



COLORADO WATER

Colorado Water Resources Research Institute

Colorado State University

Fort Collins, Colorado 80523

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SOUTH PLATTE RIVER BASIN STUDY IN PROGRESS

Legislators and water users will be able to make sound, long-range water management decisions in the future, thanks to research by water scientists at three Colorado universities.

Researchers at Colorado State University, Denver University, and the University of Colorado are using the computer to explore the long-range impact of agriculture, energy development, population growth and other activities on water supplies in the South Platte River basin. The long-term basinwide effects of management decisions on those water supplies can be simulated in a few minutes on the computer.

The South Platte River basin contains the major portion of Colorado's population. Increasing urban and industrial demands will shape future management of this water, and water conservation — by both agriculture and municipalities — will be important, says Dr. Norman A. Evans, project leader and director of the Colorado Water Resources Research Institute.

Although agricultural, industrial and urban users withdraw 91 percent of Colorado's entitled water from the river, an average of 300,000 acre-feet of water annually passes downstream and out of the state because of inadequate storage. Critical decisions must be made on location, timing and size of new storage projects and changes in water management to optimize the basin's water supply.

Another concern of water scientists is the salt balance in the basin. A recent analysis of salt load in the river shows that irrigation is leaching salt from the basin's upper areas to deposit the minerals on irrigated land in the central part of the basin.

Groundwater in non-tributary aquifers will be drawn upon heavily, and competition for that water will create conflicts. Further advances in water law and administration of those supplies are urgently needed.

Protection of groundwater quality also will require both technological and institutional developments.

Basin management decisions will come from voluntary cooperation among water users and water officials.

The computer will process their possible decisions, then provide a record of simulated changes in the water supply that resulted from those decisions. Water users, engineers and officials may analyze the results, and make decisions in the light of long-range basinwide impacts of those decisions.

Objectives of the water management project are to help increase cooperative decision-making and efficiency of water use; develop the state's compact entitlements;

reduce agriculture's vulnerability to fluctuating water supplies; and minimize adverse ecological impact of human activities.

The research is supported by the U.S. Department of Interior, and managed by the Colorado Water Resources Research Institute.

The institute, a state agency, works with water users and state officials to develop research projects that help solve state water problems. It is located at CSU, but research is conducted by experts in all of the state's research universities, said Evans.

COLORADO WATER ISSUES FORUM

Denver-area water interests can keep informed on key statewide water issues by attending the institute's monthly no-host noon luncheons at Wyatt's Cafeteria at Alameda and Wadsworth. Meetings are scheduled regularly on the third Tuesday of each month throughout the year (December excepted).

Response to this new public-information approach on important statewide water issues and problems organized by Bill Raley, the Institute's Extension Water Resource Specialist, is very good.

At the first luncheon in July, Charles Jordan of Governor Lamm's staff recapped the Metropolitan Roundtable recommendations on future water supply for the metropolitan area. Speakers and topics for subsequent meetings included:

- Bob Rounph, U.S. Army Corps of Engineers — the Denver-Metro water supply systemwide study now in progress;
- Hester (Tess) McNulty, Colorado League of Women Voters, opportunities for statewide water planning;
- Rollie Fischer, Manager, Colorado River Water Conservation District, West-Slope view of transmountain diversion issues;
- Harold Miskel, Colorado Springs' Water Utilities Director, current status of Homestake II transmountain diversion project and its relation to metropolitan Denver's water supply;
- Lewis Grant, Atmospheric Science Department, CSU, progress and outlook for augmenting precipitation by cloud seeding;
- James Gibson, Natural Resources Ecology Lab, CSU, acid rain in Colorado.

The Jan. 17 program will cover the Nov. 7 Supreme Court decision on the Huston case involving rights to non-tributary groundwater and also the groundwater-law issues it has raised. David Brown, an attorney with Moses, Wittemyer, Harrison and Woodruff in Boulder, will be the speaker.

SEP 18 1982
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COLORADO RIVER BASIN RESERVOIR OPERATION

Colorado River Basin reservoirs operate under rules established to meet withdrawal demands while producing as much hydropower as possible. The rules represent best judgments of proper proportions of runoff to be stored to meet future demands and runoff to be passed through for immediate hydropower production.

