ARIZONA WATER RESOURCES NEWS BULLETIN

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Yuma Desalting Test Facility Runs 'Round the Clock Daily

The Yuma Desalting Test Facility is operated daily, around the clock, to develop, test and evaluate equipment and techniques which may be coupled for later use in a large desalting complex to be built to treat water discharged from the Wellton-Mohawk Irrigation and Drainage District.

Sited 14 miles east of Yuma and adjacent to the Wellton-Mohawk Main Conveyance Channel, the test facility has been managed since 1974 by the U.S. Bureau of Reclamation (USBR), which assumed management responsibilities from the Office of Water Research and Technology in an effort to better coordinate the many facets of the Colorado River Basin Salinity Control Project, authorized in 1974 by Public Law 93-320.

Salinity control measures downstream from Imperial Dam authorized by Title I of PL 93-320 include operation of the test facility and the later construction of the large desalting complex at a 60-acre site four miles west of Yuma and slightly south of the Colorado River South Levee. Title II of the law provides for salinity control programs upstream from the dam.

The Colorado River Basin Salinity Control Project will help the United States meet its obligations to Mexico as outlined in a 1944 treaty, which guaranteed that country 1.5 million acre-feet of Colorado River water annually, and as agreed to by the two countries in the 1973 International Boundary and Water Commission Minute No. 242, a document dealing with the quality of the water delivered to Mexico.

According to the terms of Minute No. 242, acceptability of river water arriving at Mexico's Morelos Dam is based upon the salinity of the river water when it arrives at Imperial Dam, upstream from the Wellton-Mohawk Irrigation and Drainage District which contributes more saline waters to the Colorado River.

To ensure that river water of acceptable saline levels reaches the Morelos Dam, Wellton-Mohawk drainage waters either would have to be diverted away from the dam or would have to be previously processed to reduce salinity. It was decided to salvage the Wellton-Mohawk drainage water through desalinization so that it could be credited to the U.S. treaty obligation. Wellton-Mohawk drainage waters are now routed around the Morelos Dam.

The large desalting complex is designed to produce 87 million gallons per day (mgd) of desalted water which will be mixed with 22 mgd of untreated water for delivery to Mexico. The test facility produces about 1.6 mgd of treated water under full operation.

Two desalting processes using membranes are being tested, electrodialysis and reverse osmosis. Both the quantity and quality of Wellton-Mohawk drainage waters warrant membrane desalinization rather than other desalting techniques, according to a USBR spokesman. The larger desalting complex will use either electrodialysis or reverse osmosis membrane desalting processes, or a combination of both when it is operational, the spokesman added.

Early trials at the testing facility demonstrated that raw drainage waters filtered through either membrane system made necessary more frequent than usual membrane replacement. To provide the quality of feedwaters required by the membrane units, a partial lime softening pretreatment process for the raw drainage water (water with salinity in excess of 3,500 parts per million) is being developed.

Five lines of water flow have been set up to pretreat the 1,100-gpm of drainage with various combinations of clarifers and filters. In each line of flow, slaked lime Ca(OH)2, is added to the water in a rapid mix tank. In a chemical reaction with some substances in the raw water, calcium carbonate is precipitated along with quantities of strontium and all the iron and manganese compounds. Additionally, practically all the phosphate and organic debris in the drainage is removed.

All precipitated materials remain temporarily suspended in the water until the flow passes through the clarifier where the greater part is removed. After clarification, flow from the lines passes through filters which remove the remaining precipitates. The filters also are being tested and might consist of dual media units of anthracite and sand, or of multimedia units using garnet, anthracite and sand.

Adding lime to the drainage water increases its pH to 9.5, up from the raw drainage water level of 7.9. To lower the water's alkalinity, small quantities of 98 percent sulphuric acid are injected into water before it reaches the membrane desalting units. The acid adjusts the pH to about 5.5. Water intended for reverse osmosis units is treated further with sodium hexametaphosphate (SHMP). Small quantities of SHMP, less than 10 parts per million, are introduced to the water to inhibit scaling on the membrane surfaces. Tests are being conducted now to determine the minimum beneficial quantity of SHMP to be used.

Both desalinization processes use a membrane to separate brine waste from the drainage waters. The reverse osmosis process employs pressure to force the water through the membrane to produce fresh water. The saline concentrate is retained either for additional treatment or for discharge later as waste.

Reverse osmosis units being tested utilize membrane configurations consisting of spiral wound elements, or of fine hollow

fibers. Both are housed in cylinders or modules the outside diameters of which vary from 2 to 12 inches. Module length ranges from 3 to 20 feet, depending upon the configurations being used.

