueducts, necessarily used in connection therewith, as well as the sites for reservoirs necessary for collecting and storing the same shall be held to be a public use. 14/

It should here be noted that the Federal Government left it to each state to adopt such a rule for governing the waters flowing within its boundaries as it sees fit to adopt. The state may adopt the common law of rights, the doctrine of appropriation, or both. Congress cannot enforce either rule upon any state. 15/

Why did the control of water pass to the states? The Federal Government owned the public domain and also the water. Officials spent much time devising ways of disposing of the land, but instigated no legislation as regards water. Was it because water in the humid East was so plentiful that it had no value? Whatever the reason, they failed to recognize the value of water in the arid West, and continued to let control of water rights fall to those who, either from chance or foresight, desired such control. John Wesley Powell saw the problem and made a proposal which would have made water available to many more individuals, but the government did not follow his proposal. 16/

14/ Montana Constitution, Article III, Section 15.

15/ Kinney on Irrigation and Water Rights, Vol. III, Section 1338, p. 2421.

16/ Powell, op. cit., p. 54.

It would have been a fortunate circumstance if the government had had the foresight to retain control over the water as well as over the land. Instead, two separate groups had control of the two most vital assets of the West. The Federal Government controlled the land, and the states the water, both finding it needful to modify old existing customs and laws to fit the settlement of the arid West.

The creation of a new water right by the Montana Constitution necessitated methods for acquiring it. Riparian rights are acquired with title to the land; not so with appropriation rights. For a number of years the Montana livestock ranchers had acquired their appropriation rights by diverting the stream water into their ditches and making beneficial use of it, but they had not registered their rights with the appropriate officials, nor followed the proper procedure.

A person desiring to appropriate water must post a notice, in writing, in a conspicuous place at the point of diversion, stating: (1) the amount of water he claims; (2) the purpose and place of use; (3) the means of diversion and size of diversion. A copy of the notice must, within ten days after it is posted, be recorded in the office of the recorder of the county in which it has been posted. Within 60 days construction must start and proceed diligently. 17/

A bill to make water appropriations a matter of record, such as stated above, became law in Montana in 1885.

17/ Chandler, op. cit., p. 14.

How were the individuals who had made prior appropriations without registry to establish their claims? Any appropriator of water from a stream can initiate a water right suit. In the process a district court judge examines the claims of all involved and establishes by decree the rights of each appropriator in the stream. If there is not sufficient water to satisfy all the rights, a district judge, when petitioned by 15 percent of the decreed rights, appoints a water commissioner to divide the water in accordance with priorities. 18/

Much controversy developed between individuals concerning the relative value of their water rights, and court records are mute evidence of the number of suits brought to court so as to bring order to a chaotic situation. Did riparian rights exist to the detriment of appropriated rights? This question was settled by a suit instigated by Anna Mettler against the Ames Realty Company, 1919:

> Lacking sufficient irrigation water, the Ames Realty Company, near Helena, changed its point of diversion on the Prickly Pear Creek from a place below the land of Anna Mettler to a place on the stream above it and proceeded to divert the entire stream into the ditch. Although Mrs. Mettler had no appropriation or diversion of the creek as it flowed through her ranch, she relied upon it for household purposes and for watering her livestock. Now it disappeared and the bed of the creek became dry. Basing her case upon her right as a riparian owner, she sued the Ames Realty Company, demanding that the creek be returned to its accustomed channel and be permitted to flow as it was wont to flow. Here was a clear cut controversy between a riparian right and an appropriation right. Did the riparian doctrine still prevail in Montana?

18/ Montana Session Laws, 1899, pp. 136-137.

> The Supreme Court said No--"Our conclusion is that the common law doctrine of riparian rights has never prevailed in Montana since the enactment of the Bannack Statutes in 1865, and that it is unsuited to the conditions here." In this manner Montana discarded the doctrine of riparian rights and joined the other Rocky Mountain states in adopting a water right suited to its arid environment. 19/

So ended an era of water use in Montana which had existed for nearly 60 years.

The ranchers and farmers had built many small canals to divert water for their beneficial use from the smaller streams, but there existed larger rivers that could be utilized for irrigation if someone with enough capital could be interested in developing the system. Here again is evidence of the damage the land policy of the United States had done to Montana by severing the water from the land. If the two had remained together it would have fallen naturally to the Federal Government to aid in the development of irrigation to provide water for irrigated homesteads. In 1902 the Reclamation Act was passed, which was the first attempt upon the part of the government to provide national projects for the construction of irrigation works for the reclamation of its arid public lands, and to dispose of both its lands and a water right to settlers. The lands, subject to entry only under the provisions of the Homestead Laws, were to be in tracts of not less than nor more than 160 acres.

The Desert Land Act of 1877 stipulated that water must be placed upon the land. As a result, those tracts closest to streams and with the

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19/ Dunbar, Robert G., "The Search for a Stable Water Right in Montana," reprinted from Agriculture History, p. 141.

easiest access to water were filed upon, leaving many thousands of acres of land which would qualify under the Act not taken due to the cost of transporting water. The construction of the necessary diversion system was beyond the financial ability of the settlers.

The Cary Land Act was passed in 1894 with the idea that some organization with the necessary capital would develop the land and sell it and the water to the settler.

Under the Act the states were to receive not more than 1,000,000 acres of desert land, which they were to develop into irrigated units of 160 acres each.

Thus the arid regions of the West have provided opportunity for not only political innovations, but also for social and technological growth arising out of the vigor and self-reliance of her populace.

CHAPTER III

ECONOMIC SIGNIFICANCE OF EARLY IRRIGATION DEVELOPMENT

Introduction

In the beginning, the buffalo roamed at will over the area drained by the Teton and its tributaries, multiplying and growing fat on the prairie grasses--grasses watered by the spring rains, growing to maturity under the warm summer sun, and curing into abundant winter feed during the sunny fall days, winter feed kept free from deep snow by the Foehn winds.

Early trappers observed this abundance provided by Nature and carried the story across the land.

Entrepreneurs, with a desire for adventure, listened to these tales and were influenced to try their luck in this far off place. So came the early cattle and sheep men, not content to take from Nature only that which she had freely provided to the buffalo, but intent on increasing this bounty by development of latent resources.

Demand for Irrigation Water

Individuals

As early as 1854, James Doty, meteorologist with Governor I. I. Stevens' expedition, wrote of the Teton Valley in the vicinity of where Choteau now stands, "A beautiful country hitherto unexplored." 1/

1/ Monkman, Olga, History of Teton County, unpublished.

James Gibson was the first white man to settle permanently in the Teton Valley. Making use of the Federal Government's provision for disposal of the public domain, he filed on a homestead west of the present town of Choteau, the year, 1876.

Ed Dennis was the second white man to settle in the Teton Valley. His homestead filing is dated 1878. During the growing season of 1881, Mr. Dennis diverted waters from the Teton River for the purpose of making his homestead more productive. Observing that this was a profitable venture and wishing to provide for future security, he filed a water right on the Teton River in the year 1883. Desiring to increase his legal land holdings, in 1884 he filed a tree claim, using his diverted water to irrigate the portions of these holdings that were suitable for irrigation, and raising crops of hay and grain.

A previous water appropriation of interest was one made by a man named Williamson. In the year 1877 he appropriated water from the Teton River to irrigate 20 acres of land, upon which he grew oats and potatoes. The method by which the size of the diversion ditch is described is no longer in use. The ditch constructed by Mr. Williamson was described as being four furrows wide and one furrow deep. This water right was later acquired by Fred Perry, and figured in litigation instigated at a later date against the developing canal companies.

The ditching and damming methods used by these early developers is aptly described by the following quote: "I felled a tree across the Teton

(the year being 1882), and dug a ditch about two rods and turned the water into a dry swale." 2/

The methods used were primitive, making use of as many natural waterways as possible, but effecting the desired results of increasing production upon the homestead lands.

That these early users of water had their problems concerning division of water and use of right of way and ditches is made evident by the testimony of Ed Dennis during a court trial concerning the unauthorized use of Mr. Dennis's ditch by Mr. Truchot. In reply to the lawyer's questions regarding this unauthorized use, Mr. Dennis answered, "Mr. Truchot used my ditch without permission. I did not want to appear to be a hog, and it was no use to object to Mr. Truchot." 3/ Brought out in the same trial was the fact that a Mr. Cowell also used the Dennis ditch without permission. He had purchased 160 acres of government land and claimed that the ditch went with it. This was probably part of the Government Ditch, one-quarter mile long, constructed in 1881 to irrigate the Government Farm located in this area. No record can be found of this ditch, only referrals in court proceedings.

In 1882, in order to prove up on three sections of desert land filings, J. C. Emerson and his associates filed upon water from the Teton River, to be used for irrigation purposes. Between 1882 and 1885 they completed

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2/ Testimony of John R. Gleason, Fred Perry Et Al Plaintiffs vs George D. Beatty Et Al Defendant, District Court of the Ninth Judicial District of the State of Montana in and for the County of Teton.

3/ Ibid., p. 71.

their ditches and were able to prove up on their desert land filings. The water used flowed through a natural runway for three miles before reaching their land, then was diverted to each 40 acre tract by means of plow furrows. This water filing, in the amount of 6,000 inches, was used to irrigate pasture and hay land. The land patents issued for the three sections are in the names of J. C., W. H., and R. G. Emerson. An interesting side light, when the Eldorado Ditch Company began construction of their ditch in 1885 they, without permission, constructed their ditch across the Emerson lands, ruining the Emersons' irrigation system, making it impossible for the Emersons to do any further irrigation. 4/

In the meantime Charlie McDonald had established a ranch on the Teton west of the present location of Choteau, and having observed how the application of water could provide for more abundant living, proceeded to use the waters of the nearby stream to irrigate a small area around his ranch buildings; then, in 1887, he placed a filing upon these waters in the amount of 1,000 inches, expanding his irrigation system to include level land adjacent to the river, upon which native hay could be produced if it received supplementary water.

These early appropriations of water from the Teton follow a pattern, the users of the water having suitable level land close to the water supply. Little expense or labor was involved in placing the water upon their holdings, the application of water to the land being for a dual

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4/ Ibid.

purpose, to enable the appropriator to obtain larger tracts of Federal land under the various federal acts for obtaining public lands and to provide water for specialized crops of potatoes and grain. Natural waterways were used in the majority of the instances, with only a minimum of actual ditch construction being engaged in. 5/

The early settlers in the area established their holdings along the waterways for two reasons, one dictated by Nature and the other an outgrowth of the land laws of the Federal Government, which were drawn for the purpose of disposing of the public domain to those desiring and able to wrest a living from the virgin territory.

Water for livestock and living purposes, plus available trees for construction of buildings, as a fuel supply, and as a natural shelter from the elements dictated the early locations of ranches. But of more importance was the desirability of controlling additional acres of public domain for grazing purposes, without actually owning these acres. If the rancher could by some means control the available water supply for livestock purposes, he automatically assured himself of the public range that was within cow or sheep walking distance of his water supply.

This being a semi-arid region, the available water supplies that could be depended upon throughout the entire season were the streams flowing from the higher mountains to the west, streams fed by the accumulated snows of the winter months. The procedure followed was to take advantage

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5/ Ibid.

of the various provisions of the Homestead Act and to obtain the land adjacent to both sides of the stream for as great a distance as possible. This was accomplished by homesteading in a pattern of adjacent 40 acre tracts following the location of the stream. Note that a 160 acre homestead, by use of this method, could control one mile of stream bank. Cowboys, drifters, and others were paid by the ranchers to file on land, then after proving up relinquish this holding to the rancher, making it possible for him to obtain control of several miles of stream bank and the dry range extending back from his water supply.

Many thousands of acres of "bench land" thus came under the indirect control of the holders of the stream banks.

Companies

Continued immigration of persons desiring to settle in the area could not long countenance this situation. Pressure was growing to settle the "bench lands" and more fully utilize their potential. In order to fulfill this end, water was needed, the closest available source being the Teton River. The topography of the area was ideal for the culmination of such a plan, to divert water from the river to the higher bench lands. The land has a natural slope of approximately 12 feet per half mile to the north and east, making it practical and inexpensive to construct diversion ditches to carry the diverted waters to the outlying "benches."

In May, 1883, the first water filing for this purpose, 4,000 inches, was made by land owners D. W. Buck, Ira Myers, M. Carrol, A. B. Hamilton, Samuel Burd, G. Steel and I. N. Hazlett. These men were owners of land

lying to the north of the Teton River in what is now Teton County. They were desirous of making their holdings more productive and of having available water to prove up on additional land. On August 29, 1883, in accordance with the laws of the territory, they incorporated the "Eldorado Ditch Company", and on November 16, 1883, deeded the 4,000 inches to the company in consideration of stock in the company, which entitled the holder to sufficient water to irrigate his land. They proceeded immediately with construction of their ditch. 6/

This was the first ditch company to file on waters of the Teton River. Initial capital of the company was $60,000, divided into 1,200 shares, term of existence beginning September 1, 1883, and to continue for 20 years. On August 25, 1903, new articles of incorporation were filed changing the name to "The Eldorado Co-operative Canal Company" and extending its term of existence for another 20 years. Again, on October 24, 1924, articles of incorporation were filed, increasing the capital stock from $60,000 to $75,000 and number of shares from 1,200 to 1,500, with a par value of $50 per share, the term of existence to be for another 40 years.

Not only stockgrowers, land speculators, and individual farmers were interested in the development of the land resources and saw the benefits that could accrue to the economy, but the Federal Government was also an interested participant, a fact made clear by the following letter:

6/ Ibid.

Department of Interior
United States Geological Survey
Washington, D. C., July 19, 1889

The Honorable:
The Secretary of the Interior

Sir:

In conformity with the Act approved, October 2, 1888, making appropriations for the Sundry Civil Expenses of the Government, and the clause thereof which appropriates:

"For the purpose of investigating the extent to which the arid region of the United States can be redeemed by irrigation, and the segregation of the irrigable lands in such arid region and for the selection of sites for reservoirs and other hydraulic works for the storage of water for irrigation, etc."

And which further provides that:

"All the lands which may be hereafter designated or selected by such United States surveys for sites for reservoirs, ditches and canals for irrigation purposes and all the lands made susceptible for irrigation by such reservoirs, ditches or canals, are from this time henceforth hereby reserved from sale as the property of the United States and shall not be subject after the passage of this Act to entry, settlement or occupation until further provided by law."

I have the honor to report that the lands described below located in Meagher, Jefferson, Lewis and Clark and Choteau Counties (Teton County was then a part of Choteau County) in the State of Montana have been selected as reservoir sites, the said lands being included in the following townships: . . .

An engineer officer of the Survey has made a preliminary examination of the above reservoir sites, and pending their more accurate description by township, section and quarter section lines, I respectfully recommend that further entries of public lands within the limits above defined be refused, and that the Registrar and Receiver at Helena, Montana, be instructed, without delay, to govern themselves accordingly.

I am, with respect,

Your obedient servant

_____
Director

Reply:

Department of Interior
July 26, 1889

Respectfully referred:

> Instruct Helena office in accordance with the Act of October 2, 1888, not to allow further entries or filings on the lands named herein.
>
> Secretary 7/

A portion of the storage facilities used by the divertees of waters of the Teton River became available to them as a direct result of the above quoted letter. The importance of the directive will become more evident as the history of the Farmers Cooperative Canal Company is related.

Land speculators observed the developing phenomenon and made their plans accordingly. One of the foremost of these in the area of Teton County, using irrigation waters from the Teton River, was Z. T. Burton. After assessing the possibilities of development, he filed on waters of the Teton River in 1890, appropriating 3,000 miners inches for the purpose of irrigating lands located six miles north and east of the present town of Choteau. (In 1891 he filed on an additional 10,000 inches.) The ditch was called "Glendora Ditch" and that year was completed to Lake Glendora, approximately half of the required distance. The following year construction was completed to deliver water to the above described area. Mr. Burton named his ditch and reservoir, which covered only a few acres, after his daughter.

7/ Farmers Cooperative Canal Company Plaintiff against Charles Kroft Defendant, District Court of the Ninth Judicial District of the State of Montana in and for the County of Teton.

The area to be irrigated consisted of about 4,000 acres, but Mr. Burton felt that he could easily irrigate 30,000 acres and for this purpose organized the Eureka Reservoir, Canal and Irrigation Company as follows:

State of Montana, County of Lewis and Clark

W. Zachary, T. Burton, J. P. Bouscarian, C. W. Burton, W. M. G. Settles, L. H. Hershfield, W. G. Allen and P. H. Little.

Purpose:

To purchase and otherwise procure real estate, dig ditches, build flumes, run and open tunnels, open and build canals, construct and erect reservoirs, purchase, hold, develop, use, lease, sell, convey, or otherwise dispose of water, water power and sites, also to purchase or otherwise become the owner, hold, layout, plat, lease and sell and otherwise deal in and dispose of town sites or town blocks, lots, etc., plant and grow trees, etc., own all kinds of machinery for construction. Purchase and become owner of horses, cattle, sheep, feed, pasture, and grow them to maturity, sell and dispose of them. Own and use all farming implements.

Capital stock of $200,000 divided into 40,000 shares.

Business to commence 1890 and continue for 20 years. The business to be run by five trustees with offices in Helena.

That this promotion scheme received due publicity for the purpose of attracting settlers to the area to purchase the land and water is attested to by the following extract from the N. W. Magazine, re-published in the Teton Times.

The Eureka Reservoir, Canal and Irrigation Company purchased Glendora Ditch and extended it to cover 30,000 acres of as good a lands as lie outdoors situated between the Teton and Marias Rivers. The land is fertile to the extremes, with a slope of 12 feet and for irrigation purposes cannot be excelled within the limits of arid North America.

The Canal is 42.8 miles long, 18 feet wide at the bottom and 24 feet wide at the top. It will tap the Teton River eight miles North West of Choteau. It will have a capacity of 12,000 cubic feet per minute, enough to cover 30,000 acres to a depth of one foot each 90 days, a superabundance of water.

Three large reservoirs have been constructed along the line of the Canal having a capacity of 2,000,000 feet of water all completed and the company is ready to supply water to 30,000 acres of land all enclosed in a good three wire fence.

Eureka owns 12,000 acres, the rest is government land subject to entry under the Homestead and Desert Land Act.

The Company will sell water and land for $20 per acre or water alone for $15 an acre. Terms will range from five to eight years with interest at 7 percent.

When all the land is sold the Company will convey to the farmer the Company's interest so that the farmer becomes owner of the system. "The only irrigation company in America to adopt this feature."

On a 200 acre experimental farm set up in the area the following yields were obtained: Oats 52 bushels, barley 42 bushels, wheat 30 bushels and potatoes 530 bushels per acre.

Burton and his Company have taken up the irrigation of land in Montana in a practical way. They have an abundance of water. 8/

Very little of the aforementioned facilities were constructed. The original Glendora Canal was in existence, but not of the capacity stated.

The three large reservoirs did not exist and do not to this day. Water was definitely not abundant, as attested to by the testimony of H. R. Ferris in a district court trial. When asked about adequate water

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8/ Teton Times, Published at Choteau, Montana, Vol. 2, No. 45, February 28, 1894.

supplies he stated in his reply that they, the users, were short during the months of July and August. 9/

The planning, for those days, was on a grand scale, and the promotion and advertising to attract settlers to purchase the land and water was carried out without too much regard to facts relating to the project.

Nowhere has the researcher been able to find a refutation of the above stated claims, even though most of them were based upon plans never culminated.

That enthusiasm was high and hopes and plans without bounds can be gathered from this description by a writer to the Teton Times in the year 1893. Probably due to this seemingly unlimited, infectious faith in the future, a slight bending of the facts did not seem worthy of refutation.

The Teton Valley

> The opportunity for irrigation is excellent in so much as the river has a fall of 25 feet per mile. So great the fall that the water may be thrown upon the highest benches at a small cost.
>
> From the base of the mountains to Choteau lie thousands of acres of land under irrigation either natural or artificial interspersed with the finest hay lands that have ever charmed the eye of stockmen. Everything denotes prosperity and comfort and the picture is genuine.
>
> Below the town the scene does not change except in extent. Stand on Priest Butte (a promontory several miles south of Choteau) and survey the surrounding country. If you have not you have missed a treat; looking up the valley you see a strip of level farming land stretching out to the mountains. Turning your eyes south and east you will see something to astonish you. Stretching to the horizon 20 to 30 miles lies a carpet of green verdure a fitting floor for the azure canopy of Heaven. A tract of land that Nature has watered as if to show us how.

9/ Perry Et Al vs Beatty Et Al, op. cit.

> Countless heads of livestock feed and grow fat on the luxuriant grass which never seems to diminish in quantity so fertile is the soil. Here lies homes for hundreds and wealth too, awaiting only to be taken and appreciated. Those who have taken advantage of the location have thriven and there many others may do the same. 10/

And later the same year:

> When men see how much can be produced off this desert land they will hardly rest content till engineering possibilities will have been exhausted to put water upon the higher benches. 11/

In the face of such optimism it is not hard to see why refutations of land developers' claims were not forthcoming. A more pertinent reason could be hypothesized that none of the populace was willing to jeopardize the growth of the area by creating doubt in the minds of prospective settlers.

The company accumulated such indebtedness that refinancing became necessary to complete the work that had been started. In order to accomplish this, a new corporation was formed called the Montana Land and Water Company. This newly formed corporation agreed to acquire all debts and obligations of the Eureka Reservoir Canal and Irrigation Company. The president of the new corporation and sole owner was Z. T. Burton. The corporation issued bonds in the amount of $500,000, the loan being obtained through the Kansas City Loan and Trust Company of Topeka. Troubles of the

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10/ The Teton Times, Vol. 2, No. 11, 1 July, 1893.

11/ Ibid., Vol. 2., No. 28, 28 October, 1893.

irrigation company were not at an end; the settlers on the project became suspicious of the way the finances were being handled. Z. T. Burton left one day, never to be heard of again. 12/

Under the leadership of prominent settlers on the project, the system continued to operate, not on the grand scale envisioned by its founder, but on one more suited to the water and facilities available. The name was changed to Teton Cooperative Canal Company.

In 1903 articles of incorporation were filed, the term of existence to be 20 years. Capital stock was set at $30,000, divided into 60 shares having a par value of $500. In 1923 its term of existence was extended for an additional 20 years, then in 1943 the term was extended for a period of continual succession. The stock of this irrigation company is assessable.

