WATER FOR COMMERCIAL OIL SHALE DEVELOPMENT IN UTAH:
ALLOCATING SCARCE RESOURCES AND THE SEARCH FOR NEW
SOURCES OF SUPPLY

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I. BACKGROUND

A. What Is Oil Shale and Why Do We Care?

Oil shale is a sedimentary rock containing solid bituminous materials. When oil shale is heated, petroleum-like liquids and gasses are released. The process of heating shale and capturing resulting liquids and gasses is called retorting and can occur in combination with conventional mining methods (surface retorting), or by in-place liquification and gasification (in-situ retorting).

The world’s largest known oil shale deposits are contained in the Green River Formation, in portions of Colorado, Utah, and Wyoming. Estimates of the Green River Formation’s in-place resources range from 1.5 to 1.8 trillion barrels of oil equivalent. Potentially recoverable oil shale resources are estimated at between 500 billion and 1.1 trillion barrels of oil. At a mid-range estimate of 800 billion barrels, the Green River Formation contains more than three times Saudi Arabia’s proven oil reserves.

Given that current U.S. demand for petroleum products is about 20 million barrels per day, 800 billion barrels of shale oil should last for more than 400 years, assuming oil shale can be used to meet a quarter of the nation’s oil demand. Utah’s resources are but a fraction of the total, yet they still represent an estimated

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2 JAMES T. BARTIS ET AL., OIL SHALE DEVELOPMENT IN THE UNITED STATES: PROSPECTS AND POLICY ISSUES, at ix (Rand Corp. 2005).

3 Id. at 6.

4 Id. at 8-9.

5 Id. at 1.

6 Id. at 9.
147.4 billion barrels of oil equivalent. Applying these same assumptions, Utah has enough oil shale to supply 25% of the United States’ oil needs for almost eighty-five years. If leaner or deeper resources are developable economically, the size of Utah’s latent resources increases significantly.

While oil shale development could provide significant energy resources, a commercial oil shale industry has thus far failed to develop. In fact, oil shale has long been held forth as a promising answer to U.S. national energy needs only to fall victim to repeated boom-bust cycles, most recently in the 1970s and early 1980s. Today, concerns over adverse environmental impacts, fluctuations in the price of oil, and regulatory uncertainty are often cited as obstacles to the development of oil shale as a viable source of energy. These concerns, combined with today’s challenging economic climate, complicate efforts to obtain up-front funding for oil shale development.

Given oil shale’s considerable challenges and lack of prior success, it is not surprising that oil shale opponents highlight the numerous promises that oil shale is the fuel of the future and that these promises have repeatedly failed to materialize. However, for the past three decades, several large energy companies and a number of smaller innovators have been working quietly towards cost-effective and environmentally acceptable means of producing oil from shale. Most of these efforts have been located on non-federal land and the details of ongoing research efforts are often shrouded in secrecy. While the details are murky, technology developers recognize the major constraints to commercial oil shale development and have been working to address these issues. While carbon emissions, land use and surface impacts, impacts to protected species and water quality are all potential showstoppers, great attention has been focused on water use and availability. This latter issue is the focus of this paper and where we now turn.

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7 MICHAEL D. VANDEN BERG, UTAH GEOLOGICAL SURVEY, BASIN-WIDE EVALUATION OF THE UPPERMOST GREEN RIVER FORMATION’S OIL-SHALE RESOURCE, UINTA BASIN, UTAH AND COLORADO 7 (Utah Dep’t of Natural Res. 2008). Based on resources capable of producing at least twenty-five gallons of oil per ton of shale.

8 Id. For example, if shales bearing fifteen gallons per ton were developed, available resources increase to 292.3 billion barrels.


B. Regulating Water Use

In Utah, and throughout the arid west, water is considered a public resource.\textsuperscript{12} Except for federal reserved rights and a small number of water rights obtained prior to codification of Utah’s water code, water rights must be obtained through application to the Office of the State Engineer.\textsuperscript{13} A five-part test must be satisfied before the State Engineer can issue a new water right: (1) there must be unappropriated water available, (2) the proposed appropriation cannot impair existing rights or interfere with more beneficial uses, (3) the proposed plan must be physically and economically feasible and not detrimental to the public welfare, (4) the applicant must have the financial resources to complete the proposed project, and (5) the application must be filed in good faith and not for purposes of speculation or monopoly.\textsuperscript{14} If the test is satisfied and the application granted, the water right will prescribe the source of supply, the point of diversion, the quantity of water that can be appropriated, the nature of the use allowed, the period of use, and the place of use.\textsuperscript{15} While the process in Colorado is somewhat different, Colorado’s substantive requirements affect a similar result.

Given that not enough water exists to satisfy the needs of all individuals or entities who seek to use this scarce resource (an assumption that will be validated later on), the question becomes: whose rights will prevail? The maxim of “first in time, first in right” is the foundation upon which western water law is built.\textsuperscript{16} Each water right has a priority date established in accordance with statutory requirements or, in the case of pre-water code rights, corresponding to the date upon which the appropriator first initiated successful and diligent efforts to put the water to a beneficial use. When demand for water exceeds available supply, those with senior rights can require full or partial curtailment of junior water users’ diversions, leaving junior priority users with less than their allotted amount of water, or with no water at all.\textsuperscript{17} Since the value of water relates directly to its availability, senior rights are much more valuable than their junior counterparts because the former provide a more certain source of supply.\textsuperscript{18}

\textsuperscript{12} E.g., UTAH CODE ANN. § 73-1-1 (2009) (“All waters in this state, whether above or under the ground are hereby declared to be the property of the public.”).
\textsuperscript{13} Id. § 73-3-1.
\textsuperscript{14} Id. § 73-3-8.
\textsuperscript{15} Id. § 73-3-2.
\textsuperscript{16} Id. § 73-3-1; see also United States v. County of Denver, 656 P.2d 1, 12 (Colo. 1982) (noting that the doctrine of prior appropriation generally governs, in one form or another, the acquisition of water rights in the nineteen western states).
\textsuperscript{17} Under Utah law, a senior appropriator is guaranteed the full measure of his or her appropriation before any junior claim may be satisfied. Sanpete Water Conservancy Dist. v. Carbon Water Conservancy Dist., 226 F.3d 1170, 1173 (10th Cir. 2000).
\textsuperscript{18} Until recently, Utah’s water code included an important exception to this general rule whereby: “[I]n times of scarcity, while priority of appropriation shall give the better right as between those using water for the same purpose, the use for domestic purposes, without unnecessary waste, shall have preference over use for all other purposes, and use for agricultural purposes shall have preference over use for any other purpose except domestic use.” UTAH CODE ANN. § 73-3-21 (2009). While this provision was never invoked by a court of law, it provoked considerable discussion and
Consistent with a policy of encouraging development and beneficial use of water, western water law can flexibly accommodate reallocation of water rights to economically more profitable uses. This is so because water rights may be conveyed separately from the land upon which they are used. Changes in the use of a water right are also allowed, subject to the general rule that such changes cannot result in an enlargement of the water right or injury to other water users. It follows that when there is not enough water to satisfy the needs of all prospective users, markets develop and water rights are conveyed to economically more profitable uses. Historically, conversion of agricultural water rights to municipal and industrial rights has facilitated a significant amount of western expansion.

Consistent with statutory provisions encouraging economically efficient use, a wasteful use of water is not protected and appropriators are generally unable to hold water rights for future, speculative needs. Thus, if a water right is not put to a beneficial use within the statutory period, it reverts back to the state and is available for appropriation. Statutory timelines for perfecting a water right may be extended where the applicant exercises due diligence in developing water rights. In 2008, the Utah legislature revised the water code to exempt public water supplies from forfeiture if water is required for the reasonable needs of the public and the supplier can demonstrate a need for the water within the next forty years based on projected population growth or other water use demand.

The concept of relinquishment is important because many prospective oil shale developers obtained significant water rights in anticipation of the development that appeared certain in the 1970s. As the energy crises abated with
opening of the Prudhoe Bay oil field, supplies increased, oil prices fell, and interest in commercial oil shale development evaporated. Accordingly, anticipated development did not occur and many water rights went unperfected. Companies that bet on the oil shale boom and their successors in interest hold significant water rights, the continued validity of which is subject to state law. So far, Colorado’s Water Court has generally accepted potential oil shale producers’ efforts as sufficient to demonstrate diligent development, but the longer such rights remain contingent, the more difficult it may become to demonstrate diligent development. Many of the water rights obtained in anticipation of commercial oil shale development were leased to agricultural users, thus avoiding relinquishment, but necessitating a change in use if they will be used to support future oil shale development.

While converting senior irrigation rights to other purposes is a relatively common practice and does not create new demands on the system, two points deserve mention. First, irrigation rights reflect a diversionary and a consumptive component, almost invariably allowing diversion of far more water than can be consumed, with excess water being used to move useable water through the irrigation system and create pressure for sprinklers. Excess, unused water is returned to the source of supply and therefore does not represent a consumptive use. When irrigation rights are converted to other uses, only the amount of water actually consumed is available for other consumptive uses, so irrigation rights that include large diversionary components are generally much smaller in terms of allowable consumption. This important factor was surprisingly overlooked in earlier efforts to acquire water for oil shale development. Second, when irrigation rights are converted to other uses, the previously irrigated land is taken out of agricultural production. Farms with the most valuable water rights are also the largest, oldest, and most established farms in the area. The shift in water use that will invariably come with commercial oil shale development stands to

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25 E.g., Municipal Subdistrict, Northern Colorado Water Conservancy Dist. v. Getty Oil Exploration Co., 997 P.2d 557, 565 (Colo. 2000) (holding that under the “can and will” test, Getty “can” develop oil shale given existing technology and “will” upon changed economic considerations); Municipal Subdistrict, Northern Colorado Water Conservancy Dist. v. OXY USA, Inc., 990 P.2d 701, 708 (Colo. 1999) (holding conditional water right application not filed for purposes of speculation and OXY “can” develop oil shale given existing technology and “will” upon changed economic considerations); Municipal Subdistrict, Northern Colorado Water Conservancy Dist. v. Chevron Shale Oil Co., 986 P.2d 918, 924 (Colo. 1999) (holding economic conditions properly considered in evaluating adequacy of efforts to perfect water rights for oil shale); but cf. Bar 70 Enterprises, Inc. v. Highland Ditch Ass’n, 694 P.2d 1253, 1254-55 (Colo. 1985) (holding the association failed to obtain required finding of reasonable diligence in developing its conditional water right); and Bar 70 Enterprises, Inc. v. Tosco Corp, 703 P.2d 1297, 1306-08 (Colo. 1985) (denying claimed appropriation date for conditional water right because Tosco failed to demonstrate diligent development).


fundamentally change the character of communities throughout Colorado and Utah.

II. WATER FOR COMMERCIAL OIL SHALE DEVELOPMENT

The popular perception is that commercial oil shale development requires vast quantities of water that are simply unavailable in the arid west. While oil shale development will unquestionably require water, the process appears to need less water than is currently assumed, and less than competing sources of liquid transportation fuels. But, regardless of the precise amount of water required, any appreciable increase in water demand could be problematic as water supplies near oil shale resources already are stretched thin.

A. Water Demand

Oil shale opponents contend that commercial development will require tremendous and unacceptable amounts of water; water that simply is not available in the parched and arid west. On the high end, a recent federal assessment concluded that commercial oil shale development could consume up to four gallons of water for each gallon of shale oil produced via conventional mining methods and above ground retorting, and three gallons of water for each gallon of shale oil produced via in-situ retorting.

Conversely, water needs stated by oil shale proponents reflect decades of innovation and a trend towards less water intensive technologies. Chevron, which holds a federal Research, Discovery, and Development (RD&D) lease in Colorado, claims its in-situ method “will consume less water than the quantity of

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30 U.S. DEPARTMENT OF INTERIOR, BUREAU OF LAND MANAGEMENT, PROPOSED OIL SHALE AND TAR SANDS RESOURCE MANAGEMENT PLAN AMENDMENTS TO ADDRESS LAND USE ALLOCATIONS IN COLORADO, UTAH AND WYOMING AND FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT, 4-4, 4-8, 4-11 (2008) [hereinafter FINAL PEIS]. Note that the BLM’s analysis of surface retorting relies on assumptions contained in U.S. DEPARTMENT OF INTERIOR, FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE PROTOTYPE OIL SHALE LEASING PROGRAM, Vol. 1, at III-34 (1973) and therefore reflects untested 37-year old assumptions. Discussions of in-situ water requirements draw from more recent publications. See BARTIS ET AL., supra note 2 which adopted the assumptions contained in U.S. WATER RESOURCES COUNCIL, SECTION 13(A) WATER ASSESSMENT REPORT, SYNTHETIC FUEL DEVELOPMENT IN THE UPPER COLORADO REGION (July 1981).
groundwater pumped out of the target zone,” making it “a net producer of water.” 31 Red Leaf Resources, which has almost 17,000 acres of state land under lease in Utah, 32 contends that its modified surface retorting process requires no outside water and total water use will be less than half a gallon of water for each gallon of shale oil produced, almost all of which is dedicated to post-production site reclamation. 33

Compared to production of other liquid transportation fuels, such as ethanol or gasoline, commercial oil shale development does not appear uniquely water intensive. Producing ethanol from corn requires 10 to 324 gallons of water for each gallon of ethanol produced, with the high degree of variability attributed to regional variation in irrigation needs. 34 Cellulosic ethanol, which is produced from the structural materials comprising the bulk of plant mass, is much less water intensive, requiring 1.9 to 9.8 gallons of water for each gallon of ethanol produced. 35 Cellulosic ethanol’s relative water efficiency occurs because it utilizes perennial grasses, forest wood residues, and agricultural residues such as wheat straw and rice hulls that require little to no irrigation. 36 Gasoline produced from domestic crude oil requires 3.4 to 6.6 gallons of water for each gallon of gasoline produced, and gasoline produced from Saudi Arabian crude oil requires 2.8 to 5.8 gallons of water for each gallon of gasoline produced. 37 Gasoline produced from Canadian oil sands requires 2.6 to 6.2 gallons of water for each gallon of gasoline produced, depending on the geologic source formation and production technology. 38

Considering water demand attributable to different liquid transportation fuel development technologies is also important because the Uinta Basin, which contains almost all of Utah’s oil shale deposits, is home to not only oil shale, but a large and growing oil and natural gas industry as well. Oil and natural gas production within Uintah County has grown over the last four years, for which records are available, and at current rates, oil production will reach nearly 7

31 HANSON & LIMERICK, supra note 9, at 20. The ability to capture and use water “produced” as a byproduct of energy extraction is not a given and raises complicated legal issues, which will be addressed in more detail later in this article.

32 Figures are as of October 31, 2008. Statistics were compiled from data provided by the Utah School and Institutional Trust Lands Administration (SITLA), http://168.178.199.154/publms/contents.htm.

