

## COLORADO OIL SHALE AND WATER

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The Colorado River is the most controlled, and, therefore, the most controversial and most litigated river in the world. As you may know, the Colorado is the subject of two Congressionally ratified interstate compacts and one international treaty. The 1922 compact divided the Colorado River at Lees Ferry, Arizona, into the Lower Basin (California, Arizona and Nevada) and the Upper Basin (Colorado, New Mexico, Utah and Wyoming). The 1944 Mexican Treaty guaranteed 1½ million acre-feet per year to Mexico. The root cause of all the controversy and litigation is that the compacts and treaty divided up more water than the river produces. In my remarks I will assume that this audience understands Colorado's appropriation system. Further, the Mexican Treaty has recently caused increased controversy because the federal administration has interpreted it very broadly to include water quality which was not mentioned at all in the treaty itself.

The Colorado River may be the subject of even more controversy in the relatively near future as the Upper Colorado River Basin begins to put more of their compact-allocated share of the river to beneficial use. Much of the near term increase in use will come in Colorado, specifically western Colorado. Certainly Colorado is going to increase its use of water for irrigation, but the immediacy of western Colorado increasing its use of its rivers comes about primarily because of the nation's energy crisis or "energy opportunity," if you prefer, and your interest here today is Colorado's energy resources, specifically oil shale, as related to water. I will emphasize shale oil and water, although coal will be a heavy energy resource user of water and actually shale oil and coal-fired thermal electric plants cannot be neatly separated.

For background, the Colorado River Water Conservation District is the primary western Colorado water policy body, and the principal head-

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*Secretary-Engineer, The Colorado River Water Conservation District, Glenwood Springs, Colo.*

waters of the Colorado River originate within its boundaries. All of Colorado's oil shale lies within the River District (fig. 1). The area of the River District is 29,000 square miles, which is a little over one-fourth of the state. The District is a quasi-municipal corporation of Colorado, established by the legislature in 1937 to conserve, develop and safeguard for Colorado all of the waters to which the state is equitably entitled under the 1922 compact. The State Water Board was established at the same time. Ever since the River District was established, it has anticipated the need for shale oil water and has appropriated water for shale oil and fought transversions in the courts to hold some water on the western slope in the basins of origin so it would be there when the time came. It looks like the time is now.

I mentioned the geographic division of the river into two basins.

