Wyoming Hydrogram

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Wet Side Story

Steven P. Gloss
Director, WWRC

Recent happenings at the Water Research Center include the final approval of both U.S. Geological Survey (federal) and Wyoming State grants for water research projects to be conducted this year. A complete listing of these studies can be found on the insert in this newsletter. The state grants were made following approval by the Water Center's Research Review and Priorities Committee in Casper on April 11. Please feel free to contact the WWRC should you desire additional information about any of the projects.

The Water Research Center is pleased to welcome State Senator Thomas Strook of Casper as the newest member of our Research Review and Priorities Committee. Senator Strook was appointed recently by Governor Mike Sullivan. He replaces Senator Richard Larson of Albin, who retired from the Senate last year.

Earlier this year Governor Sullivan appointed your Director as Wyoming's representative on the High Plains Study Council. The High Plains Study Council was authorized by Public Law 99-662 to coordinate the Ogallala Aquifer Research and Development Program. Current efforts of the Council are directed toward getting an appropriation for this program from Congress. The Ogallala is the largest aquifer in the U.S. and has experienced significant groundwater depletions over the last two-plus decades. P.L. 99-662 authorized a five-year research and on-farm demonstration program to prolong the life of the aquifer and improve the economic vitality of the Ogallala region, but no funds have been appropriated.

Groundwater is but one source of Wyoming's water supply. The vast majority of our water supply comes from precipitation, much of it in the form of snow. Although Wyoming is considered a semi-arid state (10-20 inches of annual precipitation) overall, we have some desert areas (less than 10 inches) and some high mountain areas which receive over 60 inches of annual precipitation. Much information about our climate is available in the Wyoming Climate Atlas published in 1987. Current and historical climate records are also available through the Water Resources Data System at the Water Center. The many facets of our climate (wind, rain, snow, temperature) combine with legal, social, and economic factors to determine our water supply in Wyoming.

My Sediments Exactly

Ted Gilbert, Water Supply Specialist
Soil Conservation Service, Casper, WY

Snow surveys are by no means new. Many early westerners realized the tie between winter snowpack in the high mountains and summer water supplies. One of the longest records of usable data on snow depth in the U.S. is at Donner Summit where the Southern Pacific Railroad crosses the Sierra's. This site has continuous records since 1878.

Snow surveying as a science began at the turn of the century and is largely due to the efforts of Dr. James Church, a professor of classics at the University of Nevada in Reno. Church's early work was determining the effect of mountains and forests on the conservation of snow, and he soon recognized the need for a method of determining water equivalent of snow. In 1909 Church developed the Mt. Rose Sampler and the Mt. Rose Scale, tools used basically the same today to determine water content of the snowpack.

The first practical use of snow survey data was in forecasting the rise of water levels in Lake Tahoe. With the success of Church's forecasting methods, California officials realized the great value forecasts could be to irrigation interests in the Sacramento and San Joaquin Valleys. Thus, in 1917 they began snow survey-streamflow forecast activities. Other western states soon followed.

During the severe droughts in the 1930s, Congress appropriated money to the Bureau of Agricultural Engineering authorizing it to coordinate activites and develop uniform equipment and methods for snow surveying and water supply forecasting within and between states. With the creation of the Soil Conservation Service in the late 1930s, the Federal-State-Cooperative Snow Survey program was transferred to SCS. Since then, the SCS has taken the lead in all snow survey activites.

In Wyoming, high mountain snowpacks are one of the state's greatest resources, and it is renewable! Wyoming's present snow data information network consists of 137 manual snow courses, 78 automated or SNOTEL data sites, about 85 high elevation precipitation gages, and 10 aerial markers that are read by low flying aircraft.

Manual snow courses are measured around the first of the month during February, March, April and May. These periodic measurements provide insight into snowpack accumulation patterns that forecasters need for runoff predictions. Forecasters are always looking for more information to improve accuracy.

Various methods of remote

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data acquisition have been tested including conventional line-of-sight radio telemetry, satellite base telemetry and finally the system SCS settled upon called Meteor Burst Telemetry or SNOTEL (Snow Telemetry). SNOTEL relies on the billions of sand-sized meteorites that enter the atmosphere every day. As these particles heat and burn, they leave a cigar-shaped trail of ionized gasses which are short lived, but provide enough time to reflect VHF radio signals from ground points that are up to 1,200 miles apart. Two ground master stations, one at Boise, Idaho, and one at Ogden, Utah, continually probe the skies for meteor trails suitable for relaying data.

Radio signals beamed from the two stations bounce off the trails and down to the remote data sites. These reflected signals trigger a small computer at the selected remote site, which then broadcasts current site data along the same short-lived route. Data transmitted include current snow water equivalent readings, precipitation information, current air temperature, and previous 24-hour high, low and average temperatures.