33 See Testimony before the Utah Legislature’s Interim Committee on Natural Resources, Agriculture, and the Environment (June 17, 2009), available at http://le.utah.gov/asp/interim/Commit.asp?Year=2009&Com=INTNAE. Dr. Nelson, Chair of the Utah Mining Association’s Oil Shale and Oil Sands Committee, also testified that estimated water use is falling rapidly as industry continues to innovate and currently sits at an average of 1.5 barrels of water for each barrel of shale oil produced, less than water demands associated with conventional oil and gas production. Id.

34 MAY WU ET AL., ARGONNE NATIONAL LABORATORY, CONSUMPTIVE WATER USE IN THE PRODUCTION OF ETHANOL AND PETROLEUM GASOLINE 6 (2009).

35 Id.

36 Id.

37 Id. The difference between U.S. and Saudi Arabian water use is attributable largely to the comparative age of the oil field and the amount of water flooding required to produce oil from older domestic fields. Id. at 46.

38 Id. at 6.
million barrels during 2009 while natural gas production will reach almost 290 billion cubic feet.\(^3^9\) This could expand dramatically if EOG Resources’ proposal to drill 7,028 new natural gas wells is approved.\(^4^0\) Given the Uinta Basin’s potential oil shale resources and the growing conventional oil and natural gas industry, there is little doubt that water conflicts will increase regardless of which energy source dominates.\(^4^1\) Indirect increases in water demand, attributable to population growth accompanying an energy boom, will only further tax scarce water resources.

In light of the growing thirst for water, industry and opponents alike agree that water availability could be key to developing a viable commercial oil shale industry:

> Today, more than ever before, a variety of competing industrial, municipal, agricultural, tribal, and environmental interests . . . battle over every acre foot of water in the Colorado River system. Farmers and ranchers, recreational anglers and whitewater rafters, and residents of major metropolitan areas, not to mention endangered fish species and the other members of the region’s intricate ecosystem, rely on adequate flows and water quality in the Colorado and its tributaries. Water is a potential dealbreaker for any extraction process that requires too much or poses too great a risk of groundwater contamination.\(^4^2\)

While the actual water demands associated with commercial oil shale development are uncertain, we can say that commercial oil shale development will require water, and that the amount of water required is likely to be proportional to the size of the industry that develops. Demand attributable to new municipal, agricultural, energy, industrial, and instream water uses will only add to the competition for water. With these factors in mind, we turn to the most logical sources of water for oil shale development within the Uinta Basin.

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\(^4^0\) See Notice of Intent to Prepare an Environmental Impact Statement for the Greater Chapita Wells Natural Gas Infill Project, Uintah County, UT, 74 Fed. Reg. 46,458 (Sept. 9, 2009).

\(^4^1\) Nuclear power is also very water intensive, requiring an average of 30 gallons of water per megawatt-hour of electricity produced, not including mining and processing of the fuel which requires an additional 45 to 150 gallons of water per megawatt-hour produced. U.S. Department of Energy, ENERGY DEMANDS ON WATER RESOURCES, REPORT TO CONGRESS ON THE INTERDEPENDENCY OF ENERGY AND WATER 65, 38 (2006). Nuclear power proponents recently filed for rights to consume 53,600 acre-feet of water from the Green River to satisfy cooling water requirements for a proposed nuclear power plant near the town of Green River, Utah. Water Right Change Application No. a35402, available at http://www.waterrights.utah.gov/cgi-bin/wrprint.exe?Startup.. This project has engendered significant opposition, including at least 239 formal protests with the Office of the State Engineer, because of concerns over impacts to resources including instream flows and endangered fish. See Amy Joi O’Donoghue, Critics Say N-Plant Would Harm Ecosystem, DESERET NEWS, May 27, 2009, available at 2009 WLNR 10098963.

\(^4^2\) HANSON & LIMERICK, supra note 9, at 35.
B. Potential Water Sources

Demand is but one part of the equation; water availability is an issue in part because Utah is the second driest state in the West. In addition, water resources proximate to Utah’s oil shale resources are already over appropriated. There simply is not enough water to support all potential uses, at all possible times, and at unlimited levels—and increasing energy demand will place further strains on scarce water resources. We begin by discussing surface water resources, turn to the storage facilities needed to facilitate water use, and conclude with a discussion of groundwater.

1. Surface Water

The White River, which is included in Utah’s Drainage Area 49 (Southeast Uinta Basin), is the only major surface water source in close proximity to Utah’s richest oil shale resources. As of June 2009, there were 1,652 water rights claims within Area 49, dating from as early as 1861. Surface waters, except for small isolated springs, are fully appropriated throughout the Southeast Uinta Basin and any new diversion or consumptive use within the Southeast Uinta Basin must be accompanied by change applications filed on existing water rights. Other surface water resources within the region are similarly over appropriated and closed to new appropriations. Even if available, conveying water from more distant sources would increase significantly the cost of development.

The White River flows west from its headwaters in Colorado’s Flat Tops Wilderness, crossing the border with Utah before merging into the Green, and eventually, the Colorado rivers. On its way, the White River flows along the north edge of Colorado’s rich oil shale bearing lands and then through the heart of Utah’s oil shale country. As the only major surface water source close to Utah’s rich oil shale resources, the White River is of particular importance. Its proximity to Colorado’s oil shale resources is also important, as diversions upstream in Colorado will reduce the amount of water available downstream in Utah.

Because of the White River’s proximity to oil shale resources and the complex topography between oil shale resources and other water sources, the financial cost of obtaining water from the White River is much lower than that of developing alternate sources. As such, it has been described as the “first-choice

44 Priority lists for each of the 51 drainage areas within Utah are available at http://www.waterrights.utah.gov/cblapps/prioritylist.exe?Startup=NOW.
source of water. Accordingly, in 1965, the Utah Division of Water Resources filed an application to appropriate 350 cubic feet per second (cfs) and 250,000 acre-feet annually from the White River and its tributaries, identifying the intended uses as mining, drilling, and retorting oil shale. These claims reflect 100% of the river’s flow during low-flow periods. The State of Utah also filed applications with the Bureau of Land Management seeking authorization to construct an 11.7 mile long reservoir on public land just west of the Colorado border. As proposed, the reservoir would have impounded 109,250 acre-feet of water and had an active storage capacity of 70,700 acre-feet. As the energy crises and rapid oil price increases of 1973 and 1979 were replaced by falling demand and increasing supply, due in part to opening of the Prudhoe Bay oil field, oil prices fell and interest in commercial oil shale development evaporated. Interest in the White River Dam expired along with interest in oil shale, and the dam was not constructed. However, the water right claims remain, and some water may be available for lease from the State.

The White River, while the most convenient source of supply, is not the only option. The State of Utah also filed applications to appropriate significant flows from the Flaming Gorge Reservoir on the Green River, as well as from tributaries to the Green River. Although the State has leased much of this water to other users, it appears that some amount of water is available from remaining, unleased state water rights. However, under rules promulgated by the Utah Division of

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46 UTAH DEPARTMENT OF NATURAL RESOURCES AND ENERGY, UTAH ENERGY OFFICE, AN ASSESSMENT OF OIL SHALE AND TAR SANDS DEVELOPMENT IN THE STATE OF UTAH, PHASE II: POLICY ANALYSIS 27 (1982).
47 An acre-foot is 325,851 gallons—enough water to cover one acre of land one foot deep in water.
48 UTAH STATE DIVISION OF WATER RESOURCES, WHITE RIVER DAM PROJECT: PROPOSED ACTION PLAN (REVISED) 3 (1980).
49 Id.
50 See U.S. DEPARTMENT OF INTERIOR, BUREAU OF LAND MANAGEMENT, FINAL ENVIRONMENTAL IMPACT STATEMENT OF THE WHITE RIVER DAM PROJECT ENVIRONMENTAL IMPACT STATEMENT 59 (May 1982) [hereinafter WHITE RIVER DAM FEIS].
51 Id. at 1. The difference between capacity and active storage is attributable primarily to capacity dedicated to sediment storage.
53 Water rights held by the State of Utah, but stored in a reservoir operated by the federal government pursuant to the Warren Act, 43 U.S.C. § 523-24, are distinguishable from water rights held by the Bureau of Reclamation. The latter are subject to preferential use for irrigation under section 9(c) of the Reclamation Act, 43 U.S.C. § 485h(c). Accordingly, municipal or industrial development may rely on water supply contracts from the Bureau of Reclamation only to the extent “it will not impair the efficiency of the project for irrigation purposes.” Id. Ensuring Bureau water is used for irrigation may free up state water rights for non-irrigation uses.
54 Under Water Right No. 41-3479, the State of Utah Board of Water Resources holds the right to divert up to 447,500 acre-feet from the Green River at Flaming Gorge Dam. Water Rights Website, supra note 52. Twenty-five separate water rights, representing rights to divert a total of 147,815,398 acre-feet, have been contractually segregated from this right, leaving the Board with a paper right to divert 299,684,602 acre feet of water. See id. If this water can be diverted in light of other
Water Resources, which holds the State’s water rights in Flaming Gorge Reservoir, water from the reservoir is unavailable for “mining.” The term “mining” is undefined in the rule and, if interpreted to include commercial oil shale development, could limit availability of water from this source.

Even if commercial oil shale development is outside the scope of the term mining, leases supporting such uses would still be the lowest priority for approval under an administrative rule giving priority first to uses involving public health, safety, and welfare; next to political subdivisions requesting water rights for existing or anticipated municipal and industrial water uses; third to agricultural water projects providing a significant economic benefit to a local community; and only then to applications submitted for a private development located outside of a political subdivision that provides municipal and industrial water service. The rule marks an important policy shift from the State’s supported use of water from Flaming Gorge for commercial oil shale development during the 1980s. Promulgated in 1998 after the most recent boom-bust cycle and at a time when commercial oil shale development appeared unlikely, the regulation reverses this policy.

The last oil shale boom also led to the construction of the Red Fleet Reservoir, approximately ten miles north of Vernal, Utah. The burst of the oil shale bubble left about 70% of Red Fleet water unsubscribed as of a decade ago. It is unclear whether this water source remains undersubscribed; what water may currently be available, if any, will likely be exhausted quickly as planners anticipate growing water demands.

During the last oil shale boom, the State of Colorado also considered constructing major impoundments along the White River to provide water for development. As with Utah’s White River Dam, efforts at water development withered with falling oil prices and most projects were never built. But, also as in Utah, the water rights associated with these projects remain. A recent study by Western Resource Advocates notes that “there are 114 proposed structures with conditional water rights in [Colorado’s portion of] the White River Basin. These conditional structures include proposed reservoirs, pipelines (most with pumps), ditches, wells, and springs.” Proposed upstream developments should be of great interest to Utah and its residents since water diverted and consumed upstream in Colorado will be unavailable for downstream users in Utah.

Other important river systems and potential water supply sources for commercial oil shale development include the Yampa River, as well as the Duchesne River and its tributaries (including the Uinta and Lake Fork rivers), which all drain into the Green and Colorado rivers. The Yampa is a potential

considerations (e.g., the Endangered Species Act and state bypass flow requirements), some water from this source may be available to support commercial oil shale development.

58 MacDonnell, supra note 26, at 8.
source of supply for developments in Colorado. The Green River and its tributaries are potential sources of supply in Utah and Colorado, though diversions from the Green River would involve a system of pipelines and pumping that would significantly increase costs over diversions associated with withdrawals from the White River.\textsuperscript{59} The Colorado River is south of most major oil shale resources, but still relevant to the discussion of potential sources because changes to its tributaries will impact this highly regulated river.

In sum, unappropriated surface water simply is not available. Surface water resources do, however, remain available through the transfer, exchange, or lease of existing water rights, which are described below. But as we shall see, simply having a water right will not be enough; the water must be available reliably when and where it is needed.

2. Water Storage

Even if water is obtained, significant storage capacity will almost certainly be required in order to support a year-around industry. On average, the White River near the Colorado-Utah border discharges 590,100 acre-feet annually,\textsuperscript{60} with mean flow of 631 cfs.\textsuperscript{61} Flows are highly variable year-to-year and season-to-season, with spring runoff swelling the river to an average discharge of 1,765 cfs during June—almost five times the average discharge experienced in December and January (350.1 and 353.5 cfs, respectively).\textsuperscript{62}

While the amount of available water fluctuates throughout the year, the demands for water attributable to commercial oil shale development are far more stable. Therefore, in order to maintain reliable year-round supplies, water users must either hold very senior water rights, allowing them to continue to divert water during low-flow periods, or divert and store water during high-flow periods for use when less water is available. Securing reliable, year-round supplies of water from variable stream flows will require a significant increase in water storage capacity, and impoundment construction will require both federal and state permits.

In Utah, construction or modification of a dam or reservoir requires a permit from the state engineer.\textsuperscript{63} A formal application and approval process is required for impoundments over twenty acre-feet, as well as for those impoundments posing a threat to human life, should they fail. Smaller, presumably safer impoundments require only submission of formal plans.\textsuperscript{64}

Impoundment construction results in alteration to stream beds and banks, and in Utah, alteration of the beds and banks of any natural stream also requires a

\textsuperscript{59} UTAH DEP’T OF NATURAL RES. AND ENERGY, UTAH ENERGY OFFICE, AN ASSESSMENT OF OIL SHALE AND TAR SANDS DEVELOPMENT IN THE STATE OF UTAH, PHASE II: POLICY ANALYSIS 27 (1982).

\textsuperscript{60} FINAL PEIS, supra note 30, at 3-81.

\textsuperscript{61} WHITE RIVER DAM FEIS, supra note 50, at 59.

\textsuperscript{62} Id. Between 1963 and 1978, average monthly flows just west of the state line peaked at 2,934 cfs; monthly low flows over the same period were just 140 cfs. Id.

\textsuperscript{63} UTAH CODE ANN. § 73-5a-201 (2009).

