Memorandum Concerning Water Storage and Conservation Prepared by the Colorado Experiment Station for the Agricultural Clearing Committee

R.L. Randall 1930-
I. Need of Program

The conservation of water in the arid West is rapidly becoming more and more important. First, because of the urgent need for water for agricultural and industrial purposes and second, the constantly increasing population which of necessity requires additional supplies that are dependable and fit for human consumption. To best satisfy these requirements, over the period of years, very definite attention must be given to the economical and practical consideration of the very complex and interrelated water problem of our state. It is quite obvious in approaching this situation that some definite scheme or plan of development be followed so coordinated and worked out that in the ultimate this great natural resource will be made to serve with high efficiency.

It is doubtful whether our present viewpoint of the problem is sufficient in scope to meet the full extent of our needs, and therefore we are not at the point of tracing out the definite pattern of our final water plan. It is further obvious that geographically our State is the fountain head of water supplies which flow in all directions into areas demanding of us that due consideration be given to their needs in developing our plan. As the years go by, these interrelated questions of use and contamination of common water supplies will be a constant source of irritation and controversy. Because of the far-reaching effects of ultimate development in any of our natural drainage basins, upon the plans and hopes of our neighboring states, it would at this time be sound judgment to first know the facts before definitely outlining this scheme of development. We cannot plan independently for ourselves here in Colorado except in such ways as to enhance the service of our present water
supply where consumptive use is not involved. Plans whose consumptive use, contamination, retardation and non-beneficial or unproductive use of supplies are proposed and realized would no doubt be subject to further controversy on the part of states now enjoying the benefits of such common water supplies. The plan which covers our great State should be developed in conjunction with the common interests of the several drainage basins of which Colorado is but a part. With this as a premise, we could not effectively extend our endeavors outside our boundaries with the intention of formulating the plans and schemes of development in adjoining states, likewise our neighbors could not do an acceptable job for us. The magnitude of this great problem is without question beyond the reach of a single state. Since comprehensive planning should be for the good of all and based on scientific facts and knowledge, it appears that some federal agency should be charged with the responsibility of impartially reporting the procedure and development of water plans for the irrigated states where interstate streams are common supplies.

Colorado can effectively include in a water conservation plan the following:

1. Transmountain diversions: The allocation of waters by the Colorado compact to the upper and lower basin states does permit of more extensive diversions than now contemplated by the Colorado-Big Thompson Project. Studies and reports have been made relative to the Blue River-South Platte Project. There are at least two others which may be considered in such a plan, namely: Colorado-Arkansas and the San Juan-Rio Grande Projects. It is doubtful if all those are to be realized to their fullest extent would Colorado be using its full quota of the water of the Colorado River assigned by this compact.

2. Storage of flood flows: Particularly throughout the east slope of the Divide, in Colorado, the loss of flood flows have at times in the past been of great amounts. However, over the past few years great deficiencies have
occurred within this area. The present outlook indicates that the spring floods this year, 1939, will be much above the average and that there will be a loss in water over our state lines. Snow conditions in the mountains now in some areas are 50 percent greater than a year ago. The economic limitations of the construction of reservoirs to retain flood flows does not now stand out clearly, and thus make possible a definite decision in planning. This feature of planning requires painstaking studies and long periods of reliable records to determine the final development in this field.

3. Development of underground supplies: Much has been done in this phase of the problem and at present pumping for irrigation is being extensively practiced in the South Platte Valley area from Denver east to Sterling, Poudre Valley, and in the San Luis Valley. There are opportunities for further development in some of the drainage areas of tributary streams to the lower South Platte River, and possibly in local areas on the Plains in eastern Colorado. This feature of investigation of underground water supplies, for irrigation, live stock and domestic purposes should occupy an important place in the conservation program of state planning.

4. Improved use of water on farms: This is an important item in the general scheme of a water conservation program. We are making some progress in the field of measuring water deliveries to the farm, but it is known that at present there is less than 1/3 of the supply to the user measured with any degree of accuracy. The efficiency of irrigation water will be materially increased if delivered to the farm in the just and equitable proportion as defined and paid for by the farmer. This feature warrants consideration.

5. Lining of channels to prevent losses: Water loss from canals, ditches, and laterals, due to seepage, is in many of the irrigated areas of Colorado, an important matter. Experiments are now being conducted by the Experiment
Station, in cooperation with the Bureau of Agricultural Engineering, to determine the effectiveness of preventing seepage by the use of cotton fabric with tar and asphalt compounds as the supporting medium. A case may be cited where a canal near Ft. Collins suffers a loss of 10 to 12 second-foot in a distance of 1/3 mile.

