You Never Step in the Same River Twice - The Effects of Changes in Supply and Demand in the Colorado River Basin on Wyoming Water Users

Kevin Carrico

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You Never Step in the Same River Twice—
The Effects of Changes in Supply and Demand in the
Colorado River Basin on Wyoming Water Users

Kevin Carrico*

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* Candidate for J.D., University of Wyoming College of Law, 2014. I would like to thank
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piquing my interest on the issues facing water users in the Colorado River Basin.
I. INTRODUCTION

The Colorado River is a vital water source for seven western states and parts of Mexico, supplying water to nearly forty million people.1 Twenty-one percent of the State of Wyoming is located within the Colorado River Basin and relies on the River’s water.2 This area in Wyoming includes the streams and rivers that flow into the Green River, the largest tributary of the Colorado River, and the Little Snake River Basin, which drains into the Yampa River and eventually into the Green River in Colorado.3 Collectively, both basins are referred to as the Green River Basin.4

The waters of the Colorado River system are over-allocated.5 Thus far, the shortfall between supply and demand has been met, largely because of the immense volume of storage in the Colorado River system.6 However, a recently released study suggests that the gap between supply and demand will increase, eventually causing the water levels in Lakes Powell and Mead to fall to zero around 2030 and rarely rise above this level going forward.7 Although such an outcome seems unfathomable, studies addressing supply and demand imbalances in the Colorado

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3 Id. at ch. 3-6.

4 Id. For the purposes of the 2010 Green River Basin Plan (2010 GRB Plan) and this comment, the Green River Basin includes both the Green River and the Little Snake River Basins in Wyoming. Id.

5 See infra notes 128–30 and accompanying text.

6 See infra notes 133–35 and accompanying text.

River system are unsettling. The United States Bureau of Reclamation (Bureau of Reclamation) recently released the Colorado River Basin Water Supply and Demand Study (Supply and Demand Study). While the results of this study do not predict such dire consequences for water storage in the Colorado River Basin, it does predict a significant shortfall between supply and demand in the future.

This potential for this shortfall establishes the need for Wyoming water users to inform themselves how changes in water supply in the Colorado River Basin as a whole will affect water use and availability in Wyoming. Wyoming has addressed this situation and attempted to limit the impacts on Wyoming water users; however, the discrepancy between supply and demand in the Colorado River Basin presents many issues to Wyoming water users. This comment discusses and critiques various features of Wyoming’s position in light of these recent studies to more fully inform Wyoming water users about the state’s current and future position in the Colorado River Basin.

To understand Wyoming’s position in the Basin, it is important to first explore the rights and obligations Wyoming has to the other states relying on the water of the Colorado River; thus, this comment begins with an overview of the “Law of the River.” Second, this comment discusses current and anticipated uses of Colorado River Basin water in Wyoming to determine the availability of water for current and future users. Third, this comment analyzes supply and demand imbalances in the Colorado River Basin, which will determine the amount of water available for current and future uses. Fourth, based on this discussion, this comment details the amount of Colorado River water available for use in Wyoming, the water users at risk in the state, and the likely interpretation of the compacts governing the use of Colorado River water. It concludes by discussing how Wyoming water users can protect their use of Colorado River water.

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9 Id. In 2012, the U. S. Bureau of Reclamation, in collaboration with representatives of the seven Colorado River Basin States, completed the Colorado River Basin Water Supply and Demand Study. Id. A major purpose of the Supply and Demand Study was to define current and future imbalances between water supply and demand in the Colorado River Basin. EXECUTIVE SUMMARY, supra note 1, at ES-4.

10 See FINAL STUDY REPORT, supra note 8.

11 See infra notes 16–78 and accompanying text.

12 See infra notes 89–108 and accompanying text.

13 See infra notes 112–28 and accompanying text.

14 See infra notes 154–213 and accompanying text.

15 See infra notes 214–55 and accompanying text.
II. Background

A. The Law of the River

The complex body of law determining the allocation of the waters of the Colorado River is called the “Law of the River.” There is no exact definition of the Law of the River, but it is composed of a myriad of compacts, treaties, statutes, and guidelines governing apportionment and utilization of the waters and tributaries of the Colorado River. The Law of the River determines both the amount of Colorado River water available for consumption in Wyoming and the obligations owed to other states. This comment focuses on the five main aspects of the Law of the River affecting the allocation of water in the Colorado River Basin. These are the 1922 Colorado River Compact, the Mexico Water Treaty of 1944, the Upper Colorado River Basin Compact of 1948, the decree the United States Supreme Court issued in Arizona v. California, and the 1968 Colorado River Basin Project Act.

1. 1922 Colorado River Compact

The 1922 Colorado River Compact (1922 Compact) is the original law governing the management of the Colorado River. The primary purpose of the 1922 Compact was to provide for an equitable apportionment of the use of the Colorado River system between the Basin states. To achieve this result, the 1922 Compact first divided the Colorado River Basin into two basins, using Lee Ferry, Arizona as the dividing line. The 1922 Compact defines the Upper Basin as the
parts of Arizona, Colorado, New Mexico, Utah, and Wyoming located within the Colorado River system, and from which waters naturally drain into the Colorado River System above Lee Ferry.\textsuperscript{23} The Lower Basin includes the parts of Arizona, California, Nevada, New Mexico, and Utah located within the system, and from which waters naturally drain into the Colorado River System below Lee Ferry.\textsuperscript{24}

Article III of the 1922 Compact describes how water is apportioned in the Colorado River Basin.\textsuperscript{25} First, the Compact allocates consumptive use of 7.5 million acre-feet (maf) per year to both the Lower and Upper Basins in perpetuity.\textsuperscript{26} Additionally, the 1922 Compact gives the Lower Basin the right to increase its beneficial consumptive use by 1 maf per year.\textsuperscript{27} Thus, the 1922 Compact allocates 16 maf of water on a yearly basis: 7.5 maf to the Upper Basin and 8.5 maf to the Lower Basin.\textsuperscript{28} Next, Article III(c) provides that if a right is recognized for Mexico to receive Colorado River water, it will first come from the aggregate over and above any surplus of the 16 maf allocated to the Upper and Lower Basins.\textsuperscript{29} However, if there is no surplus, the obligation to Mexico is shared equally between the two basins.\textsuperscript{30} Finally, Article III(d) requires the Upper Basin states to “not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75 maf for any consecutive ten year period.”\textsuperscript{31} The 1922 Compact further provides protection to perfected rights in use prior to its enactment, making clear they would be unimpaired.\textsuperscript{32}

2. Mexico Water Treaty of 1944\textsuperscript{33}

As allowed under Article III(c) of the 1922 Compact, the United States signed a treaty with Mexico in 1944, apportioning 1.5 maf of Colorado River Basin water to Mexico annually.\textsuperscript{34} Because this delivery obligation comes from an international

\textsuperscript{23} Id.
\textsuperscript{24} Id.
\textsuperscript{25} Id. art. III.
\textsuperscript{26} Id. art. III(a).
\textsuperscript{28} Id. art. III(a), (b).
\textsuperscript{29} 1922 Compact, supra note 18, art. III(c).
\textsuperscript{30} Id.
\textsuperscript{31} Id. art. III(d).
\textsuperscript{32} Id. art. VIII.
\textsuperscript{34} Treaty, supra note 33.
treaty—the Mexico Water Treaty of 1944, this allocation has the highest priority on the river.\textsuperscript{35} The Treaty also determines how water surpluses and shortages will be handled between the two nations.\textsuperscript{36} The treaty provides that Mexico will share in any surplus or shortage of water in any given year.\textsuperscript{37} Therefore, if the United States declares a surplus in addition to the amount needed to supply uses in the United States as well as the guaranteed delivery to Mexico, the United States can deliver up to 200,000 acre-feet of additional water to Mexico.\textsuperscript{38} This treaty also declares that in the event of “extraordinary drought or serious accident” to the United States’ irrigation system, the quantity of water delivered to Mexico will be reduced proportionately to the United States’ decreased consumptive uses.\textsuperscript{39}

