

KEY IMPLICATIONS OF AND LIMITATIONS ON WATER DEVELOPMENT FOR OIL SHALE

The possible development and use of substantial amounts of water for oil shale production raises important considerations for Colorado because of the potential to adversely affect some existing water uses and many expected future water uses. Companies with an interest in oil shale development own enormous portfolios of water rights. While there is great uncertainty with respect to the manner in which these rights will be developed and used, the consequences of such development are unquestionable.

Among the many likely changes in the use of Colorado water resulting from oil shale development are changes in existing irrigated agriculture, limitations on existing and planned water development for the Front Range and the West Slope, and likely limitations on other water development for new uses on the West Slope. While these general impacts are relatively easy to project, it is harder to identify the exact development scenarios and the resulting impacts on a given water right or a specific project. This uncertainty largely stems from not knowing which water rights will be used or which storage and delivery systems will be utilized (including which ones will be built).

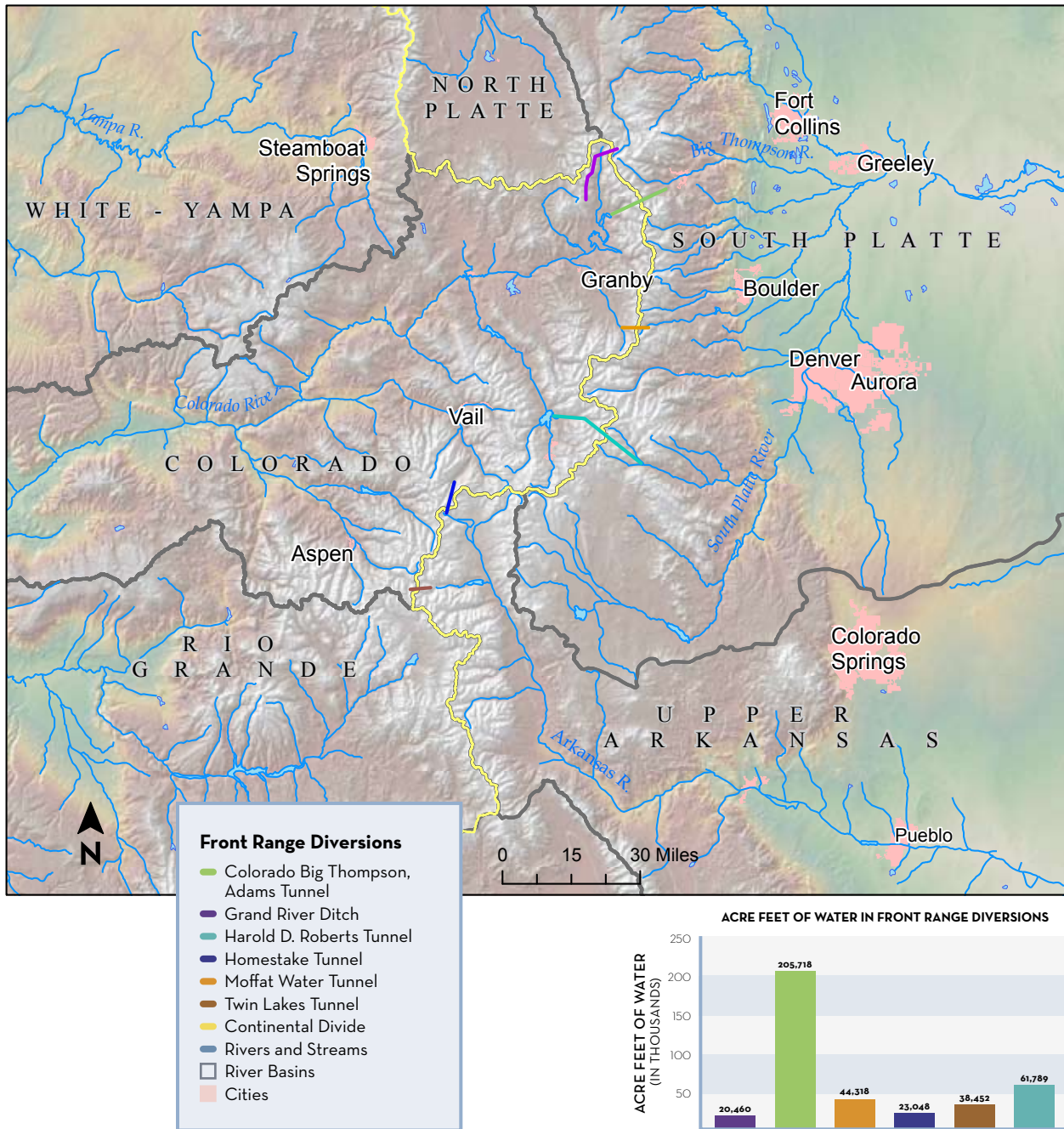
A. OIL SHALE AND EXISTING WATER USES

Perhaps the most immediately evident effect on existing water uses from potential oil shale development would be the shift of water from irrigated agriculture in the area to industrial uses. Energy companies own large portions of the water rights historically used to irrigate lands in the region. Many of these rights date back to the late 1800s and early 1900s. As pre-Colorado River Compact rights, these diversions would not be affected by a call placed against the Upper Basin. Most of the associated water still remains in irrigation use as energy companies lease back the water to ranchers. Should oil shale development move beyond the research phase, many, if not all, of these rights would be changed in use, and the lands historically irrigated would be taken out of agriculture. The result would be a dramatic transformation of land and water uses in these areas.

A second, less obvious outcome of oil shale development would be the displacement of some existing uses by new oil shale-related uses with senior priorities. As mentioned earlier in this report, conditional rights for oil shale development date back to the 1950s. Should these rights be placed into use, they would be senior to all existing uses from the same source of water with subsequent priority dates, thereby affecting rights used both in western Colorado and in Colorado's Front Range.

Front Range water providers divert several hundred thousand acre-feet of water annually out of the Colorado River Basin for both urban and agricultural use. Most of the existing transbasin diversions occur under water rights senior to conditional rights established for oil shale development. Plans to enlarge these diversions and to develop new projects, however, are more likely to

Figure 9. Major Diversions to the Front Range of Colorado



have priority dates junior to some of the oil shale rights. Should these oil shale rights be developed, they will have to be satisfied before the more junior transbasin rights. (See *Figure 9*)

