Colorado Stream Lines

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COLORADO DIVISION OF WATER RESOURCES

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Judge Anderson Approves Arkansas River Rules

On April 30, Arkansas River Basin Water Judge John Anderson approved amended rules and regulations governing the pumping of ground water in the Arkansas River basin. The new rules are effective June 1, giving well owners who desire to continue using their wells a short time frame to come into compliance.

The rules were proposed in September of 1995 to prevent ground water depletions to the Arkansas River stream flow. The rules prevent pumping by all wells with capacities of more than 50 gallons per minute which pump ground water tributary to the Arkansas River unless the State Engineer has approved an individual's replacement plan or the well owner has joined an augmentation group such as the Colorado Water Protective and Development Association, the Lower Arkansas Water Management Association or the Arkansas Groundwater Users Association. Most low capacity residential wells are not affected by the rules.

The rules became necessary as a result of the United States Supreme Court ruling in the lawsuit between the states of Kansas and Colorado, in which the court found that post-compact ground water well development in the state of Colorado was depleting useable stateline flows required as part of the Arkansas River Compact. The rules also require that out-of-priority depletions to senior surface right owners in Colorado be replaced.

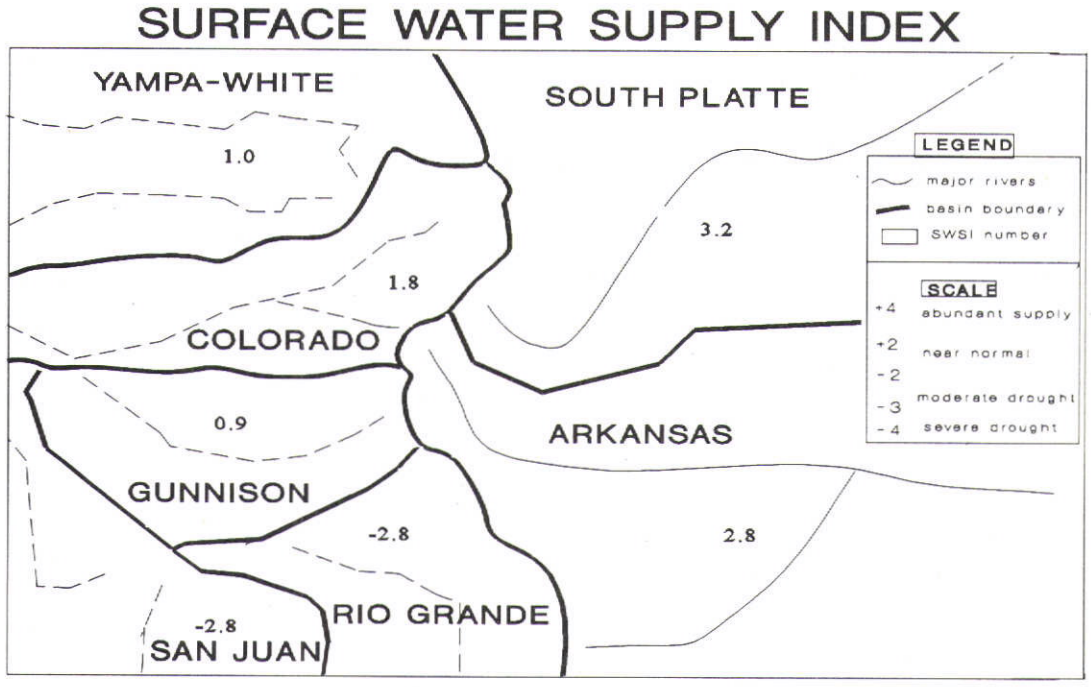
The judge also approved amendments to the Rules Governing the Measurement of Tributary Ground Water in the Arkansas River Basin which were originally approved in 1994 to require data on amounts of water pumped in the Arkansas River basin to be reported to the Division 2 Water Engineer in Pueblo. The amendments will provide more accurate pumping data amounts and make data submittal easier. The amendments were approved after no protests to the proposal were filed with the water court.