3. Upper Colorado River Basin Compact of 1948

In 1948, the states of the Upper Basin negotiated the apportionment of water the Upper Basin received under the 1922 Compact.\textsuperscript{40} The two major purposes of the Upper Colorado River Basin Compact of 1948 (1948 Compact) were: (1) to provide equitable apportionment of the Colorado River System waters allocated to the Upper Basin under the 1922 Compact and (2) to establish the obligations of each state in the Upper Basin with respect to the flows required at Lee Ferry under the 1922 Compact.\textsuperscript{41} Unfortunately, the negotiators of the 1922 Compact vastly overestimated the average annual flows of the Colorado River system.\textsuperscript{42} Realizing these estimates were much higher than average, the Upper Basin states allocated consumptive use of the waters of the Colorado River system on a percentage basis because it was becoming apparent the Upper Basin might be able to consume

\textsuperscript{36} Treaty, supra note 33, art. X.
\textsuperscript{37} Id.
\textsuperscript{38} Id.
\textsuperscript{39} Id. The terms “extraordinary drought” and “serious accident” are not defined by the treaty. See id. This treaty has been amended repeatedly; over 300 minutes have been added to the Treaty since it was originally signed. Interim International Cooperative Measures in the Colorado River Basin through 2017, Minutes between the United States and Mexican Sections of the IBWC (2012), http://www.ibwc.gov/Treaties_Minutes/Minutes.html (last visited May 1, 2013). A minute is a subsequent development to the treaty. Damien M. Schiff, Rollin', Rollin', Rollin' on the River: A Story of Drought, Treaty Interpretation, and Other Rio Grande Problems, 14 IND. INT'L & COMP. L. REV. 117, 118 (2003). Minute 319, passed in 2012, allows for greater flexibility regarding water delivery to Mexico—such as allowing Mexico to store water in Lake Mead to be available in future years—and establishes operation measures which reduce water delivery when Lake Mead levels are low to deter more severe reductions in the future. International Boundary and Water Commission, Minute 319, Interim International Cooperative Measures in the Colorado River Basin Through 2017 and Extension of Minute 318 Cooperative Measures to Address the Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja California (2012) available at http://ibwc.state.gov/Files/Minutes/Minute_319.pdf.
\textsuperscript{40} See 1948 Compact, supra note 18.
\textsuperscript{41} Id. art. 1.
\textsuperscript{42} See Lochhead, supra note 16, at 317.
the 7.5 maf allocated to it in the 1922 Compact. The 1948 Compact first gives Arizona 50,000 acre-feet per year for its small area in the Upper Basin and then allocates the remaining Upper Basin share on a percentage basis: 51.75% to Colorado, 11.25% to New Mexico, 23.00% to Utah, and 14.00% to Wyoming.

The 1948 Compact describes how curtailment among the Upper Basin states will occur in the event the Upper Basin is unable to supply the 75 maf over a ten year period as required under Article III(d) of the 1922 Compact. If the Upper Basin has failed to meet this obligation, the Lower Basin can “call” on the Upper Basin to provide the under-supplied water at Lee Ferry. In this situation, the Upper Basin states will determine the extent of the curtailment for each state based on the following predetermined principles: first, the extent and timing of the curtailment are to assure Upper Basin compliance with Article III of the 1922 Compact. Second, if one Upper Basin state has used more than its share in the ten year period immediately preceding the year in which curtailment is necessary, then that state must supply at Lee Ferry the amount of the overdraft during this period before any demand will be made upon the other states of the Upper Basin. Third, in the event curtailment is necessary to satisfy the flow obligation to the Lower Basin, and no state has used more than its allocated share, each Upper Basin state must deliver to Lee Ferry a portion of the total curtailment based on the consumptive use of each state during the immediately preceding water year. For example, in a situation where no state consumed more than its allocated share, and Wyoming consumed fourteen percent of the total consumptive use of the Upper Basin in the year prior to curtailment, Wyoming would be required to supply fourteen percent of the curtailment. Finally, the 1948 Compact specifically notes rights perfected prior to November 24, 1922 shall be excluded from curtailment.

The 1948 Compact also provides for how losses due to evaporation in storage reservoirs are divided among the Upper Basin states. The losses from reservoirs

44 Id. art. III(a).
45 This is a legal requirement that the Upper Basin will not cause the river to be depleted to an extent that the obligations in the treaty are violated. Id. art. IV.
46 See 1922 Compact, supra note 18, art. III(d).
47 1948 Compact, supra note 18, art. IV.
48 Id.
50 See 1948 Compact, supra note 18, art. IV.
51 Id.
52 Id. art. V.
that are used to assist the Upper Basin states in meeting the delivery requirements of Article III(c) and (d) of the 1922 Compact are charged to an individual state in proportion to the amount of total water that the states in the Upper Basin used.\textsuperscript{53} Thus, if Wyoming consumed fourteen percent of the total water consumed in the Upper Basin, Wyoming would be charged fourteen percent of the total evaporation losses.\textsuperscript{54}

The 1948 Compact addresses the consumptive use of water by the United States of America or any of its “agencies, instrumentalities, or wards” and requires the use to be charged to the state in which the water is used.\textsuperscript{55} Finally, the 1948 Compact protects the unused portions of the water allocated to the individual states in the Upper Basin.\textsuperscript{56} Under Article XVI of the Compact, a failure of any state to use water apportioned to it will not constitute abandonment, forfeiture, or a relinquishment to the Lower Basin or any other state of the right to use the water.\textsuperscript{57}

4. Arizona v. California

The United States Supreme Court’s decision in \textit{Arizona v. California} focused mainly on water allocations in the Lower Basin; however, it is important to this discussion.\textsuperscript{58} This decision results in the Upper Basin having increased pressure to deliver water to the Lower Basin in two ways. First, the Court held that “the tributaries \[of the Colorado River\] are not included in the waters to be divided, but remain for the exclusive use of each state.”\textsuperscript{59} Thus, the Court held the Lower Basin was entitled to 7.5 maf of main stem Colorado River water, of which tributaries within each state would not be included.\textsuperscript{60} This puts more pressure on the Upper Basin to assure enough water reaches Lee Ferry than if the tributary flows were counted as part of the 7.5 maf allocated to the Lower Basin in the 1922 Compact because all of the 7.5 maf allocated to the Lower Basin must come from the Upper Basin.\textsuperscript{61}

Second, \textit{Arizona} reaffirmed a prior United States Supreme Court decision by holding that the United States reserved water rights for the Indian tribes of the

\textsuperscript{53} \textit{Id.}

\textsuperscript{54} \textit{See id.}

\textsuperscript{55} \textit{Id.}

\textsuperscript{56} \textit{Id.} art. XVI.

\textsuperscript{57} \textit{Id.}

\textsuperscript{58} \textit{See Arizona v. California, 373 U.S. 546 (1963).}

\textsuperscript{59} \textit{Id.} at 567.