\textsuperscript{64} Id. § 73-5a-202.
permit from the state engineer.65 Dam and reservoir construction similarly involves placement of fill material in waters of the United States, which is regulated under the Clean Water Act66 and the Rivers and Harbors Act.67 In administering these state and federal statutes, the State of Utah and U.S. Army Corps of Engineers (Corps) utilize a common permit application which is circulated to potentially affected state and federal agencies as well as local governments, adjacent property owners and the general public.68 The joint permitting process allows the Corps to authorize actions under Regional General Permit 40, provided the action does not impact sensitive resources, such as species protected by the Endangered Species Act or critical habitat for any such species.69 Where sensitive resources preclude general permit issuance, applicants must proceed with the more complicated individual permitting process.70 In either case, the Corps reviews applications for compliance with Clean Water Act Section 404(b)(1) Guidelines, approving only applications that achieve the project purpose while resulting in the least adverse impact to the aquatic environment.71

In addition to construction related requirements, prospective developers will need to obtain rights to access and use reservoir sites. Where reservoirs and related facilities such as roads or pipelines are located on public land, operators will need to obtain rights of way pursuant to Federal Land Policy and Management Act.72 If a reservoir or associated infrastructure will encroach on state or private lands, additional land use permissions will be required. And of course, construction of a reservoir or associated infrastructure on federal lands almost certainly qualifies as a major federal action significantly affecting the quality of the human environment, thereby necessitating preparation of an environmental impact statement.73

As an alternative to conventional reservoir storage and the complexities it entails, water may be injected and stored in underground aquifers for subsequent use. If appropriate geologic formations are available, aquifer storage may be an attractive alternative to surface reservoir storage as it avoids both evaporative losses and the long list of reservoir construction issues. In Utah, aquifer storage projects are governed by the Groundwater Recharge and Recovery Act,74 which prohibits groundwater recharge and recover, absent specific authorization, again by the Office of the State Engineer.75 To obtain permission to operate an aquifer

65 Id. § 73-3-29.
67 Id. § 403.
68 Army Corps of Engineers Regional General Permit No. 40, for Discharges of Dredged and Fill Material or Excavations in Streams in the State of Utah Where a Stream Alteration Permit has Been Issued by the State Engineer, available at http://www.spk.usace.army.mil/organizations/cespk-co/regulatory/regional.html.
69 Id.
75 Id. § 73-3b-103.
storage program, the applicant must first possess a valid water right for the water placed into storage.\textsuperscript{76} The applicant must also demonstrate that the project is hydrologically feasible, will not cause unreasonable harm to land, will not impair any existing water right within the area of hydrologic impact, and will not adversely affect the water quality of the aquifer as well as the technical and financial capability to conduct and operate the project.\textsuperscript{77} Within the Uinta Basin, the viability of an aquifer storage project will relate directly to structural geology and potential conflicts with energy development and produced water disposal.

Storage is key as commercial oil shale development needs water year-around and surface water availability fluctuates seasonally. Permitting and construction of large reservoirs are complex processes that, if poorly planned or managed, could significantly delay large scale water intensive development.

3. \textit{Groundwater}

Groundwater provides an additional potential source of water, but the prospect for utilizing conventional groundwater resources to support commercial oil shale development is not promising. New groundwater resources proximate to Utah’s oil shale resources are available only for single-family residential use or temporary, fixed-time projects not exceeding five years.\textsuperscript{78} Commercial oil shale’s best hope, at least with respect to groundwater, may be to harness groundwater produced as a byproduct of oil and gas development, provided formidable legal hurdles can be cleared.

In Utah, no distinction is drawn between surface and groundwater rights, and acquisition of a groundwater right is grounded in the same five-part test discussed earlier, regardless of the source of supply. That being said, important differences exist between administration of surface and groundwater rights. In applying for a groundwater right, the applicant must indicate the source of supply.\textsuperscript{79} The state engineer must then approve the application if, based on information contained in the application and in accordance with the criteria noted above, “there is unappropriated water in the proposed source.”\textsuperscript{80} Because a policy of encouraging development and application of water to beneficial uses\textsuperscript{81} undergirds the Utah Water Code, the state engineer is directed to approve an application to appropriate water unless:

\begin{itemize}
  \item \textsuperscript{76} \textit{Id.} § 73-3b-106.
  \item \textsuperscript{77} \textit{Id.} § 73-3b-202.
  \item \textsuperscript{78} See Utah Division of Water Rights, \textit{supra} note 45.
  \item \textsuperscript{79} UTAH CODE ANN. § 73-3-2(1)(b)(v) (2009).
  \item \textsuperscript{80} \textit{Id.} § 73-3-8(1)(a)(i).
  \item \textsuperscript{81} “Beneficial use” is a “vague judicial concept” which evolves with time. Traditionally, domestic, municipal, irrigation, stock watering, mining, hydropower generation, and recreation are considered beneficial uses. New uses such as fish and wildlife maintenance, instream flow protection, groundwater recharge, soil leaching, and the use of reclaimed water for surface spreading, wetland restoration and streamflow augmentation have been recognized as beneficial. A. DAN TARLOCK, \textsc{Law of Water Rights and Resources} § 5.66 (2009).
\end{itemize}
[I]t clearly appears that there is no unappropriated water in the proposed source . . . . [I]f the question is fairly doubtful and there is reasonable probability that a portion of the waters are not necessary to supply existing rights the engineer should have the power to approve the application and afford the applicant the opportunity for an orderly recourse to the courts, who have the facilities and powers to dispose of the matter definitely and satisfactorily.82

However, the presumption can be reversed “where perfected appropriations and prior pending applications of record in the state engineer’s office[ ] established the appropriation of all available water of the source.”83

For purposes of this paper it is assumed that applicants will act in good faith, possess the financial resources necessary to develop groundwater resources, and that such developments are physically and economically feasible. The question therefore becomes whether unappropriated water is available and developable without interfering with more beneficial uses. Even if the basin was not effectively closed to new groundwater appropriations, groundwater development could prove problematic because the Utah Water Code does not distinguish between surface and groundwater.84 Accordingly “no one can interfere with the source of supply of [a] stream, regardless of how far it may be from the place of use, and whether it flows on the surface or underground, in such a manner as will diminish the quantity or injuriously affect the quality of the water of these established rights.”85

Unfortunately, continuity between surface and groundwater is not always easily ascertained. Given this difficulty, it is not surprising that Utah, like most western states, applies the “rule of reasonableness” in addressing groundwater withdrawals.

[The rule of reasonableness] involves an analysis of the total situation: the quantity of water available, the average annual recharge in the basin, the existing rights and their priorities. All users are required where necessary to employ reasonable and efficient means in taking their own waters in relation to others to the end that wastage of water is avoided and that the greatest amount of available water is put to beneficial use.86

Thus, some level of reservoir drawdown is permissible provided it does not interfere with others’ reasonable use of that water source. The technicalities of new groundwater appropriations are of limited import because, as noted earlier, the

82 Little Cottonwood Water Co. v. Kimball, 289 P. 116, 118 (Utah 1930) (announcing a policy of approving water right applications when adequacy of supplies is contested but interference has not been established); see also Rocky Ford Irr. Co. v. Kents Lake Reservoir Co., 135 P.2d 108, 113 (Utah 1943); Lehi Irr. Co. v. Jones, 202 P.2d 892, 895 (Utah 1949) (“If then it is not clear that there is no unappropriated water in the proposed source, and the applicant satisfies the other requirements, the State Engineer should not withhold his approval.”).
83 Little Cottonwood Water Co., 289 P. at 118.
84 UTAH CODE ANN. § 73-1-1 (2009).
85 Little Cottonwood Water Co. v. Sandy City, 258 P.2d 440, 443 (Utah 1953).
state engineer treats the Southeast Uinta Basin as closed to most new water rights acquisition and has done so for at least seven years. The 1,600 plus existing water rights claims within the area, together with existing hydrologic data, demonstrate appropriation of essentially all available water. Thus, acquisition of significant new groundwater rights appears difficult at best, depending on the applicant’s ability to convince the state engineer that the new appropriation would not impair existing rights in the already over appropriated basin.

When water is in scarce supply, creative souls invariably emerge heralding discoveries of new, untapped water supplies. Today, many of these claims involve groundwater reservoirs that are purportedly isolated from all other known surface and groundwater sources. But in reality, groundwater is rarely isolated, and regulators look with skepticism on claims of newly discovered water. If truly isolated and untapped, withdrawal can be made without risking interference with existing water rights.

Deep groundwater, where confined by impermeable geologic strata, may be isolated from surface waters or shallower groundwater that is subject to beneficial use and may represent the exception to the general proposition that undiscovered groundwater is more promise than promising. A proposal to construct 70,000 new residences north of Albuquerque, New Mexico provides an example. During 2007, Sandoval County and Aperion, Inc. drilled two deep groundwater wells (3,850 and 4,820 feet deep), which could produce up to 750 gpm of groundwater containing approximately 12,000 mg/l total dissolved solids, 3,100 mg/l chloride, and 4,400 mg/l sulfate. While too brackish to drink untreated, the cost of treatment is estimated at $1 to $3 per 1,000 gallons, which appears attractive in comparison to the cost of purchasing existing groundwater rights, which runs $20,000 to $35,000 per acre-foot. Similar projects are likely to grow in number as easier and less expensive alternatives become more difficult to find.

Groundwater produced in association with natural gas extraction provides another example. The overlaying geologic strata that prevent natural gas from escaping also prevent co-located water resources from interacting with surface water or shallower groundwater. Such deep groundwater is, at least in theory, isolated so new diversions would not impair existing rights. However, deep groundwater encountered during natural gas production is, like the groundwater encountered in Sandoval County, generally high in salinity and dissolved solids. The high cost of extraction and treatment helps explain why deep, isolated, and often saline groundwater has generally escaped development. If the cost of development is less than alternative sources of supply, as could be the case if well

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87 See Utah Division of Water Rights, supra note 45.
88 Priority List, supra note 44.
89 See, e.g., Mark Havens, Geologist: Southern Utah Aquifer Could be Developed, SALT LAKE TRIBUNE, June 14, 2009, available at http://www.sltrib.com/ci_12582743 (describing claimed discovery of a “deep aquifer, filled with prehistoric water that has filtered through a porous formation of Navajo sandstone, [and which] slumbers deep underground in southern Utah, waiting to be tapped.”).
drilling and pumping is already a cost attributed to fossil fuel development, the marginal cost of putting deep groundwater to use may justify development.

However, deep groundwater, when produced in association with natural gas production, raises complicated legal issues that are addressed in more detail as part of the produced water section. For this discussion, it is enough to recognize the at least theoretical existence of deep, isolated groundwater. As a practical matter, viability of deep groundwater as a source of supply will depend on complex legal, geologic, and hydrologic factors as well as pumping and treatment costs.

Not unlike Utah, Colorado presumes groundwater is tributary to surface water.91 In fact, groundwater ultimately bound for a natural stream is “recognized as a part of the waters of the stream to the same extent as though flowing upon the surface.”92 However, Colorado’s administration of groundwater is more complex and provides an interesting contrast. Outside of the Denver Basin, which is subject to unique regulations, Colorado recognizes three types of groundwater. “Designated groundwater basins” contain groundwater, “which in its natural course would not be available to and required for the fulfillment of decreed surface rights.”93 “Nontributary groundwater” is “ground water, located outside the boundaries of any designated ground water basins . . . the withdrawal of which will not, within one hundred years, deplete the flow of a natural stream . . . at an annual rate greater than one-tenth of one percent of the annual rate of withdrawal.”94 Prior appropriation does not apply to nontributary ground water, which is allocated based on ownership of the overlying land. Therefore, reasonable reductions in hydrostatic pressure and aquifer water levels are allowed.95 Finally, “tributary groundwater” (referred to in the Colorado Water Code as “not nontributary ground water”), reflects the broadest classification and groundwater outside of designated basins where withdrawal will “within one hundred years, deplete the flow of a natural stream.”96

Therefore, regardless of location, any attempt to develop deep groundwater resources within Colorado must begin with the factual question of whether the water is tributary to waters already subject to beneficial use. Deep groundwater may be financially viable when brought to the surface by development of other valuable resources such as oil or natural gas.

A final wrinkle is that groundwater could be developed in exchange for releases of water from surface storage facilities, thereby avoiding the major infrastructure costs of building long distance pipelines and pumping stations. This may prove to be a viable option if water is available and can be released to mitigate impacts to the river system resulting from the diversion of tributary groundwater—though this is, of course, a highly complex and site-specific factual question. For now, it appears that groundwater represents an attractive option only where

91 McClennan v. Hurdle, 33 P. 280, 282 (Colo 1893).
92 Medano Ditch Co. v. Adams, 68 P.431, 434 (Colo. 1902).
94 Id. § 37-90-103(10.5).
95 Id. § 37-90-102(2).
96 Id. § 37-90-103(10.7).
development of other resources can defer some of the cost of developing otherwise cost prohibitive deep groundwater resources. This scenario is discussed in detail in Section IV.

III. ALLOCATING AND REALLOCATING EXISTING WATER RESOURCES

Water rights in Colorado and Utah are subject to complex allocative procedures, none of which is more important than the Law of the River, which is where we begin this section. The Law of the River forms the backdrop for subsequent discussions of interstate water allocation, water rights reserved under federal law, and water for endangered species protection.

A. The Colorado River Compact and the Law of the River

As part of the Colorado River System, surface waters proximate to Colorado and Utah’s oil shale resources are subject to the Colorado River Compact, which apportions water among the seven states that drain into the Colorado River. The Compact divides the Colorado River watershed into upper and lower basins based on whether lands drain into the Colorado River at points above and below Lee Ferry, Arizona. Under the Compact, both the upper and lower basins are entitled to annual consumptive use of up to 7,500,000 acre-feet of water. The lower basin is also “given the right to increase its beneficial consumptive use of such waters by one million acre-feet per annum.” Additionally, Mexico is entitled to 1,500,000 acre-feet pursuant to the Treaty with Mexico. Mexico’s entitlement is provided out of surplus flows; otherwise, the obligation is born by an equal reduction in each basin’s apportionment.

The upper basin’s 7,500,000 acre-foot annual entitlement is misleading because the upper basin must deliver an average of 7,500,000 acre-feet of water at Lee Ferry without regard to the amount of water in the river. Since surpluses are seldom available to satisfy Mexico’s rights, the upper basin’s share of the obligation to Mexico is an additional 750,000 acre-feet, meaning that the upper

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98 These states are Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming.

99 Colorado River Compact, supra note 97, at Art. II §§ (f) and (g).

100 Id. at Art. III § (a).

101 Id. at Art. III § (b).


103 Colorado River Compact, supra note 97, at Art. II § (c).

104 Id. at Art. III §§ (a) and (d).
basin is really obligated to deliver 8,250,000 acre-feet at Lee Ferry.\textsuperscript{105} Furthermore, the upper basin’s ability to consume its full apportionment was based on assumed levels of flow that rarely occur. During compact negotiations, it was widely assumed that the Colorado River’s annual flows averaged at least 17,400,000 acre-feet at Lee Ferry.\textsuperscript{106} However, estimated and gauged flow from 1906 through 2005 averaged 15,072,000 acre-feet (ranging between 5,399,000 and 25,432,000 acre-feet).\textsuperscript{107} Recognizing the significant variability in Colorado River flows and that gauged data may not provide an accurate assessment of either variability or average flows, several studies have attempted to utilize tree-ring data to establish historic flow levels. The most widely cited of these, Long-Term Surface-Water Supply and Streamflow Trends in the Upper Colorado River Basin, concluded that the natural flow at Lee Ferry is only 13,500,000 acre-feet.\textsuperscript{108} The more recent Updated Streamflow Reconstructions for the Upper Colorado River Basin concluded that natural streamflows at Lee Ferry were somewhat higher, but still below gauged levels.\textsuperscript{109} In light of more realistic estimates of river flows, the upper basin states’ obligation to the lower basin, and obligations to Mexico, the upper basin states are left with an average annual allocation of at most 6,000,000 acre-feet, and possibly much less.\textsuperscript{110}

\textsuperscript{105} Under very limited circumstances, the upper basin states’ delivery obligations can be reduced to 7,480,000 acre-feet if Lake Powell’s storage capacity falls below 9,500,000 acre-feet (39% of capacity) and Lake Mead is above the 1025 foot elevation level. Delivery obligations can be reduced further to 7,000,000 acre-feet annually if Lake Powell’s storage capacity falls below 5,900,000 acre-feet (24% of capacity). U.S. DEP’T OF INTERIOR, RECORD OF DECISION, COLORADO RIVER INTERIM GUIDELINES FOR LOWER BASIN SHORTAGES AND THE COORDINATED OPERATIONS FOR LAKE POWELL AND LAKE MEAD 50 (Dec. 2007). Such shortages have not occurred during the period of operation for these two facilities but appear possible based on longer term instream flow estimates and in light of modeled instream flow reductions attributable to climate change.