In contrast to the reverse osmosis process, electrodialysis uses the pull of a DC potential in the desalinization process. Electrodes attract dissolved salt ions through ion-selective membranes. Negatively charged anions and positively charged cations are drawn out of the saline solution to the oppositely charged electrodes. The originally saline feedwater will have lost enough salt ions to the process to be classified as desalted water.

Each of the desalting units being tested initially will be subjected to a 2,000-hour test run, after which additional tests will be conducted to provide variable factors data pertaining to each unit's operation. Test facility maintenance and operation are contracted to Burns and Roe Industrial Services Corp., Paramus, NJ. The 30-member Burns and Roe staff is working with a USBR facility manager and a USBR resident engineer in the testing program.

Potential Evapotranspiration Losses from Flood-plain Areas in Central Arizona Reported

An average of 80 million acre-ft. (98,600 hm3) of water falls per year as rain and snow in Arizona; however, more than 95 percent is consumed by evaporation and transpiration. The remaining 5 percent is available for man's use, but this small amount of water is poorly distributed in time and space.

Several potential sources of water augmentation and methods for better water management have been suggested in an attempt to increase the available supply, including water importation, interbasin transfer, cloud seeding, augmentation by groundwater pumpage, and vegetation modification in the watershed.

To accrue a beneficial value, any additional streamflow, regardless of source, must reach downstream users. Natural channels would be the means of conveyance of any increase from the upstream watersheds to users, but some of the increased streamflow might be lost in transit. These potential losses are the subject of a just completed study conducted by the U.S. Geological Survey in cooperation with the Arizona Water Commission.

The present, near-future, long-term future, and potential evapotranspiration losses from flood-plain areas are estimated for most streams in central Arizona. It is assumed that the near-future and long-term future evapotranspiration losses will change as a result of a change in the surface-water flow regimen. Although the surface-water flow regimen may be changed by any water-augmentation scheme, the most probable source of additional water will be from vegetation modification in the watershed.

The estimates of present evapotranspiration lossses were determined by an integration technique based on areal mapping of vegetation types and densities and on relations between water use by different types of vegetation and depth to groundwater along 1,287 miles of perennial and intermittent streams. Near-future evapotranspiration losses are attributed to probable shallower depths to water; it is assumed that long-term future losses will increase further because of an increase in riparian vegetation density. Empirical methods were used to estimate the potential evapotranspiration losses.

Many of the streams included in the study are perennial; the near-future and long-term future increases in evapotranspiration losses are estimated to be negligible for the perennial streams. The streams for which large increases in evapotranspiration losses are predicted are generally in the west-central part of Arizona, where the environment is desert to semidesert.

The report gives a summary of the general hydrologic, vegetative, and geomorphic conditions for most streams in the study area. In addition, the present, near-future, long-term future, and potential evapotranspiration losses and the estimated increase in evapotranspiration losses are presented.

The report has been released to the open file by the U.S. Geological Survey (Number 76-864) and may be viewed at their Tucson and Phoenix offices. A limited number of copies are available for distribution from the Arizona Water Commission. Write 222 N. Central Ave., Suite 800, Phoenix, AZ 85004, or call (602) 258-8175.

CONDENSATION

Lands Irrigated by Bureau of Reclamation Projects

Nearly $50 million in food, fiber and forage were produced in 1975 on the 9.3 million acres of U.S. Bureau of Reclamation (USBR) irrigated lands. Water deliveries by USBR projects, according to its annual report, totaled 9.1 trillion gallons including 8.5 trillion gallons for irrigation, 511 billion gallons for municipal and industrial use and 151 billion for other nonagricultural uses while serving 17.8 million people, about 31 percent of the 1975 population of the 17 states in the West.

USBR irrigation land produced enough food to feed 36.5 million people for the year; gross value of the crops totaled $4.4 billion. Some 146,000 farms representing 92 percent of the irrigable area were served by USBR project facilities. And major reservoir flood control operations prevented an estimated $99.8 million in damages, or almost twice the 26-year average of $48.1 million, according to the report.

The USBR's 50 hydroelectric plants produced 39.7 billion kilowatt-hours and supplied electricity to about 26 percent of the households in the 17 western states. In all, 56 billion kilowatt-hours of hydroelectricity were marketed by USBR for a record $247 million in revenues.

Total investment in facilities constructed under the federal program amount to $6 billion, an amount less than one-eighth the total worth produced in 1975. Nearly 84 percent of the dollars spent for USBR projects and facilities are reimbursable to the Federal Treasury by direct beneficiaries of the projects, according to the report.

Copies of "Water and Land Resource Accomplishments for 1975" are available from the U.S. Bureau of Reclamation, Division of Water and Land, Economics and Program Analysis Branch, U.S. Department of the Interior, Washington, DC 20240.