\textsuperscript{60} \textit{Id.}

Basin effective from the date the Indian reservations were created.\textsuperscript{62} The Court in \textit{Arizona} went one step further by quantifying the amount of water intended to be reserved.\textsuperscript{63} The quantity of water reserved was the amount intended to satisfy the future as well as the present needs contemplated for the Indian reservations.\textsuperscript{64} The Court ruled the standard employed in quantifying the right associated with the reservations was whether enough water was reserved to irrigate all the practicably irrigable acreage on the reservations.\textsuperscript{65} The Court further determined the principle underlying the reservation of water rights for Indian reservations is equally applicable to other federal establishments, such as national recreation areas and national forests.\textsuperscript{66} The Court held “that all uses of mainstream water within a State are to be charged against that State's apportionment, which of course includes uses by the United States.”\textsuperscript{67} This means the main stem Colorado River water used to serve all federal reserved rights within a state is charged against that state’s allocation.\textsuperscript{68} The amount of water that must come from the individual state’s allocation is substantial to satisfy the federal reserved rights. The Bureau of Reclamation estimates that Indian tribes already hold quantified water rights to 2.9 maf of Colorado River water with substantial rights remaining to be quantified.\textsuperscript{69}

5. 1968 Colorado River Basin Project Act\textsuperscript{70}

The 1968 Colorado River Basin Project Act (1968 Act) directed the Secretary of the Interior to prepare, in consultation with the states of the Colorado River Basin, a Long-Range Operating Criteria (LROC) for the Colorado River reservoir system.\textsuperscript{71} Pursuant to the 1968 Act, the Secretary prepared and adopted the criteria for the first LROC in 1970.\textsuperscript{72} These criteria provide for the coordinated operation of reservoirs in the Upper and Lower Basins and also set conditions for releases

\begin{itemize}
\item \textsuperscript{62} \textit{Arizona}, 373 U.S. at 600; see Winters v. United States, 207 U.S. 564 (1908).
\item \textsuperscript{63} \textit{Arizona}, 373 U.S. at 600.
\item \textsuperscript{64} Id.
\item \textsuperscript{65} Id.
\item \textsuperscript{66} Id. at 601.
\item \textsuperscript{67} Id.
\item \textsuperscript{68} Id.
\item \textsuperscript{70} Colorado River Basin Project Act, 43 U.S.C. §§ 1501–1556 (1968).
\item \textsuperscript{71} Law of the River, supra note 17.
\item \textsuperscript{72} Id.
of water from Lake Powell and Lake Mead.\textsuperscript{73} The 1968 Act gave the Secretary of the Interior several directives for the coordinated operation of many federal reservoirs on the Colorado River.\textsuperscript{74} For example, the original LROC of 1970 directs the Bureau of Reclamation to release a minimum of 8.23 maf per year from Lake Powell.\textsuperscript{75}

In December 2007, facing the eighth year of the worst drought in more than a century of recordkeeping in the Colorado River Basin, the Secretary of the Interior adopted the “Colorado River Interim Guidelines” to manage Lower Basin shortages through the coordinated operations of Lake Powell and Lake Mead.\textsuperscript{76} These interim guidelines, which will remain in effect through 2026, enable the Bureau of Reclamation to manage water to prevent shortages in the Lower Basin while assuring the Upper Basin meets its ten-year flow obligation.\textsuperscript{77} The guide-

\textsuperscript{73} Id. These reservoirs provide a buffer to shortages in the Colorado River system. David E. Lindgren, \textit{Colorado River Shortages—Crisis or Just A Serious Problem?}, 11 ABA \textbf{WATER RESOURCES COMM. NEWSLETTER}, AUGUST 2004. Lake Powell, located in the Upper Basin accounts for 26.0 maf (or 43% of system storage). Id. Lake Mead, located in the Lower Basin has a total capacity is 27.4 maf (or 46% of system storage). Id.

\textsuperscript{74} 43 U.S.C. § 1552 (2012). This act requires the Secretary to propose criteria for the coordinated long-range operation of federal reservoirs to comply with and carry out the provisions of the Colorado River Compact, the Upper Colorado River Basin Compact, and the Mexican Water Treaty of 1944. \textit{Id.} The 1968 Act requires the Secretary to store water in the federal reservoirs and to make release from Lake Powell in a listed order of priority; first, the Secretary must release water from Lake Powell to supply one-half of any deficiency in delivery to Mexico under Article III(c) of the 1922 Compact. \textit{Id.} Second, the Secretary must release water required to comply with Article III(d) of the 1922 Compact (75 maf over ten years). \textit{Id.} Finally, the act requires the Secretary to release storage water from Lake Powell, which will not be required and not reasonably necessary to supply the first two requirements for the following purposes: (i) to the extent it can be reasonably applied in the states of the Lower Basin, but no such releases shall be made when the active storage in Lake Powell is less than the active storage in Lake Mead, (ii) to maintain, to the extent possible, the equalization of active storage in Lake Mead and Lake Powell, and (iii) to avoid spills from Lake Powell. \textit{Id.}

\textsuperscript{75} \textbf{CRITERIA FOR COORDINATED LONG-RANGE OPERATION OF COLORADO RIVER RESERVOIRS PURSUANT TO THE COLORADO RIVER BASIN PROJECT ACT OF SEPTEMBER 30, 1968}, 49 Ariz. L. Rev. 217, 223–25 (2007). From this figure, 8.25 maf, the expected annual tributary flow of the Paria River, which flows into the Colorado River below Lake Powell and above Lee Ferry (0.02 maf), is deducted. \textit{Id.}


\textsuperscript{77} “The objectives of the coordinated operations are: to avoid curtailment of uses in Upper Basin; minimize shortages in Lower Basin; and to not adversely affect yield for development in the Upper Basin through attempting to ‘equalize’ or balance the contents of Lakes Powell and Mead as nearly as practicable.” \textit{Id.}
lines reduce the risk of interstate river litigation as well as the risk of Upper Basin water users needing to curtail use during this interim period.78

B. State Preparations for a Possible Curtailment: Determining Consumptive Uses in the Green River Basin of Wyoming

The State of Wyoming is well-informed on the issues Wyoming users of Colorado River Basin water currently face.79 In 2005, following the lead of other Upper Basin states, the Wyoming State Engineer’s Office submitted a budget request for initiation of a multi-year effort to improve the agency’s consumptive use water data in the Green River Basin.80 To address the Colorado River Basin water issues, the Wyoming State Engineer’s Office created a new program entitled the “Colorado River Compact Administration Program.”81

The first and foremost objective for the program was the development and approval of the “Green River Basin Consumptive Use Determination Plan” (CU Plan).82 The CU Plan was initiated to outline the steps the State Engineer’s Office and the State of Wyoming should take to build and implement a comprehensive and efficient monitoring program in the Green River Basin.83 The purpose of this program is twofold. First, the program seeks to provide the State Engineer’s Office with the capability to accurately estimate the quantity of water consumptively used annually in Wyoming’s portion of the Colorado River Basin.84 Second, the program seeks to strengthen the state’s ability to perform administrative requirements within Wyoming that might be required under the 1922 and 1948 Compacts.85 This program is intended to ensure that Wyoming is the leading authority on Colorado River water use in the state.86 As the 2008 State Engineer’s

78 WYO. WATER DEV. COMM’N., supra note 2.
80 See CONSUMPTIVE USE PLAN, supra note 79. For example, Colorado’s Decision Support System is a water management system developed by the Colorado Water Conservation Board and the Colorado Division of Water Resources for each of Colorado’s major water basins. The Green River Basin comprises nearly 21,000 square miles in the southwest corner of Wyoming. Counties that contribute large areas to the Basin are Sweetwater, Sublette, Carbon, Lincoln, and Uinta, with small areas in Fremont and Teton counties. WYO. WATER DEV. COMM’n., supra note 2, at ch. 3. The major towns in the Basin are Rock Springs, Green River, Kemmerer, Pinedale, and Baggs. Id.
81 See CONSUMPTIVE USE PLAN, supra note 79.
82 Id.
83 Id.
84 Id.
85 Id.
86 Id. at 1–2.
Office annual report states, “the ultimate goal of any action taken under auspices of this CU Plan and the overall Colorado River Compacts Administration Program is to have a clearly defined and defensible approach to the implementation and administration of an Upper Colorado River Basin Commission initiated curtailment.” In satisfaction of these goals, the state has determined the current and anticipated consumptive use in Wyoming.