The publicity given to the grand plans of the foregoing company had attracted settlers to the area, but they found that conditions were not as described. The county, though well suited to irrigation, was practically devoid of water, only a relatively few acres being benefited by available supplies. The canal system was inadequate, and there was dissension among those most closely associated with the existing irrigation company. Settlers who had anticipated purchasing water from the company found that there was none available. Those that had been lucky enough to

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12/ McCormack, early day sheep rancher.

obtain some of the scarce supply found that they were limited as to the number of acres to which they could apply water, namely 80 acres. Newcomers wishing to file homestead claims, being somewhat lacking in knowledge concerning the procedure to follow and relying upon Mr. Burton for information, were led to believe that the maximum they could file on was 80 acres. This resulted in many homestead filings of this size. Later, the Norwegian settlement that sprang up adjacent to the Burton settlement on the north discovered that Mr. Burton had stretched the truth. These settlers immediately filed upon an additional 80 acres of land (the result being the split ownership patterns evident in the early part of the century) and started proceedings to furnish their holdings with water. 13/

Mr. F. F. Daake was designated by the interested group to file on waters of the Teton River. On July 5, 1897, Mr. F. F. Daake filed on 6,000 inches of water. On September 7, 1897, Mr. F. F. Daake transferred to the Farmers Canal Company 6,000 inches of water. The time interval between the original filing and the transfer allowed the interested group to consolidate their forces and form their company.

Construction of the canal to bring the water to the settlers' farms was started immediately. The settlers, being short of cash but adequately supplied with enthusiasm, donated labor, equipment, and food, the food consisting mostly of bacon and tomatoes. What they lacked in equipment they made up for in hard work.

13/ Mrs. O. S. Forseth, old time resident of the community.

All was not tranquil. Previous settlers along the proposed survey of the canal objected for various reasons, one obvious one being that, the two canal systems being adjacent and parallel to each other, much of the Farmers Cooperative Canal Company's right of way was on land either controlled by Burton or under the control of his settlers, resulting in some devious methods of gaining access for purposes of construction.

> The route for the canal had been surveyed and settlers along the way objected most strenuously. There were only a few days left in which the Farmers had to make up their minds to go another way or stand law suits. Early one Sunday morning two of the farmers went to the Teton and one said to the other, "You drive the team and I'll guide the plow, just drive towards Farmington." So a forrow was turned which is the route of the canal today. 14/

The canal is not straight, nor does it follow a constant grade, due to the original objective of attempting to reach each man's land at its highest point and place water upon as many quarter sections as possible so as to facilitate the proving up on desert claims under the Desert Land Act.

The Problem of Supply

Farmers Cooperative Canal Company stockholders had observed and noted the difficulties encountered by the settlers on the project controlled by Z. T. Burton due to shortage of water for irrigation, especially during the months of July and August. As a result, they inquired into the feasibility of obtaining a site suitable for storage of excess water from

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14/ Monkman, op. cit.

the Teton, of which there was an abundance during the early spring run-off, this water to be used for irrigating their lands during the dry months of July and August.

It was known that the Federal Government, by action previous to this date, had set aside certain lands from the public domain to be used for the purpose which the Farmers Canal Company's stockholders had in mind; one of these sites proved to be suitable for this purpose. This site was secured from the United States by order and approval duly given and made May 11, 1907, by the Secretary of Interior, a reservoir site containing about 220 acres and located in Sections 8, 16, 17 and 18, Twp. 25 N, Rge. 6 W of Montana Meridian in Teton County, Montana, known and designated as reservoir site number 30, locally known as Harvey Lake.

At a special meeting of the Farmers Cooperative Canal Company, held on April 11, 1908, the original articles of incorporation, dated in 1897, were amended to extend the business of the company to include reservoir and other sources of water supply and all lands, dams, ditches, canals, buildings, etc. Not enough stockholders attended to meet the legal requirements, so the meeting was rescheduled for June 13, 1908, at which time 77 shares, more than the required number, were voted; 76 voted Yes, 1 voted No.

Their troubles were not over. Even though the reservoir site had been withdrawn by the United States Government from homestead entry, it continued to be used by the stockmen in the area, and some of them assumed that they had established rights by continued and uninterrupted use of the land.

Charlie Kroft, in the year 1897, filed on a 250 inch water right from the Teton River. In 1901 he built a small dam across the east end of Harvey Lake, constructed a ditch from the Teton (a distance of about four miles) to the lake and proceeded to use the site for his private irrigation system.

When the Farmers Cooperative Canal Company subsequently obtained Harvey Lake from the United States and contemplated the construction of a storage dam to create storage for their stockholders' use, a court trial was needed to clarify the situation.

Portions of the evidence submitted during this trial follow:

Complaint: Water Right

Farmers Cooperative Canal Company - Plaintiff

against

Charles Kroft - Defendant

> Since 1897 plaintiff has been, and is now, a corporation duly organized and existing by virtue of laws of the State of Montana, and is an active and going concern. . . . That for 13 years plaintiff corporation has maintained and now does maintain and control a large canal from a point at or near the SE 1/4 of the SE 1/4 of Sec. 28, TWP 25 N, RGE 6 W, of Montana Meridian in said county and said state thence running in a generally easterly direction with several branches, to, upon and adjacent to said lands of its stockholders and that during said years the plaintiff has diverted from the Teton River at said point, when not interfered with by prior appropriations of waters of said river and carried therefrom through said canal and its branches from 4,000 to 6,000 miners inches of water and has distributed same to its stockholders for irrigation.
>
> That the right of the said plaintiff to said water of said river is subsequent to many prior appropriations of the water of said river and by reason thereof said plaintiff has many times

during said 13 years been unable to secure water from said river in sufficient quantities to be of any benefit to said stockholders for irrigation purposes.

That for the purpose of collecting and storing reserve supply of water for itself and use of its stockholders said plaintiff secured from the United States by order and approval duly given and made by May 11, 1907, by Secretary of Interior thereof a reservoir site containing about 220.87 acres in Sections 8, 16, 17, and 18, TWP 25 N, RGE 6 W, of Montana Meridian. . . . Said reservoir will store and hold 2,000 af. or more and will supply about 4,000 miners inches of water for ten days irrigation. . . . Defendant claims some right to use of lands and water comprising reservoir site "Harvey Lake Reservoir".

Plaintiff has commenced the completion of reservoir and dam, July 3, 1911. 15/

Based upon information cited previously concerning withdrawal of public domain from homestead entry and set aside as sites for future water storage the Farmers Cooperative Canal Company won their suit and obtained title to the Harvey Lake reservoir site.

It was required, and the company was agreeable, to provide for Charlie Kroft to continue to use his privately constructed irrigation system. As a result, provisions were made for him to divert his water through the Harvey Lake reservoir and use the company's facilities.

The dam creating Harvey Lake was constructed by the stockholders of the company. No cash money was available with which to pay wages, so each stockholder worked so many days to pay his water assessment for the next irrigation season. What little cash was available through the levying of assessments or through borrowing from some of the more affluent stockholders was used to purchase food to feed the workers.

15/ Farmers Cooperative Canal Co. VS Charles Kroft, op. cit.

The outlet pipe was shipped to Collins, the nearest rail point, a distance of approximately 36 miles from the dam site, and thence transported by team and wagon. 16/

That the Farmers Cooperative Canal Company put forth such effort to develop Harvey Lake as a storage site was the outgrowth of dissension among the stockholders of the company. A much better site was available, not only to the Farmers Cooperative Canal Company, but also to the Burton Canal.

This site had also been set aside by the United States government for storage development, its location being several miles to the north and west of the Harvey Lake site.

Its development was for the intended purpose of furnishing supplemental irrigation water to the "Burton Bench", this area being the same as that served by the Burton and Farmers Canals. Potential storage capacity of this site was in excess of 100,000 acre feet.

Development of the site was undertaken by the Teton Cooperative Reservoir Company, which included stockholders from the area served by the Burton Canal, the Farmers Canal, and lands adjacent to the Muddy Creek. The company filed articles of incorporation on May 26, 1906, and started actual construction of a dirt dam to increase the storage capacity of the site in the year 1908. 17/

16/ Mrs. O. S. Forseth, old time resident of the community.

17/ James Peebles, Sr., early day rancher.

It was at this time that some of the stockholders conceived the idea of using the impounded waters to irrigate Cary Land in the vicinity of Brady, Montana, resulting in controversy among the several stockholders, some of whom wished to use the water upon their own lands. The result was a court action, which resulted in the abandonment of the idea to irrigate Cary Land of about 60,000 acres and concentration on about 15,000 acres closer at hand, not including the area served by the Burton and Farmers Ditch Companies, as these, the minority stockholders, had been frozen out by the majority stockholders.

The above was the birth of the idea to create the Bynum Irrigation District, to whom the stockholders of the Teton Cooperative Reservoir Company hoped to sell their stock.

The Bynum Irrigation District was finally established on March 27, 1920, by decree of the District Court of the Ninth Judicial District of the State of Montana and for the County of Teton. More than 60 percent of number and acreage of holders of land within the district had signed the petition.

The Bynum Irrigation District, organized under and in accordance with the provisions of an Act of the Eleventh Legislative Assembly of the State of Montana, passed March 4, 1909, and approved March 1909, entitled, "An Act to provide for the creation, organization, government and extension of Irrigation Districts, etc.", is the only user of water from the Teton River in Teton County to be so organized; the other users either operate as cooperative enterprises or as individuals. Lands included in the district amounted to approximately 47,800 acres, held by 129 landowners.

Between 1920 and 1925, the final court decree date making the district a reality, much work and revising of plans was accomplished. The final decree approved issuance of $1,000,000 of bonds, of which $500,000 was to be used to purchase 80 percent of the stock of the Teton Cooperative Reservoir Company, the balance to be used for construction purposes.

So ends an era of irrigation development sparked by entrepreneurs who saw the possibilities and the benefits that could accrue from the use of what Nature had provided.

The vision may have dimmed, old forces lost their significance, and new trends developed, but one can still discern an underlying awareness on the part of the descendants of the originators that resource development may be, today as yesterday, the area's salvation. It is only necessary for the proper catalyst to bring this submerged awareness into dynamic being.

CHAPTER IV

ECONOMICS OF OPERATION AND SCOPE OF EXISTING FACILITIES

Introduction

Information contained in this chapter was obtained from two separate sources: (1) from questionnaires presented to the individual farmers who own and operate land subject to irrigation by the diverted waters of the Teton River, located in Teton County, Montana, and situated in the area commonly referred to as the Choteau trade area, and (2) from field surveys of the area consisting of both ground and aerial methods.

Locations of points of diversion, reservoir sites, canals and lands irrigated were obtained from ditch company plats, aerial photographs, and county surveys.

Facilities

Teton Cooperative Canal Company

The Teton Cooperative Canal Company, in the year 1936, constructed a storage reservoir on one of the sites originally chosen by Z. T. Burton. This site lies adjacent to their original point of diversion from the Teton River in the NE 1/4 of section 35, Twp. 25 N, Rge. 6 W, and requires an inlet canal only one quarter of a mile in length.

The storage reservoir has a capacity of 5,500 acre feet of water, which furnishes supplementary water during the months of July and August, when the flow of the Teton is not adequate to supply the demand to fill theirs and prior appropriations.

From the reservoir outlet the main canal follows an easterly direction for approximately 17 miles, to irrigate lands in sections 25, 26, 27, 32, 34, 35, and 36 in Twp. 25 N, Rge. 4 W, sections 1-6 inclusive, and sections 9-14 inclusive, Twp. 24 N, Rge. 4 W, sections 5 and 8, Twp. 24 N, Rge. 3 W. These designated sections are not irrigated in total.

One mile west of Farmington the canal branches, one branch continuing in an easterly direction, the other following a more south-easterly direction. Both branches terminate at the Teton River; so any surplus water in the system returns to the river of its origin.

The size of the canal at its origin is approximately 100 cfs., the size diminishing rapidly along its length, the diminution being of such magnitude that water users on the lower end find it difficult to obtain adequate water for purposes of irrigation. If all water users wished to use their water at the same time the canal system would not be of adequate size to allow this. A system of trading water has been worked out among the stockholders which allows them to overcome this difficulty to a certain extent by each agreeing to use his water for a specified number of days, then relinquish his use to someone else. Though this is not conducive to best utilization of water, it appears to be the best that can be accomplished with the facilities available.

Methods for measuring the water diverted to each stockholder are nonexistent. No user can more than roughly estimate the amount of water he is applying to each irrigated acre. There is little or no concern felt by the average user as to efficiency either in his own application or in the distribution system.

No figures are available relating to loss from evaporation or seepage, and these can only be roughly estimated. Each user seemingly assumes that any water wasted by himself is captured and utilized by his neighbor farther down the ditch.

There is a vast discrepancy in the amount of water each user is entitled to use, due to the method of owning "shares" and not water with which to irrigate a certain number of acres. One man may own adequate water, another may have a surplus, and another may not have enough. As a result, neighboring farms range from adequate water with which to irrigate crops to a severe shortage.

This method is not conducive to the best utilization of the available water, and results in dissatisfaction on the part of those not fortunate enough to belong to the surplus or adequate owners group.

In terms of actual cash paid, the water of this company is considered cheap. Total expenses for the company in any one year are about $2,700, which, when divided among the 60 shares of the company, amount to $45 per share, a share being equivalent to 50 miners inches.

Total acres irrigated - 1,843.

Irrigable acres - 9,113.

Farmers Cooperative Canal Company

The Farmers Cooperative Canal Company has two storage reservoirs: (1) Harvey Lake, previously mentioned, with a capacity of 2,100 acre feet; and, (2) Farmers Lake, constructed more recently, with a capacity of 2,400 acre feet.

These two storage facilities are located approximately four and one half miles north and east of the original point of diversion from the Teton River, near the center of the NE 1/4 of section 35, Twp. 25 N, Rge. 7 W. Harvey Lake is supplied with water by an inlet canal with a length of approximately four and one half miles. Farmers Lake is supplied by a canal of about one mile in length flowing from the outlet of Harvey Lake to Farmers Lake. Capacity of the inlet canal is 200 cfs. The outlet of Farmers Lake delivers water directly into the main canal system. All waters diverted from the Teton flow through the two storage reservoirs. Approximate capacity of the main canal serving the irrigated area is 200 cfs. at its origin, decreasing rapidly in size until it carries little more than 10 cfs.

The main canal runs in an easterly direction for a distance of 23 miles, where it terminates by flowing into Spring Coulee, which in turn empties into the Teton River several miles east of the town of Choteau.

Five miles from its source, the main canal branches, forming a north branch flowing in a northerly direction, and a south branch flowing in a south-easterly direction, and a central canal continuing in an easterly direction. This central canal, at a location one quarter mile east of the rail siding of Farmington, again branches, one following a north-easterly direction and the other continuing on its original easterly heading.

This canal system was designed to irrigate lands located in sections 1 and 12, Twp. 25 N, Rge. 6 W; sections 3-7 inclusive, 13, 20, 22-26 inclusive, 28, 29, 33, and 34, Twp. 25 N, Rge. 5 W; sections 14, 20-23 inclusive, and 26-30 inclusive, Twp. 25 N, Rge. 4 W; sections 33 and 34, Twp. 26 N, Rge. 5 W; sections 2, 11, and 12, Twp. 24 N, Rge. 5 W. It is possible to place water upon these designated sections in their entirety, but only portions of them are irrigated at this time, due primarily to an inadequate and uncertain water supply.

The grade fluctuates from too much to too litte. Due to this variation one area two miles from the outlet of Farmers Lake has eroded extensively, cutting a gully many feet wide and nearly 20 feet in depth for a distance of several hundred yards. Soil washed from this area has been deposited in portions of the canal system where the grade is not adequate, causing a considerable decrease in carrying capacity of the system.

Methods of measuring water to the individual users do not exist, each user receiving his share according to chance. Number of shares owned by individual farmers may vary from one to ten, resulting in some users having surplus water, while neighbors may be suffering from an acute shortage.

There is no method of using his shares of water at the time the owner desires to; the policy is to make the water available when the majority of stock (not stockholders) wishes to utilize it. If the water user does not make use of his water at this time it will be used by someone else. No

provision is made in the operation of the system for individuals to obtain their water when it will be most beneficial to them. (This provision for individual delivery of water is contained in the amended by-laws, but has never been enforced.) Various stockholders have, to their consternation, thought they had unused water still available only to discover that it had been utilized elsewhere.

The canal system is in a poor state of repair. Originally it was too small, and over the years it has been allowed to decrease in size due to lack of adequate maintenance. It is impossible for all shareholders to irrigate at one time and receive their full shares of water; as a result, a method of exchange has been worked out by the individual stockholders whereby each tries to "stagger" his demand for water from that of his neighbor, so that only a small percentage of those entitled to water are using it at any one time. This method is not conducive to obtaining maximum production of crops, due to irrigation water not being available in ample quantities at the proper time.

In numbers of places water is diverted from the main canal to the farmer's lateral by the use of permanent checks placed across the canal system, resulting in excessive seepage of land adjacent to the canal system and increased sedimentation.

The practice of diverting the water at the highest point of the field is still followed, aggravating the problem of inadequate fall, with its resultant silting and seepage problems.

No accurate method of determining water delivered to each farm is available. As a result, the farmer has no way of determining the efficiency of his irrigation practices. No records of loss due to seepage, management, or evaporation are available. Each farmer assumes that any water wasted by him is recovered and used by his neighbor farther down the system.

This company owes money to the Farm Home Security Administration for construction and maintenance, so its water is not as cheap in terms of actual cash paid as is that of the Burton. In 1966 the assessment per share amounted to $75, each share being the equivalent of 40 miners inches.

Actual acres irrigated - 2,540.

Irrigable acres - 10,828.

The Eldorado Cooperative Canal Company

The Eldorado Cooperative Canal Company is the only one of the four systems that uses no storage facilities, their appropriation being of an early enough date to provide them with adequate water diverted directly from the Teton to fill their irrigation requirements.

The company utilizes a direct diversion from the Teton River located in the NW 1/4, NW 1/4, section 33, Twp. 25 N, Rge. 6 W, then flows in a north-easterly direction for a distance of fifteen miles, termination being at the Muddy Creek. Capacity of the canal at its point of diversion is 200 cfs.

In general the Eldorado is in better repair than the two previously mentioned systems, and has adequate capacity to supply the needs of the stockholders during the irrigation season.

Water is measured, in most instances, and provides a means of determining the amounts used by the individual water users.

Few of the problems characteristic of the Burton and Farmers Canals are evident on the Eldorado.

There are 1,370 shares of water, consisting of two and one half miners inches per share, included in the Eldorado Ditch Company. The yearly charge is $2.00 per share, this paying for operation and maintenance.

As noted in relation to the previous companies discussed, the number of shares owned by the individual stockholders varies greatly, resulting in some having a surplus of water and others being somewhat limited. This condition is not as serious for the users of water under this company, as they generally have adequate water all season and are not limited in the number of days water is available, as is the Farmers.

Lands irrigated by this system are located in sections 28,29,31-34 inclusive, Twp. 26 N, Rge. 4 W; sections 3-9 inclusive, 16-18 inclusive, Twp. 25 N, Rge. 4 W; and sections 1, 2, 12, 13, 15, 19, 20, and 21, Twp. 25 N, Rge. 5 W. These sections, although listed as having water available, are not irrigated in their entirety.

Actual acres irrigated - 7,160.

Irrigable acres - 13,420.

Of these 7,160 actual irrigated acres, approximately 1,500 are watered by intermingled waters of the Eldorado Cooperative Canal Company and the Teton Cooperative Reservoir Company. These lands are located in sections 28, 32, 33 and 34 in Twp. 26 N, Rge. 4 W.

Bynum Irrigation District

The Bynum Irrigation District, created in 1925, receives its water from the Teton Cooperative Reservoir, with a capacity of 90,000 acre feet, and covering a land area of 3,080 acres located in sections 36, Twp. 26 N, Rge. 6 W; and sections 23, 26, 27, and 31, Twp. 26 N., Rge. 5 W.

The storage reservoir is supplied with water from the Teton River by a canal five miles long, with its point of diversion in SE 1/4, NW 1/4, section 34, Twp. 25 N., Rge. 7 W, capacity of this canal being 1,000 cfs.

Of the 1,000 shares of stock in this company, the Bynum Irrigation District owns 704 shares; Brady, which is not included in this study, owns 156, and eight individual users own the remaining 140 shares.

The main canal for the Bynum Irrigation District flows from the outlet of the reservoir to the Muddy Creek. By utilizing the Muddy Creek and a high line lateral, water is delivered to the various laterals comprising the system.

The high line canal is designated as "A" canal, and has a length of 26 miles. Its point of diversion is in the NE 1/4, NE 1/4, section 29, Twp. 26 N, Rge. 6 W.

The canal designated as "B" is three miles long, its point of diversion on the south side of Alkali Creek, and is in the NE 1/4, NE 1/4 of section 27, Twp. 26 N, Rge. 6 W.

"C" canal has its point of diversion on the north side of the Muddy Creek in NW 1/4, SW 1/4, of section 23, Twp. 26 N, Rge. 6 W, the length of this canal being about six miles.

The canal designated as "D" also has its diversion on the north bank of the Muddy Creek, in the NE 1/4, SE 1/4, section 30, Twp. 26 N, Rge. 5 W, its length roughly eight miles.

Canal "E" diverts from the north side of Muddy Creek also, in the NE 1/4, NW 1/4, section 27, Twp. 26 N, Rge. 5 W., and is about eight miles in length.

The canals are not considered to be in the best of condition by the irrigation district members; some are not capable of carrying the necessary amount of water to furnish adequate water for all users during peak periods of irrigation.

Methods of measuring water to the individual users do not exist, and amounts used are only approximated. Due to poor state of repair and lack of measuring facilities, some users are not able to obtain adequate water for irrigation purposes at the appropriate time, resulting in some decrease in potential yield of the crops receiving the water.

After the first of September, district members are unable to obtain water for fall use, even though adequate supplies remain in storage.

Those members owning land and living on the eastern portion of the district, that is, mainly adjacent to and east of Agawam have not made any use of their water for a number of years. The distribution systems in this area have been allowed to deteriorate to the point where they are unusable.

Much seepage and souring of land throughout the entire district is attributed to the system, its operation, and lack of adequate related drainage.

There are a maximum of 20,538 irrigable acres under the Bynum Irrigation District, not all of them being irrigated, but all subject to a yearly assessment of $2 per acre regardless of the actual application of water.

Users signify that the amount of water which they obtain as a result of the $2 per acre charge is adequate to irrigate the land they are desirous of putting water upon.

As on the other systems, there is no method of determining the efficiency of the system, or the efficiency of water applied to the individual landowner's land.

Seepage, evaporation, and waste are merely estimated. Individual farmers do not consider water that goes beyond their control as being wasted, maintaining that it is used by their neighbors farther below them, or that it drains into the Muddy Creek and is used by the Brady Irrigation system.

Actual acres irrigated - 6,650.