Hydrologic data gathered from the snow data network and other climatological stations are assembled in a computer system located at the West National Technical Center in Portland, Oregon. There the data are analyzed to generate streamflow forecasts, data summaries, and narratives that describe the current water supply outlook, not only in Wyoming, but in other western states that conduct snow surveys. Many of the streamflow forecasts are coordinated with forecasts developed by the National Weather Service before being released to the public. This information is available to any interested party who has computer dial-up telecommunications. It is also available through publications printed by the SCS.

In Wyoming sixty streamflow forecasts are made throughout the state beginning in January but mainly between April 1 and September 30. As the winter progresses the forecasts are fine tuned, so that by April, water-users can make critical crop decisions based on their expected water supply.

How much snow fell in the mountains last night? Ask a snow surveyor!

Splash

State/Regional/Local News

- **Tom Cahill** has been named Executive Director of the Wyoming Water Development Association. He has been deeply involved in local, state, interstate, regional and national water related and environmental issues since 1965. Cahill's office is located in Cheyenne. WWDA is a voluntary organization founded in 1932 for the purpose of promoting the development, conservation and protection of Wyoming's water for all beneficial uses.

- **Richard Marston**, Associate Professor, Department of Geography and Recreation, and Research Faculty, Wyoming Water Research Center, has been appointed as one of ten scientists to serve on an interdisciplinary "science council" that will meet three times per year to advise the Yellowstone Coalition on matters of goals and policy.

- A **Colorado Water Court** judge has set the date on which Colorado's challenge to Forest Service water claims will go on trial. The case could determine whether or not the Forest Service will be able to assert similar rights to water on the 190 million acres of land it controls across the United States.

In 1897, Congress enacted the Organic Administration Act, which set up the national forest system to provide timber and "for the purpose of securing favorable conditions of water flows." Part of securing favorable flows, the Forest Service says, means keeping clear the dozens of small streams and channels that drain flood water out of the forests. Without adequate flows, the Service contends, the channels could shift, fill with sediment and be choked by vegetation.

- **The U.S. Environmental Protection Agency** has served notice on the U.S. Army Corps of Engineers and affected property owners that it plans to veto Denver's proposal to build the controversial Two Forks Dam. In the wake of this decision, one consulting firm (formed to put together water deals) predicts that, if the veto stands, Colorado is in for a water buying frenzy that will see the transfer of some $5 billion worth of water rights.

Mr. William K. Reilly, Administrator, U.S. Environmental Protection Agency, was prompted, in part, to initiate the seldom used "veto" provision of the Clean Water Act by a meeting and subsequent 8-page letter of March 9 from several national environmental groups. The letter detailed objections to the project and urged Reilly to start proceedings under Section 404(c) of the Act.

Section 404(c) provides a mechanism for the EPA Administration to veto any 404 permit issued by the Corps of Engineers should he determine that issuance of a permit "will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas, wildlife or recreational areas."

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Mainstream

"Wyoming's Water Supply"

Wyoming is situated astride the Continental Divide and comprises the headwaters of four major river basins—the Missouri, the Colorado, the Great Basin, and the Columbia. Wyoming's heritage stems from her abundance of natural resources. Mile after mile of grassland, alternating with numerous irrigable stream valleys, has enabled agriculture and livestock to become important industries. A wealth of scenic beauty is the basis for our recreation and tourism industry, and beneath the surface lie our mineral resources. All of these industries, as well as our cities and towns, depend on our water supply.

Surface Water

An average of about 15.8 million acre-feet[1] of surface water is produced as runoff each year from precipitation in Wyoming, and about 1.5 million-acre-feet per year flow into Wyoming from other states. Since Wyoming's present consumptive uses[2] of surface water amount to only about 2.6 million acre-feet annually, it would appear that we could expand our water utilization without depleting the resource. However, about 70% of our runoff occurs during the spring and early summer, leaving little water for the rest of the year. Compounding the problem is variability in streamflow from year to year. Thus, storage is required for reliable surface water utilization. Furthermore, interstate compacts[3] and court decrees limit the amount of water which Wyoming may legally use. It is estimated that about 2.8 million acre-feet per year, in addition to present uses, is available for new consumptive use in Wyoming under present physical and legal limitations.

Estimates of Water Yield by Rivers in Wyoming (acre-feet per year)[4]

Stream	Wy. Yield Plus Inflow	Outflow From Wy.
Missouri River Basin		
Yellowstone River, Yellowstone National Park (not compacted)	2,706,000	2,706,000
Clarks Fork River	716,000	690,000
Bighorn River	3,961,000	2,608,000
Little Bighorn River (not compacted)	119,000	114,000
Tongue River	460,000	376,000
Powder River	434,000	338,000
North Platte River (decree)	1,213,000	436,000
Colorado River Basin		
Little Snake River	404,000	385,000
Green River, including Blacks Fork and Henrys Fork	1,882,000	1,536,000
Great Basin		
Bear River, including Thomas Fork	431,000	343,000
Columbia River Basin		
Snake River	4,796,000	4,703,000
Totals	**17,349,000**	**14,400,000**

Seventy percent of Wyoming's water supply comes in the form of snow. Snowmelt occurs during the months of April, May, June and early July. Reservoir storage plays an important role in Wyoming by holding water supplies and making such supplies available during the summer and fall months. Major storage reservoirs and storage capacitities (in acre-feet) are listed here.