1. Current Water Use in the Green River Basin of Wyoming

Accurately estimating the amount of current consumption in the Green River Basin serves two important functions. First, it allows Wyoming to have a tabulation of year-to-year consumption in case there is a need for curtailment. Second, it allows for an estimation of the water that can still be developed and used in the state. An examination of both the water currently consumed in the state and the likely future demand provides insight into Wyoming’s position in the Colorado River Basin.

In 2010, Wyoming completed the 2010 Green River Basin Plan (2010 GRB Plan). This plan gathers comprehensive data to preserve Wyoming’s Colorado River compact allocation of water and ensure against future water shortages. The 2010 GRB Plan estimated the total consumptive use of Colorado River water in Wyoming is 603,878 acre-feet per year.

To accurately estimate Wyoming’s current consumption, the 2010 GRB Plan divided the total Green River Basin water use among seven sectors: agriculture, municipal, domestic, industrial, recreational, environmental, and evaporation. Table 1 lists the consumptive use of these seven sectors.

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88 Wyo. Water Dev. Comm’n, supra note 2, at chs. 5-95, 6-127.
89 See Consumptive use plan, supra note 79, at 3-4.
90 Id.
91 See Wyo. Water Dev. Comm’n, supra note 2.
92 Id. at ch. 1-2.
93 Id. at ch. 5-95.
94 Id. at ch. 5-52.
Table 1. Consumptive use in the Green River Basin of Wyoming\textsuperscript{96}

<table>
<thead>
<tr>
<th>Sector</th>
<th>Type of use</th>
<th>Consumptive use (acre-feet/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>Irrigation\textsuperscript{97}</td>
<td>396,246</td>
</tr>
<tr>
<td></td>
<td>Stock use</td>
<td>1,755</td>
</tr>
<tr>
<td>Municipal\textsuperscript{98}</td>
<td>Surface Water</td>
<td>6,578</td>
</tr>
<tr>
<td></td>
<td>Groundwater</td>
<td>884</td>
</tr>
<tr>
<td></td>
<td>City of Cheyenne Diversions</td>
<td>15,281</td>
</tr>
<tr>
<td>Domestic</td>
<td>Groundwater\textsuperscript{99}</td>
<td>3,047</td>
</tr>
<tr>
<td>Industrial</td>
<td>Surface water</td>
<td>56,833</td>
</tr>
<tr>
<td></td>
<td>Groundwater</td>
<td>1,954</td>
</tr>
<tr>
<td>Recreational</td>
<td>Non-consumptive</td>
<td></td>
</tr>
<tr>
<td>Environmental</td>
<td>Non-consumptive</td>
<td></td>
</tr>
<tr>
<td>Evaporation</td>
<td>Main Stem</td>
<td>88,500</td>
</tr>
<tr>
<td></td>
<td>In State</td>
<td>32,800</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>603,878</strong></td>
</tr>
</tbody>
</table>

2. Estimated Future Water Uses in the Green River Basin of Wyoming

The 2010 GRB Plan also analyzes the amount of Colorado River Basin water that will be required to satisfy the future water needs of Green River Basin water users.\textsuperscript{100} The two main factors affecting the future consumptive uses of water in the Green River Basin are population and economic growth rates.\textsuperscript{101} To estimate

\textsuperscript{96} Id. at ch. 5-95.

\textsuperscript{97} These use values are based on “normal year” estimates. Id.

\textsuperscript{98} The Green River Basin cities, towns, and joint power water boards that supply water to their citizens or customers from surface water are summarized in Appendix I. The largest municipal user of water in the Green River Basin actually lies well outside of the Basin; the City of Cheyenne, Wyoming, diverted an average of approximately 15,300 acre-feet of water per year from the Little Snake River Basin to the North Platte River Basin from 2003 through 2007. Id. at Ch. 5-68. Finally, the 2010 GRB Plan determined the consumptive use attributed to annual evaporation within Wyoming combined with the State’s share of main stem evaporative losses totaled 121,300 acre-feet per year. Id.

\textsuperscript{99} This value represents the average of the range of domestic ground water usage. Id. at ch. 5-95.

\textsuperscript{100} WYO. WATER DEV. COMM’N., supra note 2, at ch. 6.

\textsuperscript{101} Id. at ch. 6-97.
future population in the Basin, the 2010 GRB Plan explored three possible growth scenarios. Using low, moderate, and high growth scenarios, the 2010 GRB Plan provides wide estimates of how the current Basin population of around 60,000 could increase to anywhere between 66,464 and 134,225 by the year 2055. These population estimates permit the evaluation of Wyoming’s remaining compact allocation based on current use against possible future demands.

The 2010 GRB Plan projects that the largest changes from current consumption will be due to industrial and municipal demand increases. Table 2 summarizes the total estimated Colorado River water depletions depending on the projected growth scenario according to the 2010 GRB plan.

Table 2. Wyoming’s Remaining Compact Allocation

<table>
<thead>
<tr>
<th></th>
<th>50 year Projected Growth Scenario (acre feet/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Wyoming’s Allocation of the Upper Colorado River Water</td>
<td>847,000</td>
</tr>
<tr>
<td>Total Estimated Depletions</td>
<td>608,295</td>
</tr>
<tr>
<td>Remaining Compact Allocation</td>
<td>238,705</td>
</tr>
</tbody>
</table>

102 The river planning process developed by the WWDC determined population estimates would be developed for 10, 30 and 50 years into the future for each of the three planning scenarios: (1) Low Growth; (2) Moderate Growth; and (3) High Growth. WWC ENGINEERING, TECHNICAL MEMORANDUM: GREEN RIVER BASIN PLAN II- POPULATION PROJECTIONS, 9 (2009), available at http://waterplan.state.wy.us/plan/green/2010/techmemos/Population_Projections.html.

103 Id. at 20. Appendix II lists the projected domestic, industrial, and municipal consumptive uses through 2055.

104 See WWC ENGINEERING, TECHNICAL MEMORANDUM: GREEN RIVER BASIN PLAN II- INDUSTRIAL USE PROJECTIONS (2011); see WWC ENGINEERING, TECHNICAL MEMORANDUM: GREEN RIVER BASIN PLAN II- MUNICIPAL USE PROJECTIONS (2009).

105 WYO. WATER DEV. COMM’N., supra note 2, at ch. 6-127.

106 WYO. WATER DEV. COMM’N., supra note 2, at ch. 6-127. Wyoming’s allocation of the Upper Colorado River Water was estimated by the Wyoming State Engineer’s Office based on a position of 6,100,000 acre-feet of water supply per year and NO requirement to meet one-half of the Mexican Water Treaty obligation. Letter from John Shields, Interstate Streams Engineer, Wyoming State Engineer’s Office, to Murray Schroeder, WWC Engineering Sept. 30, 2012. (on file with author).