West Slope communities have grown considerably since the 1950s. The headwaters towns in the Colorado River Basin now support substantial year-round populations as well as large numbers of second homes. The wintertime, ski-based tourist industry has extended into a year-round tourist and business economy. Much of the water supply that has been developed to serve this population depends on water rights with relatively recent appropriation dates.

Appendix E shows the relative priorities of selected oil shale and non-oil shale conditional water rights in the Colorado River Basin. As illustrated, there are significant oil shale rights senior to these other rights. For example, as-yet-undeveloped elements of the Homestake Project that would provide additional water to Colorado Springs and Aurora hold a priority junior to several

large downstream rights for oil shale on the Colorado River. Denver Water's Williams Fork project, for example, holds a conditional claim for the Darling Creek Enlargement decreed to divert 90 cfs that is junior to conditional rights for oil shale. Those rights collectively have the decreed right to divert over 950 cfs from the Colorado River downstream of Williams Fork. Its refill right for Williams Fork Reservoir would also be junior to these oil shale conditionals, as would its proposed Straight Creek Collection System for Roberts Tunnel. Even more junior are its conditional rights to the Piney River Unit.

Likewise, the Colorado River Water Conservation District holds the conditional water rights associated with the proposed Wolcott Reservoir, to be located in the Eagle River Basin. This project is intended to store water from the Eagle River watershed as well as from the Colorado River. Wolford Mountain Reservoir is also an important junior right, providing critical water for both the Western Slope and Denver Water.

Finally, the Northern Colorado Water Conservancy District's Windy Gap Reservoir has a 1967 priority date.⁴⁰ While presently only used to divert modest amounts of water from the Colorado River Basin, this project has already encountered difficulties because of its relatively junior priority. While efforts are presently underway to improve the yield from this project, substantial new downstream development of senior rights for oil shale development would make this task much harder to achieve.

B. OIL SHALE AND THE COLORADO RIVER COMPACT

Still another important uncertainty facing future water development in western Colorado is the legal availability of water for development under the Colorado River Compact and associated laws and requirements. Under the terms of the 1922 Colorado River Compact, the four Upper Basin states (Colorado, New Mexico, Utah, and Wyoming) were thought to be entitled to consume 7.5 million af of basin water annually. Based on this assumption, in 1948 the Upper Basin states apportioned use of their share; under that agreement, Colorado was given 3.8 million af (51.75% of the Upper Basin share). However, as explained below, Colorado's rights are in actuality less than this amount.

In 1988 and again in 2007, the Bureau of Reclamation produced hydrologic determinations that make clear the Upper Basin states cannot expect to consume the allocated 7.5 million af.⁴¹ The actual amount remains uncertain, but the 2007 analysis indicated a maximum consumption of about 5.75 million af per year. Using this assumption, Colorado would be entitled to consume just under 3 million af annually.