North Platte River: Seminoe - 1,017,000; Kortes - 4,739; Pathfinder - 1,017,000; Alcova - 184,000; Glendo - 517,000; Guernsey - 46,000.

Laramie River: Wheatland No. 2 - 98,000; Wheatland No. 3 - 80,000; Greyrocks - 104,000.

Belle Fourche River: Keyhole - 340,000.

Wind and Big Horn Rivers: Bull Lake - 153,000; Boysen - 802,000; Yellowtail - 1,375,000.

Shoshone River: Buffalo Bill - 424,000 (This reservoir is now being enlarged by 271,300 acre-feet.)

Powder River: Lake DeSmet - 239,000.

Snake River: Jackson Lake - 847,000; Palisades - 1,401,000.

Green River and Big Sandy River: Big Sandy - 39,700; Fontenelle - 345,000; Flaming Gorge - 3,788,700.

Bear River: Woodruff Narrows - 57,000.

Proposed Reservoirs:

North Platte River System: Deer Creek - 65,785.

Little Snake River System: Sandstone - 52,000.

Groundwater

Groundwater can be found throughout Wyoming, although its quantity is not precisely known. An estimate of the average annual potential recharge to groundwater in Wyoming is 4 million acre-feet into bedrock or deep aquifers and 1 million acre-feet into alluvium or shallow aquifers. In many areas water-bearing formations are too deep or aquifer characteristics are unsatisfactory for obtaining water in adequate amounts or of suitable quality. Emerging desalinization technology may increase Wyoming's usable groundwater

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supplies.

The amount of groundwater available for future use appears large, but its use depends heavily on economic recoverability and decisions about whether to mine the resource or merely use it at its recharge rate.

Water Use in Wyoming

An average of 2.3 million acre-feet (approximately 90%) of surface water used per year is for irrigated agriculture. Wyoming's irrigated acreage varies annually between 1.5 and 1.8 million acres depending upon available surface water supplies and economic conditions. Approximately 300,000 acre-feet of ground water is also used for irrigated agriculture each year.

Reservoir evaporation amounts to about 400,000 acre-feet annually.

Municipal, domestic, livestock and industrial uses consume approximately 60,000 acre-feet of surface water and 100,000 acre-feet of ground water annually. About 54% of Wyoming's drinking water is supplied from ground water.

Footnotes

[1]An acre-foot is the amount of water which would cover an acre of land to a depth of one foot. One acre-foot equals about 326,000 gallons.

[2]Consumptive use is the quantity of surface water evaporated to the atmosphere, incorporated in vegetative growth, food and industrial processes, or infiltrating into the ground.

[3] Interstate stream compacts are agreements between states which provide a basis for the division of interstate waters.

[4]Estimates are based on USGS data for most outflows, State Engineer/Water Planning Program (early 1970s), and in-house work by State Engineer's Office and Water Development Commission staffs.

Wyoming Wet Ones

Featuring

Victor R. Hasfurther

Professor of Civil Engineering

and Associate Director of WWRC

Dr. Victor Hasfurther has been a faculty member in the Civil Engineering Department at the University of Wyoming since 1969. He accepted a joint appointment as Associate Director of the WWRC in 1984, and served as acting director in 1986. He also served as acting department head of the Civil Engineering Department in 1986-1987.

Dr. Hasfurther's research interests include hydraulics, open channel flow, watershed hydrology, groundwater hydrology, and mine land hydrology. He is presently directing research projects on conveyance losses in Wyoming streams and rivers, and modeling of hydrologic conditions and solute movement in processed oil shale waste under simulated climatic conditions. He is also cooperating on research projects dealing with riparian zones, streambank water storage projects, and irrigation return flows. As associate director, Dr. Hasfurther assists the Water Center director in selecting and coordinating water research projects and activities.

Dr. Hasfurther has published numerous scientific journal articles, authored chapters in water resource books and presented a number of papers at professional meetings. He has been awarded the American Society of Civil Engineering Student Chapter Outstanding Faculty Member Award (1972, 1974, 1976, 1978, 1980 and 1988); the John Ellbogen Meritorious Classroom Teaching Award (1979); and Sigma Tau Outstanding Faculty Member, College of Engineering Award (1972).