Storage space reserved for emergency use in flood control also may be established by the operation rules. Because of its economic value, the tendency has been to maximize storage for hydropower and minimize reserve storage space for flood control. The infrequency of extreme runoff events also has contributed to this practice.

However, the penalties of this strategy were dramatically shown in 1982-83 when runoff was more than 200 percent of normal and far exceeded flood-storage reserve space. Large emergency reservoir releases were necessary, and caused substantial flood damage throughout the lower basin.

The question that must be asked in establishing operating rules is:

What is the trade-off cost (power loss or flood damage) of maintaining hydropower reserves in upstream reservoirs vs. reserving the same storage space for flood flows?

Optimizing capability combined with river hydrology simulation is a must if this question is to be answered. After several years of research, Dr. John Labadie and his associates at CSU's Civil Engineering Department have developed such an optimizing-hydrologic simulation model.

They recently tested the new computer technology by evaluating reservoir storage strategies and operating rules for the Colorado River basin. The model was used under contract with the Bureau of Reclamation in collaboration with the Western Area Power Administration to investigate reservoir operating rules that would facilitate hydropower exchanges with the Columbia River Basin to meet peak power demands.

The results of this investigation show that a flexible reservoir operating policy based on continuous use of the optimizing model could replace present fixed operating rules to the advantage of all parties concerned.

Using this new technology, hydropower production in the Colorado River Basin can be substantially increased for at least the next 30 years while at the same time meeting all expected withdrawal demands and providing reasonable flood storage space.

STATE WATER INSTITUTES SUGGEST REVIEW OF RESERVOIR OPERATING RULES

Dr. Douglas James, director of Utah's Water Institute, testified on behalf of the Colorado River Basin Association of State Water Research Institutes at the October 14 Congressional hearings on the 1983 flood operation of the Colorado River Reservoir system.

He said the system's operating efficiency can be improved by using recent scientific advances in remote sensing and computer simulation modeling, and proposed the establishment of an independent panel of experts to review basinwide reservoir operating procedures.

Composed of members with technical and specialized scientific expertise in water management, the panel's reviews would supplement interagency and state reviews of the rules for the system's operation. Dr. James noted that several dam failures in the late 1970s led to the establishment of similar independent review panels to monitor dam design, construction and operation to ensure that the highest safety standards were followed.

The proposed panel would review the effectiveness of actual and proposed operating rules, suggest improvements in performance to increase the benefits of system operation, and facilitate the use of advanced techniques to forecast and monitor runoff for improved operating decisions.

FEDERAL SUPPORT FOR WATER RESEARCH

New five-year authorizing bills for a state-focused Water Resources Research Program have passed both the Senate and the House. Both include authority for State Water Resources Research Institutes. Annual funding levels authorized in the bills are as follows (millions):

	S.684	H.R. 2911
State Water Research Institutes	\$ 8.1	\$10
Matching Grants for Research	13	40
Water-Related Technology Development	-0-	10

H.R. 2911 has 75 co-sponsors, including Representatives Brown, Kogovsek and Schaefer of Colorado. It is expected that a conference committee will accept the provisions of H.R. 2911 with some reduction in authorization levels. State-appropriated cost sharing will be required.

IS SALT ACCUMULATING ON SOUTH PLATTE BASIN LANDS?