Well owners who desire more information regarding compliance with any of the new rules are encouraged to call (719) 542-3368.

Water Supply Conditions Vary

by Keith Vander Horst, Professional Engineer

(Editor's note: Streamlines will once again be providing quarterly updates on water supply conditions throughout the state. The office of the State Engineer monitors these conditions through use of the Surface Water Supply Index (SWSI), which was developed in cooperation with the U.S.D.A. Natural Resources Conservation Service. This number is an indicator of mountain based water supply conditions in the seven major river basins of the state. It includes snowpack, reservoir storage, and precipitation for the winter period (November through April).



July 1, 1996

June stream flows in the southern mountains were extremely low. The Rio Grande, Animas, La Plata, and Navajo stream flow totals were all in single digit percentiles for June, meaning the flows were lower than are expected to occur 10% of the time. These conditions are a result of last winter's very low snowpack in the southern mountains. The SWSI values in the Rio Grande and San Juan/Dolores basins are a reflection of these very low stream flows. The southern tributaries in the Arkansas basin are also running very low, but the SWSI value in that basin is supported by good flows on the Arkansas mainstem. The San Juan/Dolores basin is the only basin having a lower than average reservoir storage total.

Water Legislation

by Kate Jones, Department of Natural Resources

It was a busy year at the state legislature when it came to water issues. Below are summaries of the major bills passed.

SB124/Arkansas River Compact Protection Act of 1996

This bill provides a comprehensive approach to assist the state and the Arkansas Valley water users in reaching compliance with the Arkansas River Compact. Provisions of the bill include:

* a loan from the Colorado Water Conservation Board Construction Fund to the Lower Arkansas Water Management Association to acquire replacement water for the wells of its members;
* fines for those who violate provisions of the rules;
* allowance for the Division of Water Resources to obtain power records for wells from power companies;
* Construction Fund monies for computer hardware and software to assist private organizations in efficient compliance with the rules;
* 9.5 new staff for the Division of Water Resources to enforce the well pumping rules.

The bill was signed into law on March 1, 1996, and implementation began immediately. The substance of the bill was developed by the Arkansas River Basin Coordinating Committee, and was sponsored by Senator Rizzuto and Representative Owen.

SB74/Augmentation for Water Well Pumping in the Denver Basin Aquifers

This bill clarifies regulation of not-nontributary ground water in the Denver Basin aquifers, by requiring that post-pumping replacement of depletions to tributary streams. The bill does not become effective, however, until a special legislative committee has received the results of a study that will be completed by the Director of the Water Conservation Board and the State Engineer on a variety of issues implicated in the development of the Denver Basin aquifer to meet Metro area growth. The study will also tie into the negotiations to develop a basin wide program in the Platte River Basin to deal with endangered species habitat in Nebraska, by looking at ways that Colorado can effectively coordinate a response to and participation in that program.

SB64/Instream Flow

This bill establishes the following:

* maintains the Colorado Water Conservation Board's (CWCB) discretion regarding the appropriation of instream flows, confirming CWCB's historic practices;
* defines a process for decreasing an instream flow;
* clarifies the relationship of the CWCB and the water courts regarding instream flow matters;
* supports the CWCB's authority to file for recovery flows and to modify those flows as appropriate when water is needed for compact development.

This bill was the result of significant participation from water providers and environmental interests.

SB153/Water Conservation Board Construction Fund

This is an annual bill to fund water resource development projects through the CWCB's Construction Fund. This year's bill authorizes loans for eight new projects and funding for seven non-reimbursable projects, including:

* continued design of the Colorado River Decision Support System;
* continued maintenance of the Satellite Monitoring System;
* a water resource investigation in the lower South Platte River Basin;
* development of Multi-Objective Management Plans for the South Platte, Roaring Fork, and Frying Pan rivers;
* continued support for the Consolidated Water Resources Information Center;
* analysis of the economic life of the Denver Basin Aquifer.

HB1044/Exempting Wells in the Dakota Aquifer

This bill resolves problems encountered in the appropriation of tributary water from the Dakota Aquifer outside of the Denver Basin. It changes the standard for appropriation of this tributary water from land ownership to the traditional appropriation system.