On the lighter side, Vic was raised in the Utah/Idaho area. He and his wife, Marilyn, have six children. His leisure interests are fishing, gardening and sports.

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THE WYOMING WATER INSTITUTE FOR TEACHERS

THE UNIVERSITY OF WYOMING WATER RESEARCH CENTER AND CENTER FOR TEACHING AND LEARNING ANNOUNCE

A TWO-WEEK WATER INSTITUTE FOR TEACHERS—JULY 17-28, 1989
SESSIONS WILL MEET FROM 1:30 P.M. to 4:30 P.M.

The Goal of the Institute is to provide opportunities for classroom teachers to:

1. Expand their knowledge about water and the water issues which affect our state including water supplies, water quality, legal issues and watershed management.
2. Experience and collect classroom activities which can be used to help students better understand water and water related issues.
3. Explore ways these concepts and activities can be integrated into existing school curricula.

Institute Staff Includes:

Steven Gloss - Director, Wyoming Water Research Center
Don Brosz - Associate Director, Wyoming Water Research Center
Ron Beiswenger - Professor, Department of Geography and Recreation
Mary Larscheid - University of Wyoming, University School
Dick Marston - Associate Professor, Department of Geography and Recreation
Dave Foster - Professor, Department of Civil Engineering
Joe Vogler - Wyoming Game and Fish

Two semester hours of course credit in Natural Science 680 are available. Tuition scholarships are available. Enrollment will be limited to 25 people on a first-come, first-served basis.
PLEASE NOTE: The first class is a field trip. Dress accordingly.

* *

The Wyoming Water Institute for Teachers

Name_____

Address_____
School
Affliiation_____

Phone (Work)_____ (Home)_____
Mail to: Peter Ellsworth, Wyoming Center for Teaching & Learning
Box 3992, University of Wyoming, Laramie, WY 82071

The following is a list of the research projects funded through the Wyoming Water Research Center from its Fiscal Year 1990 state program grants and the U.S. Geological Survey FY89 State Allotment Program:

Adaptive Gridding Techniques for Groundwater Contaminant Modeling (Myron Allen)
Mathematics Department

Chemical, Physical and Biological Characteristics Which Control Selenium Form and Distribution in Soils and Plants Across Landscapes (Stephen Williams, Larry Munn and K.J. Reddy)
Plant, Soil & Insect Science

Evaluating Riparian Zones as Natural Dams to Modify Water Yield, Quality, and Erosion (Quentin Skinner, M.A. Smith, J.L. Dodd, J.D. Rodgers, T.A. Wesche, V.R. Hasfurther)
Range Management

Evaluation of an Alternative Conveyance Strategy for Municipal Water (Thomas Wesche, Q. Skinner, V. Hasfurther, W. Hubert)
Wyoming Water Research Center

Conveyance Losses in Wyoming Streams and Rivers (Victor Hasfurther, Greg Kerr)
Wyoming Water Research Center

Snowy Range Observatory (Thomas Wesche, Y.K. Tung)
Wyoming Water Research Center

A Comprehensive Water Education Program for Wyoming's Elementary Schools (Ronald E. Beiswenger, V. Sindt, P.C. Ellsworth, E.L. Sturges)
Wyoming Center for Teaching & Learning

Hydrogeology and Recharge Mechanics of Alpine Carbonate Terranes in Wyoming Thrust Belt Mountain Ranges (Peter Huntoon, James Drever)
Geology and Geophysics

Optically Amplified Fiber Raman Spectroscopy on Site Analysis of Groundwater (Keith Carron)
Chemistry

Soil-Water Interaction as a Control on Surface-Water Chemistry, West Glacier Lake Basin, Snowy Range, Wyoming (James Drever, Norbert Swoboda-Colberg, Frank Sanders)
Geology and Geophysics

Water Storage in Dinwoody Glacier, Wind River Range, Wyoming (Richard Marston, Larry Pochop, Greg Kerr)
Wyoming Water Research Center

An Analysis of Contemporary and Historical Economics Associated With Water Development Projects in Wyoming (David Brookshire)
Economics

Design and Analysis of Appropriate Economic Methods for Planning and Evaluating Wyoming Water Resource Development (Ralph d'Arge, T. Crocker)
Economics

Development of a Chemical and Biological Method to Reclaim Alkaline Solid Wastes (K.J. Reddy, S.E. Williams)
Wyoming Water Research Center

Uncertainty Analysis of Water Quality Models and its Applications to Risk Assessment and Management (Y.K. Tung, S.D. Shih)
Wyoming Water Research Center

Transformation and Stimulated Plant Uptake of Selenium by Soil Microorganisms (S.E. Williams)
Plant, Soil and Insect Sciences

Assessment of Potential Environmental Impact of Saline Oil-field discharges into Salt Creek and the Powder River, Wyoming (Harold Bergman)
Zoology Department