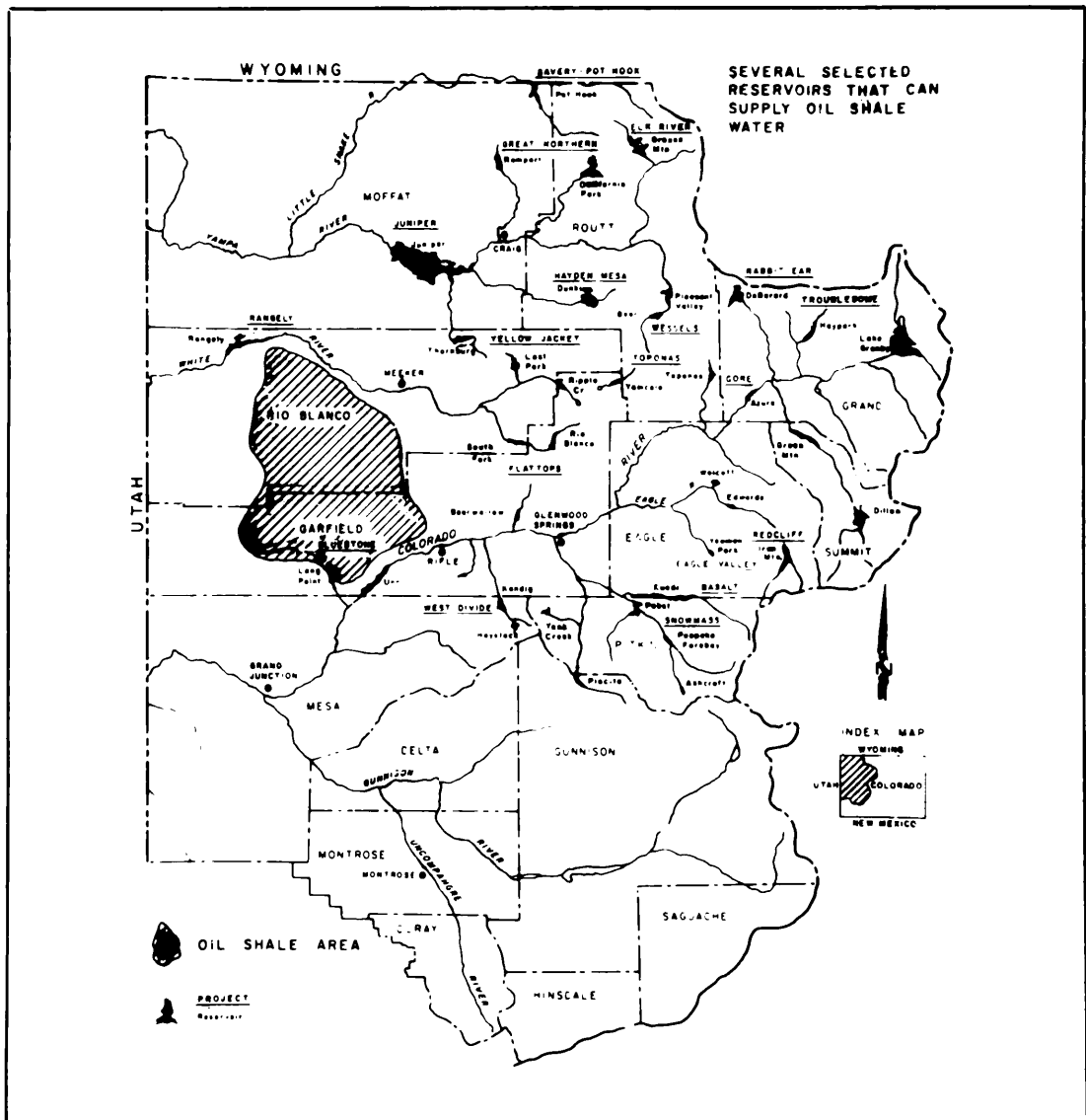


FIGURE 1.—Colorado River Water Conservation District.

Well, as far as water volume is concerned, approximately 53 percent of the gaged flow at Lees Ferry, Arizona, the dividing point between the Upper and Lower Colorado River Basins, originates within the River District. Approximately 62 percent of the calculated virgin flow at Lees Ferry originates within the District. But the compacts limit Colorado to the use of about one-fourth of the scarce Colorado River waters and the state's share can be used anywhere in the state. The state straddles the Continental Divide and the one-man-one-vote principle has cost us a lot of water and much of the high quality headwaters (currently about 450,000 acre-feet per year), are transverted to eastern Colorado. Certainly the taking of this high quality water has a detrimental effect on the dissolved solids concentration in western Colorado, and, indeed, in the entire Colorado River Basin, with measurable detriments at, say, Lake Mead.

The production of shale oil in western Colorado will certainly not reduce the controversies surrounding Colorado River water but will put some Colorado River water to use on the western slope where it belongs. I often recite the truism that where water is concerned, Colorado is divided into three parts—the west slope, the east slope . . . and Denver! For example, some in the audience may have heard of the Denver Water Board's controversial proposed Eagle-Piney transversion. Well, on the Colorado main stem there are approximately 500 cfs of conditionally decreed direct flow claims for oil shale water that are senior in priority date to Denver's Eagle-Piney transversion. The industry will probably not be able to avoid having to defend its conditional decrees, although the Denver Water Board will probably not be the only adversary.

Shale oil production is usually discussed in terms of 50,000 barrel per day units. I suspect that this is probably because retorts handling the comparable quantities of rock are the optimum size. I think everybody concerned with energy and water resources has his own set of water requirement numbers, but I doubt that anyone really knows exactly what the requirements will be. So I will give you some of the numbers we have developed in our office: these numbers are comparable to free advice—they are worth just what they cost you; and are perhaps just about as reliable. But we are using them as a guide until the industry tells us differently.