In a very thoughtful analysis of the state of Colorado's Colorado River entitlement, Eric Kuhn of the Colorado River Water Conservation District reviewed the hydrologic determinations and, using the Bureau of Reclamation's 2007 model, developed his own estimate. The primary difference between his assessment and Bureau of Reclamation's was his extension of the hydrology back to 1800 based on paleoclimatic data.⁴² (The extended record had an average annual flow of 14.23 million af.) With this longer and somewhat drier record, he estimated that the Upper Basin entitlement would be 5.25 million af and that Colorado's share would be 2.69 million af.

Kuhn also evaluated how much water Colorado now uses under its entitlement and, based on data of the Colorado River Water Conservation Board, concluded that average use for the period 1988 to 2004 was 2.11 million af. Using his assumptions and calculations, it would appear that Colorado has roughly 580,000 af remaining in its development account.

However, Kuhn takes his analysis one step further by suggesting that a longer paleo-record reveals extended dry periods and droughts. Climate modeling projects warmer and drier conditions for the Colorado River Basin and elsewhere in the Interior West that are likely to affect both supply and demand.⁴³ With this in mind, Kuhn produced a table, reproduced below, of development risk levels for the state's remaining Colorado River water. The risk is of compact curtailment based on an assumption about the likely future of available supplies.

Table 26.

Risk Levels of Remaining Supply of Colorado River Water

Risk Level	Available Development (af)
Little or No Risk	Up to 150,000
Moderate Risk	150,000 to 300,000
High Risk	300,000 to 600,000
Extreme Risk	More than 600,000

Based on Kuhn’s analysis, there is a high risk of Colorado having its use of Colorado River water curtailed by the Colorado River Compact if full-scale development (1.5 million bpd) of oil shale were to occur. That conclusion, importantly, does not account for other planned developments within Colorado, which would further stress water availability under the Colorado River Compact.

Because of the increasing possibility of water shortages in the basin that will force curtailment of some existing uses, the state of Colorado has funded a study to examine more closely the assumptions underlying the state’s remaining developable water. Getting a more reliable estimate of existing depletions is important, but more critical is an evaluation of expected physical water availability in the Upper and Lower Basins to meet demands. Evidence of warming temperatures in large parts of the basin suggests the likelihood that there will be less water available for use and that needs for water will increase, independent of the normal demand increases associated with population growth.

Since all the major rivers on the West Slope are tributary to the Colorado River Basin, depletions in any one of these rivers will limit the ability to develop and use water from the others. Each of these regions of the state anticipates growth with its associated needs for water. And, as mentioned, there are active plans for development of water for use on Colorado’s Front Range.⁴⁴ Should oil shale develop in the manner the BLM projects, competition for water on Colorado’s West Slope will be intense.

A key issue is the effect of over-development of the compact entitlement on all post-compact water rights, including rights senior to oil shale. Transmountain diversions would be among the first to be restricted in the event of a compact call. The risk that over-development by juniors would result in curtailment of senior rights under the compact’s 10-year delivery accounting procedure is one of the important issues identified by Eric Kuhn. The resulting demand for pre-1922 irrigation rights to use for compact replacement would have even more serious implications for the agricultural economy on the West Slope.

C. OIL SHALE AND THE UPPER COLORADO RIVER RECOVERY PROGRAM

Beginning in the 1970s, the U.S. Fish and Wildlife Service (USFWS) began reviewing proposed federal actions related to additional water development in the upper Colorado River Basin under the Endangered Species Act. At issue was the continued survival of four species of fish found only in this basin. USFWS had determined that additional depletions of the basin’s water would jeopardize their continued existence. Concern for survival of these species continues today, and any new water development — whether for oil shale or otherwise—must satisfy substantial program requirements intended to protect and recover these species. This section describes these requirements and their significance for further development of water in Colorado’s portion of the Upper Basin.

If the Colorado River’s endangered fish (Colorado River pikeminnow, humpback chub, bonytail, and razorback sucker) are ever to be restored, it will be in the upper reaches of the Colorado River Basin, where there is still some remaining habitat. Oil shale development in Colorado, were it to occur on even a modest scale, would find itself in competition for some of the very

same water that is currently dedicated to recovery of the fish. Two of the most important basins for the native fish in Colorado — the mainstem of the Colorado River and the White River — are the very ones in which oil shale development is most likely to occur and in which, as described above, energy companies hold extensive water rights.

Under the late 1980s Upper Colorado River Endangered Fish Recovery Implementation Program (RIP), an agreement among the states of Colorado, Wyoming, and Utah, federal agencies, water users, and environmentalists, the parties assumed that the native fish could be recovered while allowing states to develop water to which they were entitled under the Colorado River Compact and the Upper Colorado River Compact. The RIP is designed to make compact entitlement development possible, but within specific parameters and not at all places in the basin.