The bill also removes an administrative hurdle when the Water Court is determining rights to underground water. Since 1969 the State Engineer's approval or denial of a well permit was required before the court had authority to act on an underground water right. This bill removes that requirement, but still provides the court with expertise from the State Engineer by making a written consultation report to the court from the State Engineer presumptive as to the facts of the case, subject to rebuttal by any party.

The bill also allows potential well owners to give notice to other well owners within 600 feet of their proposed well 10 days prior to filing a underground water right application in court. By allowing for this, well owners will have a choice between the State Engineer's hearing process and the court's hearing process, when determining whether a well permit can be issued within 600 feet of another well.

SB190/Weather Modification Program Reauthorization

This bill extends the Weather Modification Act of 1971 until the year 2003. The program, which is administered by the CWCB, issues licenses to qualified operators and permits for projects and monitors the snowpack to determine if the project is in compliance with the suspension criteria in the permit.

HB1364/Well Permits in Counties with Rural Land Use Process

The bill allows for a cluster development process for the purpose of decreasing the number of 35-acre parcels that are exempt from local subdivision land-use planning requirements. The Division of Water Resources supported the bill and anticipates requiring flow meters as a condition on well permits that are issued to owners of lots developed under this process. Owners of such will be required to annually report the water volume pumped by their wells. Overall, the amount of water consumed within the cluster development is expected to be less than the amount that would be consumed by exempt wells issued for the same parcel developed as 35-acre lots. The water community, the Colorado Water Congress and Colorado Counties, Inc., indicated support for the bill.

HB1252/Augmentation Water Limited in Duration

This bill revises the provisions by which a water referee or water judge rules on a proposed plan for water augmentation. The bill provides that a proposed augmentation plan that relies on a supply of augmentation water that is of limited duration shall not be denied solely upon the limited duration of that supply--provided that the plan's terms and conditions must require replacement of out-of-priority depletions that occur after any groundwater diversions cease.

Extreme Precipitation

by Alan Pearson

The extreme precipitation project began in 1993 in order to make better estimates of extreme precipitation in the mountains of Colorado than are indicated in the National Weather Service's Hydrometeorological Reports 49 and 55A. These publications are considered to be too conservative based upon the assumptions used to derive Probable Maximum Precipitation, especially with elevation. Also, paleohydrologic dat indicates that large runoff has not occurred above elevation 7500 feet in Colorado, or along the Front Range of the Rocky Mountains.

A volunteer committee of hydrologists, meteorologists, state and federal officials, consultants, and dam owners was formed at the request of State Engineer Hal Simpson and Director of the CWCB, Chuck Lile. This committee recommended that the latest technology and data should be used to evaluate the potential for extreme precipitation. In order to develop a good database, and to incorporate storm modeling procedures using computers in the process, a three phase project was recommended by the committee. Phase I includes the collection and verification of storm data in Colorado, and to identify storms in the mountains which represent extreme events. Phase II includes computer simulation of these events using existing storm models in order to try and understand the physiology of rainfall with elevation, and to develop a procedure for predicting extreme rainfall in the mountains using the model. Phase III involves developing a product that the engineering community can use for estimating extreme precipitation in the mountains of Colorado.

The State Climatologist's office at Colorado State University was hired to do Phase I of the project with funds from the Colorado Water Conservation Board. Dr. Tom McKee and Mr. Nolan Doesken are the providers. A workshop that was held by them recently indicates that existing storm models have the potential for simulating extreme events. Phase I of the project will be completed in August 1996. The data collected will be maintained by the State Climatologist and is available for use by anyone. One of the critical uses will be the update of the NWS NOAA 2 Precipitation-Frequency Atlas for Colorado, which is used to estimate 100 year events. It was last published in 1978.

Plans are being made to develop the scope for Phase II of the project and seek funding from the CWCB. The board has given the nod to proceed with the modeling for Fiscal Year 97-98. They believe there is sufficient state interest in the results to fund this phase, which is estimated to cost from $300-$500,000.