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Udall Has Introduced Strip Mining Legislation Similar to Measure Tabled Last Year

Strip mining legislation recently introduced by Rep. Morris K. Udall (D.-Ariz.), Surface Mining Control and Reclamation Act of 1977, H.R.2, is similar to H.R. 13950, with minor adjustments to assure compliance with the Budget Act. H.R. 13950 was tabled last year after other similar legislation had been vetoed by the president.

The legislation introduced by Udall sets up a state-federal scheme for strip mining operations control, with primary responsibility for operations on non-federal lands falling to the state. The federal government would oversee reclamation activities on federal lands and would assume responsibility for state controlled lands if the state failed to comply.

A new office for surface mining reclamation and enforcement would be created within the U.S. Department of the Interior. Its Director, appointed by the President and confirmed by the Senate, would report directly to the Secretary of the Interior.

Legislation included detailed reclamation guidelines requiring restoration of mined lands to original condition, assuring revegetation, and protection of water supplies. A major

provision of H.R. 13950 was that strip mine operators submit plans for reclamation, consistent with land-use planning policies, and to post guarantee bonds which would be released only after reclamation was completed. Strip mine operators would have been required to reclaim land as mining progressed, and beyond the actual termination of the mining operation.

Key issue in the western states concerning H.R. 13950 was consent of surface owners regarding mining federally owned coal on their lands. A limited number of surface owners were given the right to prohibit mining or to consent to it for a specified sum of money. Also included were provisions for reclamation of "orphaned lands," areas previously mined and inadequately reclaimed, and the protection of "high-value" lands, such as parks. H.R. 13950 contained special provisions to conduct a study of strip mining for non-coal minerals on federal lands and to establish and fund mining research and mineral institutes.

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Dry-Wet Cooling Towers Save

Dry-wet cooling towers in combination save water and reduce fog and siting problems. A comprehensive computer code and methodology evaluation by the Iowa Institute for Hydraulic Research additionally identified several promising dry-wet cooling tower configurations.

The computer model considered the basic thermodynamics of evaporative or wet and conductive or dry heat transfer, steam turbines, and condensers, the influence of different power loading patterns, and changing weather conditions along with various economic parameters. Researchers found that parallel air path towers provide more flexibility and effectiveness than comparable series air path configurations. The most effective parallel air path tower results were where separate dry and wet conventional units were used simultaneously.

PUBLICATIONS

Finite-Difference Model for Aquifer Simulation in Two Dimensions with Results of Numerical Experiments, by P.C. Trescott, G.F. Pinder and S.P. Larson, simulates groundwater flow in an artesian, a water table, or combined artesian and water table aquifer. Numerical experiments results are described in documentation and a flow chart, program listing, an example simulation and sections on designing an aquifer model and data input requirements are included in the publication. Report TWI 7-C1 is available for $2.30 from Branch of Distribution, U.S. Geological Survey, 1200 S. Eads St., Arlington, VA 22202.

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Commercial development potential of geothermal energy sources in 13 regions of the Western United States which have not been fully exploited is discussed in *A Study of Geothermal Prospects in the Western United States.*

Regions with geothermal energy development potential were ranked according to geotechnical and engineering data, energy market accessibility, administrative constraints and environmental and socioeconomic factors.

The publication, Report N76-22665/3WN is available for $6 from National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

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Multi-objective Water Resources Planning: Methodology to Achieve Compatibility between Environmental Amenities and Economic Development describes development of a mathematical model of multiple water resources in natural areas.

The model represents a "unified system for the evaluation of cases where traditional forms of economic development such as industrial manufacturing, suburban residential expansion, or mineral extraction are proposed for relatively natural areas having significant environmental amenity values."

First employed in the multiple-use management study of the 18,800-acre Great Santee Swamp in South Carolina, the model can be utilized for environmental engineering, environmental planning and natural resources management.

Designated Report Number 55, the publication is available from the Water Resources Research Institute, Clemson University, Clemson SC 29631.

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Use of recording precipitation gauges, sewer-flow measurement instruments and automatic wastewater samplers is amplified in *Instrumentation for Field Studies of Urban Runoff.*

Individual instruments were tested in the laboratory and field for varied time periods. Technical data, accuracy and reliability are discussed for the individual instruments. Selection, interfacing and installation recommendations are outlined also.

Research Report Number 42 is available from the Training and Technology Transfer Division (Water), Environmental Protection Service, Environment Canada, Ottawa, Ont. KiA OH3, or the Ontario Ministry of the Environment, Pollution Control Branch, 135 St. Calir Avenue West, Toronto, Ont. M4V 1P5.