\textsuperscript{106} NORRIS HUNDLEY, JR., WATER AND THE WEST: THE COLORADO RIVER COMPACT AND THE POLITICS OF WATER IN THE AMERICAN WEST, 184 (1975). But see ERIC KUHN, THE COLORADO RIVER: THE STORY OF A QUEST FOR CERTAINTY ON A DIMINISHING RIVER 22 n.63 (Roundtable Ed. May 8, 2007) (on file with authors) (reporting that compact negotiators claimed the Colorado River had a total supply of as much as 21.6 million acre feet.).

\textsuperscript{107} U.S. DEPT. OF INTERIOR, BUREAU OF RECLAMATION, FINAL ENVIRONMENTAL IMPACT STATEMENT, COLORADO RIVER INTERIM GUIDELINES FOR LOWER BASIN SHORTAGES AND COORDINATED OPERATIONS FOR LAKE POWELL AND LAKE MEAD 3-15 (2007).


\textsuperscript{110} The amount of water available to the upper basin states is a matter of considerable controversy. Eric Kuhn, General Manager of the Colorado River Water Conservancy District, evaluated several scenarios for determining water available to the upper basin after satisfying delivery obligations, concluding that upper basin states should plan on a reasonable yield of 5,250,000 acre-feet. Notably, this estimate does not account for inflow reduction attributable to climate change and assumes shortages will occur in 6% of all years. See ERIC KUHN, THE COLORADO RIVER: THE STORY OF A QUEST FOR CERTAINTY ON A DIMINISHING RIVER 104-05 (Roundtable Ed. May 8, 2007) (on file with authors).
Climate change, the effects of which are difficult to project, further undermines water availability within the Upper Colorado River Basin. According to the National Academy of Sciences, “[b]ased on analysis of many recent climate model simulations, the preponderance of scientific evidence suggests that warmer future temperatures will reduce future Colorado River streamflow and water supplies. Reduced streamflow would also contribute to increasing severity, frequency, and duration of future droughts.”

While the amount of water available remains in serious question, we do know how available water resources will be divided. The upper basin states’ share of the Colorado River is apportioned according to the Upper Colorado River Compact. Arizona receives 50,000 acre-feet annually; Colorado, New Mexico, Utah, and Wyoming receive 51.75%, 11.25%, 23%, and 14% of the remainder, respectively. Applying these percentages to the assumption that 6,000,000 acre-feet is available to the upper basin, Colorado and Utah’s average annual consumptive rights from the Colorado River and its tributaries are 3,079,000 and 1,369,000 million acre-feet, respectively. Despite disagreement about how best to quantify water use within each state, reasonable estimates are that, during an average year, Colorado has roughly one million acre-feet of unused appropriations under the Compact. Utah has, during an average year, roughly 520,000 acre-feet of unused Colorado River apportionments. Some of this water may come from the White River, but exactly how much is unclear.

B. Water Flowing into Utah—The Size of the Pie

The prior appropriation doctrine is the bedrock principle upon which western water law draws its strength. While the doctrine’s analytical purity is hard to question, its application requires knowledge of important facts—who possesses water rights, the terms and any limiting conditions associated with those water rights, and the relative priorities of competing water rights. The system breaks

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113 Id. at Art. III § (a).


115 Between 1998 and 2006, Utah consumed an average of 848,000 acre-feet of Colorado River Basin water annually. Id. Given a right to consume up to 1,369,000 acre-feet annually, Utah has roughly 520,000 acre-feet remaining. Note however, the Utah Division of Water Resources believes even less water is available, 416,000 acre-feet as of 2000. See D. LARRY ANDERSON, Utah’s Perspective: The Colorado River 8 (Utah Div. of Water Res., 2d. ed. 2002).
down when one or more of these factors are unknown. In the absence of information, the comparative worth of water rights cannot be judged, the security of supplies is called into question, and markets struggle to reallocate assets of uncertain value. Uncertainty regarding these foundational terms threatens not just commercial oil shale development but all who plan for future water needs.

With respect to the White River, we do not know how much water Utah’s upstream neighbors must allow to pass downstream. A recent study commissioned by Western Resource Advocates details water rights for oil shale development within western Colorado, demonstrating the extent to which the energy industry has already acquired water in anticipation of future development. As the study explains, there are 114 proposed structures with conditional rights in the White River Basin which, if built, would enable total direct diversion of almost 5,700 cfs and total storage of over 1 million acre feet. Energy companies also acquired senior agricultural rights and an interest in fifty-seven ditches in the White River Basin. The total decreed absolute diversion rates associated with these ditches is approximately 200 cfs.116 Exactly how much of this can be developed is unclear.

While the Colorado River Compact and Upper Colorado River Compact apportion rights between respective states, they do little to address the management of interstate rivers, and no agreement is in place regarding the White River.117 The absence of a formal agreement leaves unresolved questions of Colorado’s and Utah’s respective rights to the only significant surface water source flowing through Utah’s rich oil shale resources.

1. Apportionment Options

In the absence of an agreement regarding apportionment of the White River, Colorado and Utah have three options to resolve their respective rights. The two states can litigate their claims before the U.S. Supreme Court, they can negotiate a mutually acceptable apportionment, or they can turn to Congress to apportion flows through legislation. While all three options have shortcomings, a negotiated settlement reflects the clearly preferable option.

In the absence of an agreement regarding their respective rights to the White River, Colorado and Utah could pursue litigation. A suit between states would be subject to the U.S. Supreme Court’s original jurisdiction.118 In addressing interstate

116 MACDONELL, supra note 26, at 7-9.
117 In some cases, states sharing tributary river systems have entered into compacts apportioning their respective rights and addressing common management. For example, the Upper Colorado River Compact requires Colorado to deliver an average of 500,000 acre-feet per year at a point upstream of Dinosaur National Monument. See Upper Colorado River Compact, supra note 112, at Article XIII § (a). A Memorandum of Understanding between Colorado and Utah for Pot Creek (in the Green River drainage) establishes a schedule of priorities for use in both states and defines a period before which direct flow diversions cannot be exercised, namely May 1st of each year. COLORADO WATER CONSERVATION BOARD, STATEWIDE WATER SUPPLY INITIATIVE §4 at 5, available at http://cwcb.state.co.us/NR/rdonlyres/60B6F1E1-A6E6-4BEC-BB37-75D945C32DC6/0/S4111504.pdf.
118 See U.S. CONST. ART. III § 2.
allocation disputes, the Court applies a rule of equity. As Professor Tarlock explains, “[t]he doctrine of equitable apportionment is a flexible rule that allows the Supreme Court to consider a variety of factors in determining what is a fair state share,” and as such, is highly fact dependent. The broad outline of factors considered in allocating western interstate rivers tend to track the same factors considered under the prior appropriations doctrine. Senior users are generally protected over junior users, beneficial use is the measure and limit of the right, and speculative or inefficient uses are disfavored. The place of origin of water is irrelevant to equitable apportionment.

In determining whether one state is “using, or threatening to use, more than its equitable share of the benefits of a stream, all of the factors which create equities in favor of one state or the other must be weighed as of the date when the controversy is mooted.” While “the effort always is to secure an equitable apportionment without quibbling over formulas,” the key question is often the extent to which water has been put to a beneficial use “and among states with the same water law, the Court has applied the common law of the party states. Thus, prior appropriation applies among appropriation states.” But prior appropriation alone is not dispositive:

"If an allocation between appropriation States is to be just and equitable, strict adherence to the priority rule may not be possible. For example, the economy of a region may have been established on the basis of junior appropriations. So far as possible those established uses should be protected though strict application of the priority rule might jeopardize them. Apportionment calls for the exercise for an informed judgment on a consideration of many factors. Priority of appropriation is the guiding principle. But physical and climatic conditions, the consumptive use of water in the several sections of the river, the character and rate of return flows, the extent of established uses, the availability of storage water, the practical effect of wasteful uses on downstream areas, the damage to upstream areas as compared to the benefits to downstream areas if a limitation is imposed on the former—these are all relevant factors.

Factors other than priority have increased in importance in the Court’s more recent interstate allocation cases. The Court, in allocating a small stream between Colorado and New Mexico, faced questions about both the efficiency of competing water uses and the proper weight afforded to competing harms and benefits. In

119 TARLOCK, supra note 81, at § 10.16.
123 TARLOCK, supra note 81, at § 10.15
an opinion that appears to mark an increasing emphasis on efficiency and relative harm, Justice Marshall wrote:

We recognize that the equities supporting the protection of existing economics will usually be compelling. The harm that may result from disrupting established uses is typically certain and immediate, whereas the potential benefits from a proposed diversion may be speculative and remote. Under some circumstances, however, the countervailing equities supporting a diversion for future use in one state may justify the detriment to existing users in another state. This may be the case, for example, where the state seeking a diversion demonstrates by clear and convincing evidence that the benefits of the diversion substantially outweigh the harm that might result. In the determination of whether the state proposing the diversion has carried this burden, an important consideration is whether the existing users could offset the diversion by reasonable conservation measures to prevent waste. This approach comports with our emphasis on flexibility in equitable apportionment and also accords sufficient protection to existing uses.\textsuperscript{126}

As interstate allocation decisions are highly fact dependent and the weight the Court gives to various considerations is an evolving matter of law, neither Colorado nor Utah can be confident in the outcome of a suit to apportion their respective rights in the White River. Moreover, neither state stands to gain through protracted litigation. The fact intensive nature of these cases may explain why the Supreme Court disfavors equitable apportionment cases, preferring states to resolve matters on their own.\textsuperscript{127} Rather than allow uncertainty to fester or rely on what would almost certainly be long and complex litigation, the states should negotiate a compact for the White River.

Interstate compacts provide states a more flexible means of apportioning flows and achieving related objectives. Under Article I § 10 of the U.S. Constitution, “[n]o State shall, without the Consent of Congress . . . enter into any Agreement or Compact with another State.” Congressional ratification is therefore required for all interstate compacts, whether granted implicitly or explicitly and whether granted before or after negotiations are complete.\textsuperscript{128} Upon ratification, an interstate compact operates both as federal law and as a contract among the signatories.\textsuperscript{129} Less formal agreements that do not increase the political power of the states at the expense of the federal government can also create a binding agreement between the multiple states while avoiding the congressional ratification requirement.\textsuperscript{130} However, such procedural expediencies may be outweighed by the

\textsuperscript{126} Id. at 187-88.
\textsuperscript{128} TARLOCK, supra note 81, § 10.25.
\textsuperscript{129} Id.
\textsuperscript{130} See New Hampshire v. Maine, 426 U.S. 363, 369 (1976) (“[A]pplication of the Compact Clause is limited to agreements that are ‘directed to the formation of any combination tending to the
prospect that such an agreement could be challenged as a compact masquerading as a contract and that fails to satisfy constitutional requirements. Negotiated settlements also avoid a potential thicket of procedural problems that accompany litigation such as ripeness. A compact apportioning waters of the White River was proposed at least once before; renewed development interest in the White River may provide the spark needed to rekindle negotiations.

A third alternative means of allocating White River flows is for Congress to apportion Colorado’s and Utah’s respective rights, though this is the least appealing or likely option. The Commerce Clause of the U.S. Constitution provides Congress with authority to allocate interstate rivers to further federal interests. There is little question that increasing domestic energy production and reducing reliance on imported oil would further a federal interest. However, congressional action furthering federal interests may not produce a resolution amenable to either of the states involved. Accordingly, Congress has been reluctant to apportion interstate rivers through legislation, acting only when negotiations break down and litigation proves impractical.

In the end, how Utah and Colorado choose to resolve their competing claims to the White River is of less importance than the actual resolution. As one water law scholar notes: “Until state claims have been reduced to definite rights in specific quantities of water, private capital cannot afford the investment risk, states will have difficulty selling bonds, and even the federal government will not authorize projects.” Thus, until state claims have been reduced to definite rights, the availability of commercial oil shale development remains uncertain. But even if commercial oil shale development does not come to pass, knowledge of the states’ respective rights will benefit residents of both states as they plan for growth and increasing demands for water that are unrelated to oil shale.

C. The Role of Reserved Water Rights

In addition to questions of water resource availability, we must recognize significant but unquantified water rights that could play an important role in oil shale development. Indian reserved rights are the most important of these rights, at

increase of political power in the States, which may encroach upon or interfere with the just supremacy of the United States.”) (quoting Virginia v. Tennessee, 148 U.S. 503, 519 (1893)).


Letter from Utah Governor Calvin L. Rampton to Colorado Governor John D. Vanderhoof, (Dec. 11, 1973) (on file with authors).


least for Utah, but reserved water rights associated with upstream federal reservations deserve consideration.

1. Indian Reserved Rights

The Uintah and Ouray Indian Reservation, located in Utah’s Uinta Basin, was established by Executive Order in 1861. According to the tribe, the Uintah and Ouray Reservation is the second largest Indian Reservation in the United States, covering over 4.5 million acres and containing approximately 1.3 million acres of trust land.

Under the landmark case, *Winters v. United States*, creation of federally recognized Indian reservations impliedly reserved to the Indians the water required to meet the needs of the reservation, even if water rights are not expressly discussed or quantified in the treaty. The priority date associated with Indian reserved rights is generally the date upon which the reservation was created, and unlike water rights granted under state law, *Winters*’ rights are not subject to forfeiture or abandonment for nonuse. Reserved rights claims must be satisfied by the states in which the reservation lies, and will be debited against the state’s apportionment under the Law of the River.

Quantification of Indian reserved rights is no simple task. Two concerns dominate resolution of Indian reserved rights—finality and objectivity. In discussing these objectives, the Supreme Court concluded that “[h]ow many Indians there will be and what their future needs will be can only be guessed . . . . [T]he only feasible and fair way by which reserved water for the reservations can be measured is irrigable acreage.” In the leading case quantifying irrigable acreage, *In re General Adjudication of All Rights to Use Water in the Big Horn River System (Big Horn I)*, the Wyoming Supreme Court determined that the primary purpose of the Wind River Indian Reservation was to promote agriculture.

