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Application of Stream Gaging to the Administration of Water Rights

by Guy M. Vincent

It is possible that, to some of you, it is somewhat difficult to visualize just what use other than flood forecasting and a strictly academically interesting study of river behavior can be made of the stream gaging program of which each of you is an integral part.

Of course we are all familiar with the use of information obtained in the stream gaging program by the River Forecast Section of the Weather Bureau in their forecasts of river conditions, but we also have in the irrigated area along the Arkansas River west from Garden City one of the better examples of the day-to-day use of stream gaging information in the administration of the rights of users of water from a stream.

There is, in that area, a group of eight irrigation canals, all having rights to water from the Arkansas River for irrigation purposes. Under the Water Appropriation Law these are all vested rights, since all of the canals were in operation prior to the applicable date of that law on June 28, 1945.

It was found after the building of the canals in the late 1880's and the early 1890's that seldom was there sufficient water in the river to supply the wants or even the reasonable needs of all of the canals, and, as a result, there grew up a great deal of antagonism among the owners of the several ditches for the use of the water. As an interesting side light on this matter, I might mention some of the other canal companies that were proposed and some of them were actually chartered to "develop irrigation, generate electricity, build hotels, sell land and insurance, etc. etc.", and which, had they all been built, would have required that the river run in flood stage continuously to provide the water proposed to be diverted from the river.

In 1911, some of the more solid citizens among the owners of four of the canals got together and with the backing of the then existing State Water Division, instituted a friendly suit in the courts looking toward the establishing of a rotation system of diversion of water from the river in the belief that each ditch could thereby get sufficient water at one time to satisfactorily carry on their irrigation operation, instead of each canal striving to take all of the water, with the net result that nobody got enough to get the job done.

Attempts were made at the time to get all of the canals (which are divided into, roughly, an upstream group of three ditches and a downstream group of five ditches) to go into the rotation agreement, but the upstream group were not interested since they were in a position to get water as needed. This group has not to this date been brought into the agreement and still seems to get more than a fair share of the available water supply, but it is my understanding that further efforts are in the making to get them into the rotation system either by friendly suit or otherwise. The present status of these efforts are, so near as I can learn, that the upstream boys have been notified of the planned suit and the attorneys for the downstream group are preparing their case. The attorneys have contacted our office for certain discharge information which was furnished, but I believe that developments have been a little slow since that time, and it may be some time before the matter actually gets into the courts.

That the rotation system was a success among the four downstream ditches participating is shown by the fact that the one ditch not included asked in 1912 that the suit be reopened so that they might be included, and that was done, so that now the entire group of five downstream ditches are operating successfully under a court decree which establishes the order of priority, together with the rate of diversion and the quantity of water per rotation, allocable to each of the ditches. I use the term "operating successfully" somewhat with tongue-in-cheek because drought conditions during the past three years have made irrigation with river water a sketchy proposition at the best; however, what water does get down to the irrigation canals can be and still is divided on the equitable basis established by the courts in 1911 and 1912.

The Amazon Canal is first in rotation, with a decreed capacity of 200 c.f.s. and a rotation quantity of 3,000 acre feet. It is followed in order by the South Side Ditch with 200 c.f.s. and 3,000 acre feet; the Great Eastern Canal with 300 c.f.s. and 5,312½ acre feet; the Farmers Ditch with 250 c.f.s. and 3,937½ acre feet, and the Garden City Canal with 80 c.f.s. and 500 acre feet. The number of rotations available to each ditch in any year is limited only by the amount of water available and the demand. It will run three to four rotations in a normal year and less than that in a dry year. The Garden City Canal had originally 1,500 acre feet per rotation, but in 1921, with the approval of the courts, sold 1,000 acre feet of that amount to the Great Eastern Canal. The method of arriving at the quantity available to each ditch, or rather, the reason back of such division, is something that seems to have been lost down through the years, and all that we are able to determine now is that a total river capacity of 1,050 cubic feet per second (and how I wish it were available) was divided up on the basis of a specified number of 84ths to each canal.