For production of each 50,000 barrel per day unit of crude shale oil, approximately 8,000 acre-feet of water per year will be totally consumed; there will be no return flow. So for a 1 million barrel per day industry, 160,000 acre-feet of water will be totally consumed. The percentage breakdown is as follows:

40% evaporated	64,000
60% chemically and mechanically locked in	96,000
	<u>160,000</u> acre-feet

For each 50,000 BPOD unit, municipal water will be required for at least 1,000 people. These people-water requirements are not included in the above estimate, and neither are the associated thermal power requirements.

The largest, richest oil shale reserves are bounded on the north by the White River and the south by the Colorado River. Under Colorado's appropriation system, just because water is in a river does not mean it is available for the taking. In spite of almost countless studies of the water of the Colorado River Basin, including the White River, at this time no one really knows how much water is actually reliably available at any given time for an oil shale industry. In late 1969 the River District recognized the problem and started the first efforts toward trying to find a solution. After a great deal of effort by many people over a long period of time, a tool has been developed that will give reliable answers to questions about water availability in the two basins. The tool is CORSIM II, a digital computer model of the two basins. There are 15 participants who funded the development of CORSIM II. It is the only tool of its kind and it can determine the amount of water available at any given point at any time on either river. CORSIM II, or a similar tool, is absolutely essential for any operation involving large capital investments, especially oil shale and coal, that will require water from the Colorado or White Rivers. Of the 15 participants, 10 are directly interested in oil shale (Arco, Exxon, Cities Service, Getty, Mobil, Cleveland-Cliffs, TOSCO, Union Oil, Chevron, Sohio); four are water agencies (The River District, Denver Water Board, the Northern Colorado Water Conservancy District, and the City of Colorado Springs); one is a public utility (Public Service Company of Colorado). CORSIM II cost \$475,000 and was completed and accepted January 31, 1974. The consultants were a joint-venture of David E. Fleming Company of Denver and Parsons, Brinkerhoff, Quade and Douglas of New York.

A great deal of publicity has been given to the federal Colorado oil shale lease sales in the White River Basin but five of the seven current oil shale ventures we are aware of are on private land and four are in the Colorado River Basin. They are:

#### *ON FEDERAL LAND*

Colorado federal oil shale tract Ca: White River Basin

Colorado federal oil shale tract Cb: White River Basin

*ON PRIVATE LAND*

The Superior Oil Compact Tract: White River Basin

The Garrett Research (Occidental Oil Co.) in-situ process:  
Colorado River Basin

The announced Colony Group 50,000 BPOD plant: Colorado River Basin

The announced Union Oil Company of California 50-150,000 BPOD plant: Colorado River Basin

The 18-company pilot plant venture now under way near Rifle, Colorado, at the old Bureau of Mines Anvil Points facility, testing the Paraho retorting process: Colorado River Basin

Although some direct-flow water may be available part of the year, especially in the White River under the Yellow Jacket project decrees and we have heard quite a bit about the saline ground waters under Colorado federal oil shale tracts Ca and Cb in the White River Basin, surface water storage will be required to ensure a reliable industrial and associated municipal water supply. As of now it appears to the River District that the industry will need to provide its own storage facilities. Almost everyone in this room probably has some ideas about Green Mountain and Ruedi Reservoirs. Some may have concluded or even been advised that Green Mountain Reservoir holds 100,000 acre-feet of water for an oil shale industry. This is simply not true. The issue is fairly complex in legal analysis, but the short of it is that Senate Document 80, which covers the waters of Green Mountain Reservoir, establishes in paragraph (c) the priorities for the consumptive use of the 100,000 acre-feet, as follows: (1) agricultural and domestic uses existing as of June 15, 1937; (2) river losses; (3) future domestic and irrigation requirements in western Colorado on the Colorado River and its tributaries above the confluence with the Gunnison River; and finally (4) the shale oil and other industries. Any contract entered into between the Secretary of Interior and a shale oil water user would necessarily provide for interruptions when water is required for any of the first three priorities. The River District believes that the future domestic and irrigation requirements will be significant.