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136 The discussion of Indian reserved rights expands on the analysis contained in Ruple & Keiter, *supra* note 1.
137 For a detailed discussion of reservation establishment and subsequent modifications, see Ute Indian Tribe v. State of Utah, 521 F.Supp. 1072, 1092-1150 (D. Utah 1981) (involving reservation disestablishment and jurisdictional implications). While *Ute Indian Tribe* was reversed in part, it contains a wealth of valuable, historic information.
140 Arizona v. California, 373 U.S. 546, 600 (1963) (holding the United States reserved water rights for the Indians effective as of the time reservations were created). The Uintah Valley Indian Reservation was created by Executive Order in 1861. The Spanish Fork Reservation was created by treaty on June 6, 1865. The two were subsequently combined into the Uintah and Ouray Indian Reservation. The reserved rights doctrine was extended to reservations created by Executive Order in United States v. Walker River Irrigation Dist., 104 F.2d 334, 336 (9th Cir. 1939).
141 See, e.g., *In re General Adjudication of All Rights to Use of Water in Gila River System and Source*, 35 P.3d 68, 72 (Ariz. 2001).
142 Arizona v. California, 376, U.S. 340, 346 (1964) (holding that water delivered to the tribes is to be applied against the total allocation for each state within which the reservation is located).
among the resident tribes and that the proper measure of the tribes’ reserved rights was “those acres susceptible to sustained irrigation at reasonable costs.” This is known as the practicable irrigable acreage (PIA) standard.

PIA has been criticized for including projects that are unlikely to be developed. Conversely, where reservations were established in particularly harsh and arid areas, little if any of the reservation may meet minimum standards of economic feasibility, and tribes could be left with very little water. In light of these concerns, the Arizona Supreme Court rejected PIA, choosing instead to balance a “myriad of factors” in quantifying reserved rights. The Arizona Court noted that “the essential purpose of Indian reservations is to provide Native American people with a ‘permanent home and abiding place,’ that is, a ‘livable’ environment.” It went on to explain that:

Other right holders are not constrained in this, the twenty-first century, to use water in the same manner as their ancestors in the 1800s . . . . [A]griculture has steadily decreased as a percentage of our gross domestic product. Just as the nation's economy has evolved, nothing should prevent tribes from diversifying their economies if they so choose and are reasonably able to do so. The permanent homeland concept allows for this flexibility and practicality. We therefore hold that the purpose of a federal Indian reservation is to serve as a “permanent home and abiding place” to the Native American people living there.

Great effort has gone into quantifying the Northern Ute’s reserved rights, resulting in at least two draft settlements. The most recent negotiations resulted in the Ute Indian Rights Settlement, which was then added to the federal Reclamation Projects Authorization and Adjustment Act of 1992. Negotiations also produced the Ute Indian Water Compact, which Utah codified subject to ratification by the parties. The Ute Indian Water Compact, however, was not ratified by the tribe’s

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145 753 P.2d at 101.
148 In re General Adjudication of All Rights to Use Water in Gila River System and Source (Gila V), 35 P.3d 68, 79-80 (Ariz. 2001) (identifying five non-exclusive considerations for quantifying reserved rights: (1) the tribe’s history and culture, (2) “the tribal land’s geography, topography, and natural resources, including groundwater availability,” (3) the reservations “[p]hysical infrastructure, human resources, including present and potential employment base, technology, raw materials, financial resources, and capital,” (4) past water use, and (5) “a tribe’s present and projected future population.”).
149 35 P.3d at 74 (quoting Winters, 207 U.S. at 565 and Arizona I, 373 U.S. at 599).
150 35 P.3d at 76 (internal quotations and citations omitted).
membership. While not binding, the Ute Compact is a reasonable starting
point for discussing the tribe’s rights.

Under the Ute Compact, the tribe would obtain the right to divert a total of
471,035 acre-feet of water annually and deplete up to 248,943 acre-feet. Of this
total, the tribe could divert 66,502 acre-feet from the White River and its
tributaries, consuming up to 32,880 acre-feet. The remaining water rights would
come from the Duchesne and Green river systems. Tribal water rights recognized
under the Ute Compact would have priority dates dating to as early as 1861,
making them some of the most senior in the basin.

Additionally, under the Ute Compact, water would “not be restricted to any
particular use, but may be used for any purpose selected by the tribe,” including
“sale, lease, or any other use whatsoever.” Furthermore, the Ute Compact
anticipates changes in the point of diversion, place of use, or nature of use—
including transferring water to uses off the reservation, subject to the requirements
of state law and approval of the Secretary of the Interior.

While the Ute Compact represents the best estimation of the tribe’s water
rights, it is only an estimate. Figures reflect neither the extent of acreage that could
be put into cultivation with modern irrigation practices nor water duties applicable
to modern technology. Most importantly, the Ute Compact predates the
homeland theory espoused by the Arizona Court. Therefore, the Ute Compact
stands as a caution to the extent of Ute reserved rights as well as uncertainty in
their quantification and terms.

Continued uncertainty regarding tribal reserved rights casts a cloud over not
only oil shale development, but development in general. If the tribe’s water rights
are settled, the tribe would be in a powerful position to provide water for
commercial oil shale development, should it choose to do so. Conversely, a
decision to utilize water rights for other purposes could make water for oil shale
development harder to obtain. Regardless of how the tribe’s water rights are put to
use, the tribe should stand to displace many junior rights holders and upset what
has long been a fairly stable allocation of resources. Accordingly, resolution of
tribal reserved rights and clarification of water development plans must be a high
priority.

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154 See DANIEL MCCOOL, NATIVE WATERS: CONTEMPORARY INDIAN WATER SETTLEMENTS AND
THE SECOND TREATY ERA 177-82 (Univ. of Ariz. Press 2002) (discussing the history of settlement
negotiations); see also Daniel McCool, THE NORTHERN UTES’ LONG WATER ORDEAL, HIGH COUNTRY
NEWS, JULY 15, 1991, at 8-9 and NATIVE WATERS: CONTEMPORARY INDIAN WATER SETTLEMENTS
AND THE SECOND TREATY ERA, at 174 (discussing concerns over potential transfer of tribal water to
Las Vegas and southern Nevada).
156 Id. § 73-21-2, Art. III.
157 Id.
158 Id.
159 Water duty is the total amount of irrigation water required to mature a particular crop,
usually expressed as acre-feet per acre.
2. Reserved Water Rights for Naval Oil Shale Reserves

Reserved water rights can be created any time the federal government reserves land and therefore are not limited to Indian reservations. The priority date is generally the date upon which the reservation was created and the quantity of water reserved is the amount required to fulfill the “primary purpose” of the reservation. In the early 20th century, with the U.S. Navy transitioning from coal to liquid fuels and facing concerns over fuel availability, the President of the United States issued a series of executive orders setting aside three federal oil shale reserves. Naval Oil Shale Reserves (NOSRs) Nos. 1 (36,406 acres) and 3 (20,171 acres) are located roughly 8 miles west of Rifle, Colorado. Reserve No. 2 (88,890 acres) was located in Utah’s Carbon and Uintah counties.

In 1971, the United States filed a statement of claim with the Colorado Water Court, seeking confirmation of its reserved water rights for NOSR Nos. 1 and 3. In amended filings, the United States asserted the right to divert 100 cfs from the mainstream of the Colorado River at the Anvil Points Diversion, near NOSR Nos. 1 or 3. The Colorado Supreme Court assumed without deciding that the NOSRs created a federal reserved right. The decision, however, subordinated the federal right to other state rights because of the federal government’s failure to comply with state procedural requirements. Therefore, while the existence of this right does not appear to be in question, its value is presumably low, absent associated storage, because of its late priority date. Nonetheless, the potential existence of reserved rights associated with the original Naval Oil Shale Reserves could affect water availability for contemporary oil shale development.

NOSR No. 2 presents a different situation. The National Defense Authorization Act of 2000 transferred NOSR No. 2 to the Ute Indian Tribe, which received the land and mineral rights in fee simple and not subject to federal management in trust status. It appears NOSR-2’s transfer terminated any reserved rights claim because the Act specifically states that “[e]ach withdrawal that applies to NOSR-2 and that is in effect on the date of the enactment . . . is

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162 CONGRESSIONAL RESEARCH SERVICE, REPORT TO CONGRESS, OIL SHALE: HISTORY, INCENTIVES, AND POLICY 2 (Apr. 13, 2006).
164 Id. at 635.
165 Id.
revoked to the extent that the withdrawal applies to NOSR-2.169 However, the Tribe may be able to make a reserved rights claim independent of NOSR status as the lands were part of the Tribe’s reservation before creation of the reserve.170 The basis of the reserved right is important because it affects both the priority date and the purposes to which the water may be put to use. Under United States v. New Mexico, reserved rights for federal lands are limited to the primary purpose of the reservation,171 thus limiting a reserved right to waters needed to produce oil shale from the reservation. Indian reserved rights are normally available for more expansive purposes.172 The basis for the claim therefore determines how much water is available and where it can be used as well as the priority date. Hopefully, these issues will be resolved through negotiated settlement of all tribal reserved rights claims. If not, additional investigations will be needed.

D. Protected Species and Instream Flows

The most prospective area for oil shale development includes critical habitat for at least four species of fish protected under the federal Endangered Species Act (ESA).173 The ESA imposes obligations on federal agencies, agency licensees and permittees, state and local governments, and private individuals that may supersede state water rights. In such instances, water resources may be available physically, but not legally.174

The ESA protects and aids in the recovery of imperiled species and the ecosystems upon which they depend,175 protecting listed species and their habitats by prohibiting the “take” of listed animals, unless authorized by Federal permit.177 The prohibition against a take applies regardless of land ownership.178

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169 Id. § 3405(c)(5), 114 Stat. 1654.
170 Courts have generally found that reacquired lands retain reserved water rights and most disagreements involve the priority associated with reserved rights for reacquired lands. See WATER AND WATER RIGHTS vol. § 37.02(f)(3) (Robert E. Beck, ed., 1991 ed. 2004 replacement vol.) for a discussion of the issues associated with reacquired lands.
172 See generally section III(C)(1), supra.
174 See, e.g., O’Neill v. United States, 50 F.3d 677, 686-87 (9th Cir. 1995) (holding that ESA obligations supersede contractual obligations to deliver a set quantity of water).
176 Under the ESA, species may be listed as either endangered or threatened: “Endangered” species are in danger of extinction throughout all or a significant portion of their range, 16 U.S.C. § 1532(6) (2006) “threatened” species are likely to become endangered within the foreseeable future, 16 U.S.C. § 1532(20). Section four of the ESA requires species to be listed based solely on their biological status and threats to their existence; economic impacts of a listing decision are not considered. 16 U.S.C. § 1533 (2006). The Service also maintains a list of “candidate” species which warrant listing, but whose listing is precluded by higher listing priorities.
177 16 U.S.C. § 1538(a)(1)(B) (2006). ESA listed plants are not protected from take, although it is illegal to collect or “maliciously damage or destroy” them on Federal land. Id. §1538(a)(2). Protection from commercial trade and the effects of Federal actions do apply for plants.
and take is defined broadly to mean “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct.” 179 Through regulations, “harm” is defined as “an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.” 180 The U.S. Fish and Wildlife Service (Service) implements the ESA with respect to listed terrestrial and freshwater organisms.

Section seven of the ESA requires federal agencies to promote the ESA’s conservation purposes and consult with the Service as appropriate to ensure that effects of actions they authorize, fund, or carry out will not jeopardize the continued existence of listed species. 181 During consultation, the action agency receives a biological opinion or concurrence letter addressing the proposed action, 182 stating whether the proposed action would jeopardize a listed species or its habitat. In the relatively few cases in which the Service makes a jeopardy determination, it offers reasonable and prudent alternatives to the proposed action that could avoid jeopardy. 183

The ESA also requires the designation of critical habitat for listed species when “prudent and determinable.” 184 Critical habitat includes geographic areas containing physical or biological features essential to the species conservation that may need special management or protection. 185 Critical habitat may include areas that are not occupied by the species at the time of listing but are essential to its conservation. 186 Unlike the initial listing decision, an area can be excluded from critical habitat designation if the economic benefits of excluding it outweigh the benefits of designation, unless failure to designate the area as critical habitat may lead to extinction of the listed species. 187 Federal agencies are required to avoid destruction or adverse modification of designated critical habitat. 188

Section ten of the ESA provides relief to non-federal landowners proposing to develop property inhabited by listed species. 189 Non-federal landowners can receive a permit to take listed species incidental to otherwise legal activities, provided they have developed an approved habitat conservation plan (HCP). 190 HCPs include an assessment of the likely impacts on the species from the proposed

178 Id. §1538(a)(1); see also Babbitt v. Sweet Home Chapter of Communities for a Great Oregon, 515 U.S. 687, 703 (1995).
182 Id. § 1536(b)(3).
183 Id. § 1536(b)(3).
184 Id. § 1533(a)(3)(A).
185 Id. § 1532(5)(A)(i).
186 Id. § 1532(5)(A)(ii).
188 Id. § 1536(a)(2).
189 Id. § 1539.
action, the steps that the permit holder will take to minimize and mitigate the impacts, and the funding available to carry out the steps.\footnote{Id. § 1539(a)(2).}

Designation of critical habitat can have a major effect on the exercise of water rights because the designation creates what can amount to a de facto reservation of water for species protection.\footnote{See TARLOCK, supra note 81, at § 9.29.} Utilization of state water rights is subject to the ESA’s prohibition against the take of a listed species.\footnote{See United States v. Glenn-Colusa Irrigation Dist., 788 F.Supp 1126, 1134-35 (E.D. Cal. 1992) (enjoining pumping in accordance with state granted water rights where pumping was a substantial proximate cause of injury to listed salmon species).} Bureau of Reclamation water delivery contracts are likewise subject to curtailment to comply with the ESA,\footnote{See Klamath Water User Protection Ass’n v. Patterson, 191 F.3d 1115 (9th Cir. 1999); Bartelos & Wolfsen, Inc. v. Westlands Water Dist., 849 F.Supp. 717, 732 (E.D. Cal. 1993).} and the Act may require federal reservoir operations to maximize species protection, thus subordinating state and federal contract water rights.\footnote{See Carson-Truckee Water Conservancy Dist. v. Clark, 549 F.Supp 704 (D.Nev. 1982), aff’d in part, rev’d in part 741 F.2d 257 (9th Cir. 1984).} Under such circumstances, instream or bypass flow requirements for listed species can trump water rights, including water rights apportioned by interstate compact.\footnote{See TARLOCK, supra note 81, at § 9.31.} Therefore, while water for listed species does not have a fixed priority date, it effectively supersedes competing uses.