Acres irrigable - 16,980.

All four systems have much in common--lack of adequate maintenance, inadequate canal size, no systematic system of pro-rating water to their users, no measuring devices for determining how much water is being delivered to the individual farmer, cheap water based on cash outlay, and an underlying feeling that all is not well and that the systems are not efficient.

Individual stockholders of water in the Teton Cooperative Reservoir use water stored in this facility to irrigate lands located in sections

23, 26, 27, and 31 in Twp. 26 N, Rge. 5 W, and in sections 28, 32, 33, and 34 in Twp. 26 N, Rge. 4 W.

The waters are intermingled with that of the Bynum Irrigation District and the Eldorado Ditch Company, the acreages involved being included in those tabulated for those two systems.

Individual Divertees

In addition to the three ditch companies and the one irrigation district, there are ten individual users that divert water from the Teton River to be used in Teton County in what is considered to be the Choteau trade area.

Eight of these users have direct diversions from the Teton, and provide and maintain their own private ditch systems. Generally the point of diversion and the land irrigated are in close proximity, resulting in economies of water and actual cash outlay.

The remaining two individual users also own shares of water in the Teton Cooperative Canal Company and have, through legal arrangements, made provisions for using the facilities of this company to obtain delivery of their water for purposes of irrigation.

Adequacy of available water depends upon the original appropriation date and the amount of water appropriated, resulting in some of the individual users having adquate water and others not having enough.

Acres irrigated by individual appropriators - 5,630.

Irrigable acres - 13,300.

Lands irrigated by individual divertees of the waters of the Teton River are located in the following described areas:

Sections 11, 14, 21, 22, 23, 24, 28, 29, and 33 in Twp. 25 N, Rge. 6 W.

Sections 20, 26, 27, 28, 29, 30, 31, 32, and 33 in Twp. 25 N, Rge. 6 W.

Sections 19, 20, 21, 29, and 32 in Twp. 25 N, Rge. 5 W.

Section 1 in Twp. 24 N, Rge. 6 W.

Sections 6, 8, 9, 10, and 15 in Twp. 24 N, Rge. 5 W.

These sections are not irrigated in their entirety, in many instances only a small portion actually being irrigated at any one time. Most of this water is used to add to the productivity of natural hay meadows and pasture, a very small portion being used for alfalfa.

Total acres irrigated by users of diverted waters of the Teton River in the area encompassed by this study are 25,420.

Total acres that the farmers themselves class as irrigable amount to 63,640.

It will be noted that the Bynum Irrigation District lists 20,538 acres as being irrigated and entitled to water under the project, and the farmers listed a total of 16,980 as being irrigable.

Water rights data included in the following chapter will help to clarify references made concerning variations of available water to the various water users.

CHAPTER V

WATER RIGHT DATA CONCERNING THIS STUDY

Water Right, A Property Right Protected By Law

A person, company, or corporation with a water right does not own it, he owns only the right to use it. It is a property right and is protected by law.

That protection is provided is made evident by the following:

Fred Perry et al.
Plaintiffs

-vs-

George D. Beattie et al.
Defendants.

BE IT REMEMBERED that the above entitled cause came on regularly for trial on the 5th day of December, 1905, and subsequent days before the court, Hon. J. M. Clements, Judge Presiding, without a jury.

The respective plaintiffs and non-defaulting defendants appearing by their respective counsel. Evidence was introduced on the part of the plaintiffs and on the part of the defendants and thereafter the cause was duly submitted and argued by written briefs, which the court took under consideration, and thereafter made the following findings of fact, and conclusions of law, which said findings of fact and conclusions of law are as follows:

-1-

The plaintiff, Fred Perry, is the owner of one hundred and fifty miners inches of the waters of the Teton River appropriated by him and his predecessors in interest of date August 2nd, in the year 1879. And, he is also the owner of forty inches of the waters of said Teton River appropriated by him and his predecessors in interest, of date June 4th, in the year 1889. And, he is also the owner of forty inches of the waters of said Teton River appropriated by him and his predecessors in interest, of date June 11th, in the year 1885.

-2-

That the plaintiff Albert L. Hallady is the owner of one hundred and twenty inches of the waters of said Teton River appropriated by him and his predecessors in interest of date June 11th, in the year 1883, and that he is also the owner of 80 inches of the waters of said Teton River appropriated by him and his predecessors in interest of date June 4th, in the year 1889, and that he is also the owner of fifty inches of the waters of said Teton River, appropriated by him and his predecessors in interest of date December 3rd, in the year 1901.

-3-

That the plaintiff, John R. Gleason, is the owner of one hundred and fifty inches of the waters of said Teton River, appropriated by him and his predecessors in interest, of date June 4th, 1889.

-4-

That the plaintiffs, Edward Dennis and Lucy Dennis, are the owners of two hundred inches of the waters of said Teton River appropriated by them and their predecessors in interest, of date April 1st, 1880.

-5-

That the defendant, M. F. Ralston, is the owner of five hundred inches of the waters of said Teton River, appropriated by her and her predecessors in interest of date July 15th, 1882.

-6-

That the defendant, John C. Kinney, is the owner of eight hundred inches of the waters of said Teton River and Spring Creek, appropriated by him and his predecessors in interest, of date the month of August, 1884; that he is also the owner of three hundred inches of the waters of said Teton River and Spring Creek appropriated by him and his predecessors in interest through what is known as the Emerson & Kennedy Ditch, of date in the year 1884. That he is also the owner of four hundred inches of the waters of said Teton River appropriated by him and his predecessors in interest through what is known as the Cooper Ditch of date in the year 1889; that he is also the owner of two hundred inches of the waters of said Teton River appropriated by him, and his predecessors in interest, through what is known as the Mitchell Ditch, of date in the year 1889. That the first appropriation above mentioned of eight hundred inches was through what is known as the Unc-Burd Ditch.

-7-

That the defendant, Robert Fairburn, is the owner of five hundred inches of the waters of said Teton River appropriated by him, and his predecessors in interest, in the year 1887.

-8-

That the defendant, Frank Truchot, is the owner of three hundred inches of the waters of said Teton River, appropriated by him and his predecessors in interest, in the year 1876.

-9-

That the defendant, John J. Daley, is the owner of three hundred inches of the waters of said Teton River, appropriated by him, and his predecessors in interest, in July, 1892.

-10-

That the defendant, the Burd Estate, is the owner of three hundred inches of the waters of said Teton River, appropriated by said Estate, and its predecessors in interest, of date July 4th, 1876. That said Estate is also the owner of one hundred inches of the waters of said Teton River appropriated by said estate and its predecessors in interest, May 21st, 1883.

-11-

That the defendant, the County of Teton, is the owner of 20 inches of the waters of said Teton River, appropriated by its predecessors in interest of date May 21st, 1883.

-12-

That the defendant, the Chadwick Estate, is the owner of eighty inches of the waters of said Teton River, appropriated by it, and its predecessors in interest, of date June 1st, 1885; and that said Chadwick Estate is also the owner of forty inches of the waters of said Teton River, appropriated by it, and its predecessors in interest, of date May 22nd, 1900.

-13-

That the defendant, Martha Kropp, is the owner of fifty inches of the waters of said Teton River, of date May the 15th, 1889. Also of twenty inches of the waters of said Teton River, of date July 1st, 1891. Also of one hundred inches of the waters of said Teton River of date July 7th, 1902. By virtue of appropriations made by her and her predecessors in interest at said dates.

-14-

That the defendant, C. W. Gray, is the owner of one hundred inches of the waters of said Teton River appropriated by him and his predecessors in interest, of date November the 7th, 1889.

-15-

That the defendant, William G. Cook, is the owner of one hundred and sixty inches of the waters of said Teton River, appropriated by him, and his predecessors in interest, of date April 1st, 1893.

-16-

That the defendants, Thomas Brooks and Margerite Brooks, are the owners respectively of one hundred and two hundred inches of the waters of said Teton River appropriated by them and their predecessors in interest of date October 17th, 1901.

-17-

That the defendants, Thomas Brooks, and A. Peebles, are the owners of one hundred inches each of the waters of said Teton River, appropriated by them and their predecessors in interest of date May 29th, 1903.

-18-

That the defendants, Charles S. McDonald, and Phil G. Rinell, co-partners, are the owners of one hundred and sixty inches of the waters of said Teton River appropriated by them, and their predecessors in interest, from the south bank of said stream, of date the month of June, 1887. That said co-partners are also the owners of two hundred and sixty inches of the waters of Spring Creek, appropriated by them, and their predecessors in interest, of date in the year 1891; that they are also the owners of two hundred inches of the waters of said Spring Creek appropriated by them, and their predecessors in interest, in the year 1883; that they are also the owners of four hundred inches of the waters of said Teton River appropriated by them and their predecessors in interest from the north bank of said Teton River, of date in the month of December, 1882.

-19.[sic.]

That the defendant, George D. Beattie, is the owner of four hundred inches of the waters of said Teton River, appropriated by him and his predecessors in interest, of date in the month of December, 1882.

-20-

That the defendant, Charles Krofft, is the owner of two hundred and fifty inches of the waters of said Teton River, appropriated by him, and his predecessors in interest, of date in the year 1887.

-21-

That the defendant, Alexander Burrell, is the owner of two hundred and fifty inches of the waters of said Teton River, appropriated by him, and his predecessors in interest, of date in the year 1887.

-22-

That the defendants, Charles G. Monkman and Edgar Stonehouse, are the owners of three hundred inches of the waters of said Teton River, appropriated by them, or their predecessors in interest, of date June 15th, 1895.

-23-

That the defendant, The Eldorado Co-operative Canal Company, is the owner of three thousand inches of the waters of said Teton River, appropriated by it, and its predecessors in interest, of date May the 17th, 1883.

-24-

That the defendant, The Teton Co-operative Canal Company, successor in interest of the defendant, Russell E. Shepherd, is the owner of three thousand inches of the waters of said Teton River, appropriated by it and its predecessors in interest of date April 18th, 1890.

-25-

That the defendant, The Farmers Co-operative Canal Company, is the owner of four thousand inches of the waters of said Teton River, appropriated by it and its predecessors in interest of date August the 1st, 1897.

CONCLUSIONS OF LAW

-1-

The plaintiff, Fred Perry, is entitled to the use and enjoyment of one hundred and fifty inches of the waters of Teton River, of date August 2nd, 1879; and is also entitled to the use of forty inches of the waters of said Teton River of date June 4th, 1889, and is also entitled to the use of forty inches of the waters of said Teton River of date June 11th, 1883.

-2-

The plaintiff, Albert L. Hallady, is entitled to the use of the waters of said Teton River as follows: One Hundred and twenty inches of date June 11th, 1883: eighty inches of date June 4th, 1889; of fifty inches of date December 3rd, 1901.

-3-

The defendant, John R. Gleason, is entitled to the use of one hundred and fifty inches of the waters of said Teton River of date June 4th, 1889.

-4-

The plaintiffs, Edward Dennis and Lucy Dennis, are entitled to the use of two hundred inches of the waters of said Teton River, of date April 1st, 1880.

-5-

The defendant, M. F. Ralston, is entitled to the use of five hundred inches of the waters of said Teton River of date July 15th, 1882.

-6-

The defendant, John C. Kinney, is entitled to the use of the waters of said Teton River and Spring Creek as follows: Eight hundred inches of date in the month of August, 1884; three hundred inches of date in the year 1884; four hundred inches of date in the year 1889; two hundred inches of date in the year 1889.

-7-

The defendant, Robert Fairburn, is entitled to the use of five hundred inches of the waters of said Teton River of date in the year 1887.

-8-

The defendant, Frank Truchot, is entitled to the use of three hundred inches of the waters of said Teton River of date in the year 1876.

-9-

The defendant, John J. Daley, is entitled to the use of three hundred inches of the waters of said Teton River of date the month of July, 1892.

-10-

The defendant, the Burd Estate, is entitled to the use of the waters of said Teton River, as follows: Three hundred inches of date July 4th, 1876; one hundred inches of date May 21st, 1883.

-11-

The defendant, the county of Teton, is entitled to the use of twenty inches of the waters of said Teton River of date May 21st, 1883.

-12-

The defendant, the Chadwick Estate, is entitled to the use of the waters of said Teton River as follows: Eighty inches of date June 1st, 1885, and forty inches of date May 22nd, 1900.

-13-

The defendant, Martha Kropp, is entitled to the use of the waters of said Teton River as follows: Fifty inches of date May 15th, 1889; twenty inches of date July 1st, 1891; one hundred inches of date July 7th, 1902.

-14-

The defendant, C. W. Gray, is entitled to the use of one hundred inches of the waters of said Teton River of date November 7th, 1889.

-15-

The defendant, William G. Cook, is entitled to the use of one hundred and sixty inches of the waters of said Teton River of date April 1st, 1893.

-16-

The defendants, Thomas Brooks and Margerite Brooks, are entitled respectively to the use of one hundred and two hundred inches of the waters of said Teton River of date October 17th, 1901.

-17-

The defendants, Thomas Brooks and A. Peebles, are entitled to the use of one hundred inches each of the waters of said Teton River of date May 29th, 1903.

-18-

The defendants, Charles S. McDonald and Phil G. Rinell, co-partners, are entitled to the use of the waters of said Teton River and Spring Creek as follows: One hundred sixty inches of the waters of Teton River from the south bank of said stream of date the month of June, 1887; two hundred and sixty inches of the waters of Spring Creek of date in the year 1891; two hundred inches of the waters of Spring Creek of date in the year 1883; and four hundred inches of the waters of Teton River from the north bank of said stream of date the month of December, 1882.

-19-

The defendant, George D. Beattie, is entitled to the use of four hundred inches of the waters of said Teton River of date the month of December, 1882.

-20-

The defendant, Charles Krofft, is entitled to the use of two hundred and fifty inches of the waters of said Teton River of date in the year 1887.

-21-

The defendant, Alexander Burrell, is entitled to the use of two hundred and fifty inches of the waters of said Teton River of date in the year 1887.

-22-

The defendants, Charles G. Monkman and Edgar Stonehouse, are entitled to the use of three hundred inches of the waters of said Teton River of date June the 15th, 1895.

-23-

The defendant, The Eldorado Co-operative Canal Company is entitled to the use of three thousand inches of the waters of said Teton River of date May 17th, 1883.

-24-

The defendant, The Teton Co-operative Canal Company, is entitled to the use of three thousand inches of the waters of said Teton River of date April 18th, 1890.

-25-

The defendant, The Farmers Co-operative Canal Company, is entitled to the use of four thousand inches of the waters of said Teton River of date August 1st, 1897.

DECREE

THE PREMISES BEING BY THE COURT DULY CONSIDERED, IT IS ORDERED, ADJUDGED AND DECREED, that the respective plaintiffs and defendants heretofore named and mentioned in the findings of fact, and conclusions of law, are each entitled to the use and enjoyment, and they are hereby each decreed the use and enjoyment of the waters of

the Teton River and its tributaries, for irrigating purposes, the repsective amounts in the order of priority as fixed by the number of inches and the dates of priority in said findings of fact and conclusions of law.

IT IS FURTHER ORDERED, ADJUDGED AND DECREED that the rights and priority of the several parties to this action to the use of the waters of said Teton River, and its tributaries, be and the same are hereby fixed according to the findings of fact, conclusions of law herein made.

IT IS FURTHER ORDERED, ADJUDGED AND DECREED that each of the parties to this action, and their successors in interest, and their agents, servants, employees, and all persons acting by, through or under them, be and they are hereby perpetually enjoined from in any manner interfering with the rights of each of the other parties as established in the findings of fact, conclusions of law, and in this decree.

IT IS FURTHER ORDERED, ADJUDGED AND DECREED that the water hereby decreed is to be measured according to the rule fixed by the laws of this state.

IT IS FURTHER ORDERED, ADJUDGED AND DECREED that neither of the parties to this action shall recover costs, but that each of said parties shall bear the costs of this action incident to the establishment of their respective rights.

Dated this 28th day of March, A. D. 1908.

J. M. Clements
Judge.

Filed March 31, 1908. Judgment Record Vol. One Page 425.
S. McDonald, Clerk.

STATE OF MONTANA,) ss.
County of Teton.)

I, James Gibson Clerk of the District Court of the Eighth Judicial District of the State of Montana, in and for the County of Teton, do hereby certify that the foregoing is a true and correct copy of the findings of fact, conclusions of law and decree of respective rights to the waters of the Teton river and tributaries of all the parties settled thereby in the action of Fred Perry et al vs. George D. Beattie et al filed March 31st 1908 and now on file and of record in my office.

WITNESS, my hand and the seal of said Court this 17th day of February 1910.

James Gibson Clerk
(COURT SEAL) _____ Deputy Clerk

Filed for Record February 17, 1910, at 3:10 o'clock P.M.
E. C. Garrett,
(No. 7832). 1/ County Recorder

1/ Fred Perry et al., Plaintiffs vs. George D. Beattie et al., Defendants, in the District Court of the Ninth Judicial District of the State of Montana, in and for the County of Teton.

Water Rights of Each Company and Individuals

On March 28, 1908, the Teton River became an adjudicated stream by a district court decree. In total, as a result of the court decree and subsequent filings and purchase, the following water rights are listed for each company and individual divertee.

The Teton Cooperative Canal Company, by decree, was given 3,000 miners inches of water from the Teton River, of the priority date April 18, 1890. 2/

On October 11, 1921, the Teton Cooperative Canal Company filed an appropriation from the Teton River for 4,000 miners inches. 3/

The Farmers Cooperative Canal Company has two decreed rights, the first a decree to the Farmers Cooperative Canal Company from the Teton River for 4,000 miners inches, August 1, 1897. 4/ The second decree to the Farmers Cooperative Canal Company gave the company exclusive right to Harvey Lake as a reservoir site and the exclusive right to the use of water of the lake. 5/

2/ Judgment Book 1, Case No. 371, p. 425, and Orders and Decrees Book 18, p. 94, Clerk of the District Court, Teton County, Choteau, Montana.

3/ Book 9C, Water Right Records, p. 392, Clerk and Recorder's Office, Teton County, Choteau, Montana.

4/ Teton River Decree, Case No. 371, March 28, 1908, Judgment Book Volume I, p. 425, Clerk of the District Court, Teton County, Choteau, Montana.

5/ Harvey Lake Decree, Case No. 712, September 19, 1912, Judgment Record, Volume IV, pp. 140-142, Clerk of the District Court, Teton County, Choteau, Montana.

In addition, the Farmers Cooperative Canal Company has an appropriation from Ralston Slough and Springs for 1,000 miners inches, April 12, 1937; 6/ also an appropriation of 200 miners inches by Carl Hanson for the Farmers Cooperative Canal Company from a drainage canal, April 18, 1925. 7/

The Eldorado Cooperative Canal Company, in addition to its original appropriation, has through purchase acquired several of the early appropriations on the Teton River. As a result, all the water rights owned by the Eldorado Cooperative Canal Company were decreed in the adjudication of the Teton River, March 8, 1908. The early priority dates of water rights held by this company assure it an adequate supply of irrigation water without the necessity of storage. The decreed water rights for this company follow:

(1) 3,000 miners inches decreed to the Eldorado Canal Company from the Teton River, December, 1882. The Eldorado Cooperative Canal Company obtained this right through purchase.

(2) 400 miners inches decreed to George D. Beattie from the Teton River, December, 1882. The Eldorado Cooperative Canal Company obtained this right through purchase.

(3) 200 miners inches decreed to Edward and Lucy Dennis from the Teton River, April 1, 1880. Eldorado Cooperative Canal Company obtained this right by stock.

6/ Ref: Book VII, Miscellaneous Records, p. 454, Clerk and Recorder's Office, Teton County, Choteau, Montana.

7/ Ref: Book IX-C, Water Right Records, p. 398, Clerk and Recorder's Office, Teton County, Choteau, Montana.

(4) 300 miners inches decreed to Frank Truchot from the Teton River, 1876. Eldorado Cooperative Canal Company obtained this right by stock. 8/

The Teton Cooperative Reservoir Company, the majority of the stock being owned by Bynum Irrigation District, uses a water filing from the Teton River; it is an amended appropriation from Donald Bradford, grantor, to the Teton Cooperative Reservoir Company in the amount of 120,000 miners inches, July 3, 1902. 9/

The Teton Cooperative Reservoir Company also claims the following water rights:

(1) An amended appropriation to the Teton Cooperative Reservoir Company from Ole Wagnild, grantor, for 100,000 miners inches from the Teton River, April 17, 1906. 10/

(2) An appropriation by the Teton Reservoir Company for 120,000 miners inches from Muddy Creek, August 26, 1909. Note: (This right provides a minimal amount of water to the company due to the small drainage involved.) 11/

8/ Teton River Decree, Case No. 371, dated March 28, 1908, Judgment Book I, p. 425, and Orders and Decree Book XVIII, p. 94, Clerk of the District Court, Teton County, Choteau, Montana.

9/ Ref: Book V-M, p. 354 of Miscellaneous Transcribed Records, Clerk and Recorder's Office, Teton County, Choteau, Montana.

10/ Ibid., p. 355.

11/ Ibid., p. 356.

(3) An appropriation by the Teton Cooperative Reservoir Company for 100,000 miners inches from Blackleaf Creek, known also as North Fork of Muddy Creek, August 26, 1909. Note: (This right provides a minimal amount of water to the company due to the small drainage involved.) 12/

(4) An appropriation by the Teton Cooperative Reservoir Company for 60,000 miners inches from Chicken Coulee and branches, September 25, 1909. 13/ Note: (Same as (2) and (3).)

(5) An appropriation by the Teton Cooperative Reservoir Company for 60,000 miners inches from Cooper Coulee and all branches, September 25, 1909. 14/

All of the decreed water rights and amounts of water set forth in the Teton River Decree have priority over the appropriations used by the Teton Cooperative Reservoir Company.

The ten individuals who divert decreed water from the Teton River to be used on land in Teton County covered by this study, have acquired their present right to the use of these appropriated waters by direct purchase of existing rights from individuals who no longer had use for them, or the rights have been included in the land purchases by the present owners.

12/ Ibid., p. 357.

13/ Ref: Book VIX, p. 384 of Water Right Records, Clerk and Recorder's Office, Teton County, Choteau, Montana.

14/ Ref: Book VIX-B, p. 383 of Water Right Records, Clerk and Recorder's Office, Teton County, Choteau, Montana.

Table I presents data on the ten individual present owners, amounts of waters in miners inches owned, original appropriators, with amounts in miners inches, and date of appropriation. Reference to present ownership can be found in the Clerk and Recorder's Office Teton County, Montana.