The River District is currently in the process of developing data to determine the future domestic requirements from the 100,000 acre-feet. These domestic requirements will be for the existing and future towns in the Colorado River Basin, which will grow and their water requirements will increase as a result of the shale oil industry. We have not yet calculated that future requirement, but the future domestic and irrigation requirements will necessarily place a first call on the 100,000 acre-feet pool

of Green Mountain water. Further, the River District wants to point out that the industry cannot anticipate taking the already existing stored water away from the domestic users because the towns are not able to finance the construction of storage and thereby subsidize the industrial water supply.

Although there may be water in the 102,000 acre-foot Ruedi Reservoir available for short-term contract to the industry, there are similar uncertainties about this water. The Basalt project will take about 40,000 acre-feet of water from Ruedi Reservoir. Further, even without a shale oil industry, a firm water supply for domestic purposes in the Roaring Fork River area is becoming critical. At this point we do not know to what extent domestic uses will draw on Ruedi Reservoir.

In addition, Ruedi is an important recreation reservoir. The dead storage pool is usually considered to be the recreation pool; in Ruedi the level below which water cannot be drawn out is 1,000 acre-feet. Some Forest Service personnel and many vocal conservation groups do not want any variation at all in the present water level of Ruedi Reservoir, that is, they want it left at 102,000 acre-feet. Further, part of the construction costs of Ruedi Reservoir is in nonreimbursable recreation funds and it will certainly be the basis for a demand that a fairly large amount of Ruedi Reservoir water be left in the recreation pool.

There is yet another uncertainty. Ruedi is the Fryingpan-Arkansas transversion project replacement reservoir. Part of Ruedi's water must necessarily be used to replace existing senior users in the Roaring Fork Basin, so the Fryingpan-Arkansas project's direct flow diversions are not shut off. At this point in time nobody knows how much Ruedi water will be required to meet those senior decrees. The Bureau of Reclamation gave up trying to figure it out.

But if we can assume that the Basalt project will require 40,000 acre-feet, that there is a replacement requirement of maybe as low as 7,000 acre-feet, and to this we must then add whatever recreation requirement is imposed, the amount of water available for contract from Ruedi Reservoir is uncertain and will be subject to interruption.

Therefore, we wish to point out that it is the River District's opinion that although the reservoirs contain some short-term water for a shale oil industry, neither Green Mountain nor Ruedi Reservoirs can be looked upon as reliable long-range sources of large amounts of water for a shale oil industry.

The necessary water storage for the industry will probably be constructed on decrees held by the industry and by the River District. My comments here are limited to River District decrees, however, and the

River District's decrees in both basins will ensure a reliable water supply for an oil shale industry and associated municipal requirements. In the White River Basin, decrees held for the Yellow Jacket project by the Yellow Jacket Conservancy District may be available to supply some reliable direct-flow water, but beyond a certain point storage will be required there, too. (See fig. 1.)

We have all heard comments that front end money will be required to pay at least in part for the early impacts of an oil shale industry on the western slope counties. This is true. Colorado is looking to the federal government for front end money, at least part of which would come from the 37½ percent allocated to Colorado from the federal oil land lease sales. But the industry must pay its own way and will probably, with front end money, be asked to help. For instance, two Garfield County commissioners with whom I recently discussed this problem believe that Garfield County cannot look to the receipt of federal funds in the amounts or in time to help pay for the front end problems that are fast coming upon the county. And they say that industry must supply money to help solve these problems that are being created by the industry's activities. These funds are required for planning, roads, schools, sewer plants, and on and on. They have stated that they have no intention of bankrupting Garfield County to meet the large impact expenses between now and the time shale oil facilities actually generate tax revenues. We are sure the industry recognizes the need to satisfy these requirements and is willing to meet its responsibility to work with the counties and the state to help solve the problem.

Colorado is pressing forward with our planned irrigation projects; we are not willing to trade off totally our western Colorado agricultural base for the production of energy. We just are not ready to let the money market alone make the decisions about the relative value of a bushel of peaches vs. a barrel of oil. The River District thinks that all of these uses can be accommodated, but just as Colorado is perfectly capable of making its own energy environmental decisions, the decisions as to how Colorado's water is to be used must be made in Colorado, by Colorado, and not in Houston, Los Angeles, New York or Washington, D. C.