107 The state can store 120,000 acre-feet of water in Fontenelle Reservoir. WYO. WATER DEV. COMM’N., supra note 2, at ch. 6-127. The estimate of Remaining Compact Allocation is based on the assumption that the future industrial depletion shown will be met, in part, by the State of Wyoming’s water storage in Fontenelle. Id.
This table illustrates two important parts of the 2010 GRB Plan. First, Wyoming’s allocation of Colorado River water is 847,000 acre-feet on a yearly basis. Second, using this yearly figure, the State of Wyoming will have sufficient water for all anticipated water uses, even under the “High Growth Scenario.” Thus, under the 2010 GRB Plan, Wyoming appears to be in a good position with sufficient water for both current and anticipated demands.

C. The Growing Disparity Between Colorado River Water Supply and Demand

In 2012, the Bureau of Reclamation, in collaboration with representatives of the seven Colorado River Basin states, completed the Colorado River Basin Water Supply and Demand Study (Supply and Demand Study). A major purpose of the Supply and Demand Study was to define current and future imbalances between water supply and demand in the Colorado River Basin. Water supply and demand assessments were two major phases used to accomplish this goal.

1. Decreased Water Supply in the Colorado River Basin

The Supply and Demand Study explains climate is a driving force in the Colorado River’s water supply. The Supply and Demand Study determined change in the climate is likely to decrease the annual flows of the Colorado River, resulting in a decreased mean natural projected annual flow of between 13.7 to 15.0 maf at Lee Ferry by 2060. In 2007, the Bureau of Reclamation conducted an extensive review of Colorado River climate and hydrology studies. The

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109 Final Study Report, supra note 8.
110 Executive Summary, supra note 1, at ES-4.
111 Water Demand Assessment, supra note 69, at ch. C-1.
113 Id. at chs. B-74, 76.
114 Id. at ch. B-8. This report provides a summary of the assessment of the state of knowledge with regard to climate change and modeling for the Colorado River Basin and provides recommendations on future research and development needs. Climate Technical Work Group, U.S. Dept. of the Interior Bureau of Reclamation, Review of Science and Methods for Incorporating Climate Change Information into Reclamation’s Colorado River Basin Planning Studies U-2 (2007), available at http://www.usbr.gov/lc/region/programs/strategies/FEIS/AppU.pdf. This review found: (1) that there is strong scientific consensus that the earth has been warming and will continue to warm, and is due substantially to human emissions of greenhouse gases; (2) the impacts of climate change on the Colorado River Basin are less certain, but indicate the regional temperatures will increase; (3) The studies, taken together, show a common message; that runoff will decrease; (4) that system storage in the Basin is very sensitive to changes in mean inflows as well as to sequences of dry and wet years. Id.
Bureau of Reclamation’s Supply and Demand Study provides a summary of this review and concluded: “Common to nearly all this research is the projection of continued and accelerated warming in the Basin and very likely increases in the severity of future droughts.”115 The Intergovernmental Panel on Climate Change (IPCC) also predicts an overall warming in the United States, with increasingly severe temperature changes in the Southwest by the end of the 21st century.116 The Supply and Demand Study reports that the average annual mean temperature of the Colorado River Basin has increased approximately 3 °F since 1910 with a 2 °F increase since 1970.117 Going forward, the authors of the Supply and Demand Study predict a median increase in temperature of about 6 °F by 2080.118 Increased temperatures result in increased evapotranspiration, increased potential evapotranspiration, decreased snowpack, earlier runoff, and decreased soil moisture, which all contribute to decreased supply.

2. Increased Water Demand in the Colorado River Basin

The demand section of the Colorado River Supply and Demand Study provides a very thorough determination of the anticipated future demands for Colorado River Basin water.119 The Supply and Demand Study estimated Colorado River demand to increase to between 17.7 and 20.1 maf in 2060, factoring in Mexico’s allotment and losses, reservoir evaporation, phreatophyte losses, and operational inefficiencies.120

\[\text{Id. at ch. B-52.}\]

\[\text{Id. at ch. B-16.}\]

\[\text{Id. at ch. C-5.}\]

\[\text{Id. at ch. C-22.} \]

\[\text{Id. at ch. C-23.}\]
Both the population and the climate of the Basin will influence future demand. Population increases in the Lower Basin will account for the majority of increased demand in the Basin. About forty million people are estimated to reside in the Study Area today; the Supply and Demand Study anticipates this number to increase to between forty-nine and seventy-seven million by 2060. According to the IPCC, the vulnerability of water systems to extended drought is exacerbated by population growth and economic development. Population growth and economic development create more water demands from agricultural, municipal, and industrial uses, resulting in frequent over-allocation of water. Climate affects not only water supply, but also water demand. The Supply and Demand Study also concluded temperature changes are likely to increase demand from agricultural, municipal, and industrial sectors and also increase losses from reservoir evaporation.

D. The Effects of Decreased Supply and Increased Demand in the Colorado River Basin

The Supply and Demand Study compared the median water supply projections against the median Colorado River water demand projections and determined the long-term projected imbalance in future supply and Colorado River demand results in a shortfall of about 3.2 maf per year by 2060. The disparity between supply and demand is already significant. The Bureau of Reclamation estimated the total consumptive use, including evaporation, in the Colorado River Basin for 2005 to have already increased to 16.998 maf, with the average annual supply being around 15 maf. Thus, the waters of the Colorado River Basin are already over-allocated, making supply and demand imbalances even more likely and more pronounced in the future. To date, these imbalances have been managed and demands have been met through the use of the considerable amount of water

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121 See id.
122 Id. at ch. C-22.
123 Id. at ch. C-20.
124 Intergovernmental Panel on Climate Change, supra note 116, at 14.2.1.
125 Id.
126 See Water Demand Assessment, supra note 69, at ch. C-2.
127 Id. at ch. C-50. A phreatophyte is a deep-rooted plant that obtains its water from the water table or the layer of soil just above it. Phreatophyte Definition, Merriam Webster.com, http://www.merriam-webster.com/dictionary/phreatophyte (last visited May 1, 2013).
128 Executive Summary, supra note 1, at ES-6.
130 Id.; Water Supply Assessment, supra note 112, at ch. B-22.
131 Id. at ch. B-1.
storage available in the basin and the fact that the Upper Basin states have not fully developed their apportionment.132

1. **Storage Capacity of the Colorado River System**

The Colorado River experiences highly fluctuating flows on an annual basis.133 Without the storage built into this system, the Upper Basin would face chronic calls for curtailment of water use from the Lower Basin.134 The storage capacity of the Colorado River System is around 60 maf, four times the yearly average flow.135 The reality of continued consumptive uses exceeding supply has taken a toll on the immense storage of the Colorado River. At the end of water year 2004, Lake Powell was at thirty-eight percent of capacity, and Lake Mead was at fifty-four percent of capacity.136 At the end of water year 2012, the overall level of storage had not improved much, with Lake Powell measured at fifty-seven percent of capacity and Lake Mead at fifty percent in 2012.137

A recent study assessing the vulnerability of water supply in the United States (Vulnerability Study) concluded “Climate change can increase water demand and decrease water supply to the extent that, barring major adaptation efforts, substantial future water shortages are likely, especially in the larger southwest.”138 The Vulnerability Study found that, because of increasing demand and a likely decreasing supply due to climate change, the storage levels in Lakes Powell and Mead will fall to zero around 2030 and will rarely rise above this level going forward.139

The Bureau of Reclamation recently stated that under the 2007 Colorado River Interim Guidelines, only 7.48 maf will be released from Lake Powell in water year 2014.140 This is the lowest release of water from Lake Powell since

132 Executive Summary supra note 1, at ES-1; Water Supply Assessment supra note 112, at ch. B-1.

133 See Water Supply Assessment supra note 112, at ch. B-22 (stating that the inflow to Lake Powell in the period from 1895 through 2003 has averaged only about 15 maf per year, with a range from 5.6 maf in 1977 to 25 maf in 1984).