Within Colorado, the stream reach below Rio Blanco Lake is designated critical habitat for ESA listed fish.\footnote{COLORADO WATER CONSERVATION BOARD, STATEWIDE WATER SUPPLY INITIATIVE, 3-83 (Nov. 2004).} Most of the White, Green, and Colorado rivers in Utah are critical habitat for ESA listed fish.\footnote{See U.S. FWS Critical Habitat Portal, http://criticalhabitat.fws.gov/ (last visited Jan. 29, 2010).} Accordingly, activities within the Yampa/White/Green river system will require consultation under section seven of the ESA and water use must not affect a take of a listed species or destruction of its habitat.\footnote{“Take” is defined broadly as “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to collect, or attempt to engage in any such conduct.” 16 U.S.C. § 1532(19). The prohibition against a “take” includes harming its habitat. See Babbitt v. Sweet Home Chapter, 515 U.S. 687 (1995).} There are five main classes of activities that will be of concern with respect to water resource development: (1) reduced quantity and quality of seasonal back-water habitat used during spawning and migration; (2) reduced availability of nursery and rearing habitat; (3) reduced sediment transport capacity and associated changes in river habitat and productivity; (4) created habitats favoring non-native fishes that compete with endangered native species; and (5) reduced future flexibility in stream flow management resulting from increased consumptive use.\footnote{WATER AND WATER RIGHTS, 43-44 (Robert E. Beck, ed., vol. 6 1991 ed. & 2005 repl. vol.) (citations omitted).}
Minimum flows for species protection are imposed under the Colorado River Endangered Fish Recovery Program\textsuperscript{201} and Programmatic Biological Opinion for operation and depletions to the Colorado River above the Gunnison River,\textsuperscript{202} which call for additional water deliveries for fish while restricting future depletions. In accordance with the recovery program and Fish and Wildlife Service recommendations, the Utah State Engineer recently amended its policies to require year-around bypass flows on all new or changed water rights on the Green River between Flaming Gorge Dam and the Duchesne River. Bypass flow requirements are now keyed to hydrologic conditions as set forth in the Service’s 1992 Biological Opinion for Operation of the Flaming Gorge Reservoir.\textsuperscript{203} The Service is also in the process of finalizing interim flow recommendations for the White River and will likely issue a Biological Opinion incorporating flow requirements and depletion limits.\textsuperscript{204} Individually or together, these limitations stand to complicate future diversions, whether for commercial oil shale development or other uses.

Protections afforded ESA listed species and their habitat will complicate efforts to increase diversions from all perennial streams within the most geologically prospective area and may preclude on-channel reservoir development. Thus, ESA protections may serve as a stronger limiting factor on withdrawals and changes than even state water law.

IV. MAKING “NEW” WATER

With existing water resources in short supply, those seeking water must either acquire existing water rights or come up with creative ways of making “new” water. This section focuses on the latter. Four potential new sources of water are: water produced through precipitation augmentation, water imported from other basins, reuse of water produced through natural gas production, and conservation. These are addressed in turn.


\textsuperscript{204} See U.S. Fish and Wildlife Service, supra note 201, at 18.
A. Precipitation Augmentation

Precipitation augmentation or cloud seeding is not new to the Colorado River Basin. Water users in central Utah began seeding clouds as early as the 1950s, the State of Utah began funding cloud seeding projects in 1973, and large-scale seeding projects have been ongoing ever since.\textsuperscript{205} During 2007, there were six active cloud seeding projects in Utah, utilizing 148 generators and reportedly increasing seasonal precipitation by 2 to 25%.\textsuperscript{206} Four of these projects target areas within the Colorado River Basin, and four additional potential target zones have been identified within the Basin.\textsuperscript{207} Utah’s cloud seeding projects operate December through March and are intended to increase snowfall at times when atmospheric conditions minimize loss to evaporation. Snowmelt is captured as spring runoff and used to fill reservoirs throughout the state. Generally, precipitation that results from cloud seeding is treated as a public resource, indistinguishable from natural precipitation and available for appropriation through existing state regulatory programs.\textsuperscript{208} The benefit of augmentation projects, therefore, can be diffuse and is not guaranteed to befall private project funders.

The most obvious question regarding cloud seeding is whether it works. While difficult to test empirically, Utah claims a 2 to 25% increase\textsuperscript{209} and information published by the American Society of Civil Engineers indicates cloud seeding may increase precipitation from 5 to 20%.\textsuperscript{210} Streamflow model simulations conducted by the National Weather Service reportedly predict that new cloud seeding programs together with augmentation of existing programs could produce an average increase of 1,227,000 acre-feet of runoff into Lake Powell and that new seeding programs in Arizona could gain an additional 154,000 acre-feet of runoff.\textsuperscript{211} Preliminary cost estimates indicate that full development of these programs would cost around $7,000,000 annually, or approximately $5 per acre-foot.\textsuperscript{212} If accurate, the amount of water potentially made available and its relatively low cost make cloud seeding a very attractive technology.

\textsuperscript{207} Don A. Griffith and Mark E. Solak, Cloud Seeding in the Upper Colorado Basin: Technical Feasibility, SOUTHWEST HYDROLOGY, Mar./Apr. 2007, at 19.
\textsuperscript{208} UTAH CODE ANN. § 73-15-4 (2009).
\textsuperscript{210} Thomas P. DeFelice and Conrad G. Keyes, Jr., Executive, in, GUIDELINES FOR CLOUD SEEDING TO AUGMENT PRECIPITATION, 1 (American Society of Civil Engineers ed., 2d. ed. 2006).
\textsuperscript{211} Don A. Griffith and Mark E. Solak, Cloud Seeding in the Upper Colorado Basin: Technical Feasibility, SOUTHWEST HYDROLOGY, Mar./Apr. 2007, at 19. Ongoing and planned projects in both Colorado and Wyoming could increase precipitation upstream of Utah’s oil shale resources and, if allowed to flow downstream, increase water availability. See id. See also Wyoming Weather Modification Pilot Program, http://www.rap.ucar.edu/projects/wyoming/ (last visited Jan. 29, 2010).
\textsuperscript{212} Don A. Griffith and Mark E. Solak, Cloud Seeding in the Upper Colorado Basin: Technical Feasibility, SOUTHWEST HYDROLOGY, Mar./Apr. 2007, at 19.
However, recent studies raise cautionary flags. Regional air pollution may result in decreased downwind precipitation, negating gains obtained by cloud seeding. While cloud seeding injects silver iodide or similar cloud condensation nuclei (CCN) into the atmosphere to enhance downwind precipitation, air pollution introduces much smaller CCN into the atmosphere. These smaller, more numerous CCN result in clouds with higher droplet concentrations but smaller droplet diameter. These smaller droplets fail to reach the critical mass required to fall as rain or snow. The potential reduction in precipitation can offset gains resulting from cloud seeding and reductions in precipitation from 15 to 25% were tied to air pollution in California and Israel. Closer to home, research attributed 30% or greater reduction in localized snowfall in Colorado’s Rocky Mountains to pollution occurring in the Denver and Colorado Springs areas.

Not only can pollution reduce precipitation, modeling conducted by the Department of Energy’s Pacific Northwest National Laboratory demonstrates that soot from fossil fuel combustion reduces snow’s reflective capacity and can accelerate snowmelt and alter stream flows, inducing earlier melts and exacerbating summer water shortages. Thus, water made available through precipitation augmentation could be offset by reductions in precipitation attributable to new energy production related emissions.

These changes in precipitation are separate and distinct from climate change, but could have an additive effect. The Intergovernmental Panel on Climate Change attaches “high confidence[ ]” to its conclusion that decreases in water resources attributable to climate change will impact much of the western United States. The National Research Council concurs, concluding that “the preponderance of scientific evidence suggests that warmer future temperatures will reduce future Colorado River stream flow and water supplies.” Such changes would make water intensive development even more difficult and renew calls for additional reservoir storage.

213 Randolph D. Borys et al., Mountaintop and Radar Measurements of Anthropogenic Aerosol Effects on Snow Growth and Snowfall Rate, 30 GEOPHYSICAL RESEARCH LETTERS No. 10, 1538 at 45-1 (May 2003); see also Amir Givati and Daniel Rosenfeld, Separation Between Cloud-Seeding and Air-Pollution Effects, 44 JOURNAL OF APPLIED METEOROLOGY 1298-1314 (2005); see also Daniel Rosenfeld and William L. Woodley, The Double-Sided Sensitivity of Clouds to Air Pollution & Intentional Seeding 21 SOUTHWEST HYDROLOGY, Mar./Apr. 2007, at 21.


215 Amir Givati and Daniel Rosenfeld, Quantifying Precipitation Suppression Due to Air Pollution, 43 JOURNAL OF APPLIED METEOROLOGY 1038 (Jan. 2004).

216 Borys et al., supra note 213, at 45-1; Israel L. Jirak and William R. Cotton, Notes and Correspondence: Effects of Air Pollution on Precipitation Along the Front Range of the Rocky Mountains, 45 JOURNAL OF APPLIED METEOROLOGY AND CLIMATOLOGY 236 (June 2005).

217 Yet Qiant et al., Effects of Soot-Induced Snow Albedo Change on Snowpack and Hydrological Cycle in Western United States based on Weather Research and Forecasting Chemistry and Regional Climate Simulations, J. GEOPHYS. RES. (2009).

218 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE [IPCC], 2007: SYNTHESIS REPORT 49 (Nov. 2007).

How intentional and inadvertent climate modification will interact to affect precipitation is unclear, but any decrease in precipitation would exacerbate competition for already scarce water resources. Reductions in precipitation would likely raise concern not just in Colorado and Utah, which obtain most of their water from snowfall in areas upstream of oil recovery, but with the other basin states that depend on upstream mountain snowfall for Colorado River flows. Given the potential to drastically impact water availability, weather modification, both intentional and unintentional, should be a key component of future research efforts.

B. Water Importation

A second option to increase water within the Colorado River Basin is to import water. As the Office of Technology Assessment noted near the tail of the last oil shale boom:

Interbasin transfers could be used to relieve the water problems of the oil shale region in several ways, [w]ater could be transferred directly to the oil shale region, either exclusively for oil shale development or for all users. Alternatively, the water needs of Colorado’s eastern slope cities, presently being supplied in part from the Upper Colorado River Basin, could be met from other hydrologic basins. The water presently being exported from the Upper Basin then could be used for oil shale development. In a third application of interbasin transfers, all or a portion of the 750,000 acre-ft/yr presently being supplied to Mexico by the Upper Basin States under the Mexican Water Treaty of 1944-45, could be taken from another hydrological basin (perhaps the Mississippi basin). The water thus freed in the Upper Basin could be assigned in part to oil shale development.220

Exxon proposed water importation during the oil shale boom of the 1970s and 1980s. As proposed, a 680-mile long, nine foot in diameter pipeline would have run from the Oahe Reservoir on the Missouri River in South Dakota, bringing 1.1 million acre-feet of water yearly to the Piceance Basin.221 A 1980 report estimated the cost of water delivered via this project at between $950 and $1,150 per acre-foot.222 The report also mentioned the possibility of importing water from the Yellowstone or Columbia rivers at an economic cost of $750 and $1,520 per acre-foot, respectively.223 Diversions from the Columbia River appear unlikely as the Columbia River Compact states: “No waters of the Columbia River System shall

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220 OFFICE OF TECHNOLOGY ASSESSMENT, AN ASSESSMENT OF OIL SHALE TECHNOLOGIES 77-78 (June 1980).
221 David F. Prindle, Shale Oil, Water and the Politics of Ambiguity, Center for Energy Studies at the University of Texas at Austin 22 (Oct. 1982); see also GULLIFORD, supra note 9, at 127.
222 OFFICE OF TECHNOLOGY ASSESSMENT, supra note 220, at 393.
223 Id. at 388.
be diverted out of the Columbia River Basin for use for any purpose except with the approval of all of the member states.”

While importation has some appeal, it suffers from three major problems. First, the Colorado River Basin Project Act guarantees the state of origin “adequate and equitable protection” sufficient to ensure continued availability of reasonably priced water. More importantly, the state of origin retains “priority of right in perpetuity to the use of the waters of that [exporting] river basin” unless otherwise stated in an interstate compact. The basin of origin must have, in effect, so much excess water that the basin of origin will not now, or in the foreseeable future, need its own water. As competition for water resources increases, the likelihood of such excess supplies becomes increasingly suspect.

Second, the enforceability of state export restrictions appears questionable in light of the U.S. Supreme Court’s opinion in Sporhase v. Nebraska. Sporhase involved a farm bisected by the Colorado-Nebraska boundary, which used water from a well located in Nebraska to irrigate crops in both Colorado and Nebraska. Under Nebraska law, a permit was required before water drawn from a well in Nebraska could be used in another state, the granting of which was contingent upon, inter alia, a grant of reciprocal rights to withdrawal and transport of groundwater from the state of use into Nebraska. In invalidating the statute, the Supreme Court held that water is an article of interstate commerce and such restrictive state statutes unreasonably burden the power of Congress to regulate interstate commerce. Justice Stevens did leave the door slightly ajar, suggesting that certain unique circumstances involving state-wide water shortages could conceivably justify reciprocity provisions. However, as one prominent authority notes, “[t]his standard can probably never be met,” and subsequent cases appear to support this conclusion. Thus, in light of Sporhase and its progeny, the enforceability of the Colorado River Basin Project Act’s export restrictions appear suspect. While the potential invalidity of export restrictions could favor a water importing oil shale industry, the financial and temporal cost of challenging the provision likely offsets the potential benefit and creates a level of uncertainty that makes this option less appealing.

Third, interbasin transfers raise significant environmental questions. Such a project would almost certainly be subject to review under the National Environmental Policy Act and would need to comply with a host of other federal laws.

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224 UTAH CODE ANN. § 73-19-7 Art VII(B) (2009). While a small portion of the northwest corner of Utah is within the Columbia River Basin, this area is well removed from the most geologically prospective oil shale areas. Therefore, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming would all need to consent to a diversion to the main area of shale producing land in Utah. In light of pressures on Columbia River salmon stocks, it is unlikely that all states would agree to significant out-of-basin transfers.
226 Id. § 1513(b).
228 Id. at 953-54.
229 Id. at 958.
230 See TARLOCK, supra note 81, at § 10.32 (2008).
and state environmental laws. The review and approval process alone would take years and cost millions of dollars, not counting financial costs and temporal delays resulting from likely litigation.

One such noteworthy environmental consideration that has garnered recent attention is whether water transfers require Clean Water Act discharge permits. The U.S. Court of Appeals for the 11th Circuit recently answered this question in the negative, removing one potential hurdle to interstate transfers. The Clean Water Act generally prohibits the “discharge of any pollutant” except as otherwise authorized by the Act. The Clean Water Act establishes the National Pollutant Discharge Elimination System (NPDES), allowing the EPA or state administrators to issue a permit for the discharge of a pollutant into national waters at or below the effluent limitations specified in the permit.

Under the Act, “discharge of pollutants” means “any addition of any pollutant to navigable waters from any point source.” A “pollutant” is broadly defined to encompass a large number of substances, including industrial, municipal, and agricultural wastes. “Navigable waters” are “the waters of the United States, including the territorial seas.” A “point source” is “any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.”