6. Drainage of Marsh or Wet Lands: This problem primarily involves the reduction of evapo-transpiration losses by vegetation which uses excessive amounts of water and returns little value. Tests made at Ft. Collins with sweet clover grown in tanks showed that under optimum conditions these plants absorbed a water depth of 3 inches over an area 24 inches in diameter per 24 hour day. On this basis, a field covered with a heavy growth of this plant and supplied abundantly with moisture, would dissipate one acre-foot of water in about four days.

7. Hydrographic Data: Over the past years the inadequacy of stream flow records has been apparent. Such records should be increased to cover practically all the natural streams of the state in order that these data may be available as a basis for the purpose of intelligent planning in the future. In this respect much has been accomplished, but there still remains the rounding out of a systematic and complete coverage of stream flow data. The question of the occurrence and extent of return seepage flow is closely associated with such records.

8. Storage of Water at High Elevations: Management of storage and distribution of the irrigation supply should be developed whereby a greater efficiency may be realized by storing water at high elevations. Water held at high elevation could be diverted to rightful owners in combination with natural stream flow maintaining a more or less constant flow and reduce materially the present penalty charge for transportation. The probabilities are the evaporation losses from reservoirs at high elevations in the mountains will be less than for the valley storage basins.
9. Forest Cover: Encouragement should be given to the matter of reforesta-
tion over the mountain water sheds of Colorado. The control of insect pests and
forest fires should be made a matter of extreme importance in the broad scheme of
water conservation planning.

10. Snow Surveys: A very comprehensive net work of snow courses has been
established throughout the mountain area of the state where regular monthly
observations are made during the winter and spring months of the year for the pur-
pose of forecasting stream run-off in the interests of irrigation. There are now
68 active snow courses regularly observed in the state. These surveys show the
depth and water content of the snow storage. Monthly reports are made showing
the prospects of the future water supply.

11. Topographical Surveys: Accurate topographical maps of the State
should be made available of all areas not now covered by such surveys. Such
topographic data are of great importance in the development of a comprehensive
water plan of the state.

II. Review of Accomplishments

The work of the section of Irrigation Investigations, of the Experiment
Station in cooperation with the Bureau of Agricultural Engineering, United States
Department of Agriculture, has materially aided in the water conservation problem
of our state through the development and use of improved methods of measuring
irrigation supplies, not only in large flows of the main canal, but the small
stream turned out in the lateral as well. The more reliable and dependable gaging
of the decroal diversions from natural streams tends to the more equitable and
proper use of the common supply. The rightful apportionment of the supply in the
canal by measurements to the user also tends to improve conditions, which are
in the direction of economy and beneficial use of the water. The development of
devices for recording rates and summation of flows are necessary and important
accessories to the problem of water measurements. New types of measuring devices are being perfected.

The perfection of devices intended to rid channels of sand and silt deposits are now being developed, which increases the efficiency of irrigation systems and reduces the cost of operation.

Advice and assistance given to the practical solution of developing supplemental supplies by pumping from underground sources.

Contributing to the Rio Grande Joint Investigation which has proved to be the foundation for the settlement by compact of the long standing controversy between Colorado, New Mexico, and Nezna, concerning the waters of this river.

Contributing to the successful initiation of the Colorado-Rio Thompson diversion project which ultimately will be one of the great irrigation developments in our state.

Development of snow surveys throughout the state, for the purpose of forecasting water supplies for irrigation, domestic purposes, industrial uses and power.

Lining of earthen channel to prevent seepage losses as a means of increasing the efficiency of irrigation supplies.

Council and advice relating to the subject of planning in connection with the water conservation problem of our State.

III. Phases of Program Now Being Stressed.

In hydraulics attention is being given to the development of new types of water measuring devices. First, for measuring the rate of flow in channels of flat grade and low velocity; second, improvements to the Parshall measuring flume; and third, the perfection of a new type of meter to operate in a pipe line under pressure and particularly adapted in measuring the rate of discharge from pumps. Hydraulic recording instruments, particularly of the integrating type. The integrating instrument now developed can be made and sold at a
relative small cost which is intended primarily for use in the farm. At this time the farmer does not know definitely the extent of water applied to his crops. Such an instrument operated in connection with the Parshall measuring flume would enable the user to determine accurately the amount in acre-feet applied to each of his several crops grown. Experience and knowledge of the duty of water for different crops should govern the extent of application and could be checked by the instrument record for each individual irrigation and later for the entire season. Knowledge as to time, amount and rate of irrigation would tend to the more efficient use of the supply.