By the foregoing methods, present owners of the rights to waters of the Teton have obtained their rights to varying amounts of usable water. The amounts of waters actually available to each specified owner of a right are subject to the date of appropriation and the whims of Nature, as there is not enough water flowing at all times to the Teton River to satisfy all the appropriations for the entire season when irrigation waters would be used.

The following chapter notes what uses are made of these diverted waters, decreed and others, and how those whose rights do not provide them with adequate irrigation water during the dry summer months have attempted to solve their problems.

TABLE I. INDIVIDUAL DIVERTEES AND AMOUNTS OF WATER IN MINERS INCHES, AND ORIGINAL APPROPRIATORS, WITH AMOUNTS OF WATER IN MINERS INCHES AND DATES OF APPROP OF WATERS OF THE TETON RIVER IN TETON COUNTY, MONTANA.

Present Owner	Miners Inches	Original Appropriator	Miners Inches	
Baker, William	440	Fred Perry	150	Aug.
		" "	40	June
		Albert L. Halladay	120	June
		" " "	80	June
		" " "	50	Dec.
Beteman Ranch	1700	John C. Kinney	800	Augu
		" " "	300	
		" " "	400	
		" " "	200	
Bouma Post Yard*	150	John R. Gleason	150	June
Crary Ranch	500	Robert Fairburn	500	
Crawford Ranch	560	Charlie S. McDonald and Phil G. Rinell, co-partners	560	June
Hamilton Ranch	400	Burd Estate	300	July
		" "	100	May
Knaff, Elmer	150	John R. Gleason	150	June
Larson Ranch	300	John J. Daley	300	July

(TABLE I, CONTINUED)

Present Owner	Miners Inches	Original Appropriator	Miners Inches	I
Olsen Ranch	170	Martha Kropp	50	May
		" "	20	July
		" "	100	July
Peebles Ranch	760	C. W. Gray	100	Nov.
		W. G. Cook	160	April
		Thomas Brooks	100	Oct.
		Margerite Brooks	200	Oct.
		Thomas Brooks	100	May
		A. Peebles	100	May
Rex Moss	70	John Lyons	30	June
		Otis P. Whaley	40	June

* Bouma Post Yard diverts little water. It is a small family business.

The two above rights of John Lyons and Otis P. Whaley were acquired by Fred Pe adjudicated to him by the decree of 1908. Subsequently Fred Perry sold the above r J. E. Malman, who in turn sold them to John W. Hospers, who in turn sold them to D. Oosterhout. D. P. Oosterhourt sold the two rights to Ed Ferrin.

Source: Book XVII, Water Right Records, p. 291, Clerk and Recorder's Office, Teton Choteau, Montana.

CHAPTER VI

DIVERTED WATER-ECONOMICS OF USE BY DIVERTEES

Introduction

Information used in compiling the data and related information contained herein were derived from a questionnaire submitted to the individual water users under the three irrigation companies, one irrigation district and to the ten individual appropriators of waters of the Teton River in conjunction with court records.

Water losses due to evaporation, seepage, or waste do not enter into the data; what is considered is the actual amount of water diverted by each divertee and distributed to the adjacent lands through his storage facilities and distribution system.

The water year used extends from October 1 to September 30. The amount of water used by each company and each individual divertee of Teton River waters is the average for the water years 1964, 1965, and 1966.

Method of measuring the water diverted at each point of diversion is by Parshall Flume installed in compliance with specifications drawn up by the Soil Conservation Service of Teton County, Montana. Amounts of diverted water are measured in acre feet, these amounts being recorded by a water commissioner appointed by the District Court of the Ninth Judicial District of the State of Montana in and for the County of Teton.

The Teton Cooperative Canal Company, the Farmers Cooperative Canal Company, the Eldorado Cooperative Canal Company, the Bynum Irrigation District, and the ten individual divertees will be treated individually, with some additional data pertaining to internal aspects of the individual system being recognized where it is considered to be relevant to the study.

The Teton Cooperative Canal Company*

The Teton Cooperative Canal Company utilizes storage facilities with a capacity of 5,500 acre feet. This storage is adjacent to their point of diversion on the north bank of the Teton River. The storing of water is commenced early in the fall of the year and continued without interruption until the facility is full, which is usually by early spring. From that time until the irrigation season starts, which varies from May 20 to June 1, the water continues to flow down its natural channel.

When the irrigation season commences, their adjudicated right to the waters of the Teton is diverted through their storage reservoir to their distribution system. Being a relatively early right, it continues to be utilized without diminution until some time in July when, due to prior rights, it is decreased and, in an extremely dry year, may be discontinued. At this time the Company utilizes its stored waters to supply water demanded by its stockholders.

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* See Map I, Appendix E showing area served by the Teton Cooperative Canal Company.

A ditch rider is engaged to supervise the division of the waters of the Company to the individual shareholders. Due to lack of adequate facilities to properly measure and divert water from the main distribution system, his efforts are largely negated. In addition, some shareholders do not always abide by the rules, increasing or decreasing their water flow at their own discretion. This, at times, leaves the irrigator at the lower end of the system without adequate water, and at other times with more than he can use.

The Teton Cooperative Canal Company, since construction of their storage facility, has experienced no water shortage. Many years they come to the end of the irrigation season with more than ample reserves of stored water. Water of this company can be bought and sold; it is not appurtenant to the land. Recent sales have established a value of $1200 per share or $24 a miners inch. A share is equivalent to 50 miners inches. Additionally, if a shareholder so wishes he may, providing he can find a cooperative party, rent additional shares of water to use on his land.

Acres irrigated under this system, compiled from the individual questionnaires, amount to 1,843. Additional acres that could be irrigated amount to 9,113, making a total of 10,956 acres that could be irrigated with little or no special preparation. Reasons given for not irrigating more of the irrigable land vary from preference for dry land farming to considering irrigation to be too much work, no one reason dominating.

Based upon the figures obtained from the questionnaires and from court records, the following data are presented, on usage of diverted waters of the Teton by shareholders of the Teton Cooperative Canal Company in Table II.

The data presented in Table II show the amount of water each shareholder is entitled to at the point of diversion. These figures are based upon the average amount of water diverted by the Company over the three year period 1964, 1965, and 1966, and on number of shares each stockholder of the Company owns. It emphasizes the variation in amount of water available to acres irrigated by the various individuals served by this system. That this variation is not as great as Table I would indicate, in the final analysis, can be assumed, due to the practice of those with insufficient shares being able to rent shares from those stockholders who do not utilize their water on their own land, but that it is of some importance is made evident by the number of shareholders who indicated that they could use more water; 53.3 percent of those contacted indicated that they could utilize more water, 60 percent had no idea how much water they used in a season, but indicated that it was adequate, 40 percent estimated the amounts they used per season, this amount varying from one acre foot to four acre feet.

Of those contacted, 80 percent indicated that they, as individuals, wasted water, the amounts varying from 20 percent to 60 percent, but that in the final analysis it was not really wasted because their neighbors were able to utilize it; the remaining 20 percent stipulated that they wasted no water.

The following is a breakdown recorded as percentages of land usages under the Teton Cooperative Canal Company.

Total irrigable acres	9,113
Total irrigated acres	1,843
Percent of acres irrigated	20%
Percent of irrigated acres devoted to alfalfa hay	45%
Percent of irrigated acres devoted to native hay	08%
Percent of irrigated acres devoted to pasture	46%
Percent of irrigated acres devoted to grain	01%

Farmers Cooperative Canal Company*

The Farmers Cooperative Canal Company has two small storage reservoirs located approximately four and one half miles north and east of their point of diversion on the Teton River. The first of these facilities, called Harvey Lake, has a capacity of 2,100 acre feet; the second, located a mile to the east, called Farmers Lake, has a capacity of 2,400 acre feet, making a total usable storage capacity of 4,500 acre feet. Both facilities are rather shallow and cover a considerable area to obtain their present capacity.

All waters diverted from the Teton River by the Farmers Cooperative Canal Company pass through both storage reservoirs, first Harvey Lake, then Farmers Lake, thence into the distribution system of the company.

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* See Map II, Appendix E showing area served by Farmers Cooperative Canal Company.

TABLE II. AVERAGE ANNUAL USE OF WATER BY INDIVIDUALS IN THE TETON COOPERATIVE CANAL COMPANY, FOR THE THREE YEARS 1964, 1965, 1966*

Shares Owned By Individuals	Crops Irrigated					Water Diverted	
	Alf. Hay	Native Hay	Pasture	Grain	Total	Total	Per Acre
	Acres	Acres	Acres	Acres	Acres	Acre Feet	Acre Feet
3	120		160		280	504	1.80
3	40	40			80	504	6.30
2	50	20			70	336	4.80
1	80				80	168	2.10
8	80	120	200		400	1344	3.38
1			10		10	168	16.80
3	30		10	20	60	504	10.08
1	70		90		160	168	1.50
1 1/4	20		60		80	200	2.50
1			30		30	168	5.55
2 1/3	90				90	392	4.35
4			14		14	672	48.00
4	174		50		224	672	3.00
2			15		15	336	22.40
2	40		60		100	336	3.36
2	50		110		160	336	2.10
40	844	180	809	20	1853	6808	5.3**

* Acre feet of water, Column 7, were obtained by dividing the 59 shares of water owned by the individuals comprising the company into the total diverted water (9,934 acre feet) and multiplying by shares owned. This figure represents the acre feet of water the various stockholders are entitled to. Each share of water is equal to 168 acre feet.

Column 8 was obtained by dividing the acre feet of water the individual stockholders are entitled to by the number of acres each stockholder irrigates. Column 8 shows available water for each irrigated acre.

We show 6,808 total acre feet, Column 7; actually 9,934 acre feet are diverted. There are 18 5/12 shares not credited to any specific irrigation practice, since their owners do not utilize them for purposes other than irrigation of farmsteads or rental to others desiring more water.

(Continued on page 90.)

Storage of water is not commenced until the spring run-off. This lack of utilization of winter river waters is due to several factors. The inlet canal to Harvey Lake is approximately 4 1/2 miles in length due to the original survey attempting to reach certain designated homestead sites. The grade of the canal at some points does not have adequate fall, resulting in a "slow" ditch in some areas due to excessive freezing and plugging of the channel by ice and snow, which is not conducive to carrying water during the winter months. The Teton Cooperative Reservoir Company, whose inlet canal to the Bynum Reservoir runs adjacent to and approximately parallel to the Farmers Cooperative Canal Company, because their canal has adequate fall (their survey not having been limited by the conditions imposed upon the Farmers Cooperative Company, as stated above) is able to utilize the winter flow of the Teton River.

To the Teton Cooperative Reservoir Company this is important, as it keeps their inlet canal free from winter snows which would hamper their ability to make use of the first spring run-off from the Teton. This is so important to their well-being that on several occasions the Court has stipulated that, though the Teton Cooperative Reservoir Company has no

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* (Continued from Table II, page 89)

This unused water is available to the shareholders using the waters under this system, but is not shown in Column 7 because there is no way of determining who used it, which somewhat inflates the above acre feet of water available to be used by each individual.

** Average acre feet of diverted water for each acre of land irrigated.

adjudicated right to waters of the Teton River, enough water be diverted into their inlet canal to keep it free from accumulated snow during the winter. The practices have, over the years, led to a pattern that has resulted in a negative attitude on the part of the Farmers Cooperative Canal Company toward correcting the deficiencies of their inlet canal. In some years this has resulted in the Farmers' storage not being up to capacity when the irrigation season started.

The adjudicated right of the Farmers Cooperative Canal Company is not of an early enough date to insure them of an adequate flow from the Teton except during the spring, when the flow of the river is quite high. The remainder of the season this company has only the 5,400 feet of storage for irrigation purposes, resulting in severe water shortages during dry seasons.

A ditch rider is hired to supervise the canal system and the storage facilities, and to divide the waters among the various shareholders. As there are no adequate facilities to properly divert or measure the water diverted into the individual farmer's laterals, this is accomplished by guess and the size of the individual laterals. At times the shareholders do no abide by these divisions, taking it upon themselves to increase or decrease their "head" of water, which results in users toward the end of the canal system either being "short" or "long" on water.

Under the Farmers Cooperative Canal system, even though provided for in the by-laws, there is no way that an individual can utilize his water when it would be to his greatest advantage. If he does not make use of it

when the majority wish their water, he will find that it will have been used by the other shareholders and he will be left without any water with which to irrigate his crops. In practice, water is turned into the system when the majority wish to irrigate, and is turned off when the majority no longer require water or when the storage reservoirs are empty.

This company, most years, experiences a definite shortage of water. The most serious shortages are experienced in years when water is most needed. Only on years when it is not so badly needed do they have more nearly adequate supplies of water.

Water of this company can be bought and sold. It is not appurtenant to the land. This practice has been followed in the past by those individuals trying to assure themselves of an ample supply of water, but has not been of much practical value due to the methods followed by the company in delivering water to the land. Recent sales have established a value of $500 per share or $12.50 per miners inch, one share being equivalent to 40 miners inches. Water may also be rented if a cooperating shareholder can be found. The usual rental fee is the amount of the actual assessment levied against the share of water.

Acres irrigated by this system, compiled from questionnaires submitted to the individual water users of the Farmers Cooperative Canal Company, amount to 2,540; total acres that could be irrigated equal 10,020. This could be accomplished with little or no special preparation.

Reasons for not irrigating these additional acres are lack of adequate water, irrigating is too much work, and a preference for dry land farming.

Based upon figures obtained from the questionnaires and court records, the following data are presented. (See Table III.)

The information presented in tabulated form indicates the amounts of water each shareholder is entitled to at the point of diversion. The figures contained herein are based upon the average amount of water diverted by the Farmers Cooperative Canal Company for the years 1964, 1965, and 1966 as related to the shares owned by each stockholder. It is amply evident that, should each share receive its alloted amount of water, namely 40 miners inches per share, a vast inequality exists as to the amount of water available for each irrigated acre owned by the several stockholders. This condition is accentuated by the practice of water delivery followed by the company. Each stockholder is allowed to maintain his water flow, determined by the shares he owns, for the entire time he so desires or until the storage facilities are empty. As an example, a shareholder with ten shares is entitled to 400 inches for as long as the supply lasts, even though in doing so he may be using someone else's water.

Should the demand for irrigation water by the majority of the shareholders cease while there is still stored water available, the company follows the practice of allowing a small, continuous flow in the canals for stock water purposes. This water is not to be diverted from the canal system even though, due to location of pastures, all are not benefited.

That the varying amounts of water owned by the different stockholders have an impact upon the land being irrigated is evidenced by the fact that, of those contacted who were utilizing their water for irrigation purposes,

TABLE III. AVERAGE ANNUAL USE OF WATER BY INDIVIDUALS IN THE FARMERS COOPERATIVE CANAL COMPANY, FOR THE THREE YEARS 1964, 1965, 1966*

Shares Owned By Individuals	Crops Irrigated					Water Diverted	
	Alf. Hay	Native Hay	Pasture	Grain	Total	Total	Per Acre
	Acres	Acres	Acres	Acres	Acres	Acre Feet	Acre Feet
3	90		50		140	258	1.84
4				170	170	344	2.02
5	114		76		190	430	2.26
3				50	50	258	5.16
5				210	210	430	2.04
2	20	50			70	172	2.45
7	112		100	380	592	602	1.02
1	40				40	86	2.15
7	35		65	80	180	602	3.34
1	25				25	86	3.44
2	80			95	175	172	.98
1			80		80	86	1.07
1	50		30		80	86	1.07
1	15		15		30	86	2.86
4	80		60		140	344	2.45
3	90			128	218	258	1.18
3	30		20		50	258	5.16
1				100	100	860	8.60
54	781	50	496	1213	2540	5418	3.3**

* Acre feet of water, Column 7, were obtained by dividing the 96 shares of water owned by the individuals comprising the company into the total diverted waters (8,280 acre feet) and multiplying by shares owned. This figure represents the acre feet of water the various stockholders are entitled to. Each share of water is equal to 86 acre feet.

Column 8 was obtained by dividing the acre feet of water the individual stockholders are entitled to by the number of acres each stockholder irrigates. Column 8 shows available water for each irrigated acre.

(Continued on page 95.)

75 percent indicated that they could use more water; 62 percent had no idea how much water they used; the remaining 38 percent estimated their usage, the amounts varying from one acre foot to two and one half acre feet per acre. Seventy-five percent stated that they wasted water, the amounts varying from 20 percent to 50 percent, but that their waste was utilized by users farther towards the end of the system. Twenty-five percent stated that they wasted no water. Of those that indicated they did not use all the water they were entitled to, 62 percent said their unused portion was diverted to some other user.

Following is a breakdown of land uses on the Farmers Cooperative Canal Company irrigation system in percentages:

Total irrigable acres	10,828
Total irrigated acres	2,540
Percent of acres irrigated	23%
Percent of irrigated acres devoted to alfalfa hay	30%
Percent of irrigated acres devoted to native hay	02%
Percent of irrigated acres devoted to pasture	23%
Percent of irrigated acres devoted to grain	45%

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* (Continued from page 94.)

We show 5,418 total acre feet, Column 7; actually 8,280 acre feet are diverted. The difference is due to shares not utilized by their owners for irrigation on any specific area of land being rented to other stockholders or allowed to be utilized by those individuals who use company water. This practice inflates the acre feet of water actually available to the individuals using water under the company.

** Average acre feet of diverted water for each acre of land irrigated.

Eldorado Cooperative Canal Company*

The Eldorado Cooperative Canal Company utilizes direct diversion from the Teton River, which gives the stockholders ample water for the entire irrigation season, due to their early date of appropriation of waters of the Teton River.

As is true of the previous systems discussed, shares of water owned by the individual stockholders vary from individual to individual. Since this company does not rely upon storage facilities to provide adequate water for the irrigation system, this practice does not appear to present the problems that it does on the Teton Cooperative Canal Company system and the Farmers Cooperative Canal Company system.

This company hires a ditchrider to tend the waters flowing in their distribution system, and to divide such waters among the stockholders. Water is measured by weir.

As with companies previously discussed, water of this company can be bought and sold. Most recent sales, of which there are relatively few, have averaged $100 per share, or $40 per miners inch, a share being equivalent to two and one half miners inches.

Acres irrigated under this system, compiled from questionnaires submitted to the stockholders and from county records, amount to 5,160 acres; those that could be irrigated amount to 13,420 acres. This total acreage could be placed under irrigation with relatively little cost.

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* See Map III, Appendix E showing area served by the Eldorado Cooperative Canal Company.

The information presented in the following table (Table IV) was derived from court and county records, Teton County, Montana, in addition to information obtained from questionnaires submitted to the individual water users of the Eldorado. One share of water of this company is equal to two and one half miners inches.

In addition to the waters diverted by the Eldorado Cooperative Canal Company for use on lands within their project, approximately 1500 acres of land included under this project are subject to water from the Teton Cooperative Reservoir Company. A total of 143 shares of the Teton Cooperative Reservoir Company are involved, amounting to 5720 acre feet of water. This last figure is based on an average yearly draw down of the Teton Cooperative Reservoir Company storage of 40,000 acre feet.

The actual acres irrigated by this water are impossible to determine due to its being intermingled with water from the Eldorado Cooperative Canal Company. It is assumed that the 1500 acres is not too high; using Bureau of Reclamation figures for a comparative area it was determined that the 5,720 acre feet would irrigate approximately 1500 acres of native hay or pasture land.

Using the above data the total figures relating to the Eldorado Cooperative Canal Company are as follows:

Water Diverted	Total Acres Irrigated	Acre Feet Per Acre
16,176 a/f	7160	2.26

TABLE IV. AVERAGE ANNUAL USE OF WATER BY INDIVIDUALS IN THE ELDORADO COOPERATIVE CANAL COMPANY FOR THE THREE YEARS 1964, 1965, 1966*

Shares Owned by Individuals	Crops Irrigated					Water Diverted	
	Alf. Hay	Native Hay	Pasture	Grain	Total	Total	Per Acre
	Acres	Acres	Acres	Acres	Acres	Acre Feet	Acre Feet
10					0	76.30	
155	88	40	72		200	1182.65	59.13
1					0	7.63	
204		200			200	1556.52	77.82
361		700	1550		2250	2754.43	1.22
270	100	400	400		900	2060.10	2.28
10					0	76.30	
10					0	76.30	
53		440	100	100	640	404.39	.63
100		100	400		500	763.00	1.52
45			250		250	343.35	1.37
10					0	76.30	
9		40			40	68.67	1.71
46						350.98	
46 one	owner	200	480		680	350.98	1007.16
40						305.20	1.48
1370	188	2120	3252	100	5660	10,453.10	1.83**

* Acre feet of water, Column 7, were obtained by dividing the 1,370 shares of water owned by the individuals comprising the company into the total diverted waters (10,456 acre feet) and multiplying by shares owned. This figure represents the acre feet of water the various stockholders are entitled to. Each share of water is equal to 7.63 acre feet.

Column 8 was obtained by dividing the acre feet of water the individual stockholders are entitled to by the number of acres each stockholder irrigates. Column 8 shows available water for each irrigated acre.

In addition to water diverted by the Eldorado Cooperative Canal Company directly from the Teton, stockholders of this company utilize approximately 5,720 acre feet of water stored in the Teton Cooperative Reservoir Company storage for purposes of irrigation on approximately 1,500 acres of land.

(Continued on page 99.)

There are 16 actual stockholders in the Eldorado Cooperative Canal Company. Of these 16 there are nine that actually irrigate land included under this company; waters of the remaining seven are used by the active irrigators.

The following percentages have been computed using as a basis the nine active irrigators and information derived from the questionnaires.

That the disparity of shares owned by the various stockholders affects the overall operation of the system and land irrigated by the individuals under the company is evidenced by these percentages. Thirty-three percent indicated that they could use more water to good advantage, 22 percent estimated the number of acre feet used per acre as approximately two and one half; the remaining 78 percent had no idea how many acre feet they were using; 22 percent stated that they wasted no water; 78 percent indicated that they wasted water, the estimates ranging from 10 percent to 40 percent; 55 percent indicated that they did not use all the water they were entitled to, but allowed it to remain in the distribution system to be used by some neighbor who could utilize it.

Land uses under the Eldorado Irrigation Company are given in percentages in the following tables:

Total irrigable acres	13,420
Total irrigated acres	7,160

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* (Continued from Table IV, page 98.)

The addition of this water to the direct diversion changes the average acre feet per acre used by this company from 1.83 acre feet to a figure of 2.26 acre feet per acre.