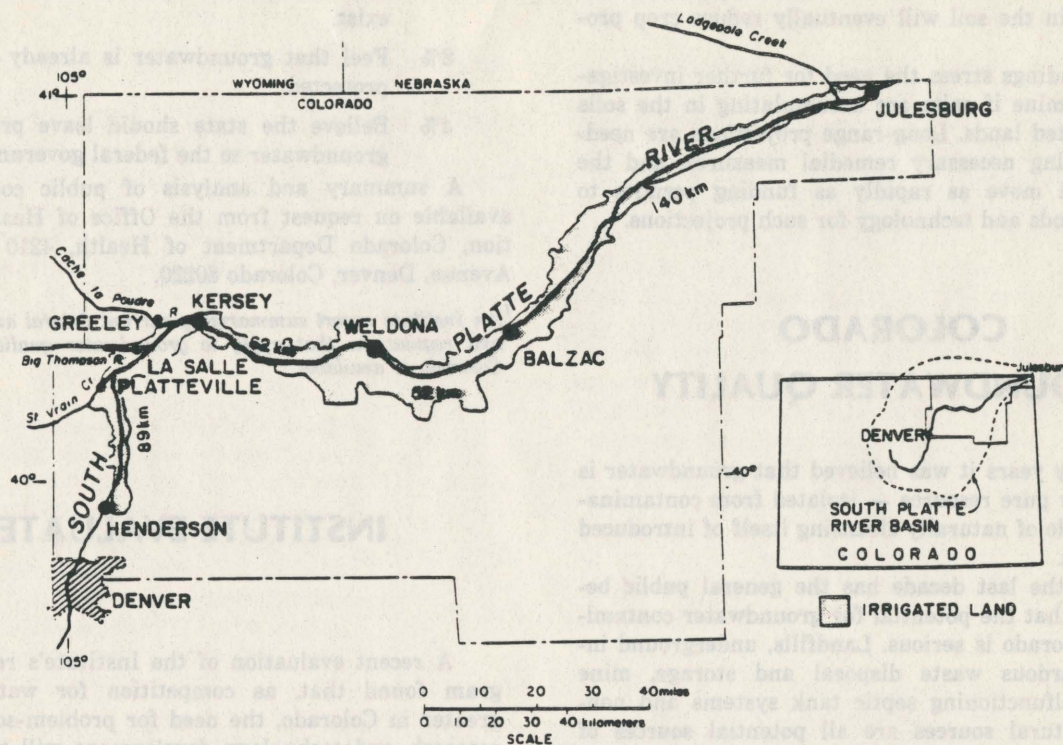


Figure 2. Lower South Platte River in Colorado (adapted from Hartz, et al., 1975).

Salinity concentrations in the South Platte River are a source of water quality concern and have been monitored for many years. But now an Institute study reveals a new dimension to the potential salt problem.

The study reveals that the river gains salts in the section from Henderson to Kersey, while it loses salts between Kersey and Balzac. While there is a small gain again between Balzac and Julesburg, the net change between Kersey and Julesburg is loss of salt load.

This pattern of gain and loss in river salt load is consistent for each year of the 15-year study period, and indicates that salts are being deposited in the Kersey-

Balzac section, perhaps on the irrigated land.

Salt gains in the river come from irrigation return flows containing salts leached from lands along the main stem and three tributary streams (St. Vrain Creek, the Big Thompson River, and the Cache la Poudre River).

The table below shows mean daily salt loads at several points including the three tributaries. This data shows that the river's upper section from Henderson to Kersey is receiving an average of 1700 metric tons of salt per day, while 640 metric tons per day are lost from the river between Kersey and Balzac.

Mean Daily Salt Mass Flows at Stations in the South Platte River and Tributaries, Averaged Over the Period 1965-1979.

Station	Mean Daily Salt Mass Flow (tons/day(metric))
Base salt load of native and imported water at mouths of canyons	400.0
South Platte River at Henderson	523.0
St. Vrain Creek near Platteville	464.3
Big Thompson River near LaSalle	312.7
Cache la Poudre River near Greeley	327.7
South Platte River near Kersey	2007.8
South Platte River near Weldona	1713.2
South Platte River near Balzac	1368.0
South Platte River near Julesburg	1627.9

If there is not a salt balance for irrigated lands (amount of salt added = amount of salt removed) salt accumulations in the soil will eventually reduce crop production.

These findings stress the need for further investigation to determine if salts are accumulating in the soils on the irrigated lands. Long-range projections are needed for planning necessary remedial measures, and the Institute will move as rapidly as funding permits to develop methods and technology for such projections.

COLORADO GROUNDWATER QUALITY

For many years it was believed that groundwater is an essentially pure resource — isolated from contamination or capable of naturally cleansing itself of introduced contaminants.

Only in the last decade has the general public become aware that the potential for groundwater contamination in Colorado is serious. Landfills, underground injection, hazardous waste disposal and storage, mine drainage, malfunctioning septic tank systems and non-point agricultural sources are all potential sources of groundwater pollutants.

The current legal framework for groundwater quality protection consists of several different laws not primarily concerned with groundwater but directed at pieces of the problem, such as hazardous waste disposal. Some of these laws provide for federal regulation, while others are state laws that delegate administrative responsibility to several different state agencies.