With the setting up of the rotation system of diversion of water from the Arkansas River by the several canals, the problem of the administration of the decrees came to the fore and a water bailiff was appointed to handle the distribution. He was an employee of and paid by the Association formed among the participating irrigation companies. It was with the appointment of the Water Bailiff that the matter of stream gaging came into its own in the irrigated area of southwestern Kansas.

Statute effective June 5, 1933

In May of 1934, a State law became operative which provided, among other things, that "It shall be the duty of the Division of Water Resources of the State Board of Agriculture, under the direction of its chief engineer and other officers and employees, to distribute the water in any natural stream, among the several ditches or water users taking water from such streams, according to the rights of each as adjudicated by court decree", and it was with the passage of that act that the administration of the water rights on the Arkansas River became a duty of the Water Resources Division. Of course, it applies only to the downstream group of five ditches, since the rights of the upstream group have not been adjudicated by court decree.

The system of gaging stations used in administering the canal water rights at the time such duties fell to the Water Resources Division comprised seven stations each equipped with a recording gage. They were: one on the Arkansas River at Syracuse, just above the point at which the river water becomes available to the participating ditches; one at or comparatively near the diversion headgate of the Amazon Canal; the South Side Ditch; the Great Eastern Canal; the Farmers Ditch and the Garden City Canal and, finally, one on the Arkansas River at Garden City, some eight miles downstream from the diversion headgate of the canal lowest down on the river.

The gages on the canals are, of course, the direct basis for the record of diversions by each canal, but those on the river also serve a very practical purpose in administering the rights on the river. For instance, the readings at the Syracuse station are used to determine the amount of water available to the ditches in the rotation system and we can tell immediately whether more than one ditch will be able to divert water from the available supply. Measurements at the river stations are computed as taken in order to determine the shift adjustments that need to be applied from day to day to the rating tables in order that our planning of water distribution may be on a sound basis. The station at the State Line helps immeasurably in determining the water supply available to the rotation ditches after the upstream ditches have supplied their wants for water. This is particularly true when water is being called down from John Martin Reservoir because it enables us to call for enough water to supply the upstream demand and still have water available for one or two of the rotation ditches. The Garden City station serves as a check to see that no water is escaping that can be used for irrigation purposes.

Due to the fact that the stream beds at all gaging stations were of a sandy nature, causing frequent changes in the volume of water represented by a given gage height, and considering the desirability of accurate recording of the quantity of water passing each gaging station, the policy of weekly measurements at each station was early established and has been continued to the present. Of course, bad roads in the earlier days, snow drifts and other conditions of an adverse nature have at times prevented getting a measurement each week, still a review of the record shows that the taking of measurements each week has been the established practice for many years and, since I took charge of the office at Garden City in June, 1949, I can recall only one or two weeks when we have failed to get a discharge measurement at such of the canals as were running water when we made our measuring trip. One of those times was when a blow-out caused me to upset our transportation putting both Howard and myself in the hospital and, since we are the whole crew, it left us a bit shorthanded for taking stream flow measurements.

The system of gaging stations involved in the administration of water rights on the river has, during the past few years, been expanded to include another station on the Arkansas River located near the Kansas-Colorado State-line just above Coolidge, and one on each of the group of three upstream canals which are the Frontier Ditch, the Alamo Canal and the Ft. Aubrey Canal.

While the upstream group of ditches are not subject to the terms of Court Decrees under which the Division of Water Resources administers water rights on the river, it was found desirable, or, we might say, necessary to keep an accurate record of the diversions by these canals after a compact was reached between the States of Colorado and Kansas concerning the division of water released from John Martin Reservoir, a Corps of Engineers project located at Caddoa, Colorado, some fifty miles above the State Line.