135 Executive Summary, supra note 1, at ES-1.


138 See Foti, supra note 7.

139 Id. at 130.

it was filled in the 1960s. The Bureau of Reclamation anticipates this lower-than-average water release will cause Lake Mead to drop an additional eight feet next year. In explaining the current situation in the Colorado River Basin, the Bureau of Reclamation noted: “Currently the longer-term projections from Reclamation’s hydrologic models show a very small chance of lower basin delivery shortages in 2015, with the first significant chance of reduced water deliveries in the lower basin in 2016.”

2. The Upper Basin Has Not Developed Its Full Compact Allocation

At the time of the signing of the 1922 Compact, the Lower Basin economy was growing at a faster rate, thus developing more Colorado River water than the Upper Basin states. The Upper Basin states wanted to protect its right to future development of Colorado River Water and develop water at a pace consistent with their needs. The Upper Basin has still not developed its full apportionment under the 1922 Compact. The Upper Basin’s estimated use and evaporation for 2005 were estimated at 3.796 maf. The Bureau of Reclamation estimated the Upper Basin’s average total consumptive use—including evaporation and other losses—for the 2006-2010 time period had increased to an average 4.499 maf per year for this period. As consumption in the Upper Basin continues to increase, it will be more difficult to ensure that the Upper Basin complies with Article III(d) of the 1922 Compact.

III. Analysis

The discrepancy between supply and demand in the Colorado River Basin presents many issues to Wyoming water users. This comment will first discuss the amount of water that will likely be available to Wyoming water users in the future. Second, it will explain how a call on Wyoming water users could happen.
despite the state having not used its full 1922 Compact allocation. Third, it will discuss how the state’s share of a curtailment will likely be determined under the 1948 Compact. Fourth, this comment will describe which water users will likely be affected by a valid curtailment. Finally, this comment will outline and critique proposed options the state has suggested for dealing with the difficulties facing Wyoming users of Colorado River Basin water.

A. Colorado River Water Likely Available to Wyoming Based on Predicted Hydrology of the River

Because Wyoming has taken progressive efforts to quantify the current levels of consumptive use in the basin, the state knows how much water it is currently consuming. However, estimates of the water available to Wyoming water users in the future vary widely. Consumptive use of Green River Basin water in Wyoming is limited by the 1922 Colorado River Compact, the 1948 Upper Colorado River Basin Compact, and possibly the 1944 Treaty with Mexico.

1. Obligation Under the 1944 Treaty with Mexico

Whether the Upper Basin has an obligation to supply one-half of the delivery to Mexico under the 1922 Compact and the 1944 Treaty has been a point of contention. A thorough discussion of this contention is beyond the scope of this comment; however, a brief description is warranted for context. The Upper Basin states argue they have no obligation because there is a surplus available in the Basin, and the Lower Basin is consuming it illegally and thus should curtail its own use to satisfy the obligation under the 1944 treaty. The Lower Basin states, on the other hand, contend that they are not consuming surplus Colorado River water. The Lower Basin argues they are instead consuming tributary water and this use is exempt from Compact apportionment and therefore, the Upper and Lower Basins should split the Mexican apportionment from main stem Colorado River water.

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150 See infra notes 180–85 and accompanying text.
151 See infra notes 187–208 and accompanying text.
152 See infra notes 209–13 and accompanying text.
153 See infra notes 214–55 and accompanying text.
154 See supra notes 92–98 and accompanying text.
155 See infra notes 156–71 and accompanying text.
156 For example, a thorough discussion is made in: Lochhead, supra note 16, at 320; Douglas Kenney et al., The Colorado River and the Inevitability of Institutional Change, 32 PUB. LAND & RESOURCES L. REV. 124 (2011).
158 Kenney et al., supra note 156, at 124.
159 Id.
2. Wyoming’s Allocation Under the 1922 and 1944 Compacts

Collectively, the 1922 and 1944 Compacts allocate to the Upper Basin consumptive use of 7.5 maf on a yearly basis, of which Wyoming is apportioned 14%. Assuming the Upper Basin has consumptive use of the full 7.5 maf allocated in the 1922 Compact, Wyoming can consume 14% of the 7.5 maf, or 1.043 maf of water, on a yearly basis. However, the Upper Basin is not guaranteed 7.5 maf of consumptive use under the 1922 Compact. Article III(c) and (d) of the 1922 Compact entitle the Upper Basin to the consumptive use of water only after the delivery obligation of the seventy-five maf per ten year requirement has been met, and satisfaction of a valid delivery obligation to Mexico.163

Wyoming is thus entitled to 14% of the waters allocated to the Upper Basin only after the Upper Basin’s obligations under the 1922 and 1948 Compacts have been met. Therefore, the amount of water available to Wyoming depends on two factors: (1) whether the Upper Basin has a delivery obligation of 0.75 maf per year under the 1944 Treaty with Mexico and (2) what amount of the 7.5 maf per year allocated to the Upper Basin is actually available because of the requirement to meet the obligation of seventy-five maf per ten years. Incorporating these two conditions, the Wyoming State Engineer’s Office computed the following table to describe the variability of water available to Wyoming appropriators.

Table 3 illustrates the substantial variability in the amount of water Wyoming can ultimately expect to consume from the Green River Basin based on these two factors.

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160 1922 Compact, supra note 18, art. III(a); 1948 Compact, supra note 18, art. III(a).
161 See 1948 Compact, supra note 18, art. III(a).
162 See 1922 Compact supra note 18, art. III(c), (d).
163 Id.
164 Shields, supra note 107.
Table 3. Wyoming’s Allocation of the Colorado River

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Upper Basin Annual Supply (acre-feet/yr)</th>
<th>Arizona’s Upper Basin Share (acre-feet/yr)</th>
<th>1944 Mexico Treaty obligation (acre-feet/yr)</th>
<th>Wyoming’s 14% Share (acre-feet/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario A</td>
<td>7,500,000</td>
<td>50,000</td>
<td></td>
<td>1,043,000</td>
</tr>
<tr>
<td>Scenario B</td>
<td>7,500,000</td>
<td>50,000</td>
<td>750,000</td>
<td>938,000</td>
</tr>
<tr>
<td>Scenario C</td>
<td>6,100,000</td>
<td>50,000</td>
<td></td>
<td>847,000</td>
</tr>
<tr>
<td>Scenario D</td>
<td>6,100,000</td>
<td>50,000</td>
<td>750,000</td>
<td>742,000</td>
</tr>
<tr>
<td>Scenario E</td>
<td>6,000,000</td>
<td>50,000</td>
<td></td>
<td>833,000</td>
</tr>
<tr>
<td>Scenario F</td>
<td>6,000,000</td>
<td>50,000</td>
<td>750,000</td>
<td>728,000</td>
</tr>
</tbody>
</table>

The 2010 GRB plan is based on the state having an allocation of 847,000 acre-feet of water available on a yearly basis. This reflects a position represented by “Scenario C” that there is 6.1 maf available to the Upper Basin, and the Upper Basin is not responsible for one-half of the delivery obligation to Mexico.