** Average acre feet of water diverted for each acre of land irrigated.

Percent of acres irrigated	42%
Percent of acres devoted to alfalfa hay	3%
Percent of acres devoted to native hay	37%
Percent of acres devoted to pasture	58%
Percent of acres devoted to grain	2%

Bynum Irrigation District*

The Bynum Irrigation District receives its water for irrigation purposes from stored waters of the Teton Cooperative Reservoir Company, which has a total storage capacity in excess of 90,000 acre feet. Figures released by the Bynum Irrigation District indicate that they use, on an average, each irrigation season approximately 35,000 acre feet of water for irrigation purposes. There are 1,000 shares included in the Teton Reservoir Company; of these, 704 shares are presently owned by the above mentioned district. From the foregoing it can be ascertained that the Bynum Irrigation District has a two-year supply of irrigation water on hand, without any additional storage, when the Teton Cooperative Reservoir Company is full to capacity. This is of great importance, due to the fact that the only waters stored in this facility are those in excess of that which the decreed rights on the Teton do not utilize. As a result, this reservoir company depends exclusively on winter flow and high water of early spring from the Teton River. Some years, when this flow is low due

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* See Map IV, Appendix E showing area served by the Bynum Irrigation District.

to lack of adequate snow pack on the headwaters of the Teton drainage, the Teton Reservoir Company has not been able to store the necessary additional water, which has resulted in some water shortage on the Bynum Irrigation District lands.

The Bynum Irrigation District engages a superintendent to oversee the entire operation and maintenance of the system, and a ditch rider to regulate the water delivered to the individual water users.

Originally, the distribution system was provided with checks and devices for measuring water into the individual laterals of the farmers. Due to improper maintenance these structures have deteriorated to the point where they either do not function properly or have completely disappeared. Today there is no method of mechanically measuring the water delivered to the individual farmers.

Each irrigable acre on the project is entitled to two acre feet. The charge for this amount of water is $2; $1.10 is for operation and maintenance and $.90 is allocated to a sinking fund, including interest payments. This charge of $2 per acre is made on a maximum of 20,538 irrigable acres. The farmer must make the payment whether or not he utilizes his water. Actual figures submitted by the individual farmers list 18,410 acres as being irrigable and only 8,080 as actually being irrigated.

Due to poor maintenance and other related factors, the distribution system of the Bynum Irrigation District is at the present time not adequate for the acres listed as actually being irrigated. Water users indicated, when contacted, that if all desired their water at the same time they would be unable to receive an adequate head for irrigation.

This district has a definite seepage problem, which causes many acres of land to be damaged to the point where it cannot be economically utilized. This problem has not been corrected. As a result, a number of the farmers do not use their water, and the district has discontinued the use of some delivery canals, predominantly towards the east end of the project.

Some farmers indicate that when the district has paid off its obligation to the bonding company they will attempt to either sell their water or withdraw their land from the district.

In common with the projects previously discussed, there is a lack of adequate facilities, inadequate management, and some shortage of water.

Acres actually irrigated under the Bynum Irrigation District, as compiled from questionnaires, Soil Conservation data, and county records, amount to 8,080. Additional acres that could be irrigated, and classed as irrigable, amount to 10,330 acres. Reasons given for not irrigating these additional acres are: (1) the addition of irrigation water sours the land, (2) irrigation is too much work, and (3) we can do better using dry land methods.

Based upon figures obtained from the sources listed above, Table V is presented.

Those farmers utilizing their water under the Bynum Irrigation District pay for and are supposed to receive two acre feet of water for each acre of irrigable land. Since few irrigate all their irrigable land, the acres

TABLE V. AVERAGE ANNUAL USE OF WATER BY INDIVIDUALS IN THE BYNUM IRRIGATION DISTRICT, FOR THE THREE YEARS 1964, 1965, 1966*

Crops Irrigated					Water Diverted	
Alf. Hay	Native Hay	Pasture	Grain	Total	Per Acre	Total
Acres	Acres	Acres	Acres	Acres	Acre Feet	Acre Feet
40	140		300	480	2.00	
300	100	100		500	2.00	
			25	25	2.00	
200	800			1000	2.00	
60	15		45	120	2.00	
145		167		312	2.00	
90	34		269	420	2.00	
70				70	2.00	
		75	80	155	2.00	
		80		80	2.00	
80	100		180	360	2.00	
50		210		260	2.00	
90			75	165	2.00	
50				50	2.00	
230	70		260	560	2.00	
30		50	140	220	2.00	
40	100	60		200	2.00	
	100		160	260	2.00	
100		500	400	1000	2.00	
		132	25	157	2.00	
	100	180	40	320	2.00	
	100	170		270	2.00	
50	50	50		150	2.00	
100		200	240	540	2.00	
100		200		300	2.00	
	46			46	2.00	
	60			60	2.00	
1825	1815	2174	2266	8080	4.3**	35,000

* (Continued on page 104.)

that they do use water on varies. The exact number of acre feet used is impossible to determine, due to the above-mentioned practice and lack of any method for measuring the water diverted into the individual farmers' laterals.

Using individual farmers' answers, the following percentages have been computed relating to water utilization: 50 percent of those contacted indicated that they could use more water; the estimates of amounts actually utilized ranged from one and one half acre feet to three acre feet per irrigated acre; 100 percent stated that they wasted water, the amounts ranging from 5 percent to 50 percent; 62 percent indicated that if they did not use all their water it would be used by their neighbors.

Following is a breakdown of irrigated land uses on the Bynum Irrigation District:

Total irrigable acres	18,410
Total irrigated acres	8,080
Percent of acres irrigated.	43%

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* (Continued from Table V, page 103.)

The Bynum Irrigation District diverts 35,000 acre feet of water and allocates two acre feet of water for each acre of land classified as irrigable, but, due to the fact that many operators do not utilize their water, those remaining receive considerably in excess of this allocated two acre feet, as can be seen from the average of 4.3 acre feet used per acre per year. This added water is obtained at no added cost to the actual user as a result of the method of assessing each irrigable acre a fixed amount per acre foot of water allocated to it, regardless of whether it is used or not. Water to the users is not measured at diversion to field ditches.

** Average acre feet of water diverted for each acre of land irrigated.

Percent of irrigated acres devoted to alfalfa hay.	22%
Percent of irrigated acres devoted to native hay	22%
Percent of irrigated acres devoted to pasture.	27%
Percent of irrigated acres devoted to grain.	28%

Individual Divertees*

The ten individual users of water of the Teton River in Teton County divert water directly into their private distribution systems. These systems have been constructed and are maintained by the individual users. The size and condition of these systems, determined by field surveys and through consultation with the individuals involved, are adequate for the amount of land each at this time desires to irrigate. Technical and engineering help to improve these systems and make them more efficient has been received through the Teton County Soil Conservation District Office, located at Choteau, Montana.

Rights for diverting water from the Teton River for each of the ten individual divertees range from an appropriation date of July 4, 1876, to May 29, 1903. The variation in date of appropriation, as well as the amounts appropriated, ranging from 30 to 800 miners inches, indicates that all ten users do not receive the same amount of water, nor do they all have the same advantageous position in regard to obtaining their full flow of water during the entire irrigation period.

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* See Map V, Appendix E showing area irrigated by the individual divertees.

Through consolidation of land holdings and purchase of water rights, these individuals have attained the standing listed in Table I, page 74, Chapter V. That this consolidation has not proven to be an adequate solution to existing water shortages for some is indicated by the fact that four of the ten indicate that they would be willing to purchase additional water, if the price were not too high. One individual placed a price of $2 on each acre foot per year, the others were noncommittal.

Crops irrigated by these ten individual divertees consist of native pasture, native hay, and alfalfa hay; their lands are located along and adjacent to the Teton River. The soil, topography, location, and environmental conditions have dictated livestock raising for the entire area controlled by these ten operators. They are continuing to increase the number of acres irrigated each year, and seven of the ten have engaged in practices that are designed to facilitate and increase the efficiency of their irrigation practices. Each user's water is measured when diverted from the Teton, and an accurate record of irrigation water used is available.

Using data obtained from the individual questionnaires submitted to the users and records of the District Court for Teton County, in addition to information from the Teton County Soil Conservation Office, Table VI has been constructed, showing diverted water and its use.

Even though each individual's water is measured at its point of diversion and an accurate record of this amount is on file with the Clerk of the District Court, Teton County, Choteau, Montana, only 30 percent of

TABLE VI. AVERAGE ANNUAL USE OF WATER BY THE INDIVIDUAL DIVERTEES, FOR THE THREE YEARS 1964, 1965, 1966*

Water Owned Miners In.	Crops Irrigated					Water Diverted	
	Alf. Hay	Native Hay	Pasture	Grain	Total	Total	Per Acre
	Acres	Acres	Acres	Acres	Acres	Acre Feet	Acre Feet
170		80	70		150	402	2.7
760		400			400	663	1.6
70		480			480	688	1.3
400		600			600	1260	2.1
1700	100	400			500	1828	3.6
300		500	500		1000	996	.99
560	390	110			500	638	1.2
500	100	400	400		900	624	.7
150	50				50	577	11.5
410	50	50			100	1006	10.06
5020	690	3020	970	0	4680	8682	1.9**

* Column 6 is the total number of acres irrigated by each individual divertee. It is obtained by adding the number of acres of each crop in Columns 2, 3, 4, and 5.

Acre feet of water used by each divertee, Column 7, is an average from the years 1964, 1965, and 1966, obtained from figures submitted by the Water Commission to the District Court of the Ninth Judicial District of the State of Montana, in and for the County of Teton.

Acre feet per acre were obtained by dividing each figure in Column 7 by the corresponding figure in Column 6.

** Average acre feet of water diverted for each acre of land irrigated.

the individual divertees of Teton River waters are aware of the actual amounts that are credited to their use.

That these individual divertees suffer from the same inequalities that exist under the four irrigation companies is evidenced by the fact that 40 percent signified that they could use more water, while the remaining 60 percent indicated that they did not use their entire appropriation right. Sixty percent estimated that they wasted a portion of their water, the amounts ranging from 5 percent to 50 percent. The remaining 40 percent stated that no water was wasted by them.

Following is a breakdown of land uses of the ten individuals:

Total irrigable acres	13,800
Total irrigated acres	4,680
Percent of acres irrigated	34%
Percent of irrigated acres devoted to alfalfa hay	15%
Percent of irrigated acres devoted to native hay	64%
Percent of irrigated acres devoted to grain	0%

The foregoing atomistic views are compiled into a composite table showing uses made of diverted water of the Teton River in Teton County. (See Table VII.)

TABLE VII. AVERAGE ANNUAL USE OF WATER BY ALL GROUPS, FOR THE THREE YEARS 1964, 196

Group	Decreed Right Miners Inches	Crops Irrigated					Water Dive	
		Alfalfa Hay	Native Hay	Pasture	Grain	Total	Total	Pe
		Acres	Acres	Acres	Acres	Acres	Acre Feet	Ac
Teton Cooperative Canal Company	3,000	844	180	809	20	1853	9934	
Farmers Cooperative Canal Company	3,000	781	50	496	1213	2540	8280	
Eldorado Cooperative Canal Company	3,000	188	2120	3250	100	5658	10456	
Bynum Irrigation District		1825	1815	2174	2266	8080	35000	
Ten Individual Users	5,020	690	3020	970	0	4680	8682	
Totals		4328	7185	7699	3599	22811	72352	

* Included are the amounts of the decreed rights in miners inches. Refer to Chapte page 69, for added information concerning these decrees.

The number of acres of alfalfa hay, native hay, pasture, and grain are totals for group listed. Column 6 is the grand total of all irrigated acres for each group Column 7 is total acre feet of water diverted averaged over a three year period, 1965, and 1966. Results in Column 8 were obtained by dividing figures in Column their corresponding figures in Column 6.

Refer to footnote, Table IV, page 98, to obtain adjusted figure for the Eldorado tive Canal Company.

** Average acre feet of water diverted for each acre of land irrigated.

Problems Relating to Inefficiency

The area that the Teton River drains, which is of prime importance to the divertees of water, consists of approximately 105 square miles of mountainous terrain, reaching a maximum elevation of nearly 9,000 feet, with an annual precipitation estimated to reach 60 inches in some of the higher elevations. That better than half of this precipitation falls in the form of snow is assumed to be a distinct benefit to the area irrigated by the waters of the Teton River.

Using figures of the United States Geological Survey, it has been determined that the average discharge of the Teton River is 119,500 acre feet per year. The readings used were taken at a water stage recorder located 20 miles west of Farmington and approximately one mile downstream from a point where the South Fork of the Teton joins the main river. There are no significant diversions of water above this point.

The three years with which this study is concerned indicate that the average total diversions from the Teton by all water users in the area amounted to 72,352 acre feet; this leaves 46,148 acre feet of water not being utilized by the irrigators.

The study provides several insights into the reasons for the lack of utilization of this 46,148 acre feet:

(1) Lack of coordinated management of the storage facilities. The Teton Cooperative Canal Company follows the practice of filling its storage facility during the winter months. This requires that the diminished winter flow of the Teton River must remain in its wide and, in many places,

multiple channels for a distance of several miles, subject to the seepage loss inherent to a stream underlaid with many feet of coarse gravel, until it reaches the point of diversion to the storage site belonging to the above-mentioned company. This storage facility is generally filled to capacity before the spring run-off.

(2) Carrying stored water from one irrigation season to the next to the detriment of those that are short of irrigation water. That this has an impact is evidenced by the pattern of water use and by the observed water remaining in two of the storage facilities at the end of the irrigation season, while the others are empty.

A Plan for Increased Efficiency

Ways of making this lost 46,148 acre feet of water available for irrigation purposes conceivably might take the following directions:

(a) Construction of one delivery canal, starting at the mouth of the Teton Canyon, and extending to the last point of diversion, thus eliminating a major portion of the loss due to seepage. This was advocated by a prominent engineer some years ago.

(b) Coordinated efforts by all storing water to make better use of the water of the Teton River.

(c) Enlarged inlet canals to storage facilities by those having canals of insufficient size, to enable the three companies utilizing storage to make use of all the spring run-off.

Much of the 46,148 acre feet of water lost to the irrigators of the area under study could be conserved if properly constructed and managed facilities were utilized, bringing a substantial increase in usable water to all interested parties.

The possibility of developing ground water that may exist under some of the areas now being irrigated by waters diverted from the Teton River has not been ascertained. That this is a feasible possibility can be assumed, since large areas adjacent to the Teton River are underlain at a shallow depth by coarse gravel soils over which the Teton River flows, disappearing completely into these soils in late summer months at certain localities.

In addition, flowing water wells are obtained within portions of the area being irrigated, and immediately adjacent to the area on its eastern and northeastern extremities. These wells range in depth from less than 30 feet to more than 200 feet.

This study has not attempted to show what portion of the 46,148 acre feet of water lost is due to seepage resulting from use of the river channel to supply each divertee, or what portion is due to inability to utilize 100 percent of the spring run-off, only that the total lost is the aforementioned figure, based upon records available to the researcher and subject to unavoidable errors of measurement.

CHAPTER VII

SUMMARY, CHAPTER I THROUGH CHAPTER VI

Introduction

With the passing of the years and the accompanying technological changes, water has come to play a different role from that which was so important to the area during the period of settlement and early development.

During the period of early settlement and development the primary purpose of water utilization was to prove up on land claims filed under the Desert Land Act, and to improve the productivity of natural grasslands adjacent to the Teton River.

Today this same water plays the role of a basic input factor in the production of alfalfa and native hay, improved pastures, and the raising of cereal grains, not only on the lands adjacent to the Teton River, but on the fertile soils of the outlying benches. Its basic function is to increase output, otherwise limited by lack of adequate moisture.

Institutional changes have caused emphasis to be placed upon policies and practices that did not exist when the first water appropriations were made diverting water from the Teton River for agricultural purposes in the Choteau area. Farms have evolved from self-sufficient small acreages producting a multitude of products to businesses specializing in one or two outputs. Cattle ranching has come to rely upon high production of

feed per acre as opposed to many acres of "open range" per animal unit. New production techniques have caused a shift in the input factors which affects the entire spectrum of resource development. Mechanization, in conjunction with technical advances and new varieties of crops, has resulted in a changed input to output ratio. Even though the ratio of output to input has increased, the cost of input factors has increased at a faster rate. As a result, it is becoming evident to the producer that he must respond to the forces of a competitive system by becoming more efficient. To accomplish this he must reduce total costs per unit of product. This will involve more total money spent, but because of efficiency of size of output will be less per unit of output.

The users of water diverted from the Teton River are aware of the changes taking place and of the required action if they are to survive economically, but due to institutional factors are bound to outmoded practices and policies which slow down and make difficult the necessary adjustments.

These factors have been discussed in Chapter II through Chapter VI. Water laws resulting from methods of disposal of the public domain, have resulted in water being divorced from the land, have brought about inequalities in available water per acre of irrigable land, and have left much water resources development in the hands of individuals who do not have the necessary financing for proper development. Present water appropriations and distribution systems were left to chance. Windfall gains have accrued to those who by chance were fortunate enough to acquire the earliest

appropriations and/or greatest number of shares in a company. Still in use are the antiquated systems designed for the purpose of bringing a minimum of water to the settler to enable him to acquire a desert claim and improve, to a limited degree, his living standard, by irrigation of a small acreage of native grass, potatoes, and oats. Owning shares instead of acre feet per acre has resulted in inequality of available water supply to adjoining acres of land within the same company, to inequality between companies and individuals, with the resultant waste of a vital natural resource and in some instances, lack of beneficial use, which is required of appropriated water.

Conservation Practiced to Increase Economic Efficiency

To aid in alleviation of the problem and to get the most economical use of the input factors of production by the farmers and ranchers as individuals, the following percentages of operators under the different irrigation systems have engaged in water conservation practices such as redesigning of distribution systems for more efficient delivery of water, land leveling to increase efficiency of water spreading, and construction of drainage facilities to improve soil characteristics where needed. These practices are designed not only to conserve natural resources, but to increase economic efficiency:

Teton Cooperative Canal Company	37%
Farmers Cooperative Canal Company	40%
Eldorado Cooperative Canal Company	17%
Bynum Irrigation District	80%
Ten Individual Divertees	70%

Through the use of statistics it has been determined that, using a ten percent significance level, a direct relationship exists between available water for irrigation purposes and conservation practices carried out by the operators under the various companies.

Through observations and data obtained from the questionnaire it can be stated that those progressive operators suffering water shortages were the first to make use of technical innovations designed to increase overall efficiency in the utilization of scarce input factors.

Changing Attitudes in Regard to Water Usage

The existing systems were developed and water appropriated as a result of an individual urge to acquire and own property. Today the driving force has lost some of its individualistic characteristics, with more emphasis being placed upon cooperative action to meet the growing complexity of the competitive enterprise system.

In answer to the question relating to opinion regarding the consolidation of all the diverted waters of the Teton River for use in the Choteau area under one cooperative enterprise, locally owned and administered, 56 percent of those willing to answer signified their approval of such a consolidation. The 44 percent disapproving varied in their reasons. It would be too difficult to bring about; there was danger of loss of advantageous position now held by the person answering; others were simply not interested. Little significance can be attributed to this percentage in favor due to the greater number that were noncommittal; this constituted 59 percent of the total.

Inefficient Use of an Economic Resource

That wasteful practices exist on all the systems is evidenced not only by answers obtained on the questionnaires, but by physical evidence, such as extensive areas of prime farm land made unproductive due to excessive seepage, roadside borrow pits full of water during the irrigation season, low areas standing full of water, and drainage facilities carrying excess water. The majority of operators estimated that they did not utilize the available water to its best advantage.

That the above condition continues to exist in the face of a water shortage for the area as a whole can be attributed to institutional factors which have made it possible for some operators and companies to gain control of a more than adequate supply of irrigation water for their use. This condition has been aggravated by lack of adequate storage, which would eliminate the necessity of any one company's protecting itself by claiming access to a larger amount of water than it can put to beneficial use. The practice of acquiring early appropriations through purchase accentuates the problem.

Lack of adequate supervision, and neglect in enforcement of water rules lead to excessive waste by individual operators.

To help clarify the above, the following information derived from the questionnaires and personal contacts with the individual operators is presented:

Name of Company	Percent of Operators Estimating Water Wasted	Estimated Water Wasted	Percent of Operators Who Could Use More Water
Teton Cooperative Canal Co.	80----------	20 to 60%	53%
Farmers Cooperative Canal Co.	75----------	20 to 50%	72%
Eldorado Cooperative Canal Co.	78----------	10 to 45%	33%
Bynum Irrigation District	90----------	10 to 60%	50%
Individual Divertees	60----------	5 to 50%	40%

The practice prevails of continuing to run water in the canal systems when there is no demand for irrigation purposes--this to provide drinking water for the livestock that are pastured adjacent to the canal systems. Adequate stock water is available throughout the area from water wells ranging in depth from 10 to 50 feet.

That waste is tolerated in the face of an obvious shortage of this valuable economic resource is due to factors which are beyond the scope of this study.

Dryland Farming Versus Irrigated Farming

The desire to follow dryland methods of farming in the area is strong. Up until recent years a higher percentage of mechanization could be used on dryland farms than on irrigated acres; thus, labor became an important factor. Due to new developments in equipment used on irrigated land a large portion of this advantage has been lost.

Economic changes have taken place which make dryland methods uneconomical if water for irrigation can be obtained.

Due to prevailing economics, the operators of the area are turning more and more to irrigation and placing greater reliance upon the returns from this enterprise. There is a total of 65,571 acres classed as irrigable by the individual operators. These are acres that, with a minimum of preparation, could be placed under irrigation. Of these, 22,803 acres are at present being irrigated, leaving a potential of 42,768 acres that can be irrigated if the water is available.

The remainder of this study will deal with this problem and suggest several alternatives that can be followed by the residents of this area to arrive at a solution.

PART II

PLANNING FOR INCREASED EFFICIENCY AND RETURNS

CHAPTER VIII

POSSIBLE FUTURE PATTERN OF WATER USE

Sources of Information

Data used in compiling the tables included in this chapter was obtained from questionnaires and personal interviews with the individual farmers and ranchers utilizing water diverted from the Teton River for use in the area covered by this study. Information from the Teton County Soil Conservation District in regard to soils and irrigation efficiencies was also utilized.

Assumptions

The following assumptions were made:

Costs and returns for present operations can be used in further analysis.

No physical reason exists for not converting 30 percent of present pasture to an alternate crop of greater net value.

Any gain in usable irrigation water will result in more acres of the most efficient crop being produced.

Institutional factors, as discussed in previous chapters, continue to dominate in shaping the structure of the area.

Lands utilized for the production of the three classifications of crops are comparable as to climate, soil structure, and productivity.

Lands not being irrigated, but classified as irrigable by the operators, can be, and are, shifted from dry to irrigated and irrigated to dry status at the will of the operator.

Computed averages are admissible as reliable data.