While the statutory authorities of six or more different agencies cover some of the pollutant sources, Colorado does not have a comprehensive and coordinated groundwater quality control program.

The Colorado Department of Health, and the Colorado Water Quality Control Commission have sought public advice during the past year on referred approaches to groundwater quality protection through public meetings. In addition, a survey of opinions drew around 200 responses from industry, agriculture, and environmental groups, local governments, and others. Results of the survey show:

- 97% Support the protection of existing and future beneficial uses.
- 87% Favor maintaining high groundwater quality that is currently better than necessary to meet use standards.
- 97% Prefer little or no discharge of toxic chemicals or hazardous wastes to groundwater.
- 36% Believe industry cost is an important consideration in developing a groundwater protection program.
- 50% Feel state government cost is an important consideration in designing a program to protect groundwater.

- 93% Feel the state should protect groundwater from pollutants where no federal standards exist.
- 8% Feel that groundwater is already adequately protected.
- 4% Believe the state should leave protection of groundwater to the federal government.

A summary and analysis of public comments is available on request from the Office of Health Protection, Colorado Department of Health, 4210 East 11th Avenue, Denver, Colorado 80220.

¹An Institute report summarizing current federal and state laws and regulations that apply to groundwater quality control in Colorado is available.

INSTITUTE EVALUATED

A recent evaluation of the Institute's research program found that, as competition for water becomes greater in Colorado, the need for problem-solving water research and technology development will become even more vital than in the past.

The review team recommends that CWRRI increase its efforts "to identify precisely Colorado's water and related land problems in such a way that research might contribute to their real solutions."

The Institute review and evaluation, conducted in May 1983, resulted in 15 specific recommendations to strengthen Colorado's water research program.

Widespread public information on Institute activities was one of them. This newsletter is a response, as is the Denver-area monthly Water Forum mentioned elsewhere.

Review team members met May 5 in Denver and interviewed representatives of state and federal agencies, local government, water-user associations and public-interest groups. On May 6, interviews were held at CSU with faculty members and the Institute director.

Henry Caulfield, review team chairman, submitted the team's report to the State Board of Agriculture through Judson M. Harper, CSU Interim Vice President for Research.

The review team included Fred Anderson, former State Senator; Gary Broetzman, Director, Colorado Division of Water Quality Control; J. Ernest Flack, Department of Civil, Environmental and Architectural Engineering, University of Colorado; Neil Grigg, Civil Engineering Department, CSU; Francis McLean, Director, Division of Research, USBR; Kenneth Nobe, Chairman, Agricultural and Natural Resource Economics, CSU; Larry Simpson, Manager, Northern Colorado Water Conservancy District; Scott Tucker, Manager, Urban Drainage and Flood Control District; Kenneth Wright, Wright Water Engineers; and Tom Ten Eyck, Government Affairs Coordinator, AMOCO Minerals Corporation.

1984-85 BUDGET REQUEST

With the help of its statewide Research Planning Advisory Committee, the institute has identified 125 major water problems facing Colorado, and 10 have been selected as highest-priority for the next five years.

The institute's 1984-85 \$315,000 appropriation request submitted to the Joint Budget Committee of the Colorado General Assembly will support a research program concentrated on five of these highest-priority problems:

- Develop technologies for planning the location, capacity and operating rules for storage reservoirs to maximize use of available water. Combine computer hydrologic simulation with economic optimization taking account of water rights, hydropower production and flood control.
\$ 84,000
- Develop technologies to help water managers and public policy makers with complex decisions on water management that affect basinwide effectiveness of water use. Loss of Colorado entitlement water downstream to other states can be reduced even without additional storage.
\$243,000
- Analyze and evaluate alternative policies for administration and management of groundwater in bedrock aquifers of the Denver Basin (with technical supporting data).
\$ 41,000
- Provide technical assistance to State agencies, the Colorado General Assembly, and water-user organizations in the use and application of research and technology products that will accelerate advances in basinwide water management and in water resources administration.
\$ 15,000

COMPENSATORY STORAGE

The Colorado River Water Conservation District has initiated talks with the Bureau of Reclamation on transferring operational control and repayment obligations of compensatory storage in Ruedi and Green Mountain Reservoirs to the District. Representatives of the two agencies met in Glenwood Springs on October 4 to initiate discussions. The Bureau is reported as willing to continue discussions which may lead to active negotiations. The Southeastern and the Northern Water Conservancy Districts are also interested in these negotiations, because they have obligations for replacement water in the reservoirs. The current Bureau program for second-round sales of water from Ruedi would be consummated before any transfer action would be taken.