3. How Changes in These Two Variables Can Affect Wyoming Water Users

The 2010 GRB Plan estimated Wyoming will have water remaining under the state’s allocation from the 1922 compact, assuming the hydrology of the River will remain current through 2055 and that the Upper Basin has no delivery requirement under the 1944 treaty with Mexico. However, it is possible for

165 Scenario A is based on 7.5 maf of water supply per year and no requirement to meet one-half of the Mexican Water Treaty obligation. Id.
166 Scenario B is based on 7.5 maf of water supply per year and the Upper Division States being required to supply one-half of the Mexican Water Treaty obligation of 1.5 maf per year. Id.
167 Scenario C is based on 6.1 maf of water supply per year and no requirement to meet one-half of the Mexican Water Treaty obligation. Id.
168 Scenario D is based on 6.1 maf of water supply per year and the Upper Division States being required to supply one-half of the Mexican Water Treaty obligation of 1.5 maf per year. Id.
169 Scenario E is based on 6.0 maf of water supply per year and no requirement to meet one-half of the Mexican Water Treaty obligation. Id.
170 Scenario F is based on 6.0 maf of water supply per year and the Upper Division States being required to supply one-half of the Mexican Water Treaty obligation of 1.5 maf per year. Id.
171 See Wyo. Water Dev. Comm’n., supra note 2, at ch. 6-127.
172 See supra note 106 and accompanying text.
173 Wyo. Water Dev. Comm’n., supra note 2, at ch. 6-127.
either of these variables to change. In estimating future uses, it is important to realize that this is only an estimate and it may be found the Upper Basin does in fact have an obligation under the treaty with Mexico, and the water available to the Upper Basin will change depending on the hydrology of the river. Thus, the 847,000 figure the 2010 GRB plan uses is likely based on more water than will actually be available to the Upper Basin as a whole.

Decreased supply and the potential for an Upper Basin responsibility for one-half of the delivery to Mexico can result in significantly less water availability for Wyoming. A simplified calculation shows the effects of these variables. If the annual flow of the Colorado River is measured at 13.7 maf, and 7.5 is subtracted to satisfy Article III(d) of the 1922 Compact, 0.0050 maf is subtracted for Arizona’s share under the 1948 Compact, and 0.496 maf is subtracted to account for the evaporation chargeable to the Upper Basin, then 5.654 maf of consumptive use is available to the Upper Basin. Under this calculation, Wyoming’s share would be 0.792 maf. However, if the Upper Basin is responsible for one-half of the delivery obligation to Mexico, the Upper Basin’s share is reduced to 4.89 maf and would decrease Wyoming’s share to 0.684 maf.

The 2010 GRB plan estimates there is sufficient water available to the Green River Basin to meet current as well as all projected demand requirements through 2055 and still have a surplus Compact allocation remaining. However, under a setting where Wyoming is only entitled to consume 0.684 maf, sufficient water will not be available for the future “high growth scenario” in the 2010 GRB Plan and the remaining Compact allocation is significantly decreased. The state is unable to control the hydrology of the Colorado River System, but should continue to argue that the Upper Basin states are not responsible for one-half of the obligation under the 1944 Treaty, thus protecting water available for future use in the state.

B. Remaining Compact Allocation, but Still Subject to a Call by the Lower Basin

A scenario similar to one in which the Upper Basin is only entitled to around 4.89 maf of Colorado River water would also severely limit the Upper Basin states’ ability to meet the requirements of Article III(d) of the 1922 Compact...
while also developing their own water uses. This is especially relevant given the current and anticipated storage concerns.\textsuperscript{180} Even though it appears Wyoming will likely have sufficient water under most scenarios outlined in the 2010 GRB Plan, under Article IV(c) of the 1948 Compact, Wyoming water users could be subject to a short-term curtailment if the Upper Basin, as a whole, fails to deliver the amount of water at Lee Ferry required by Article III(d) of the 1922 Compact.\textsuperscript{181} Failure to meet the average flow requirements of Article III(d) would result in the Lower Basin “calling” on the Upper Basin to reduce consumption by the amount necessary to supply the required amount of water at Lee Ferry.\textsuperscript{182} A call on the river by the Lower Basin because of the Upper Basin’s failure to meet the ten-year average flow obligation at Lee Ferry has never happened.\textsuperscript{183} However, it is important to understand how such a call could happen.

In a situation where the Upper Basin, as a whole, has failed to comply with Article III(d) of the 1922 Compact, the Lower Basin can request delivery of the undersupplied amount.\textsuperscript{184} The possibility of a call is concerning to Upper Basin states, including Wyoming, because it would force the Upper Basin water users to curtail their use in order to ensure delivery of this amount of water at Lee Ferry. Decreased water supply and increased water demand will make it more difficult for the Upper Basin to store water and therefore fulfill this obligation in dry years.\textsuperscript{185}

\textbf{C. Determining Wyoming’s Share of a Valid Curtailment Request}

The Upper Basin states must formulate a plan based on how the 1948 Compact will likely be interpreted if the Upper Basin fails to meet the Article III(d) requirements of the 1922 Compact.\textsuperscript{186} Fortunately, there has never been a curtailment on the Colorado River due to a failure of the Upper Basin to meet these requirements, but this also means there is little guidance to the states about how the Compact will be interpreted should a curtailment become necessary.\textsuperscript{187} In 2005, the Wyoming State Engineer, facing continued drought and its corresponding effects on the water storage in the Colorado River Basin, commissioned a report (Consultant Report) to summarize Wyoming’s obligation

\textsuperscript{180} See supra notes 133–43 and accompanying text.
\textsuperscript{181} See 1922 Compact, supra note 18, art. III(d).
\textsuperscript{182} Id.
\textsuperscript{183} See Lindgren, supra note 73, at 11–12.
\textsuperscript{184} See 1922 Compact, supra note 18, art. III.
\textsuperscript{185} See Executive Summary, supra note 1, at Ch. ES-3; see supra notes 112–43 and accompanying text.
\textsuperscript{186} Purcell Consulting, Colorado River Compact Administration Project Prepared for: Water and Natural Resources Division Wyoming Attorney General’s Office and the Wyoming State Engineer (2005) (on file with author).
\textsuperscript{187} Id.
should the Upper Basin face curtailments because of a failure to comply with Article III(d). The Consultant Report provides a plain language interpretation of the 1922 and 1948 Compacts to determine Wyoming’s share of a curtailment where no Upper Basin state used more than its allocated share where all Upper Basin states must share in the curtailment under Article IV(c) of the 1948 Compact. The Consultant Report concluded that under the current state of affairs in the Colorado River Basin, Wyoming would make its own decisions regarding how to comply with a valid request for curtailment under the 1922 and 1948 Compacts. Consequently, beyond these Compacts, which illustrate how a curtailment might occur, Wyoming statutes and the prior appropriation doctrine are the only guideposts available to the Wyoming State Engineer if there is a valid curtailment request. Thus, under Wyoming state law, the State Engineer will administer a curtailment under the prior appropriation doctrine as a matter of state law, not interstate law. The Compacts will determine when a curtailment is required, but Wyoming law will determine how it is administered in the state.

The Consultant Report further clarifies the 1922 and 1948 Compacts. The Consultant Report notes these Compacts are unique in that the entitlements to water are based on consumptive use. Therefore, the extent of any curtailments will be based on the amount of consumptive use that must be reduced in order to meet the terms of the curtailment. Quantification of consumption is therefore increasingly important, as the resources of the Colorado River are subject to decreased supply and increased demand. Because the 1948 Compact bases curtailment on an individual state’s consumptive use from the prior year, this information gathered by the state is critical in knowing which uses will be curtailed. Both the 1922 and 1948 Compacts protect water rights in use prior to the signing of the 1922 Compact. Therefore, Wyoming is not obligated to

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188 Id.
189 See id.; See 1948 Compact, supra note 18, art. IV.
190 PURCELL CONSULTING, supra note 186, at 3.
191 Id. Under the prior appropriation doctrine, water use is based on a system of priority. Colo. Dep’t of Nat’l Res., Prior Appropriation Law, http://water.state.co.us/surfacewater/swrights/pages/priorapprop.aspx (last visited Apr. 22, 2014). This means the person with the oldest, or most senior, water right receives his or her water before anybody else on a stream can use water.
192 Id.
193 See id; see also Hobbs, supra note 134, at 23.
194 PURCELL CONSULTING, supra note 186, at 2.
195 Id.
196 Id. at 3.
197 See EXECUTIVE SUMMARY, supra note 1, at ES-9; see CONSUMPTIVE USE PLAN, supra note 79.
198 1948 Compact, supra note 18, art. IV.
199 Id. arts. IV, VIII.
curtail the use of water rights perfected prior to November 24, 1922.\textsuperscript{200} The plain language of the 1922 and 1948 compacts provide that if Wyoming has curtailed the use of all rights perfected on or after November 24, 1922, and has still not reduced consumptive use to the quantity specified in the curtailment request, no other rights should be affected.\textsuperscript{201} Taking this language literally, the Wyoming water users with rights perfected prior to November 24, 1922 cannot be forced to curtail their use.