Historically, the EPA did not require NPDES permits for water transfers, and on June 13, 2008, EPA published a Water Transfers Rule stating that discharges from a water transfer do not require NPDES permits. The Rule defines “water transfer” as “an activity that conveys or connects waters of the United States without subjecting the transferred water to intervening industrial, municipal, or commercial use. This exclusion does not apply to pollutants introduced by the water transfer activity itself to the water being transferred.” Therefore, a transfer conveying lower quality water to a comparatively pristine

234 Id. § 1362(12).
235 See id. § 1362(6).
236 Id. § 1362(7).
237 Id. § 1362(14).
238 See NPDES Water Transfers Rule, 71 Fed. Reg. 32,887, 32,891 (proposed June 7, 2006) (to be codified at 40 C.F.R. § 122.3(i)) (explaining that EPA historically concluded that “Congress did not generally intend to subject water transfers to the NPDES program”). See also South Florida Water Mgmt. Dist. v. Miccosukee Tribe of Indians, 541 U.S. 95, 107 (2004) (noting the “longstanding EPA view that the process of transporting, impounding, and releasing navigable waters cannot constitute an addition of pollutants to the waters of the United States” (internal quotations omitted)).
239 See NPDES Water Transfers Rule, 73 Fed. Reg. 33,697 (June 13, 2008) (codified at 40 C.F.R. § 122.3(i)).
240 40 C.F.R. § 122.3(i).
water source would not require a NPDES permit, provided the water is not put to an intervening use, even if such a transfer would result in water quality degradation.

On June 4, 2009, the U.S. Court of Appeals for the 11th Circuit issued a highly anticipated opinion\(^\text{241}\) in *Friends of the Everglades v. South Florida Water Management District* addressing a challenge to EPA’s newly minted water transfer rule.\(^\text{242}\) The court characterized the issue as whether to afford deference to EPA’s choice between the “unitary waters theory,”\(^\text{243}\) which treats all waters as connected, and *Friends’ theory that the source and receiving bodies should be treated as separate and distinct. After noting that “all of the existing precedent and the statements in our own vacated decision are against the unitary waters theory,”\(^\text{244}\) the court concluded that such judicial conclusions were not dispositive. The issue was not whether the courts embraced the unitary waters theory, but whether the statute was ambiguous and if so, whether EPA’s regulation is a reasonable construction of an ambiguous statute.

After considering carefully the statutory language, the context in which it is used, and the broader context of the statute as a whole, the 11th Circuit concluded that the statute was ambiguous.\(^\text{245}\) With ambiguity established, the court reached a perfunctory conclusion that EPA’s interpretation of its mandate, and therefore its transfer rule, was reasonable.\(^\text{246}\) Ironically, the court recognized that under their ruling, pumping “dirty canal water into a reservoir of drinking water” is entirely permissible provided pumping added no new contaminant and only moved polluted water through the pipes.\(^\text{247}\) The court also conceded that such an event would “not comport with the broad, general goals of the Clean Water Act.”\(^\text{248}\) The court noted, however, that the Clean Water Act is far from pure in its application, and that the NPDES program ignores serious water quality problems associated with non-point pollution.\(^\text{249}\) Therefore, in the court’s estimation, it “is not difficult to believe that the legislative process resulted in a Clean Water Act that leaves more than one gap in the permitting requirements it enacts.”\(^\text{250}\)

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241 On April 29, 2009, the Federal District Court for the Southern District of New York stayed its ruling on the Water Transfer Rule’s validity, noting that a challenge to the rule’s validity was currently pending before the 11th Circuit. Catskill Mountain Chapter of Trout Unlimited v. EPA, Nos. 08-CV-5606 (KMK), 08-CV-8430 (KMK), 2009 WL 1174802, *48 (S.D.N.Y. 2009).

242 570 F.3d 1210 (2009).

243 Under the unitary waters theory “it is not an ‘addition . . . to navigable waters’ to move existing pollutants from one navigable water to another. An addition occurs . . . only when pollutants first enter navigable waters from a point source, not when they are moved between navigable waters.” *Id.* at 1217.

244 *Id.* at 1218.

245 *Id.* at 1227.

246 *Id.*

247 *Id.* at 1226.

248 *Friends of the Everglades*, 570 F.3d at 1226.

249 *Id.* at 1226-27.

250 *Id.* at 1227.
Friends of the Everglades may be headed for the U.S. Supreme Court, and one cannot help but question whether the ruling represents a conflict with specific provisions of the Clean Water Act rather than merely the Act’s “lofty goals.” If EPA’s rule confounds more than legislative aspirations, the foundation upon which Friends rests may erode quickly. Those contemplating water transfers must also remember that the rule applies only where waters are moved without the addition of new pollutants; the rule is inapplicable where contaminants are introduced as part of the transfer. Accordingly, prospective water users should be careful not to over-read Friends.

Thus, while importation has some initial appeal, the luster quickly fades as the practical realities of large-scale transfers are contemplated. While importation should not be dismissed out of hand, it is likely to make little progress unless other, less complex options are exhausted first.

C. Produced Water

When oil and gas are developed, operators often encounter groundwater that must be removed and disposed of to facilitate mineral extraction. Water produced through mineral extraction is normally treated as a waste product rather than a valuable resource and regulated as waste rather than under appropriations law. Produced water, if able to satisfy qualitative requirements and available for appropriation, represents a third potential source of “new” water for commercial oil shale development. However, the potential to use produced water in support of commercial oil shale development raises questions about the produced water’s place in the established water resources permitting scheme. A brief discussion of the produced water resource will give shape and context to the issues.

According to the Utah Mining Association:

Many of the oil shale and tar sands deposits in Utah are located near existing oil and gas activities where produced water is generally trucked from the site or replaced through injection wells. With injection well

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252 570 F.3d at 1227.

siting providing its own set of challenges and water removal transport requiring additional roadway activity, the environmental benefits of utilizing local produced water extend beyond minimization of fresh water requirements. Solutions such as recycling of produced water from conventional oil and gas production could be utilized to help offset water requirements for oil shale production.254

The Utah Mining Association’s proposal to effectively turn lemons into lemonade is intriguing, as it addresses several pressing problems. But moving from clichés to action requires substantive legal changes, which are seldom easy. Before changing existing legal institutions we must understand those institutions and why they developed as they did.

Treating produced water as a waste product made sense in the context of early oil well development, as the amount of water produced was minimal, generally of very low quality, and at the time the doctrine developed, other water sources were often readily available.255 Similarly, treating produced water associated with natural gas production as waste was often inconsequential because wells were usually so deep that produced water was isolated from usable water sources and unlikely to interfere with vested water rights. Coalbed methane wells fundamentally change this equation by producing greater quantities of higher quality water from sources that are often in continuity with usable aquifers.256

Colorado is at the epicenter of battles over produced water management, and a case involving sand and gravel mining forms the foundation for recent coalbed methane-specific litigation. In Three Bells Ranch Associates v. Cache La Poudre Water Users Ass’n, sand and gravel miners proposed to reclaim gravel pits by allowing the pits to fill with water that was in hydraulic continuity with the Cache La Poudre River, thus creating recreation amenities as well as fisheries and waterfowl habitat.257 The plaintiffs contended that pond filling and subsequent evaporative losses would increase net depletions to the over appropriated river, interfering with utilization of their water rights.258 The Colorado Supreme Court agreed, concluding that reclamation affected an appropriation,259 and that the miner’s choice not to reclaim the pits absent statutory requirements had no bearing

255 See Darin, supra note 253, at 283, 297.
256 See id. at 325. Wyoming, which is one of the nation’s leading natural gas producers, first encountered produced water from coalbed methane just 20 years ago. Id. As of 2007, Wyoming had 42,510 operating natural gas wells generating more than 300,000 acre-feet of produced water. 2007 Wyoming Oil and Gas Statistics, http://wogcc.state.wy.us/cfdocs/2007_stats.htm.
258 Id.
259 Id.
on their intent to appropriate. Thus, the lack of desire to use water does not imply the lack of intent to use water.

*Three Bells* formed the foundation for a 2007 Colorado Water Court decision holding that removing water in the course of coalbed methane production is an appropriation for a beneficial use and therefore requires a water right. *Vance v. Simpson* explicitly rejected arguments that groundwater removal is an unavoidable byproduct of production and lacks the requisite intent to appropriate. The Colorado Supreme Court agreed, dismissing appellants’ claim that produced water was a nuisance to be managed rather than a beneficial use by noting that coalbed methane producers “rely on the presence of the water to hold the gas in place until the water can be removed and the gas captured. Without the presence and subsequent extraction of water, [coalbed methane] cannot be produced.”

According to the Colorado Court, groundwater interception and use is therefore an “inevitable result” of development and the coalbed methane process “uses” water—by extracting it from the ground and storing it in tanks—to accomplish a particular “purpose”—the release of methane gas. The extraction of water to facilitate CBM is therefore a “beneficial use.” Under *Vance*, coalbed methane well operators in Colorado must now acquire water rights before proceeding, and such permits will be available only where the no injury rule is satisfied.

In response to the *Vance* decision, Colorado amended its water code to address the Division of Water Resources’ responsibility for permitting the withdrawal of groundwater as part of fluid mineral production. The amendment directs the Division of Water Resources to promulgate rules regarding the withdrawal of groundwater to facilitate oil and gas development, giving oil and gas well operators until March 31, 2010 to come into compliance with water right requirements. Notably, the rules apply equally to conventional oil and gas, not just the coalbed methane wells discussed in *Vance*. The bill also establishes a multi-tiered process to integrate coalbed methane wells that remove tributary ground water into the water court adjudication process.

A similar set of facts came before the Wyoming Supreme Court shortly after *Vance* in *William F. West Ranch v. Tyrell* where appellants claimed injury from coalbed methane process water extraction and sought declaratory judgment that the State of Wyoming improperly administered state law by not requiring a water right for process water extraction. While the Wyoming Court upheld the trial court’s

260 Id. at 173.
262 Id.
263 Vance v. Wolfe, 205 P.3d 1165,1170 (Colo. 2009).
264 Id.
265 Id. at 1167.
dismissal, concluding that the case lacked a justiciable controversy under the Administrative Procedures Act, the court recognized that the Wyoming State Engineer “has determined that produced water for CBM extraction is a beneficial use.”270 Accordingly, under Wyoming law, extracting coalbed methane production water requires a state issued water right.271

The Vance decision and Wyoming law have two important implications for commercial oil shale development. First, they create a strong incentive for coalbed methane producers to dispose of produced water in ways that minimize consumptive loss to the source aquifer because by so doing they minimize the risk of interference with vested rights. This, in turn, limits the availability of coalbed methane produced water as a source of supply for commercial oil shale development. Second, Vance, while limited to coalbed methane, could be a harbinger of legal arguments applicable to in-situ oil shale developers who need to dewater formations prior to extracting shale oil. As explained below, in-situ thermal processing wells and groundwater control wells used for oil shale development can raise the same questions that lead to the dispute in Vance.

Whether Utah courts will adopt Vance’s reasoning remains to be seen, but the opinion makes a compelling argument that gas wells affecting water rights are subject to permitting requirements under the state water code. Resolving the questions at the heart of Vance is not as pressing for Utah as it is for Colorado, at least with respect to coalbed methane. While Colorado’s Piceance Basin is rich in coalbed methane, there are no active coalbed methane wells within Uintah County.272 Yet for Utah, the proliferation of natural gas wells and associated produced water production,273 as well as the prospect of in-situ oil shale development, give rise to similar questions.

Most recently, drilled oil and gas wells within Uintah County are from 5,000 to 10,000 feet deep,274 much deeper than most municipal, industrial, or irrigation wells, and therefore likely isolated from usable surface and groundwater sources. However, Applications for Permits to Drill have been approved for natural gas wells as shallow as 1,500 feet.275 In-situ oil shale development wells are likely to

270 Tyrell, 206 P.3d at 725 n.1. See also, WYO. STAT ANN. § 41-3-904(a) (2009) (requiring any person intending to appropriate “by-product water” to file an application to appropriate groundwater with the state engineer).
271 See WYO. STAT ANN. § 41-3-930(a) (2009) (requiring filing of an application to appropriate groundwater before commencing well construction).
273 Utah Dep’t of Natural Res., Division of Oil Gas, and Mining, State of Utah Produced Water Disposition Summary Year 2006 Operations (on file with authors).
be 1,000 to 3,000 feet in depth, and therefore much more likely to intercept usable water than deep, conventional natural gas wells. Because de-watering for shallower oil shale development is more likely to interfere with existing beneficial uses of water, it is more likely that in-situ oil shale developers will face challenges similar to those raised in Vance.

Produced water management is of no small consequence because of the volume of water involved. In Utah, the Division of Oil, Gas, and Mining estimates that during 2006, oil and gas wells generated almost 20,000 acre-feet of produced water statewide. The three primary means of produced water disposal were: injection wells associated with secondary oil and gas production (44.7%), disposal wells (37.4%), and discharge to surface waters under Utah Pollution Discharge Elimination System permits (14.7%). Within Uinta County, oil and gas wells produced over 4,100 acre-feet of produced water during the year 2000, 67.6% of which was discharged to surface waters and 25.1% of which was reinjected.

Because produced water is normally treated as a waste product, legal requirements focus on disposal. As Three Bells Ranch and Vance point out, this ignores the possibility of a hydrologic connection between produced water and valuable surface and groundwater resources that could be impacted by removing produced water from the hydrologic system. Where produced water is in continuity with waters that can be put to a beneficial use and subject only to disposal regulations, regulations incentivize practices that affect what is essentially an off-the-books debit to the hydrologic system. Accordingly, greater synergy between produced water disposal regulations and appropriations law is needed.

As the Utah Mining Association notes, commercial oil shale development could be a way to beneficially use produced water, and provided use avoids impairment of other beneficial uses, such synergies could be beneficial. But these synergistic uses face their own set of challenges. Even though the produced water permit exemption still stands in Utah, indicating that extraction alone is not a beneficial use, there is little doubt that a permit is required when produced water is put to a beneficial use such as reinjecting produced water into hydrocarbon bearing formations to enhance gas production or used for dust abatement. When water is put to a beneficial use, a five-part test must be met before the state engineer can

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277 Utah Dep’t of Natural Res., Division of Oil Gas, and Mining, State of Utah Produced Water Disposition Summary Year 2006 Operations (on file with authors).