CONFERENCES

- Jan. 17, 1984 COLORADO WATER ISSUES PUBLIC FORUM — "Consequences of the Supreme Court Decision in the Huston Groundwater Case." No-host luncheon at Wyatt's Cafeteria, Villa Italia Shopping Center, Wadsworth and Alameda, Denver, 11:45 a.m. to 1:30 p.m. (The Forum is sponsored each month by the Institute and meets the third Tuesday of each month.)
- Jan. 22-26, 1984 COLORADO WATER LAW FOR ATTORNEYS, TITLE COMPANIES AND LENDERS, Maui, Hawaii, sponsored by Western Colorado Services, P.O. Drawer 2030, Glenwood Springs, CO 81602, (303) 945-2264.
- Mar. 26-29, 1984 SECOND INTERNATIONAL CONFERENCE ON GROUNDWATER QUALITY RESEARCH, Tulsa, Oklahoma, sponsored by EPA, Oklahoma State University, University of Oklahoma, and Rice University. For further information contact Norman N. Durham, Director, University Center for Water Research, Oklahoma State University, Stillwater, Oklahoma 74078, (405) 624-6995.

PUBLICATIONS

GROUNDWATER CONTAMINATION IN THE U.S., University of Pennsylvania Press, 3933 Walnut Street, Philadelphia, Pennsylvania, 19104, \$14.95 paper, \$35 cloth.

WATER CRISIS: ENDING THE WATER POLICY DROUGHT, Cato Institute, 224 Second Street, S.E., Washington, D.C., 20003. Price: \$7.95.

SUMMARY REPORT, UPPER PLATTE RIVER STUDY, U.S. Department of the Interior, Office of the Secretary, Washington, D.C., 20240. Summary of investigations of Upper Platte River by Bureau of Reclamation, Fish and Wildlife Service, and Geological Survey.

WATER CONSERVATION: AN UPDATE OF FEDERAL ACTIVITY, General Accounting Office, Document Handling Facility, P.O. Box 6015, Gaithersburg, Maryland, 10760.

OFF THE PRESS

The following publications are available upon request at prices listed. Send order with check payable to Colorado State University to: Bulletin Room, Aylesworth Hall, Colorado State University, Fort Collins, Colorado, 80523.

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| | UTILITIES, by Carol Ellinghouse and George McCoy. | \$8.00 |
| | Analyzes various scenarios of water conservation programs in Colorado cities to modify demand and reduce need for additional water, and comparing costs and benefits. | |
| CR122 | ECONOMIC IMPACTS OF TRANSFERRING WATER FROM AGRICULTURE TO ALTERNATIVE USES IN COLORADO, by Robert A. Young. | \$5.00 |
| | Assesses economic impacts of increased competition for irrigation water and policy changes needed to deal with these impacts. | |
| CR124 | EFFECTS OF WILDERNESS LEGISLATION ON WATER-PROJECT DEVELOPMENT IN COLORADO, by Glen D. Weaver. | \$7.00 |
| | Examines water-project development limitations of the Wilderness Act, the Wild and Scenic Rivers Act, and the Endangered Species Act, and the effects on water demand for population increase and economic growth. | |
| IS47 | SECTION 404 OF THE CLEAN WATER ACT — AN EVALUATION OF THE ISSUES AND PERMIT PROGRAM IMPLEMENTATION IN WESTERN COLORADO, by Dennis W. Barnett. | \$5.00 |
| | Evaluated implementation of Section 404 of the Clean Water Act in western Colorado and the effect on agriculture, energy, tourism and population growth. | |
| IS48 | PROCEEDINGS: HIGH-ALTITUDE REVEGETATION WORKSHOP NO. 5, Edited by Robin L. Cuany and Julie Etra. | \$6.00 |
| | Assembles papers presented at workshop by representatives of industry, federal and state agencies and universities and colleges on revegetation of high-altitude disturbed lands. | |
| TR28 | AN ASSESSMENT OF WATER USE AND POLICIES IN NORTHERN COLORADO CITIES, by Kelly N. DiNatale. | \$5.00 |
| | Examines municipal water management policies and water-use patterns for 25 Colorado Front Range communities and the effects of metering | |
| CR116 | EFFECTS OF RELEASES OF SEDIMENT FROM RESERVOIRS ON STREAM BIOTA, by James V. Ward | \$3.00 |
| | Evaluates temporal and longitudinal effects of sediment releases from reservoirs on downstream physical-chemical conditions, benthic algae and macroinvertebrates at Dry Creek Reservoir No. 15 and North Platte River-Guernsey Reservoir, Wyoming. | |
| CR117 | DYNAMIC WATER ROUTING USING A PREDICTOR-CORRECTOR METHOD WITH SEDIMENT ROUTING, by D.B. Simons, R.M. Li, J. Garbrecht and R.K. Simons. | \$5.00 |
| | Applies a dynamic water-routing model to evaluate alternative flood control structures and channel improvements, and to study sediment movement in floods moving through the river system. | |
| CR120 | THE EFFECTS OF WATER CONSERVATION ON NEW WATER SUPPLY FOR URBAN COLORADO | |