The river station at Coolidge and the Canal Station on the Frontier Ditch are the responsibility of the Colorado District of the U. S. Geological Survey, who are, under the terms of the Compact, the responsible agency for maintaining the so-called "key stations" used in administering the terms of the Compact between the states of Kansas and Colorado. The Administration of that compact falls to "The Arkansas River Compact Administration" which is made up of three administrators from each state who are appointed by the respective Governors and also a Chairman representing the Federal Government on the administrative

group. The deliberations of this group are also based largely on information obtained in the stream-gaging program. Even tho' these stations belong to Colorado, we take a great deal of interest in them and include them in our measuring schedule each week.

These two stations are equipped with automatic radio broadcast equipment, and we have in my home at Garden City a Hallicrafter Commercial, short-wave receiving set by which at specified times each day we can tune the two stations and determine the gage-height at the time. From the gage heights we can work out the amount of water available for distribution among the several canals under the terms of the court decrees. This, as you can well see, saves many hundred miles of driving during a busy irrigation season when it is necessary to make frequent adjustments in the distribution of the water among the participating canals. The stations are about seventy miles from Garden City.

The river gaging stations and the Frontier Ditch are equipped with Stevens continuous recorders and those at Syracuse and Garden City also have Observers who report gage heights each day, but the radio broadcasts at Coolidge and the Frontier Ditch eliminates the need for Observers there. The two remaining upstream ditches have thirty-day Stevens recorders, since there is no immediate need for determining discharges from the charts at these stations, but the five stations involved in the rotation system have W. & L. E. Gurley eight-day recorders.

These Gurley charts are pulled weekly or, more often, as needed to keep the discharge record for each canal current so as to be able to anticipate a date and time when a specified quantity of water will have been diverted by each canal under its rotation and the necessary adjustments made at the head-gates to start delivery of water through the next canal in rotation. It is not, of course, possible to hit this anticipated time exactly very often, but careful keeping of the gaging record makes the error quite minor and quantities of water run over or under a canal's specified rotation quantity is carried forward to the next rotation and this method has run into no difficulties with the canal operators to my knowledge, and you can well believe me when I say that the average ditch superintendent would be quick to register a complaint if he thought he was being cheated out of a single second foot of volume or a single acre foot of quantity under his assigned rotation.

The irrigation season, under terms of the Compact between Kansas and Colorado, runs from April 1 through October 31 of each year, and it is during this time that the stream-gaging program keeps us the busiest, but it is also the time when it serves its greatest usefulness in permitting the proper distribution of the available water supply among the canals having rights to a part of the water.

During the winter season, November 1 through the following March 31, the stream-gaging program is carried on the same as during the irrigation season because usually one or more of the canals runs some water during each month, particularly so in the case of the Great Eastern Canal which uses this winter season to replenish the water supply in Lake McKinney for use during the following summer. Most winter water is "free water" which is the status of water at times when there is sufficient water in the river to supply the wants of all the canals. This should not be interpreted as meaning that there is usually a large supply of water in the winter, but only that there is enough to supply the wants of the canals that may be small or nonexistent. It is possible for any canal to "call charge" on any other canal that is running

"free-water" which means that the canal that calls charge wants the rotation system to become operative even though they themselves might not get any water at the time. This calling charge is often resorted to by some of the canals, especially during the winter season, in order to put themselves in a more advantageous position in rotation when the irrigation season opens up. From the foregoing it is easy to see that the stream gaging program is a year around thing in connection with river administration, but it is much more active during the irrigation season when all eight canals may be diverting water at the same time.

Except for very short intervals it has been a long time since there was enough water available to bring about this condition , but even though it would work our tails off I would like to see it happen again beginning about April 1st and lasting for six or eight weeks so that the irrigators could really give their land the soaking it needs after nearly three years of a deficient water supply.

It has been said of an irrigator that he can forgive you for burning down his barn, shooting his cow or seducing his wife, but when you start messing with his irrigation water you are in for real trouble. This may or may not be true, but it has been my experience that if water rights are administered with absolute impartiality, backed up with carefully kept stream gaging records both on the canals and the source river, the average irrigator is a pretty reasonable sort of individual after all.