Diverted water from the Teton River is utilized to irrigate a total of 22,803 acres of land. Due to institutional factors, not all irrigated acres receive or are entitled to the same number of acre feet of water per acre. These amounts vary from a low of 1.85 acre feet per acre to a high of 5.22 acre feet per acre. By no means do the lands classified as irrigated in this area meet the standards necessary to be classed as fully irrigated. The prevalent practice is to use the water as an assistant to extensive farming and ranching methods, and not as a method of intensifying the land usage.

The average rancher and farmer contacted indicates that the following pattern of irrigation is most common: pasture and native hay are irrigated continuously, or as long as available water can be obtained; in some instances this is only during the early spring months; alfalfa is irrigated twice during the growing season, and cereal grains, once. That an increase in production is obtained under these conditions can be attributed to several unique factors.

Natural Elements Conducive to Increasing Production

First, the average rainfall of the area is 12 inches; 75 percent of this amount is received during the growing season, giving an average yearly amount, due to Nature, of 9.0 inches at this critical time.

Secondly, most of the native pasture and native hayland is naturally wet due to geological structure. This area is underlain by Mid-Cretaceous strata which have been folded and faulted by the same forces that created the Rocky Mountains. This belt, which lies just west of Choteau, is known as the Disturbed Belt, and is quite narrow in this area. East of the Disturbed Belt, the bedrock, consisting of Colorado Shale, gently dips three to four degrees to the west and is overlain by Quanternary gravels. The portion of this area now being irrigated by diverted waters of the Teton River was covered by a continental glacier, and presents a not-too well-drained area which is typical of such glaciation. A portion of the land is irrigated by return flow.

Crops and Acreages Receiving Supplementary Water from Teton

The following crops and their total acres receive supplemental water from the Teton River:

Alfalfa	4,328 acres
Native pasture	7,185 acres
Native hay	7,749 acres
Cereal grains	3,599 acres

Based on the average measured water diverted from the Teton River, each acre of irrigated land could receive an average of 3.40 acre feet of water per acre. That this does not occur is due to previously mentioned institutional factors and is made evident in Tables II, III, IV, and VI.

Net Returns of Irrigated Versus Net Returns Without Irrigation

Based upon information acquired from the questionnaire submitted to the users of the diverted waters of the Teton River and through personal interviews, Table VIII has been constructed to derive income per acre for each ditch company, irrigation company, and the ten individual divertees.

Total Net Income, Irrigated, is the net value per acres times the irrigated acres, giving a total value of irrigated land for each crop listed. Total Income, Dryland, is the net value per acre of dryland for this area times the acres irrigated, to arrive at a value for these same acres if no irrigation were practiced. These individual crop totals are totalled for each company, irrigation district, and individual divertees. A grand total for the entire area under study is obtained as the systems are now operated, and as they would be if no irrigation were available.

Recognizing the fact that a portion of the native pasture utilized by the individuals is non-irrigated, the following method was utilized to derive the income for each acre of irrigated pasture. The ranchers follow the procedure of irrigating the most promising area of their ranches for the purpose of enhancing the productivity of native grass to be cut for hay. The average total cost for an acre of such land was computed from cost figures provided by the landowners. Average productivity was established from productivity figures. Price x Total Product - Total Cost = Net Value. Using an animal unit cost per month of $3, it was calculated that one and one half tons of native hay was equal to six months of pasture per animal unit. After removal of hay, the operators estimated that, on

the average, they could obtain two animal units months of additional pasture, making a total of eight months pasture for one animal unit. This figure, tranlated into pure pasture, resulted in 1.5 animal units per acre for five-plus months, which is comparable to the average animal unit per acre for irrigated native pasture as managed in this area. Due to the close comparison arrived at between the two uses of the native irrigated grass land, for purposes of constructing the tables, the designation Native Hay was deleted and all native grass uses were tabulated under the common heading of Pasture.

Economies Due to Natural Phenomena

This area lends itself admirably to the raising of small grains by use of "dryland methods," due to various factors of which the following are important: total yearly precipitation, 12 inches, of which 75 percent occurs during the growing season from May through September ("It appears that Choteau represents an exceedingly favorable distribution pattern because of the extra concentration of precipitation during the growing season when moisture demand is greatest"); 16/ relatively cool days which minimize moisture loss due to evaporation; and a soil structure which has high moisture retaining capabilities. As a result, the farmers comprising the population of this area have an affinity for this method of production, and up to the present time have prospered. It is not surprising that

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16/ Montana Beef Production School, Presented by the Montana Cooperative Extension Service, 1966, p. 80.

TABLE VIII. NET INCOME, IRRIGATED LAND -VS- NET INCOME, ON SAME ACRES IF NO IRRIGATION PRACTICED

Name of Company	Crop	Per Acre Irrigated				Total Net Income Irrigated	Total Net Income Dryland*	Total, All Crops Irrigated (Each Company)	Total, All Crc Dryland (Each Company
		Acres	Gross Sale Dollars	Total Cost Dollars	Net Value Dollars	Dollars	Dollars	Dollars	Dollars
Teton Cooperative Canal Company	Alfalfa	844	$84.58	$38.70	$45.88	$38,722.72	$ 4,220.00		
	Pasture	1,039	33.75	21.00	12.75	13,247.25	1,194.85		
	Grain	30	66.90	29.00	37.90	1,137.00	195.00		
								$ 53,106.97	$ 5,609.85
Farmers Cooperative Canal Company	Alfalfa	781	84.80	39.80	45.00	35,145.00	3,905.00		
	Pasture	546	47.70	25.00	17.30	9,445.80	627.90		
	Grain	1,213	98.00	47.00	51.00	61,963.00	7,884.50		
								106,453.80	12,417.40
Eldorado Cooperative Canal Company	Alfalfa	188	59.60	35.60	24.00	4,512.00	940.00		
	Pasture	5,262	22.50	8.10	14.50	76,299.00	6,051.30		
	Grain	210	47.50	23.50	24.00	5,040.00	1,365.00		
								85,851.00	8,356.30
Bynum Irrigation District	Alfalfa	1,825	78.10	41.10	37.00	+67,525.00	9,125.00		
	Pasture	3,989	45.00	28.50	16.50	65,818.50	4,587.35		
	Grain	2,266	54.28	25.50	28.78	65,215.48	14,729.00		
								198,558.98	28,441.35
Individual Divertees	Alfalfa	690	73.37	35.40	37.37	26,199.30	3,450.00		
	Pasture	3,990	19.50	7.00	12.50	49,875.00	4,588.50		
								26,199.30	8,038.50
							GRAND TOTAL	$470,170.05	GRAND TOTAL $62,863.40

* Total net income for the irrigated land was obtained from information submitted by the individual farmers. Gross Sale - Total Cost = Net Value. Net Value X Acres = Total Net Income, Irrigated.

The total net income, dry land, was arrived at by using data from Montana Agricultural Statistics, Vol. X, December 1964, relating to Teton County and dry land farms. Dry land alfalfa, valued at $20 a ton, gave a net return of $5 a ton; dry land pasture, a net return of $1.15 per acre; dry land wheat, a net return of $6.50 per acre. Net Value X Acres = Total Net Income, Dry land.

The same number of acres was used in computing Net Income, Irrigated, and Net Income, Dry land, for each crop.

This comparison is between irrigated land under each system as now operated and 1964 dry land operations.

irrigation as practiced throughout the area has been relegated to second place in importance as a source of income, and farming practices follow the plan of dryland economics, one-half summerfallow and one-half crop.

The same unique features which make it possible to produce high-yielding dryland crops also make it possible to produce high-yielding irrigated crops with a minimum of irrigation water.

Average Value of an Acre Foot of Water

Table IX depicts the increase per acre of net income due to irrigation, as practiced by the operators in this area. The average value of an acre foot of water as used by the various divertees of Teton River water was obtained by dividing the returns from the three crops raised, by the number three, to arrive at an average value per acre of land as utilized by the operators under each company, district, or individual. The average thus obtained for each acre was divided by the average acre feet of water diverted by each of the above mentioned divertees, this figure obtained from Tables I, II, III, IV, and V. The resulting answer is an average value per acre foot of water as utilized by the operators of this area, subject to unavoidable errors inherent in the relevant data.

The table also shows total acre feet of water diverted by each company (or individual), total yearly cost of operation of company (or individual), and per acre foot of cost of the diverted water.

The acre foot costs have been included in cost of production, and hence are not subtracted from average value per acre foot of water.

TABLE IX. INCREASE PER ACRE OF NET INCOME DUE TO IRRIGATION

Name of Company	Crop	Net Income Irrigated Acre	Net Income Dryland Acre	Increase Per Acre Due To Water	Average Value Of Water Per Acre Foot	Diverted Water		
							Cost	Per Ac Foot C
		Dollars	Dollars	Dollars	Dollars	Acre Feet	Dollars	Dolla
Teton Coöperative Canal Company	Alfalfa Pasture Grain	$45.88 12.75 37.90	$5.00 1.15 6.50	$40.88 11.60 31.40	$ 6.53	9,934	$2700	$ .27
Farmers Cooperative Canal Company	Alfalfa Pasture Grain	45.00 17.30 51.00	5.00 1.15 6.50	40.00 16.15 44.50	10.17	8,280	7200	.86
Eldorado Cooperative Canal Company	Alfalfa Pasture Grain	24.00 14.50 24.00	5.00 1.15 6.50	19.00 13.35 17.50	6.32	10,456	2740	.26
Bynum Irrigation District	Alfalfa Pasture Grain	37.00 16.50 28.78	5.00 1.15 6.50	32.00 15.35 22.28	5.36	35,000	70000	2.00
Individual Divertees	Alfalfa Pasture No Grain	37.97 12.50	5.00 1.15	32.97 11.35	11.98	8,682	1736	.20

Overall Average Value Acrefoot of Water - $8.07

* Net increase due to irrigation was computed as Net Income. Irrigated Acre - Net Income Dry Land Acre = Increase Pe Acre Due to Water for each of the crops listed under each company.

$$\frac{\text{Average value of crops, each company}}{\text{Average a/f water used, each company.}} = \text{Average value a/f, each company}$$

Overall average value for an acre foot of water was obtained by taking an average of all divertees of Teton waters.

Possible On Farm Savings Using Recommended Rates of Water Application

The following are field requirements of irrigation water at stated efficiencies. Data used in arriving at the average figures relating to irrigation requirements for the three basic irrigated crops were obtained from the Choteau Soil Conservation District, Choteau, Montana, based upon field trials of cooperating farmers in the area.

Crop	Acre Feet of Irrigation Water at Field	Field Irrigation Efficiency
Alfalfa	2.40	50%
Pasture	1.25	58%
Grain	1.20	54%

If the recommended rates of water application were used, the present cropping system retained, and the efficiency of the distribution system were 50 percent, the total irrigation water required would be 66,765 acre feet. At present, 72,352 acre feet of water are used to irrigate the same acres under the same cropping pattern. This would result in a saving of 5,587 acre feet of water.

Table X is presented showing savings that can be attained through use of recommended rates of water application.

Economic Aspects of Best Land Use

In order to arrive at the best land use for each group diverting water from the Teton River, the following procedure was used.

TABLE X. SAVINGS IN IRRIGATION WATER THAT CAN BE ATTAINED THROUGH USE OF EFFICIENT IRRIGATION PRACTICES

Name of Company	Crop		Average Field Application	Total Water Applied To Each Crop b/	Water Use, Efficient Practices c/	50% Distribution Loss Under Efficient Practice d/	Total Acre Feet Used Under Present Practices e/	Sa
		Acres	Acre Feet a/	Acre Feet	Acre Feet	Acre Feet	Acre Feet	Acr
Teton Cooperative Canal Company	Alfalfa	844	2.40	2,025.60				
	Pasture	1,039	1.25	1,298.75				
	Grain	30	1.20	36.00	3,360.35	6,720.70	9,934	3
Farmers Cooperative Canal Company	Alfalfa	781	2.40	1,874.40				
	Pasture	546	1.25	682.50				
	Grain	1,213	1.20	1,455.60	4,012.50	8,025.00	8,280	
Eldorado Cooperative Canal Company	Alfalfa	188	2.40	451.20				
	Pasture	5,262	1.25	6,577.50				
	Grain	210	1.20	252.00	7,280.70	14,561.40	10,456	-4
Bynum Irrigation District	Alfalfa	1,825	2.40	4,380.00				
	Pasture	3,989	1.25	4,986.25				
	Grain	2,266	1.20	2,719.20	12,085.45	24,170.90	35,000	10
Individual Divertees	Alfalfa	690	2.40	1,656.00				
	Pasture	3,990	1.25	4,987.50	6,643.50	13,287.00	8,682	-4
Totals						66,765.00	72,352	5

a/ Average field application in acre feet obtained from field trial under the supervision of the Teton County Soil Conservation District.

b/ Total acre feet applied to each crop.

c/ Total acre feet applied to each of the three basic crops for each company.

d/ Combined diversion, storage, and distribution loss estimated to be 50 percent. A figure utilized by the Bureau of Reclamation gives amount of water needed to be diverted under efficient utilization.

e/ Acre feet used by each company under present conditions.
Water saved: Total acre feet under present conditions - acre feet under efficient utilization = water saved

72.352 a/f - 66,765 a/f = 5,587 a/f

All irrigable land under each group was divided into two classes, namely Class A and Class B. Class A land contains all land capable of producing average or better than average yields; Class B land contains all land producing less than average yields. The number of acres in each classification was arrived at by consulting landowners, checking with the Teton Soil Conservation Office, and through use of aerial survey photographs studied through a stereoscope. This method determined that 75 percent of the land under the Teton Cooperative Canal Company and the Farmers Cooperative Canal Company is Class A, the remaining 25 percent, Class B; 60 percent of land under the Eldorado Cooperative Canal Company is Class A, 40 percent, Class B; 80 percent of the land under the Bynum Irrigation District is Class A, 20 percent, Class B; and 60 percent of the land owned by the Individual Divertees is Class A, 40 percent is Class B.

The assumption is made that due to the irrigation methods practiced and the manner in which water is delivered to each user, with no method of measurement, the same number of acre feet of water per acre is used on Class A and Class B land.

Land under each class can be used for grain, alfalfa and pasture.

The acreage of alfalfa will have to be at least .3 of the irrigated grain acreage on Class A land and .2 of the irrigated grain acreage on Class B land in order to provide a crop rotation on the irrigated land which will maintain the land in its original condition.

Yield data for Class B land was arrived at by multiplying the yield for Class A land by a constant factor of .67. To obtain this factor

operators chosen at random throughout the irrigated area were consulted. Their opinions, in conjunction with those of Soil Conservation personnel, were utilized to arrive at this adjustment figure.

Acre feet of water used per acre on each crop is an estimation based upon the experience of those presently using the water.

It is realized that the above estimates are subject to error, but due to lack of complete land classification, the fact that no company measures the acre feet of water being delivered to a user, and that Class A and Class B land is not farmed separately, reliance has to be placed upon the judgment of those most closely associated with the area in question.

The optimum allocation of the land and water resources was determined after formulating a linear programming problem for each of the five groups of water users. Because of the nature of each of the linear programming problems, it was possible to obtain a solution by simple algebraic manipulation. The linear programming problems and their solution are presented in Appendix C. The possibility of an upward aggregation bias when using such an approach is recognized. While this problem was not investigated empirically, any such bias should be small because only a few landowners control enough water to irrigate all their irrigable land.

The results of the analysis presented in Appendix C are summarized in Table XI. These results show that by shifting the cropping pattern to one of grain and alfalfa, net income from available water could be increased from $470,170.05 to $973,989.62.

In formulating the linear programming problem for each of the five groups of water users, no recognition was given to the fact that 70 percent of the irrigated land now classed as pasture would have to remain in this use due to it being sub-irrigated. All of the pasture land is classified as Class B land. This restriction on the use of pasture land was not included in the linear programming models. Its omission permits all Class B land to be planted to grain. This sub-irrigated pasture probably has a higher net income of about $2 per acre more than dryland grain. Therefore the net income from non-irrigated land (which in this case includes the sub-irrigated pasture) is understated by approximately $20,000.

TABLE XI. PRESENT IRRIGATED INCOME -VS- IRRIGATED INCOME WITH BEST LAND USAGE*
(All Other Variables Remaining Constant)

	Total Income Irrigated As Operated Today	Total Income Irrigated Best Land Use With Today's Methods	Decreased Area of Dryland	Decreased Due to L Drylan
	Dollars	Dollars	Acres	Dollar
Teton Cooperative Canal Co.	$ 53,106.97	$146,604.08		
Land irrigated (acres)	1,843	3,689		
Land dry (acres)	9,113	7,267	-1,846	$ 3,987
Farmers Cooperative Canal Co.	$106,453.80	$154,800.00		
Land irrigated (acres)	2,540	3,120		
Land dry (acres)	8,288	7,708	- 580	$ -1,252
Eldorado Cooperative Canal Co.	$ 85,851.00	$171,648.00		
Land irrigated (acres)	5,160	4,768		
Land dry (acres)	8,260	8,652	+ 392	$ + 825
Bynum Irrigation District	$198,558.98	$377,099.03		
Land irrigated (acres)	8,080	12,296		
Land dry (acres)	10,330	6,114	-4,216	$ -9,106
Individual Divertees	$ 26,199.30	$123,838.51		
Land irrigated (acres)	4,680	5,129		
Land dry (acres)	9,120	8,671	- 449	$ -1,077
TOTAL	$470,170.05	$973,989.62		$-14,577

* Increase due to best utilization of resources under existing methods of operation $503,819.57 less profit from acres no longer devoted to dryland, of $14,577.84 = $489,241.73.

CHAPTER IX

A PROPOSED PLAN TO INCREASE ECONOMIC EFFICIENCY

The Plan*

That the diverted waters of the Teton River are not being utilized either to maximize economic returns to the area or to derive the greatest primary benefits is evident. This study suggests that the following plan might serve as a guide to better utilization of this natural resource: consolidation of all the waters of the Teton River diverted for use in the Choteau, Farmington, Agawam and Bynum areas under one privately controlled cooperative, utilizing existing structures where practical, and eliminating duplication of facilities where feasible.

Some of the excess storage facilities could conceivably be utilized for an alternative purpose which would be economically sound.

As noted in previous chapters, today there exist four off-stream storage reservoirs. It is suggested that of these, one, namely the Teton Cooperative Reservoir, be utilized for the storage of irrigation water. This is a natural site, well suited for the purpose. At present its capacity is in excess of 90,000 acre feet of storage. According to Farm Home Security Administration and Soil Conservation engineers, this site,

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* See Map VI, Appendix E, Composite Map showing all irrigated area with proposed canals under a consolidated irrigation system.

with the expenditure of a relatively small sum of money, could be developed to hold in storage all the waters that are discharged by the Teton River in this area.

Eureka Reservoir could become the prime source of water for those users located above the point where a new canal system from the Teton Reservoir company would connect to the existing systems of the Teton Cooperative Canal Company and the Eldorado Cooperative Canal Company. This facility would assure these users and those now diverting water from the Teton River below this point an adequate supply of irrigation water. Eureka storage would utilize the excess water from approximately 65 square miles of drainage originating below the point of diversion to the Teton Cooperative Reservoir Company storage site, as well as the winter flow from Spring Creek (McDonald Creek). In addition to serving as a source of water for these individuals, due to the limited drawdown which this would entail, it could be developed as a recreation site.

Harvey Lake and Farmers Lake, now used by the Farmers Cooperative Canal Company, could be developed into recreational areas, as they would no longer be needed for irrigation storage purposes.

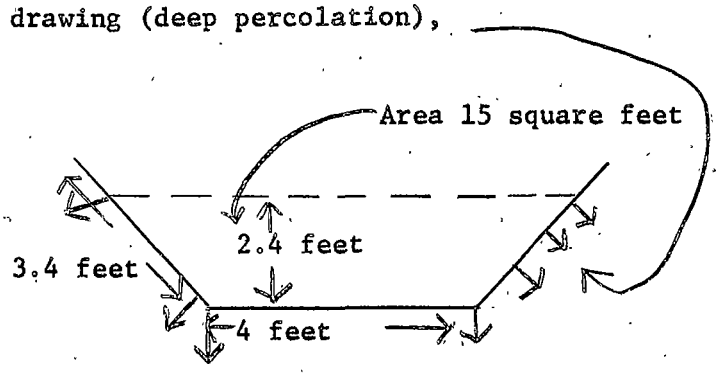
The main diversion point for waters from the Teton River to the Teton Cooperative Reservoir Company would remain in its present location. From this canal would be constructed a feeder canal to supply the private diver-tees of water whose irrigable land is below this structure, thus eliminating losses due to utilization of the river channel as a method of supplying water to these individuals.

From the outlet of the Teton Cooperative Reservoir Company, a supply canal to the area now being served by the aforementioned cooperative canal companies would be structured. A portion of this construction now exists, and would need only to be enlarged and extended. This plan would eliminate approximately 31 miles of present canal and add about 6 miles of new construction, with a net loss of 25 miles of canal and structures. Any decrease in canal length is readily translated into water saved. It is realized that a small portion of the present distribution system above the confluence of the new canal from the outlet of the Teton Cooperative Reservoir Company to the present systems will need to be retained.

Economic Implications

Without entering into the detailed engineering aspects, the following beneficial results can be expected to accrue to the area.

In order to arrive at ditch loss per mile, the following procedure was utilized. A ditch of size necessary to provide adequate water for the 22,803 acres not being irrigated was determined as indicated by the drawing (deep percolation),



Average Area = 11 square feet

Slope of sides 1 to 1, bottom width 4 feet, length of each side 3.4 feet, depth 2.4 feet.

Five hundred (500) cfs was used as an estimate to supply the 22,803 acres at peak demand.

To compute the loss in acre feet per day, the following formula, used by the State Soil Conservation Engineers, was used:

$$\frac{11 \times 110 \times 5,280}{43,560} = 146.5 \text{ acre feet per day lost}$$

Considering the irrigation season to be 120 days in length, the total loss (deep percolation) would be equal to:

146.5 acre feet x 120 days = 17,580 acre feet

Assuming a ten percent loss attributed to administrative factors, equal to 1,758 acre feet, total loss for the 110 miles of canal system equals:

17,580 acre feet + 1,758 acre feet + 19,338 acre feet of water

The above figure of 19,338 acre feet lost due to the distribution system is based upon the present estimated 110 miles of existing canals.

By eliminating 25 miles of canal the following number of acre feet of water could be saved:

$$\frac{25 \times 19,338}{110} = 4,390 \text{ acre feet}$$

In Chapter X it was determined that by increasing the efficiency of farm irrigation practices through land levelling, installation of border dykes, reorganization of delivery laterals, and installation of measuring

devices, in conjunction with good water management, 5,507 acre feet of water count be saved. To this figure add the acre feet that could be saved by the elimination of 25 miles of canal, to obtain a total of 5,587 acre feet + 4,390 acre feet = 9,977 acre feet of water saved due to efficient farm irrigation and elimination of 25 miles of canal system.