and water-use restrictions during the 1976-77 drought.

TR34 THE IRRIGATED AGRICULTURAL ECONOMY OF THE COLORADO HIGH PLAINS: DIRECT ECONOMIC-HYDROLOGIC IMPACT FORECASTS (1979-2020), by Robert A. Young, Lawrence R. Conklin, Robert A. Longenbaugh, with Richard L. Gardner.

\$7.00

Final report on the Colorado portion of the 7-state Ogallala groundwater study making forecasts to 2020 AD of groundwater depletion and associated impacts on the irrigated agricultural economy in the Colorado Ogallala-High Plains region.

PROFILE

This newsletter is our response to one recommendation from a review and evaluation of the Institute last spring. A review team of 10 senior water authorities representing state and federal agencies, water-user associations, and the private sector concluded that widespread public information on the Institute's activities is needed to strengthen the state water research program.

So, to introduce the first issue, I am inserting this brief profile of the Institute.

Marking 32 years of service to Colorado's water industry through water research, education and public service, I take great pride in the contributions water research has made to our economy and quality of life. But the challenges to research have never been greater nor the stakes higher than they are now, as water demands approach the limit of available supply.

Norman A. Evans, Ph.D.
Director

The institute's water research program began when Congress enacted the Water Resources Research Act of 1964. The act established water resources research institutes at the nation's land-grant universities.

It has continued for 19 years, financed almost entirely by the federal government. In that time, Colorado benefited by more than \$8 million for water research projects conducted in the four major research universities: CSU, CU, DU and CSM.

Beginning in 1980 with the expiration of the act, federal support for the program was reduced to a minimum with the expectation that states would fill the gap.

A National Academy of Sciences report in 1981 noted that only one-fourth of the states make significant financial investment in water research. The report said there is a growing water crisis and urged states to support problem-solving water research. State support in this immediate region currently is provided by Wyoming, Nebraska, New Mexico, Oklahoma, Texas, Arizona and California.

Also in 1980 the Colorado General Assembly authorized the Colorado Water Resources Research Institute "... for the purpose of developing, implementing and coordinating water and water-related research programs in the state and transferring the results of research and new technologies to potential users."

No regular appropriation has yet been made for Institute research. However, the last session of the General Assembly made an appropriation to the Colorado Water Conservation Board by which the institute will complete the South Platte Basin computer simulation model. This is an application of a previous institute research product.

A resurgence of Congressional interest in solving national and state water problems now indicates continued federal support for water research. New authorizing legislation has been passed by both the U.S. Senate and the House which will provide federal funds to cost share state-supported research.

State cost sharing will be required starting at \$1 state per \$1 federal, reaching \$2 state per \$1 federal by the fifth year. The Congressional intent is that states which recognize the need for problem-solving water research will provide direct support to qualify for federal funds.

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Cydney Conway	Secretary

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