Artificial Recharge

By Glenn Graham, Physical Scientist Researcher III

The present population of Colorado is about 3.7 million people. Probably about a million of these people depend partially or totally on ground water as a source of domestic water. For some of these people, this resource is finite and essentially non-renewable by natural processes.

Recent focus on growth in Colorado and dependence of the growth on ground water development has led to a suggestion that artificial recharge might be a vehicle to renew or extend the life of these heretofore non-renewable sources of water.

Artificial recharge is the process by which water can be injected or otherwise actively added to an aquifer. Artificial recharge differs from incidental recharge in that incidental recharge results from, among other things, seepage losses from reservoirs, ditches and streams, or from deep percolation of precipitation or irrigation water.

Artificial recharge as a water management tool is not a new concept. It has been practiced for several hundred years by the inhabitants of western India and by nomadic people on the Kara Kum Plain in central Asia. By capturing, directing and storing precipitation in the ground, inhabitants of these areas have been able to enhance availability of scarce sources of potable water.

There are reports of artificial recharge activities in California as early as the 1800's. The earliest documented projects in the U.S. using well recharge were developed in the 1950's in southern California. These projects were initiated to control salt water intrusion caused by withdrawal of fresh water in coastal areas. Colorado's experience with artificial recharge dates back to the 1960's.

Artificial recharge can serve many purposes. It can be used to prevent or limit the intrusion of salt water, improve the quality of naturally occurring water or recharged water, limit or reverse land subsidence, defer expansion of water facilities such as treatment plants or storage facilities, reduce the effects of stream flow diversion or the pumping of alluvial wells, for control of contaminant plumes, to slow or reverse declining ground water levels, or for storage of water when it is available for later recovery during dry years or periods of peak demand.

This last purpose fits with Colorado's pressing need to store abundant spring runoff for later use to meet summer peak or dry year demands in light of the difficulty of obtaining necessary approvals to construct surface storage facilities. Storage of water underground does not require disturbance of large areas of the surface, or the construction of dams, and loss of water by evaporation is minimized or eliminated.

Some of the obstacles to recharge projects are the seasonal availability of water suitable for recharge, the legal availability of that water, the relationship of the quality of the water to be recharged and the quality of the native water, cost of recharge water, and geochemical compatibility of the recharge water and the native water or the aquifer materials. Can the economics of the project support expensive water quality monitoring and testing that might be required? Will the recharge water be available when it is needed? How much water is to be recharged and in what time frame? How large and how many structures (wells or spreading basins) would be required to accomplish the projected recharge?

Until 1990, most, if not all of the recharge projects in Colorado involved diverting surface water through strategically located leaky ditches, or by spreading surface water in pits or dug basins along the South Platte River in northeast Colorado. The primary purpose of these projects is to provide water to replace depletions caused by pumping of alluvial wells along the South Platte during the irrigation season.

By using computer modeling techniques it is possible to predict depletions which would occur to the flow of the South Platte River by pumping wells completed in the alluvium of the South Platte. Using the same modeling techniques, and knowing when water would be available for recharge it is possible to predict when, where, and how much water should be spread on the ground so that water would find its way to the South Platte River at the right time and in sufficient quantity to replace depletions to the river. These types of projects are operated by municipalities, ditch companies, conservancy districts, and individuals and are components of plans for augmentation. Spreading of the recharge water takes place at locations where it will not affect the quality of ground water that might be used for domestic purposes. There are presently about 50 of these types of projects being operated in northeast Colorado.

In 1990, two significant recharge projects involving wells were initiated. Willows Water District and Centennial Water and Sanitation District, both water providers in the Highlands Ranch area, began to evaluate the potential for recharging water into the Arapahoe aquifer, a deep bedrock aquifer that underlies all of the greater Denver metropolitan area. Both of these water providers rely heavily on the Arapahoe aquifer as a source of water for their customers.