The projected canal from the Teton Cooperative Reservoir Company to serve the area adjacent to Farmington crosses several areas subject to greater than normal seepage (normal considered to be .5 acre feet per day), this information obtained by review of the soils maps for the proposed route of the canal. These areas are located in Twp. 25 N, Rge. 6 W, sections 8, 9, 10, 15, 16, and would involve about five miles of canal.

Blanket lining could be installed in this area for a cost estimated to be not in excess of $.55 per running foot, or $2,900 per mile. Estimated life of such a lining is 50 years. By utilizing this technique there would be a saving of

$$\frac{11 \times 5 \times 5,280}{43,560} = 6.66 \text{ acre feet per day}$$

120 days x 6.66 acre feet = 800 acre feet each irrigation season

Total cost of lining the five miles of canal would amount to approximately $14,500.

At an average value of $8.07 per per acre foot of water, yearly savings due to blanket lining would be

800 acre feet x $8.07 = $6,456.00

Average annual cost of the blanket lining is

$14,500.00 ÷ 50 years = $290.00

Increased yearly income due to blanket lining

$6,456.00 - $290.00 = $6,160.00

Without any further computations it is evident that blanket lining is a feasible project, due to the large difference between increased income and cost.

The 800 acre feet of water thus saved, when added to the saving of 5,587 acre feet derived from efficient field use and the 4,390 acre feet from elimination of 25 miles of canal gives a total of 10,777 acre feet saved.

Further savings can be attained by elimination of Farmers Reservoir and Harvey Lake as storage sites and adding their storage capacity of 4,500 acre feet to the Teton Cooperative Reservoir Company. Using these two small sites as recreational facilities would involve no diversion of Teton water, as they could be kept at a reasonable level using drainage water from an adjacent swamp. Adding the 4,500 acre feet of storage of these two to the Teton Cooperative Reservoir Company would add 1.1 feet to the elevation of this facility. Added loss due to deep percolation and surface evaporation would be negligible, due to the small rise in the level of this facility with a corresponding very small surface area added. Thus the saving would be considerable. Farmers Reservoir and Harvey Lake cover a combined area of approximately 560 acres. Deep percolation is

estimated to be .1 acre foot per day. Assuming that water is stored in these facilities for three months, total lost to deep percolation is 3,600 acre feet. Evaporation loss is estimated to be 32 inches per year, thus evaporation loss for three months would equal 430 acre feet. Total loss on these two sites is 3,600 acre feet ÷ 430 acre feet = 3,920 acre feet per year. To arrive at a total acre feet of water that could be saved by this suggested plan, combine the savings from improved field efficiency, 5,587 acre feet; elimination of 25 miles of canal, 4,390 acre feet; lining of five miles of canal, 800 acre feet; giving a total saving of 14,697 acre feet of water out of the 72,352 acre feet total diverted from the Teton River. This amounts to a saving in excess of 20 percent of total diverted waters. Translated into dollars:

14,697 acre feet x $8.07 = $158,618.79

Using records filed by the Teton River Water Commissioner with the Clerk of the District Court, Teton County, Choteau, Montana, it has been determined that the average diversion of irrigation water from the Teton River to serve the area covered by average yearly discharge of the Teton River, measured 20 miles west of Farmington, which is above any diversion, is 119,500 acre feet per year. Subtracting the acre feet of diverted water from the total average discharge leaves 47,148 acre feet of water not being utilized.

During the irrigation season, waters provided by the Teton River, (which from records have been determined to be approximately 30,000 acre feet for an average season) could be diverted through the Teton Cooperative

storage facility, which would create no added burden on this system, since the irrigation draw down would be considerably in excess of this amount. Thus, the present 90,000 acre feet of storage space proves to be adequate for an average year:

119,500 acre feet - 30,000 acre feet = 89,500 acre feet

No additional costs are envisioned at this time for creating additional storage, due to the above existing conditions.

New construction will be approximately six-plus miles of main canal. Enlarging and reorganization of some existing canals will also be necessary.

Thus, at a minimum cost, utilizing existing irrigation facilities made available to the area through some form of locally owned and managed cooperative, the aforementioned plan could provide a total additional supply of water for irrigation purposes of approximately 61,845 acre feet.

Translated into dollars and cents, this additional water supply is equal to:

61,845 acre feet x $8.07 = $498,089.35 per year.

This $498,089.35 is an estimate of increased net farm income that could be generated by consolidation of all the water diversion facilities, and minor improvements of the irrigation distribution system.

Thus it is evident that (1) altered crop patterns would result in a more efficient use of the scarce resource of water and (2) individually operated water diversion facilities, with duplication of structures serving portions of the same general area are not conducive to efficient utilization of the water of the Teton River in Teton County, Montana.

CHAPTER X

CONCLUSIONS

The development of irrigation using diverted waters of the Teton River, in the vicinity of Choteau, has been in progress for nearly a century. In the beginning, individual entrepreneurs and, at a later date, land development companies and cooperative enterprises diverted these waters and put them to beneficial use. In the process of acquiring rights of usage, strife and struggle between friends and neighbors developed; these were settled legally, but the aftermath remains--that a system so developed is resistant to change.

The area is still using the same facilities and following the practices as evolved through necessity in earlier years. Little progress has been made in utilizing technological innovations which would enhance the economic returns and conserve natural resources. Those few progressive individuals who are engaged in soil and water conservation practices are in the minority, and have done so to increase the returns to a scarce resource. Statistically, it has been shown that those engaged in this practice are operators who have access to minimum amounts of irrigation water.

The locality is unique in that of its total precipitation of 12 inches (average) a year 75 percent, or 9 inches, falls during the growing season. This fact, along with cool summer temperatures and a high water table over much of the area classed as irrigable, makes it possible to

engage in the practice of irrigation using less than what are considered the average amounts of water per acre. Moisture retention capabilities of the majority of the soils are excellent. Due to these beneficial characteristics, it is possible to irrigate a larger acreage with a fixed supply of water than is possible in areas less advantageously located. Still, in the presence of such desirable attributes, only 22,803 acres of land are actually irrigated out of a total of 52,457 acres that lend themselves to irrigation with little or no special preparation. The answer lies not in an aversion to irrigation per se, but in an affinity to dryland methods of farming, which have been made economically desirable by the same unique characteristics that give to this area its advantageous position in regard to irrigation.

Pride in one's accomplishments and those of his predecessors, fortified by years of strife and hardship, has built company loyalties that are not easily transferred or weakened. Thus, the diverse groups operating as individual water companies jealously guard and reinforce any action beneficial to themselves, and reject all others. So it has been over the years, but with the changing economic forces affecting farming, especially since World War II, there has been a gradual awareness and awakening to the knowledge that, individually, the farmer can no longer compete and progress economically in the highly complex competitive market structure that has evolved. As a result, there is more rational, concentrated thinking being displayed than has heretofore been the case.

The individual companies, each irrigating only a small fraction of the potentially irrigable acres, with excessive waste and duplication of canals and structures, cannot meet a criterion which would justify their existence either from the standpoint of efficiency or welfare. That this is realized by many of the operators is evidenced by the fact that of those making their views known a majority favor some method whereby all the waters of the Teton River which are diverted for irrigation purposes would be controlled and administered by one locally owned organization, making available to the area all those advantages that accrue to scale of operation.

That water is cheap dollar-wise in the area is due to the natural attributes of the region, but when the opportunity cost is figured, even with all the favorable advantages, the operator is not receiving the high returns this land, with its water, is capable of producing. He is actually losing money. Net dollar income does not necessarily mean that, economically, the methods being used are justifiable or even profitable.

In view of the findings of this study, a suggested plan of action was presented in Chapter IX. If such a plan of action were taken, economic benefits resulting from size and coordinated management would be significant.

Legal framework for putting such a plan into action exists in Senate Bill Number 55, "An Act Providing for the Conservation and Development of Water and Land Resources of Montana through the Creation of Conservancy Districts."

The will power and determination of the descendants of the first settlers can bring into reality those visions that were instrumental in causing the first appropriations to be made diverting water from the Teton River for irrigation purposes.

APPENDICES

APPENDIX A

TETON WATERSHED QUESTIONNAIRE

1. Acres in farm _____? Irrigated _____? Dryland _____?

2. Under what ditch company is your land located? _____

_____

3. Do you feel the system is adequate for the needs of the land under it?

_____

4. If the answer is No, how could it be improved? _____

_____

5. How much water do you own (acre feet)? _____

6. How many acres will this amount of water irrigate? _____

7. How many acres do you irrigate? _____

8. If less than the number of acres that owned water will irrigate, what happens to the remainder of your owned water? _____

_____

9. If more acres than owned water will irrigate, where does the additional water come from? _____

10. How many acre feet do you use a season? _____

11. How many acre feet per acre? _____

12. Could you use more water? _____

13.

CROP IRRIGATED	NUMBER OF ACRES	NUMBER OF IRRIGATIONS
Hay		
Alfalfa _____	_____	_____
Wild _____	_____	_____
Tame _____	_____	_____

13. (Continued)

CROP IRRIGATED		NUMBER OF ACRES	NUMBER OF IRRIGATIONS
Pasture			
Native	_____	_____	_____
Improved	_____	_____	_____
Grain			
Wheat	_____	_____	_____
Barley	_____	_____	_____
Oats	_____	_____	_____
Flax	_____	_____	_____
Others	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

14. Time of irrigation? _____

Do you have water all season? _____

15. How long have you farmed this place? _____

16. Have you increased the number of acres irrigated in the past three years? _____ Five years? _____ Ten years? _____

17. If answer is Yes, give reason. _____

_____

18. Does it pay to irrigate hay? _____ grain? _____ pasture? _____

19. Do you irrigate all your irrigable land? _____

20. If answer is No, why not? _____

_____

21. Is water available at appropriate time to irrigate all your irrigable land? _____

22. Would you buy supplementary water if it were available? _____

23. Whay do you feel such water would be worth to you? _____

What would you pay per acre foot for additional water? _____

24. Are you in favor of developing additional supplies of irrigation water? _____

25. What is your reaction to a plan consolidating all the waters of the Teton watershed under one system? _____

26. If such a plan were possible, do you feel it would provide more or less irrigation water for your farm? _____

For the total farm land served by the Teton? _____

27. Have you done any special preparation of land for irrigation in the last three years? _____ five years? _____ ten years? ____

Specify. _____ Number of Acres? _____

28.

TYPE OF IRRIGATION	NUMBER OF ACRES
Flood _____	_____
Border dyke _____	_____
Sprinkler _____	_____

29. Type of dtich? Lined _____ Unlined _____

30. Size of ditch? _____

31. Size of main delivery canal? _____

32. If you and your neighbors wish to irrigate at the same time can you get your water? _____ Comment. _____

Solution. _____

33. How is water measured? _____

34. Is this method satisfactory? _____

35. What type of farming do you prefer? Dryland? _____ Irrigated? ____

36. From which do you derive the greatest net profit? _____

37. Percentage wise, how much more? _____

38. Do you fertilize? _____ How much per acre? _____

39. Does it pay on dryland? _____ On irrigated land? _____

40. If on one and not the other, why? _____

41. What is your water worth to you per acre foot? _____

42. If underground water supply could be developed for your farm, would you be willing to use it and relinquish your ditch water to users who cannot develop an underground supply of water? _____

43. How much water do you estimate is wated by you? _____

44. What happens to this waste water? _____

45. Do you plan to irrigate every year? _____

46. What are your future plans concerning irrigation? _____

_____

47. Estimate the number of acre feet of water provided by the Teton each year. _____

48. Do you feel there is any danger of losing your water to other down stream users? _____

49. Comment on your irrigation system. _____

_____

50. Do you feel development of recreational facilities in conjunction with your irrigation system would be a good move? _____ Reasons for answer. _____

_____

51. Would you be willing to rent your farm's recreational capabilities for recreational purposes? _____

52. Have you ever considered the possibility of developing recreational assets on your farm for rental to the public? _____

APPENDIX B

METHODS USED IN ACQUIRING DATA

In order to obtain facts relevant to the development of this area and to determine underlying causes leading to increased demand for irrigation water from the Teton River, district court records and newspapers published within the county before and during the time of the development period were reached.

Persons personally acquainted with the development of irrigation in the area were interviewed concerning their recollections of past events and the underlying forces that preceded action taken by the interested land owners. D. V. McCormack, now confined in a rest home at Livingston, Montana, approaching his centennial birthday, proved to be an alert and reliable source of early development history.

Bureau of Reclamation, Soil Conservation, and published bulletins were utilized as a source of data to compare findings with. The Teton County Soil Conservation records proved to be valuable in ascertaining conservation practices carried out by landowners, and in the determination of soil classification.

To reinforce the data obtained from the formal questionnaires, personal interviews were conducted with landowners and farm operators in the affected area. This resulted in obtaining first-hand impressions and expressions of sentiments. Data relating to budget figures concerning the three major crops produced were obtained during these interviews.

APPENDIX C

TETON COOPERATIVE CANAL COMPANY LINEAR MODEL*

Activities											
PD2 010	PI2 09	PD1 08	PI1 07	AI2 06	AI1 05	GD2 04	GI2 03	GD1 02	GI1 01	≤ ≥	Constraints
0.0	4.3	0.0	4.30	4.00	4.00	0.0	2.30	0.0	2.30	≤	9934.0 a/f wa
					-1.0				.3	≤	0.0
				-1.0			.2			≤	0.0
		1.0	1.0		1.0			2.0	1.0	≤	8176.0 Class A Crop
1.0	1.0			1.0		2.0	1.0			≤	2789.0 Class B Crop
$1.00	$12.75	$1.15	$19.12	$30.58	$45.88	$4.32	$25.26	$6.50	$37.90		Σ Max Net Farm Profit

1. Acre feet of water that are available, page 89.

2,3. Material balance equation to insure at least alfalfa acreage required for rotati

4. Acres of Class A crop land, page 131.

5. Acres of Class B crop land, page 131.

6. Maximum net farm profit, Appendix C, page 158.

Teton Cooperative Canal Company

*Irrigation Formula (1) 4.00 AI1 + 2.30 GI1 = 9934

Alfalfa Requirement (2) -1.0 AI1 + .3 GI1 = 0

(1) AI1 = .3 GI1

(1') 4.00 (.3 GT1) + 2.30 GI1 = 9934
1.2 GI1 + 2.30 GI1 = 9934
3.50 GI1 = 9934
GI1 = 2838 acres

AI1 = 2838 x (.3) = 851 acres

By inspection, dryland grain is determined to be the best alternative use for remaining acres of Class A and Class B crop land.

Total Irrigated Crop land 2838A + 851A = 3689A

8167A - 3689A = 4478A Class A Crop land dryland grain

4478A x $\frac{\$6.50}{2}$	=	$ 14,553.75	
2789A x $\frac{\$4.32}{2}$	=	6,024.00	$ 20,557.75 Dry Income
2838A x $37.90	=	107,560.20	
851A x $45.88	=	39,043.88	146,604.08 Irrigated Income
Total Income			$167,161.83

FARMERS COOPERATIVE CANAL COMPANY LINEAR MODEL

Activities											
PDZ 010	PIZ 09	PD1 08	PI1 07	AI2 06	AI1 05	GD2 04	GI2 03	GD1 02	GI1 01	≤ ≥	Constraints
0.0	4.3	0.0	4.3	4.00	4.00	0.0	2.75	0.0	2.24	≤	8280.0 a/f
					-1.0				.3	≤	0.0
				-1.0			.2			≤	0.0
		1.0	1.0		1.0			2.0	1.0	≤	8121.0 Class Crop
1.0	1.0			1.0		2.0	1.0			≤	2707.0 Class Crop
$1.00	$11.84	$1.15	$17.30	$30.00	$45.00	$4.32	$34.00	$6.50	$51.00		Σ Max Net Fa Profi

1. Acre feet of water that are available, page 94.

2,3. Material balance equation to insure at least alfalfa acreage required for rotati

4. Acres of Class A crop land, page 131.

5. Acres of Class B crop land, page 131.

6. Maximum net farm profit, Appendix C, page 160.

Farmers Cooperative Canal Company

*Irrigation Equation (1) $4.00 AI1 + 2.25 GI1 = 8280 a/f

Alfalfa Requirement (2) -1.0 AI1 + .3 GI1 = 0

(2') AI1 = .3 GI1

(1') (4.00) (.3 GI1) + 2.25 GI1 =
1.2 GI1 + 2.25 GI1 = 8280 a/f
3.45 GI1 = 8280 a/f
GI1 = 2400 acres

AI1 = 2400 x (.3) = 720 acres

By inspection, dryland grain is determined to be the best alternative use for remaining acres of Class A and Class B crop land.

Total irrigated crop land 2400A + 720A = 3120A

8121A - 3120A = 5001A Class A crop dryland grain

5001A x $\frac{\$6.50}{2}$	=	$ 16,253.25	
2707A x $\frac{\$4.32}{2}$	=	5,847.12	$ 22,100.37 Dry Income
2400A x $51.00	=	122,400.00	
720A x $45.00	=	32,400.00	154,800.00 Irrigated Income
Total Income			$176,900.37

ELDORADO COOPERATIVE CANAL COMPANY LINEAR MODEL*

Activities											
PD2 010	PI2 09	PD1 08	PI1 07	AI2 06	AI1 05	GD2 04	GI2 03	GD1 02	GI1 01	≥ ≤	Constraints
0.0	2.5	0.0	2.5	3.50	3.50	2.0	1.80	0.0	1.80	≤	10456.0 a/f
					-1.0				.3	≤	0.0
				-1.0			.2			≤	0.0
		1.0	1.0		1.0			2.0	1.0	≤	8052.0 Class Cro
1.0	1.0			1.0		2.0	1.0				5368.0 Class Cro
$1.00	$9.67	$1.15	$14.50	$24.00	$36.00	$4.32	$24.00	$6.50	$36.00		Σ Max

1. Acre feet of water that are available, page 98.

2,3. Material balance equation to insure at least alfalfa acreage required for rotati

4. Acres of Class A crop land, page 131.

5. Acres of Class B crop land, page 131.

6. Maximum net farm profit, Appendix C, page 162.

Eldorado Cooperative Canal Company

*Irrigation Equation

(1) 3.50 AI1 + 1.80 GI1 = 10,456 a/f

(2) -1.0 AI1 + .3 GI1 = 0

(2') AI1 = .3 GI1

(1') (3.50) (.3 GI1) + 1.80 GI1 = 10,456 a/f
1.05 GI1 + 1.80 GI1 = 10,456 a/f
2.85 GI1 = 10,456 a/f
GI1 = 3668 acres

AI1 = 3668 x (.3) = 1100 acres

By inspection, dryland grain is determined to be the best alternative use for remaining acres of Class A and Class B crop land.

Total Irrigated Crop land 3668A + 1100A = 4768A

8052A - 4768A = 3284A Class A Crop, dryland grain.

3284A x $\frac{\$6.50}{2}$	=	$ 10,673.00	
5368A x $\frac{\$4.32}{2}$	=	11,594.88	$ 22,267.88 Dry Income
3668A x $36.00	=	132,048.00	
1100A x $36.00	=	39,600.00	171,648.00 Irrigated Income
Total Income			$193,915.88

BYNUM IRRIGATION DISTRICT LINEAR MODEL

Activities											
PD2 010	PI2 09	PD1 08	PI1 07	AI2 06	AI1 05	GD2 04	GI2 03	GD1 02	GI1 01	≥ ≤	Constraints
0.0	5.50	0.0	5.50	4.00	4.00	0.0	2.50	0.0	2.50	≤	35,000.0 a/f
					-1.0				.3	≤	0.0
				-1.0			.2			≤	0.0
		1.0	1.0		1.0			2.0	1.0	≤	14,728 Clas Cr
1.0	1.0			1.0		2.0	1.0			≤	3,682 Clas Cr
$1.00	$12.75	$1.15	$18.00	$24.66	$37.00	$4.32	$19.18	$6.50	$28.78		Σ Max

1. Acre feet of water that are available, page 103.

2,3. Material balance equation to insure at least alfalfa acreage required for rotati

*4. Acres of Class A crop land, page 131.

*5. Acres of Class B crop land, page 131.

6. Maximum net farm profit, Appendix C, page 164.

* The total irrigable acres obtained by adding rows four and five equal 18,410. T is 2,128 acres less than the total irrigable acres listed on the books of the irrigation district. This discrepancy is due to the farmers' definition of irri acres being different from the definition used by the district engineers.

Bynum Irrigation District

*Irrigation Equation (1) 4.00 AI1 + 2.50 GI1 = 35,000 a/f

Alfalfa Requirement (2) AI1 = .3 GI1 = 0

(2') AI1 = .3 GI1

(1') (4.00) (.3 GI1) + 2.50 GI1 = 35,000 a/f
1.20 GI1 + 2.50 GI1 = 35,000 a/f
3.70 GI1 = 35,000 a/f
GI1 = 9459 acres

AI1 = 9459 x (.3) = 2837 acres

By inspection, dryland grain is determined to be the best alternative use of remaining acres of Class A and Class B crop land.

Total Irrigated Crop Land 9,459A + 2,837A = 12,296A

14,728A - 12,296A = 2,432 Class A Crop, dryland grain

2,432A x $\frac{\$6.50}{2}$	=	$ 7,904.00	
3,682A x $\frac{\$4.32}{2}$	=	7,453.12	$ 15,357.12 Dry Income
9,459A x $28.78	=	272,130.03	
2,837A x $37.00	=	104,969.00	377,099.03 Irrigated Income
Total Income			$392,456.15

INDIVIDUAL DIVERTEES LINEAR MODEL

Activities											
PD2 010	PI2 09	PD1 08	PI1 07	AI2 06	AI1 05	GD2 04	GI2 03	GD1 02	GI1 01	≤ ≥	Constraints
0.0	1.60	0.0	1.60	3.00	3.00	0.0	1.30	0.0	1.30	≤	8682.0 a/f
					-1.0				.3	≤	0.0
				-1.0			.2			≤	0.0
		1.0	1.0		1.0			2.0	1.0	≤	5520.0 Class Crop
1.0	1.0			1.0		2.0	1.0			≤	8280.0 Class Crop
$1.00	$12.50	$1.15	$18.75	$23.32	$37.97	$4.32	$13.34	$6.50	$20.00		Σ Max

1. Acre feet water that are available, page 107.

2,3. Material balance equation to insure at least alfalfa acreage required for rotati

4. Acres of Class A crop land, page 131.

5. Acres of Class B crop land, page 131.

6. Maximum net farm profit, Appendix C, page 166.

Individual Divertees

*Irrigation Equation (1) 3.00 AI1 + 1.30 GI1 = 8682

Alfalfa Requirement (2) -1.0 AI1 + .3 GI1 = 0

(2') AI1 = .3 GI1

(1') (3.00) (.3 GI1) + 1.30 GI1 = 8682 a/f
.9 GI1 + 1.30 GI1 = 8682 a/f
2.2 GI1 = 8682 a/f
GI1 = 3946 acres

AI1 = 3946 x (.3) = 1183 acres.