1. Colorado River

The mainstem Colorado River from Rifle, Colorado, to Lake Powell, Utah, supports populations of humpback chub and Colorado pikeminnow, and is recognized as important to the recovery of all four endangered fishes. Relatively large and healthy humpback chub populations occur at Black Rocks and Westwater Canyon near the Utah-Colorado state line. A smaller humpback chub population occurs in Cataract Canyon, and some of the last wild bonytail were collected in this river reach. All life stages of Colorado pikeminnow occur in the section of river from Palisade, Colorado, downstream to Lake Powell. Razorback sucker populations, while present in the mainstem, have declined precipitously in the past 20 years.

In 1992, Colorado filed an application in state water court for a 581-cfs instream-flow right in the 15-Mile Reach (Colorado River upstream of the Gunnison River confluence and downstream of Debeque and Parachute, the locations of almost all of the oil shale sites). A final decree was issued in 1997. A programmatic biological opinion (PBO) for this reach was completed in December 1999, which requires additional deliveries of water and restricts future depletions. The future depletions-restriction limits are up to two 60,000 acre-feet increments, the second of which depends on the status of the native fish (i.e., the adult pikeminnow population, estimated to be approximately 870, must reach 1,100).⁴⁵ Even the first depletion increment of 60,000 af depends on the condition of the native fish. If the population estimate of pikeminnow declines, no additional depletions against this increment are allowed.⁴⁶ Two projects now under environmental review — the Windy Gap Firming Project of the Northern Colorado Water Conservancy District and the Moffat System expansion of Denver Water — would take 50,000 af of the first increment, leaving at most only 10,000 af.

The instream-flow requirements of the 15-Mile Reach PBO illustrate the complexities of the recovery program and the way in which depletion limits are intertwined with the water needs of the endangered fish. In addition to the depletion limits, there are also provisions for increased



flows for the 15-Mile Reach in the PBO. The Bureau of Reclamation has made available 5,000 af of water annually, plus an additional 5,000 af in four of every five years, from Ruedi Reservoir (on the Fryingpan River) to augment flows during July, August, and September. In addition, water is available from the lease of 10,825 af per year of water from Ruedi Reservoir and permanent commitment of 10,825 af per year from Front Range and West Slope water users. By 2009, the Colorado River Water Conservation District and Denver Water must have a plan in place to permanently provide the 10,825 af that is now delivered from existing reservoirs. Additional water is being provided through a memorandum of agreement with CRWCD for delivery of up to 6,000 af of water from Wolford Mountain Reservoir.

Other sources of water for the 15-Mile Reach include implementation of the Grand Valley Water Management Project that creates a pool of water for the fish in Green Mountain Reservoir. Water users are also exploring ways to increase participation in the expanded coordinated reservoir operations as recommended in the PBO. Superimposing oil shale development at almost any scale on top of this complex agreement is a challenge. The development of senior conditional rights by energy companies may affect the RIP's success through additional depletions. Additionally, depending on USFWS' success in recovering these fish populations, junior rights may be seriously constrained by the PBO.

In the Colorado River, all oil shale development would take place in areas north of Debeque and Parachute, primarily within the Roan Creek and Parachute Creek watersheds. In that case, all the development would be upstream of the 15-Mile Reach, a stretch of the river managed, in part, under the PBO described above. Because the first increment of 60,000 af is, for all practical purposes, spoken for by Denver's Moffat expansion and Northern's Windy Gap Firming Project, only the second increment might be available.⁴⁷

2. White River

Adult Colorado pikeminnow occupy the White River downstream of Taylor Draw Dam near Rangely, Colorado, in relatively high numbers. Adult Colorado pikeminnow in the White River spawn in the Green and Yampa Rivers. Juvenile and sub-adult Colorado pikeminnow also utilize the White River on a year-round basis. Incidental captures of razorback sucker have been recorded in the lower White River.

Interim flow recommendations for the White River were completed in 2004 and are now under USFWS review for possible refinement. This review involves the addition of peak flows to the base flow targets in the 2004 recommendations. Instream-flow filings are on hold pending re-evaluation of how flows will be legally protected in Colorado, but with their protection, whatever form it may take, future depletions will be constrained. When the flow recommendations are available and their review complete, the USFWS RIP office plans to initiate a PBO process that will, among other things, establish depletion limits on the White River in both Colorado and Utah. If the PBO is structured like its neighbor on the Colorado River, oil shale development may likewise face major constraints.

If, in the White River Basin, USFWS were to employ a PBO structured around development increments coupled with habitat restoration activities (i.e., like the 15-Mile Reach PBO), then it is very likely that, in the near future, the White River will also face depletion limits that will be tied to the status of endangered native fish in the basin and that will put constraints on oil shale development capacity.