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Environmental Pollution Control Alternatives: Municipal Wastewater describes alternative treatment methods for each technology and gives data on treatment efficiency, power requirements, operation and maintenance considerations, costs, land requirements, and actual installations. Physical-chemical treatment, nitrogen control and removal, phosphorus removal, oxygen aeration, carbon adsorption, sludge handling and disposal, land treatment, and flow equalization are among the technologies discussed. Copies of the semi-technical, full-color publication are available at no cost from Technology Transfer, U.S. Environmental Protection Agency, Cincinnati, OH 45268.

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Ground Water [sic] Pollution. Part 2. Pollution from Irrigation and Fertilization [A Bibliography with Abstracts] is a comprehensive report which includes data on pollution from sewage and wastewater irrigation, land spreading of sludges and solid wastes, nitrate and phosphate accumulation in soils, pollution control and abatement planning, salt build-up from irrigation, the use of tile drains in groundwater pollution abatement, and groundwater recharge studies. Forty-four of the 222 abstracts presented are new entries. Report NTIS/PS-76/0750/0WP is available for $25 from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

MEETINGS

Detailed abstracts of papers to be given at the 13th **Annual Conference of the American Water Resources Association, "Assessment, Management, and Politics of Water,"** are due no later than March 31, 1977. The conference will be held Oct. 31-Nov. 3, 1977 in Tucson, AZ.

Invited are papers related to any aspect of water resources research, planning, development, management, education, and information systems. Tentative session topics are: national water assessment, water law, water and energy, water and industry, water-based recreation, water quality control, desalination, water conservation, water reuse, limnology, irrigation practices,

hydrologic modeling, water planning, flood plain management, education and manpower, decision making, climatic change, and world hunger and water development.

"Abstracts may not exceed 200 words in length and are to include the paper's title and authors' names and affiliations. Typing should be single spaced with a left-hand margin of one inch and other margins not less than half an inch. Paragraphs are to be indented five spaces and should be separated by one blank line," say spokesmen for the program committee.

"Five copies of the abstract should be sent, one of which should be the original. Authors **must** also enclose on a separate page the full mailing address, including position, firm or institution, department, and telephone number, for all authors of the paper, and the appropriate topic area for the paper from the above list," the committee says.

Abstracts should be addressed to one of the co-chairmen of the Technical Program Committee, Dr. Stanley N. Davis or Dr. David B. Thorud, Department of Hydrology and Water Resources, University of Arizona, Tucson, AZ 85721.

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Thirty-two papers are scheduled for the **Joint Session of the Hydrology Section, Arizona Academy of Science, and the Arizona Section, American Water Resources Association** to be held during the **21st Annual Meeting of the Arizona Academy of Sciences**, April 15-16, 1977 at the University of Nevada, Las Vegas.

Among papers scheduled are those discussing various aspects of the Central Arizona Project, effluent, multidisciplinary water resources planning and management, pollutants, rain, reclamation, reservoirs, rivers, sediment, snow, soil, transpiration, water harvesting, and water policy.

Papers given at the joint session will be published in the annual proceedings, **Hydrology and Water Resources in Arizona and the Southwest**.

For further information about the joint session contact:

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May 23-25. **National Conference on Water**, St. Louis, MO. CONTACT: Water Resources Council, 2120 L St., N.W., Suite 800, Washington, DC 20037.

May 30-June 3, 1977. **Symposium on Quality of Precipitation**, Washington, DC. Sponsored by American Geophysical Union, Section of Hydrology, Committees on Precipitation and on Water Quality. CONTACT: Eugene L. Peck, Hydrologic Research Laboratory, NOAA-National Weather Service, Silver Spring, MD 20910 or Timothy D. Steele, U.S. Geological Survey, WRD, Colorado District, MS 415, Federal Center, Box 25046, Lakewood, CO 80225.

May 31-June 5, 1977. **International Conference on Hydrogeology**, Budapest, Hungary. CONTACT: A. Ivan Johnson, Chairman, U.S. National Committee for IAHS, U.S. Geological Survey, National Center, MS-417, Reston, VA 22092.

June 27-29, 1977. **Third International Symposium in Hydrology**, on "Theoretical Hydrology," Colorado State University, Fort Collins, CO. CONTACT: H. Morel-Seytoux, Director of Symposium, Engineering Research Center, Colorado State University, Fort Collins, CO 80523.

June 30-July 2, 1977. **Second International Conference on Transfer of Water Resources Knowledge**, Colorado State University, Fort Collins, CO. CONTACT: N.S. Griggs, Engineering Research Center, Colorado State University, Fort Collins, CO 80523.

Please address your news items or comments on the News Bulletin to any of the three editors:

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