Recent studies in the hydraulics laboratory relative to a new type of sand trap show this new device to be practical and very efficient. Special apparatus is now being assembled in the laboratory for further testing of this new type of sand trap.

Attention is being given to the problem of pumping for irrigation. Advice assistance to farmers is given upon request, both by letter and consultation in the field. A record of water tables, spring and fall, for various areas in Colorado was started 10 years ago and has been kept complete to date.

Snow surveys are being made throughout the mountain region of Colorado for the purpose of forecasting irrigation water supplies. Reports covering the Colorado, North and South Platte, Arkansas, and Rio Grande drainages are issued and widely distributed the first of the month for February, March, April and May.

Experiments are under way to determine the effectiveness and economic limitations of lining irrigation channels to prevent seepage losses by using cotton fabric in a matrix of either coal tar or asphaltum compounds. At the hydraulic laboratory, on the campus, is a short section of lined channel and near Waverly is a 30-foot section of lateral lined with cotton and tar. Considerable interest is now being taken in the possibility of this scheme of protection against water losses.
IV. Cooperation with Other States or Federal Agencies

Work conducted by Irrigation Investigations, section of the Colorado Experiment Station, has been in cooperation with the United States Department of Agriculture since the establishment of this work in 1911.

At this time a part of the work in connection with the sand trap studies is being supported cooperatively by the Forest and Range Experiment Station, U. S. Forest Service, Ogden, Utah.

The work done in the ditch lining experiments is being assisted by the furnishing of coal tar products by the Public Service Company of Denver, and asphaltum compounds by the Standard Oil Company of Indiana, offices in Denver. It is probable that about a mile of channel will be lined with tar and cotton in the vicinity of Fort Collins sometime this coming spring. Should this program go through, this work will be in cooperation with the Whitney Ditch and Timnath Reservoir Companies.

The Snow Survey Project is highly cooperative. For the season of 1939 this work will be supported in Colorado by the following agencies:

Federal —

Bureau of Agricultural Engineering
Forest Service
National Park Service
Bureau of Reclamation
Geological Survey
Weather Bureau

State —

Colorado Experiment Station
State Engineer

Others —

City of Denver
City of Boulder
Powder Valley Water Users Assn., Ft. Collins
Amarie Valley Ditch Assn., Pueblo
Rain Lakes Reservoir and Canal Company, Ordway
Parrish Reservoir and Irrigation Co., Denver
San Luis Valley Irrigation District, Monte Vista
Santa Maria Reservoir Co., Monte Vista
Water Supply and Storage Co., Fort Collins
Western Light and Power Co., Durango

In Wyoming this work is conducted by the Bureau of Agricultural Engineering in cooperation with the U. S. Forest Service and the State Engineer. In New Mexico the Forest Service and the State Engineer are cooperating, while in Arizona the Forest Service, Indian Service, and a few of the irrigation interests support the work. Irrigation interests in Nebraska are supporting this work.

The purpose of mentioning the snow survey work in Wyoming, New Mexico and Arizona is because the conduct of these surveys is directed by the Bureau of Agricultural Engineering, headquarters at the Colorado Agricultural Experiment Station. The monthly reports issued from the Experiment Station include the immediate snow survey data for Colorado, Wyoming, New Mexico, Arizona, Idaho, Utah, and Montana covering the Colorado, Missouri, and Rio Grande drainages.

V. Recommendations

From the standpoint of state planning, as related to the various water conservation problems, it is strongly recommended that before any logical scheme of development be undertaken, where major construction is involved, that very definite studies be made covering the field as a whole. The problem is not confined to a single state, but rather one extending beyond its borders, and for this reason any effective plan dealing with the complicated problem of water must be coordinated with the general broad scheme covering the entire drainage basin. To effectively determine the relative importance of all phases of a broad comprehensive plan, covering a river system extending into our neighboring states to the north, south, east and west, Colorado's pattern probably would not fit the needs and requirements of our adjoining states; nor would their plans, in all probability, meet with our approval. Because of its geographical position,
Colorado produces a large percentage of the water supply used in areas outside our boundaries and recent studies show that our state should avail itself of a greater proportion of this across-the-line supply. The down-stream states will naturally be vitally concerned with any developments having to do with trans-mountain diversions or extensions of new irrigation projects where our use will result in the depletion of their water supplies. This situation, has in the past, and will without question be more aggravated over the years to come, result in further controversy over the rightful use of this great natural asset. The complexity of this common problem of equitably enjoying the use of water can not be adjusted by the efforts of a single state, such as Colorado, or any of the other adjacent states. The plan will have to be developed jointly in cooperation with our neighbors or turn the problem over to some federal agency charged with the responsibility of planning for the whole drainage basin as a unit.

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