278 Id.

279 Utah Dep’t of Natural Res., Division of Oil, Gas and Mining, Disposition of Produced Water From the Oil and Gas Fields in the State of Utah (2000) (on file with authors).

issue a water right: (1) there must be unappropriated water available, (2) the proposed appropriation cannot impair existing rights or interfere with more beneficial uses, (3) the proposed plan must be physically and economically feasible and not detrimental to the public welfare, (4) the applicant must have the financial resources to complete the proposed project, and (5) the application was filed in good faith and not for purposes of speculation or monopoly.\textsuperscript{281}

Whether the first two prongs of the test can be satisfied depends in large part on the groundwater hydrology of the formation from which produced water is extracted. Deeper aquifers that are hydrologically isolated from waters already put to beneficial use are more likely to satisfy these requirements. However, the burden of proof in establishing that waters are in fact isolated from surface and underground sources of supply for other appropriators is on the party seeking to obtain the new water right.\textsuperscript{282} This may be difficult where appropriated waters would come from shallower sources of supply such as wells associated with in-situ oil shale development. Presumably, such projects would be physically and economically feasible and the applicant would have sufficient financial resources to complete the project or they would not proceed with a proposal. Therefore, the remaining question is whether such projects are in the public interest.

Bringing produced water into the fold of appropriative water rights law is an example of the proverbial double-edged sword. The public benefits from any measure that ends off-the-books loss of waters that could be put to a beneficial use. Existing water right holders’ ability to divert or withdraw water would be protected and scarce water resources would be preserved for future generations.

The countervailing argument is that current practices result in annual discharge of over 815,000,000 gallons of water (roughly 2,500 acre-feet) to surface waters within the Uinta Basin.\textsuperscript{283} Tighter regulation could end this informal surface water augmentation program. Moreover, the exemption from appropriative law provides tremendous economic benefit to the oil and gas industry, allowing industry to avoid complicated questions of water availability that could paralyze permit acquisition efforts. Requiring producers to ensure that produced water results in no interference with existing water rights holders could raise the cost of doing business, potentially by a significant amount. This, in turn, could impact employment, local economies, and the local tax base by discouraging development.

One possible answer is to create a rebuttable presumption, as New Mexico previously attempted, that wells deeper than 2,500 feet and drawing water with total dissolved solid levels exceeding 1,000 ppm are hydrologically isolated.\textsuperscript{284} However, such approaches appear too simplistic and New Mexico recently amended its water code, deleting the exemption and reinstating the state engineer’s

\begin{footnotesize}
\begin{enumerate}
\item[281] Utah Code Ann. § 73-3-8 (2009).
\item[283] Utah Dep’t of Natural Res., Division of Oil, Gas and Mining, Disposition of Produced Water From the Oil and Gas Fields in the State of Utah (2000) (on file with authors).
\end{enumerate}
\end{footnotesize}
jurisdiction over such waters. Whether a more carefully crafted exception could work in Utah is worth investigating.

As expensive as changing the way we look at produced water may be, sooner or later legal fictions must fall to the laws of physics. Water withdrawn and left to evaporate is water removed from localized hydrologic systems and a loss that should not be allowed to continue in the arid west, especially if it impairs other beneficial uses including nonconsumptive instream uses. Accordingly, the legislature should consider revising applicable portions of state law to address the three primary needs associated with produced water management: first, legislation must provide sufficient flexibility to accommodate variable geologic, hydrologic, environmental, and economic considerations—and must avoid the oversimplifications that plagued New Mexico’s early efforts; second, legislation must prevent withdrawals impairing sources of water that provide current or reasonably foreseeable supplies for beneficial uses; and third, legislation must ensure that produced water disposal does not impair either the quantity or quality of water available for current appropriation for beneficial uses.

It is also important to remember that intense oil and gas development may be incompatible with commercial-scale oil shale development. Whether oil and gas wells represent a source of production water or an insurmountable conflict likely depends on the site-specific development planned for both the fluid mineral and oil shale resources, which is unknown at this time. The proximity of well pads for natural gas development could impede sighting of oil shale production and retorting facilities, and multiple well perforations could interfere with in-situ well integrity. EOG Resources Greater Chapita Wells Natural Gas Infill Project foreshadows what could be an emerging conflict. The project involves drilling up to 7,028 new natural gas wells within the existing well field over the next fifteen years. Wells are expected to have a forty-year operational life. If approved as proposed, EOG would construct approximately 700 new well pads and expand approximately 979 existing or previously authorized well pads, resulting in one pad every twenty acres. Utilizing directional drilling and multiple well bores per pad, EOG would produce bottom hole spacing of approximately one bore every five to ten acres.

The 42,027 acre EOG project area contains some of the richest oil shale resources in Utah and is within the area identified as available for application for commercial oil shale leasing under BLM’s Programmatic RMP amendments. If approved as proposed, the infill project could complicate efforts to develop oil shale resources within Utah because the multiple perforations are likely to be incompatible with conventional mining methods or in-situ thermal processing.


286 See FINAL PEIS, supra note 30, at 4-18 (“Commercial oil shale development . . . is largely incompatible with other mineral development activities and would likely preclude these other activities while oil shale development and production are ongoing.”).

287 Notice of Intent to Prepare an Environmental Impact Statement for the Greater Chapita Wells Natural Gas Infill Project, Uintah County, UT, 74 FED. REG. 46,458 (Sept. 9, 2009).
Moreover, the 5,688 acres of anticipated surface disturbance will increase pressure on sensitive resources such as air, water, and wildlife, making permitting for additional surface disturbances needed for oil shale development all the more difficult.

EOG’s proposal may be but the first of many such burgeoning conflicts as, according to the Utah Geological Survey:

A significant portion of the Uinta Basin’s oil-shale resource, approximately 25% for each grade, is covered by conventional oil and gas fields . . . . In particular, the extensive Natural Buttes gas field covers a significant portion of land underlain by oil shale averaging 25 GPT [gallons per ton], ranging to 130 feet thick, and under roughly 1500 to 4000 feet of cover. Furthermore, this field is expected to expand in size and cover more oil-shale rich lands to the east. Of the 18.4 billion barrels contained in 25 GPT rock having thicknesses between 100 and 130 feet, 7.8 billion barrels, or 42%, are located under existing natural gas fields.

However, lands where the oil-shale deposits are under less than 1000 feet of cover currently do not contain significant oil and gas activity (except the Oil Springs gas field) as compared to lands with deeper oil-shale resources. The majority of planned oil-shale operations will be located on lands having less than 1000 feet of cover. This does not mean that oil-shale deposits located within oil and gas fields will be permanently off limits. In fact, most of the conventional oil and gas reservoirs are located far below the Mahogany zone. It simply demonstrates that regulators will need to recognize that resource conflicts exist and plan their lease stipulations accordingly.288

Moving forward, greater attention must be afforded to addressing and resolving multiple mineral development conflicts.

D. Conservation

Water lost to inefficient use represents a potentially untapped resource that, if used more efficiently, could help support commercial oil shale development or almost any other beneficial use. Subtly changing the prior appropriation doctrine could incentivize conservation, particularly for the most senior and least efficient water users. The task is, therefore, to make western water law more amenable to conservation, allowing water users to accomplish more with less. Oil shale development, and its associated demands for water resources, may provide an impetus to do just this.

The prior appropriations doctrine is often criticized because it “does not permit a party who conserves water to benefit from the effort; and because

288 Vandenberg, supra note 7, at 10.
implementing conservation is expensive, few venture down that road because the return is simply not worth the investment." Two competing doctrines provide legal sideboards for this critical, but accurate assessment: first, an appropriator may change the place of use, nature of use, or point of diversion without losing their original priority date, but they may do so only where the change impairs no other water right, whether junior or senior in priority. Second, a change to a water right cannot result in an increase in the quantity of water consumed. If a change holds diversions constant but lessens the amount of return flow, it enlarges the right and risks impairing the rights of other water users. Therefore, an appropriator who reduces seepage, evaporation, or conveyance loss by utilizing more efficient irrigation practices cannot use the saved water to irrigate additional land because this increases depletion and decreases water available elsewhere within the system to the detriment of other users. Together, these doctrines provide a powerful disincentive to modernization and efficiency improvements.

Incentivizing conservation effectively creates more water and can come "by plowing around the doctrine rather than plowing it under." Washington State has done just that, funding water conservation in return for title to the water conserved, which is deposited into the state trust water rights program. Acquired water rights retain their priority date and are held or authorized for use for "instream flows, irrigation, municipal, or other beneficial uses consistent with applicable regional plans for pilot planning areas, or to resolve critical water supply

290 UTAH CODE ANN. § 73-3-3 (2009); see also East Bench Irrigation Co. v. Deseret Irrigation Co., 271 P.2d 449 (Utah 1954).
291 See East Bench Irrigation, 271 P.2d at 445-46 (holding that the amount of water subject to change must be determined entirely from past water use records without regard to what the applicant claim they could have done under their right).
292 See Salt Lake City v. Telluride Power Co., 17 P.2d 281, 284 (Utah 1932) (holding that after water has been used on the appropriators’ lands, they have no further right to water that leaves their lands and finds its way back to the main channel as either runoff or seepage).
293 A downstream appropriator may make use of irrigation waste as long as the upstream irrigator makes it available, but the downstream user has no right to compel the continued wasteful use of water upon which his diversion depends. Estate of Steed v. New Escalante Irrigation Co., 846 P.2d 1223 (Utah 1992). However, if an upstream irrigator applies water more efficiently by switching from flood irrigation to a drip irrigation system, thus reducing seepage that feeds a spring relied upon by a downstream appropriators, see Howcroft v. Union & Jordan Irrigation Co., 71 P. 487 (Utah 1903) (establishing a presumption that water lost to seepage in the bed of a stream rejoins the stream), the downstream water user who receives less water can claim interference with their vested rights and seek either injunctive relief or monetary damages—provided that the spring is fed by water classified as “return flow” rather than waste or imported water. The key to this distinction is that return flows, as the term implies, return to the stream or natural groundwater system from which they were diverted. Imported water originates in another basin and is not normally available to the stream and, like waste, others cannot reasonably rely on it as a source of supply.
296 Id. § 90-42-040(3).
problems, \footnote{\textid{297} Id. § 90-42-040(1).} provided that use does not impair existing users or the public interest. \footnote{\textid{298} Id. § 90-42-030(4); R.D. Merrill C. v. Pollution Control Hearings Board, 969 P.2d 458, 464 (Wash. 1999).} A similar result could occur, without the need for state funding, if state law were to reward those who conserve water by allowing them to retain a portion of the water they conserve under their existing priority date while dedicating the remainder to instream flows. If senior water rights holders were able to obtain marketable title to a sufficient portion of the water saved through conservation, they would have an incentive to invest in more efficient infrastructure. The remaining portion, if dedicated to instream flow related purposes, could provide public benefits during periods of low flow when instream values are most at risk. In developing such an approach, legislators would need to exercise care to avoid interfering with return flows and the takings claims such perceived interferences would almost certainly provoke. Where one sits will affect where one chooses to draw the line between using the public interest to promote efficiency and taking of vested water rights. This is not an easy fix and will require considerable policy debate, but imposing efficiency requirements appears worth the effort, and emergence of a commercially viable oil shale industry may provide the impetus to begin moving down this road.

Prior appropriations law also provides an underdeveloped opportunity to critically evaluate whether a change of type or place of use is in the public interest. A water rights change application provides the state an opportunity to review the entire permit under the public interest analysis. \footnote{\textid{299} Hardy v. Higginson, 849 P.2d 946 (Utah 1993).} In Utah, public interest considerations require denial of appropriations and change applications where the change “will prove detrimental to the public welfare.” \footnote{\textid{300} UTAH CODE ANN. § 73-3-8(1)(b)(i) (2009), made applicable to change applications by § 73-3-3(5)(a).} The elements considered and their relative weights depend on local considerations, \footnote{\textid{301} Shokal v. Dunn, 70 P.2d 441 (Idaho 1985).} giving the state engineer tremendous discretion in determining whether to grant a change application. \footnote{\textid{302} Tanner v. Bacon, 136 P.2d 957 (Utah 1943) (holding the State Engineer has a duty to control the appropriation of water in a manner that is in the best interests of the public and must act reasonably, without arbitrariness or caprice, in fulfilling this duty).} The state engineer could deny a change application because the proposed use was so inefficient that a change would authorize waste, \footnote{\textid{303} Dep’t of Ecology v. Grimes, 852 P.2d 1044 (Wash. 1993) (holding that the quantum of water available for appropriation is limited to the amount needed to irrigate applying reasonable technology).} an unreasonably inefficient means of diversion would interfere with other beneficial uses, \footnote{\textid{304} Colorado Springs v. Bender, 366 P.2d 552, 555 (Colo. 1961) (“P]riority of appropriation does not give a right to an inefficient means of diversion, such as a well which reaches to such a shallow depth into the available water supply that a shortage would occur . . . even though diversion by others did not deplete the stream below where there would be an adequate supply for the senior’s lawful demand.”).} the change would harm water quality, \footnote{\textid{305} Tanner v. Bacon, 136 P.2d 957 (Utah 1943) (holding the State Engineer has a duty to control the appropriation of water in a manner that is in the best interests of the public and must act reasonably, without arbitrariness or caprice, in fulfilling this duty).} or the change would interfere with
other values such as public recreation or wildlife habitat. Thus, the public interest review may represent an underutilized tool to improve efficiency associated with projects supported by changing water rights.

Conservation has utility independent of oil shale development’s future. This benefit will only increase in importance in light of increasing scarcity attributable to population growth, growing recognition of the importance of non-consumptive uses, and variability in precipitation attributed to climate change. The prospect of oil shale development may present the impetus needed to revise the prior appropriations doctrine.

V. CONCLUSION

Commercial oil shale development will require water, and potentially lots of it. Even if oil shale extraction and retorting does not place major new demands on already scarce water resources, the population growth and economic development associated with an energy boom almost certainly will. Commercial oil shale development’s proponents understand the importance of adequate and reliable water supplies and, as seen in Colorado, have staked out claims for significant amounts of water. Aside from these already secured sources of water, development will rely on reallocation of existing water resources. Reallocation, however, means that while some users will win, others will invariably lose as their uses are displaced by more economically profitable uses. Certainty regarding the extent of available supplies and relative priorities is critical in resolving competing claims to scarce water resources—the kinds of claims that will increase in intensity with commercial oil shale development. As Professor Tarlock notes, “[u]ntil state claims have been reduced to definite rights in specific quantities of water, private capital cannot afford the investment risk, states will have difficulty selling bonds, and even the federal government will not authorize projects.”

Prospective water users can, in addition to reallocation of existing supplies, attempt to grow the overall supply of water. Potential efforts to grow the pie should not be overlooked, and of these, produced water reuse and conservation hold the most promise. However, in either scenario (reallocation or augmentation), prospective water users must recognize that requirements of protected species reflect significant constraints on paper water rights.

Water, in the arid west, always has been and always will be scarce. There are no silver bullets. Western states need to continue exploring ways to address the scarcity of water resources independent of the growing demand for energy. While the existing water laws of western states are flexible enough to accommodate changes in use, they often remain stifling to innovation and efficiency. As these states endeavor to modernize energy use and infrastructure, policymakers must recognize the opportunity to also modernize the use and regulation of water and do so in ways that do not lose sight of water’s full range of beneficial users.