Total Irrigated Crop Land 3946 A + 1183 A = 5129 A

By inspection, dryland grain is determined to be the best alternative use of remaining Class B crop land.

5520A - 5129A	=	391A	
391A x $\frac{\$6.50}{2}$	=	$ 1,270.75	
8280A x $\frac{\$4.32}{2}$	=	17,884.80	$ 19,155.55 Dry Income
3946A x $20.00	=	78,920.00	
1183A x $37.97	=	44,918.51	123,838.51 Irrigated Income
Total Income			$142,994.06

APPENDIX D

Definitions:

Acre inch - An acre inch of water is the amount of water required to cover an acre one inch deep 3,630 cubic feet of water.

Acre foot (a/f) - An acre foot of water is the amount of water required to cover one acre one foot deep or 43,564 cubic feet of water.

Appropriation - A method of obtaining the right to the use of waters from a natural source.

Bench lands - Large area of level lands lying at a higher elevation than the surrounding land.

Beneficial use - Deriving greater value from input than it would produce in its natural state.

Deep percolation - Water seeping into the soil to depths greater than can be utilized by growing plants.

Ditch rider - A person engaged to regulate and divide the waters being transferred by a canal system.

Divert - The process of taking water from its natural channel and transferring it to some other location.

Divertee - The person, company, or corporation engaging in diverting water.

Drawdown - The difference in feet between the highest elevation and lowest elevation of water in a storage reservoir.

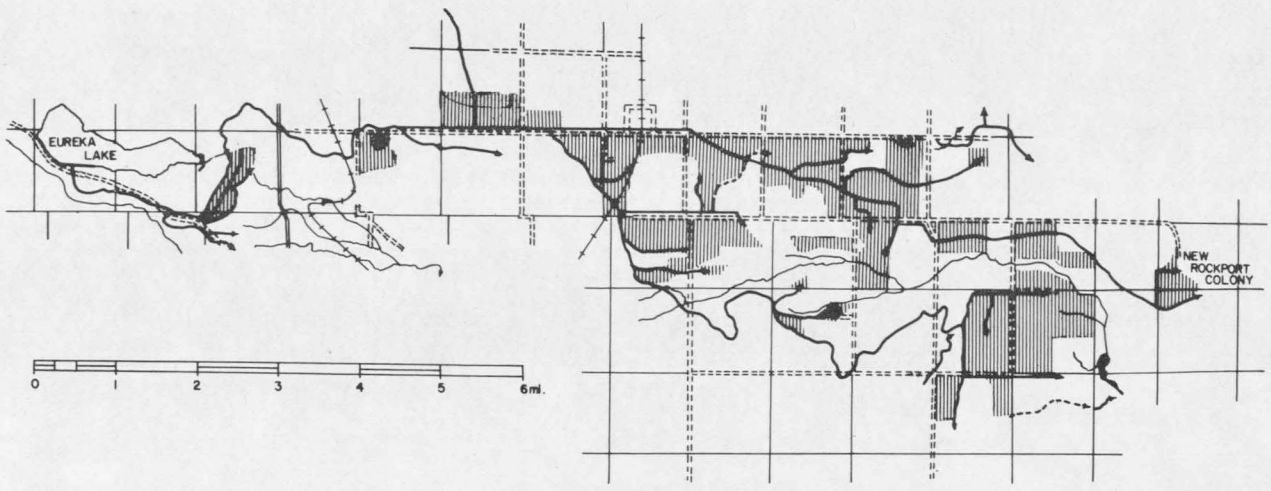
Earth blanket lining - A method of lining a water-carrying canal with earth that is resistant to infiltrating water, then covering it with several inches of coarse material to hold it in place.

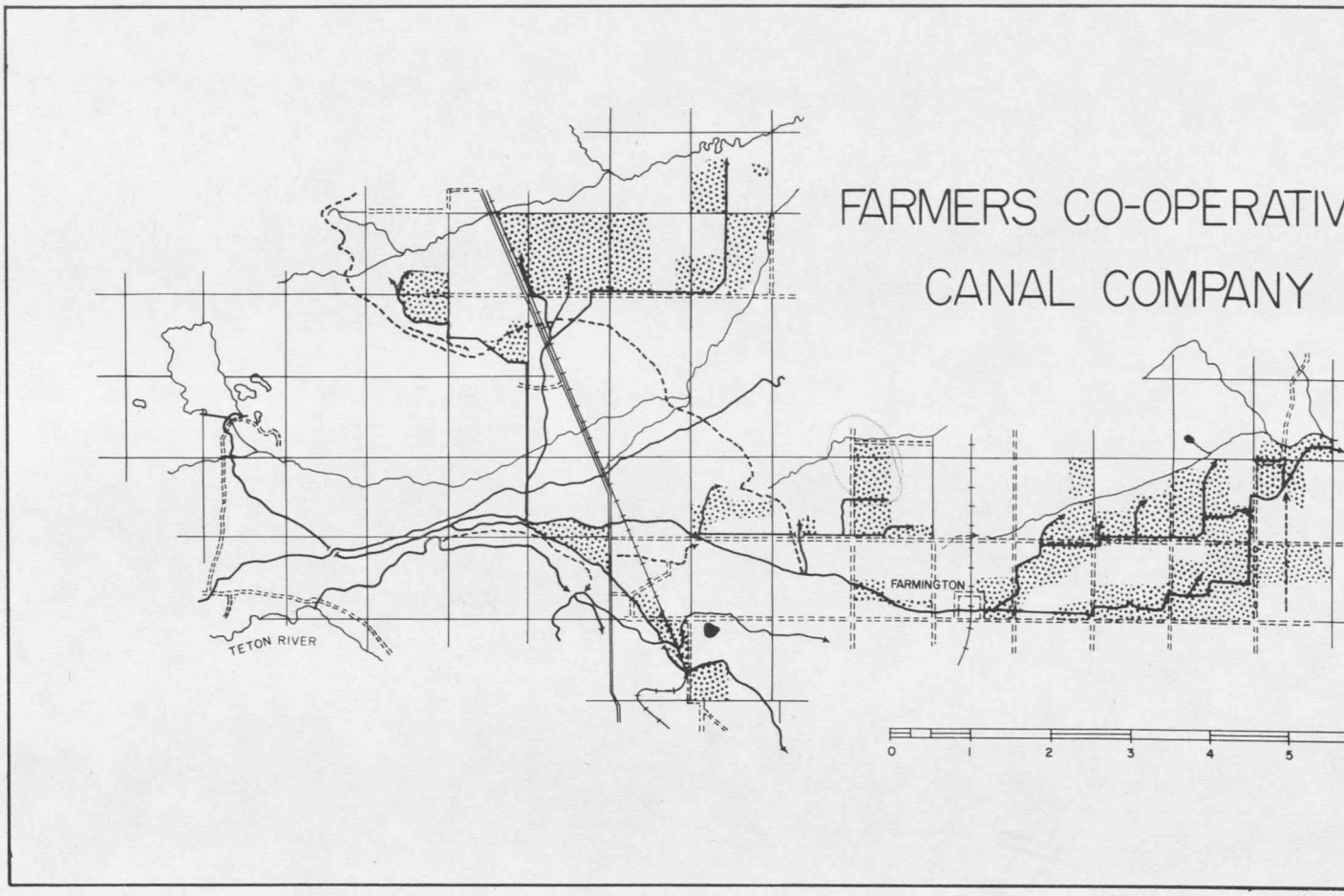
Miners inch - A flow measurement equal to the quantity of water that will flow through an opening one inch square in a vertical wall under a pressure head ranging from four to seven inches. In Montana one miners inch is equal to 1/40 cubic foot per second.

Spring runoff - Excess water leaving the surface of the land during the spring of the year.

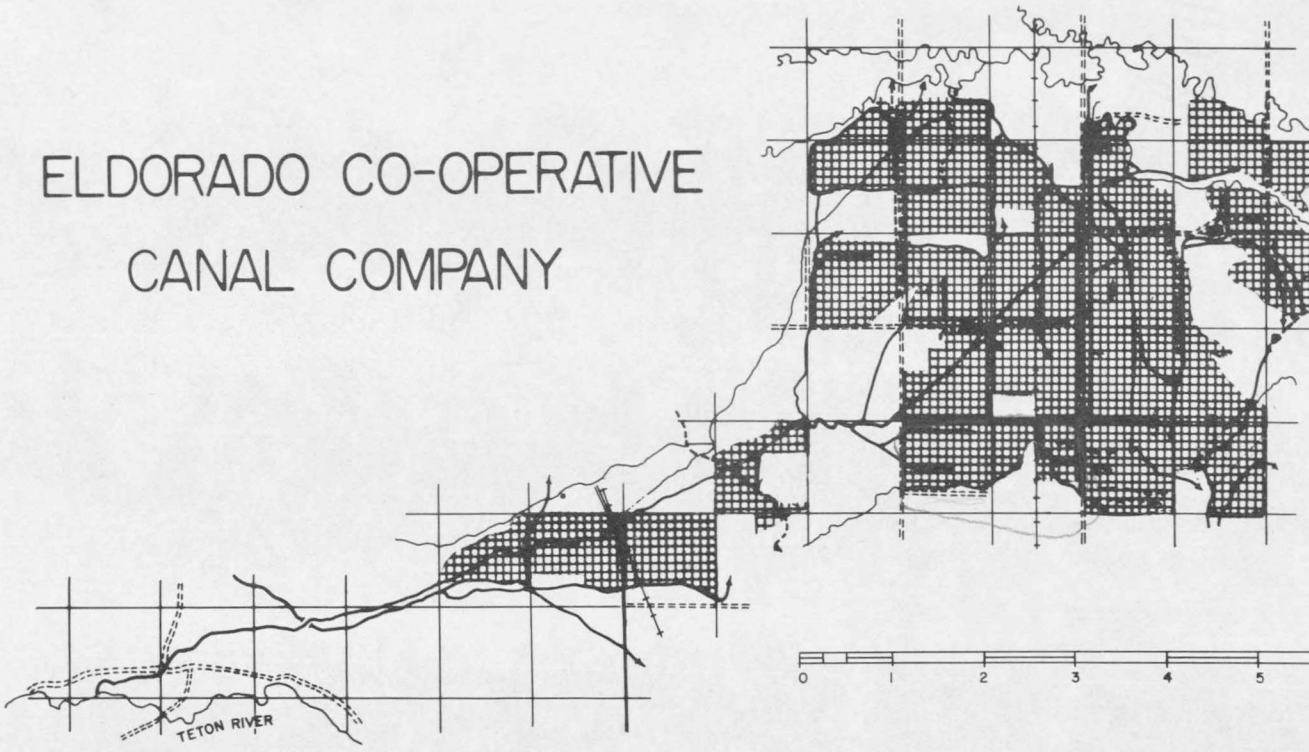
APPENDIX E

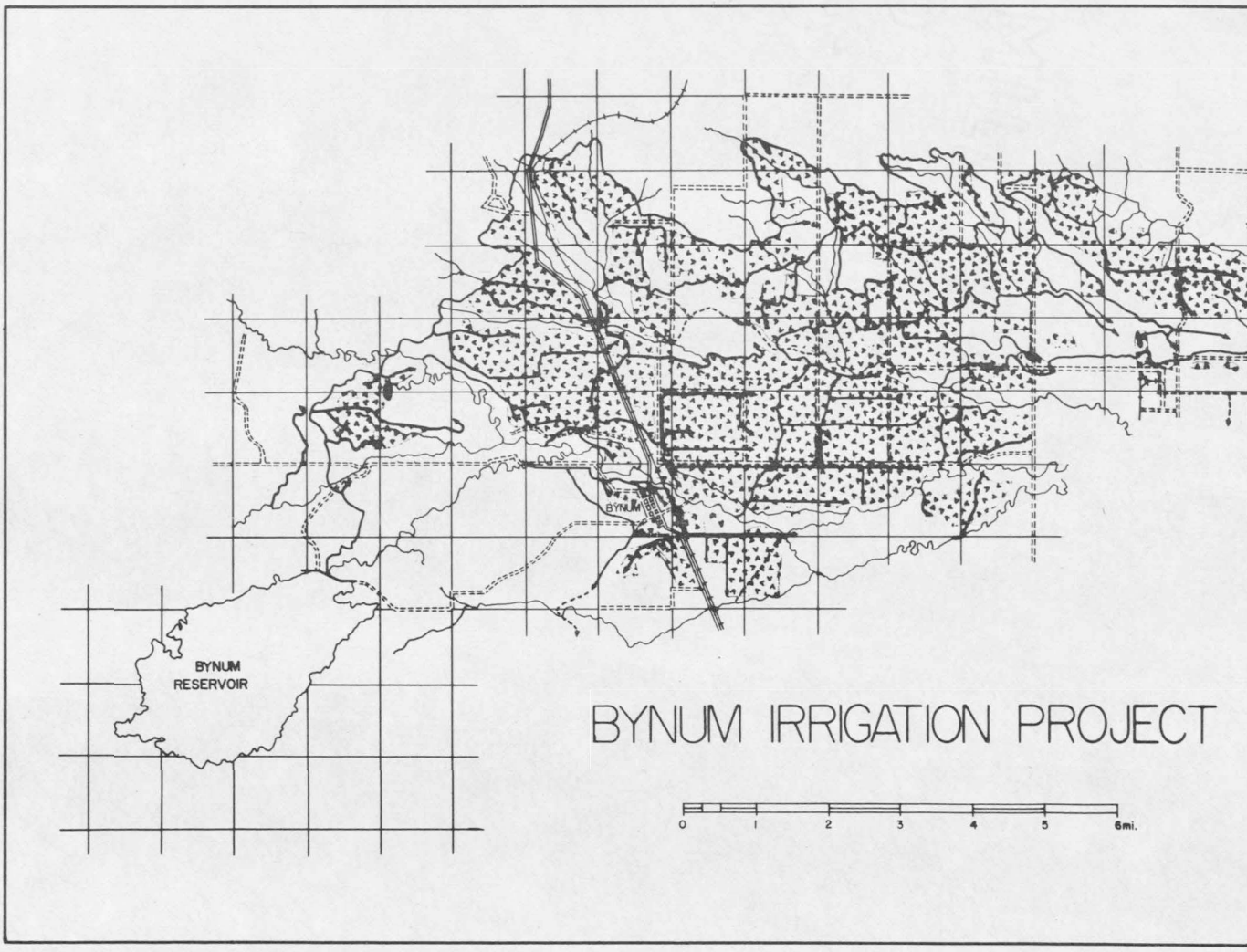
TETON CO-OPERATIVE CANAL COMPANY

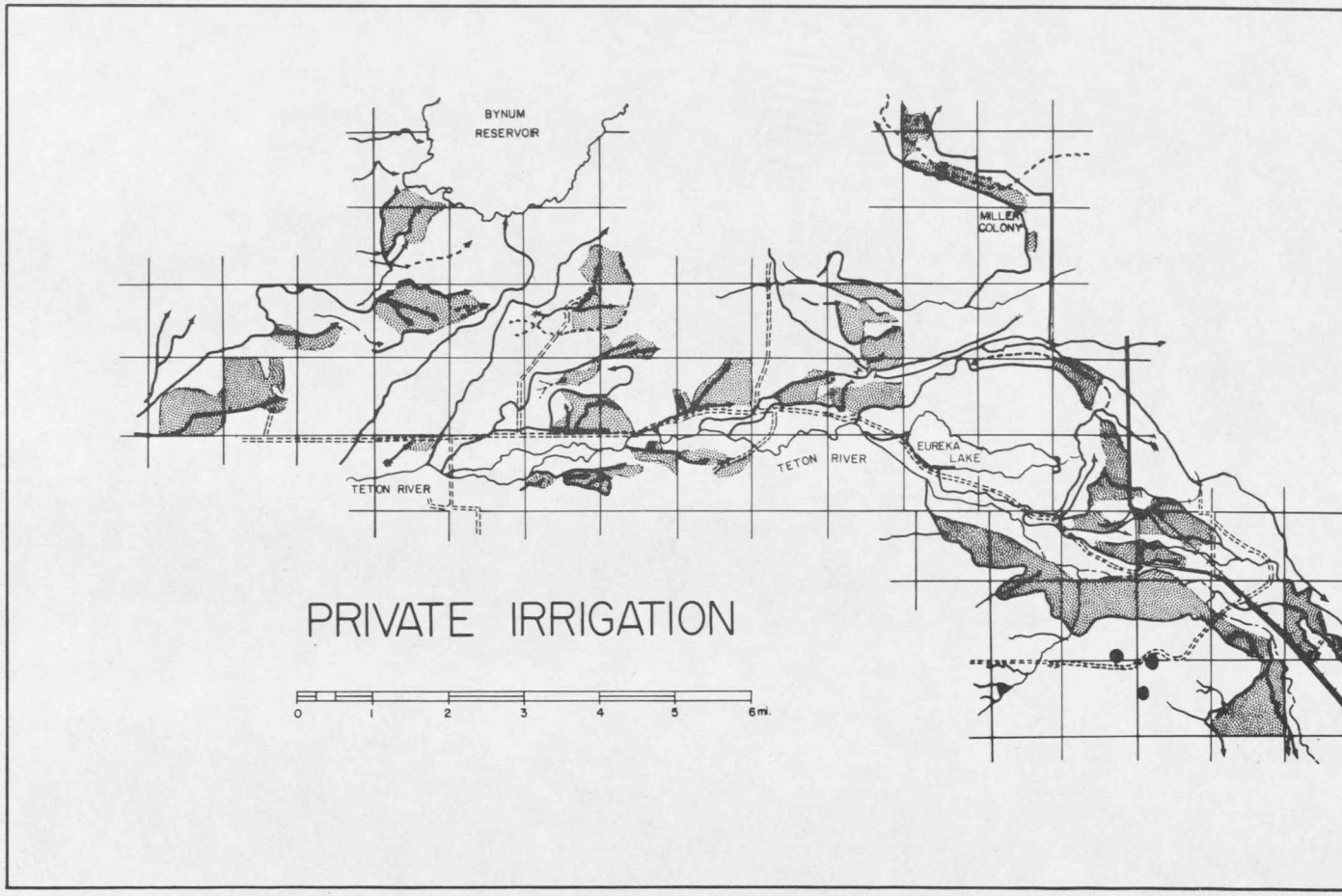



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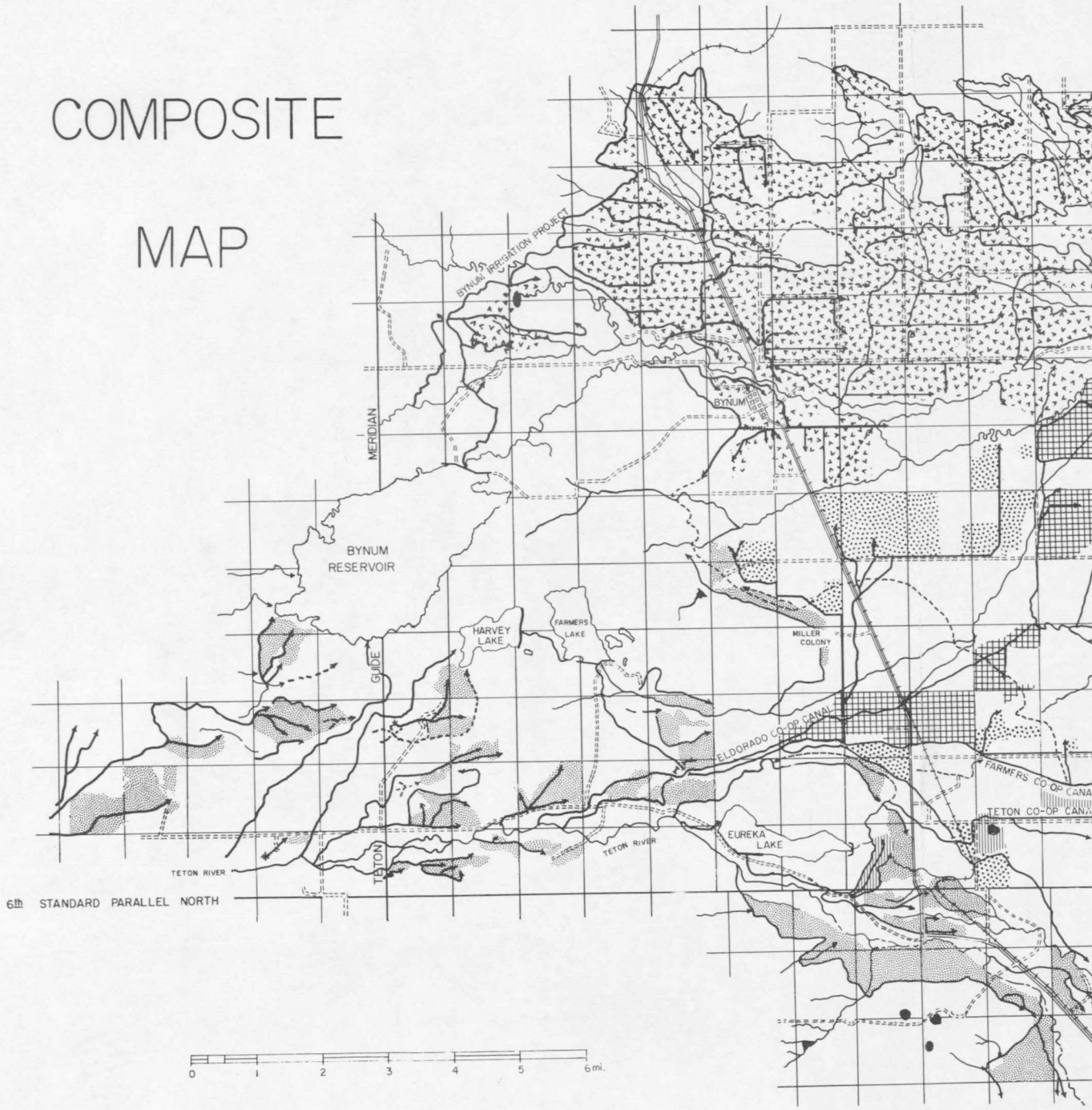



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PRIVATE IRRIGATION

COMPOSITE MAP



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