The Arapahoe aquifer has been used as a source of high quality water in the Denver area since before the turn of the century. Initially, this aquifer was a source of flowing artesian water. Rapid development around 1900 brought an end to the flowing wells, but much of the Arapahoe aquifer still exists under artesian conditions today. Development in the Denver Tech Center area and in the Highlands Ranch area continues to rely heavily on the Arapahoe aquifer for water. Ground water withdrawals to support this development have resulted in water level declines in excess of 400 feet in some places.

Willows Water District received funding from the Bureau of Reclamation as part of the High Plains Ground Water Demonstration Project to evaluate the physical and economic feasibility of recharging water into the Arapahoe aquifer. Centennial Water and Sanitation District funded their own pilot project.

In the Willows demonstration project, treated water from Denver Water's distribution system was injected through the former production well into the aquifer at rates between about 450 and 950 gpm over periods from 7 to 42 days. The volumes of water ranged from about 4.5 million gallons (13.8 acre-feet) over 7 days to 32 million gallons (98.2 acre-feet) over 42 days. The injected water was allowed to soak in the aquifer for up to several weeks. A pumping cycle then withdrew between about 166,000 and 290,000 gallons. By the end of the spring of 1995, Willows water district had injected a total of about 321,600,000 (987 acre-feet) and had extracted about 5,843,000 gallons (17.9 acre-feet). About 315,756,000 gallons (969 acre-feet) remained stored in the aquifer.

The Willows project has demonstrated that technically it is possible to provide recharge to a deep bedrock aquifer. However, the question of the economic feasibility is still unanswered. Denver Water participated in the demonstration project by providing the water to be injected, leaving the cost of water component unanswered. In addition, the cooling of the aquifer by injection of the cold surface water appears to affect well performance when the water is extracted, potentially increasing the cost to withdraw the recharged water compared to withdrawing naturally occurring water, at lest in this particular location and set of circumstances.

One thing to keep in mind relative to projects like Willows and Centennial is that it is probably not possible to inject water at a rate higher than it can be withdrawn, and since the injection season, at least for Colorado is limited by seasonal availability of suitable recharge water, it may require several expensive wells to be able to inject a meaningful amount of water in one cycle or season. In fact, a general rule of thumb is that injection rates will commonly be about 50 to 75% of pumping or withdrawal rates. Therefore, if you have a production well capable of pumping 1,000 gpm, you can conservatively assume you can inject water at an average rate of 500 gpm. 500 gpm injected for a period of 30 days in the spring would store about 66 acre-feet of water, or enough to serve 60 to 65 families for a year.

The cost of a 1500 foot Arapahoe aquifer production well capable of pumping 1,000 gpm is probably about $800,000 to a $1,000,000. How many million dollar production wells would it take to store 600 acre feet in one injection season? About 10 wells.

In summary, whether or not artificial recharge will be technically and economically feasible, at least as far as Colorado is concerned, will depend very much on site specific conditions of geology, hydrogeology, geochemistry, physical availability of water suitable for recharge, and the legal availability of water.

Because Colorado's ground water is generally of good quality, recharge of most aquifers will require a source of treated or potable water to win approval for injection from the EPA. Water quality monitoring expenses may be the single largest factor in determining the economic feasibility of a project.

CALENDAR OF EVENTS

September 9-10	Colorado Water Conservation Board (CWCB) Meeting, Holiday Inn, Alamosa, CO. Contact Susan Maul, CWCB, at (303) 866-3441.
October 1	Board of Examiners Meeting, Room 615, 1313 Sherman Street, Denver, CO. Contact Marta Ahrens, Division of Water Resources (DWR), at (303) 866-3581.
October 2-4	Colorado Water Officials Meeting, Crested Butte, CO. Contact Ken Knox, Division 4, DWR, at (970) 249-8728.
November 15	Ground Water Commission Meeting, Room 318, 1313 Sherman Street, Denver, CO. Contact Marta Ahrens, DWR, (303) 866-3581.
November 25-26	Colorado Water Conservation Board (CWCB) Meeting, Room 318, 1313 Sherman Street, Denver, CO. Contact Susan Maul, CWCB, at (303) 866-3441.

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