To satisfy a valid curtailment request, the State Engineer must be able to determine the priority date of water rights being exercised to satisfy a valid curtailment request because both Compacts provide protection for rights perfected prior to November 24, 1922.\textsuperscript{202} Thus, in a curtailment situation, the State Engineer must first determine the previous year’s consumptive water use in the Green River Basin and then separate which uses occurred under pre-Compact rights and which did not.\textsuperscript{203} With these points in mind, the Consultant Report provides a hypothetical example of how a curtailment of existing water uses in the Upper Basin might be handled in any given water year.\textsuperscript{204} In this hypothetical scenario, the Upper Basin states agree that consumptive use in the Upper Basin should be curtailed by 1.2 maf to meet obligations under the 1922 Compact.\textsuperscript{205} Article IV(c) of the 1948 Compact explains that each state’s proportionate share of any curtailment is based on the individual consumptive use in each state in the year prior to the curtailment.\textsuperscript{206} The following table represents this hypothetical scenario, where the water curtailment in year 2 would be based on consumptive use in year 1, the preceding year.

\begin{table}
\centering
\begin{tabular}{|c|c|}
\hline
Year & Consumptive Use (maf) \\
\hline
1 & \text{Upper Basin} \\
2 & \text{Upper Basin} \\
\hline
\end{tabular}
\end{table}

\textsuperscript{200} Purcell Consulting, supra note 186, at 3; see 1922 Compact, supra note 18, art. VIII; 1948 Compact, supra note 18, art. IV.
\textsuperscript{201} See Purcell Consulting, supra note 186, at 3; see 1922 Compact, supra note 18, art. VIII; see 1948 Compact, supra note 18, art. IV.
\textsuperscript{202} Consumptive Use Plan, supra note 79, at 3.
\textsuperscript{203} Id.
\textsuperscript{204} Purcell Consulting, supra note 186, at 2.
\textsuperscript{205} Id.
\textsuperscript{206} Id. at 3.
Under this scenario—where the Upper Basin is obligated to curtail 1.2 maf acre-feet of consumptive use in Year 2—Wyoming’s share would be 96,000 acre-feet based on the fact that it consumed eight percent of the total Upper Basin’s Consumption in Year 1. The table demonstrates the need to quantify the total consumptive use in the Green River Basin as well as the consumptive uses of pre-November 24, 1922 water rights on an annual basis.

This Consultant Report provides useful analysis to Wyoming water users. Because the Upper Basin has never failed on its obligation to supply the required water at Lee Ferry as required by the 1922 Compact, a curtailment situation has never occurred and therefore, it is unknown how the curtailment provisions of the 1948 Compact will be interpreted. The Consultant Report provides a plain language interpretation of how a valid curtailment would affect the individual Upper Basin states under the 1948 Compacts. This interpretation illustrates the significance and value of rights perfected prior to November 24, 1922 and the vulnerability of more junior rights.

**D. Wyoming Users of Colorado River Basin Water at Risk**

Wyoming’s share of a valid curtailment request will depend on several factors and is therefore highly unpredictable. However, the Wyoming water users that will likely be affected by curtailment can be determined more easily. Two factors allow this determination. First, as discussed above, both the 1922 Compact and

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207 Id. at 2.

208 Id.
1948 Compact specify that water rights perfected prior to the signing of the 1922 Compact are excluded from any necessary curtailment. Thus, rights perfected under Wyoming law prior to 1922 are protected from a compact call under both the 1922 and 1948 Compacts while subsequent rights are not. Second, Wyoming water law is based on the principles of prior appropriation; therefore, a compact call by the Lower Basin will require curtailment of the most junior Wyoming appropriators’ consumptive water use until enough water flows past the state line to satisfy Wyoming’s portion of the curtailment.

Under these factors, Wyoming water users can determine if their use is vulnerable to a possible curtailment situation. As a general rule, the majority of the agricultural water rights in the Green River Basin in Wyoming have priority dates prior to November 1922, and the majority of municipal and industrial water rights have priority dates subsequent to November 1922. Therefore, it will be the most junior users, primarily municipal and industrial, who will face short-term impacts if curtailment is required to meet the flow requirement outlined in Article III(d) of the 1922 Compact.

E. Wyoming’s Proposed Options to Prepare for Curtailment

The state has outlined several strategies to help prevent a curtailment or at least lessen its effect on the users who would likely be affected by curtailment. Suggesting ways in which water users can overcome challenges of water availability in the event of a curtailment requirement was an objective of the 2010 GRB Plan. The following section discusses the proposed recommendations and strategies in the 2010 GRB plan.

209 1922 Compact, supra note 18, art. IV(c); 1948 Compact, supra note 18, art. IV.

210 Under Wyoming law, it is possible for water appropriators to use water under permits that have not been adjudicated. Green River Dev. Co. v. FMC Corp., 660 P.2d 339, 348 (Wyo. 1983). Therefore, it must be determined exactly when a right is actually “perfected” under state law to know whether it will be subject to curtailment in the event of a compact call. As there has never been a compact call, the definition of a perfected water right under the compacts has not been established. However, the Wyoming Supreme Court in the Green River decision concluded that a water right is “perfected” at the time of beneficial use. Id. at 349.

211 See Wyo. Const. art. VIII, § 3.

212 Consumptive Use Plan, supra note 79, at 9.

213 Tables A-1 and A-2 in Appendix 1 list the municipal and industrial water users in the Green River Basin.


215 Id. at ch. 1.
1. *Trans-Basin Diversions*[^216]

Because the Green River Basin has unused compact allocations, it is a potential source of water for trans-basin diversions.[^217] Although a trans-basin diversion would physically take water away from the Green River Basin, such a diversion could have beneficial effects on the Basin.[^218] In any trans-basin diversion, the resulting negative impacts to the basin of origin must be mitigated under Wyoming law.[^219] The 2010 plan identifies this requirement as an opportunity to barter currently available surplus water for improvements in the Basin, such as reservoir construction or enlargement to aid agricultural or municipal users.[^220] However, the drawbacks to trans-basin diversions in certain situations can be prohibitive.[^221] Trans-basin diversions can be expensive, time-consuming, and complex because of environmental and other regulations, and be subject to political and social controversies.[^222]

Though often inviting controversy, trans-basin diversions can provide water to Wyoming water users outside of the Basin who are unable to appropriate water while also providing benefits to water users in the Green River Basin. The mitigation requirement of these diversions can allow storage to be built in areas of the Green River Basin that do not currently have adequate storage. High Savery Reservoir is an example of a mitigation reservoir built in exchange for an out-of-basin diversion by the City of Cheyenne, which is located in a fully appropriated water system.[^223] Because the Green River Basin has unallocated water, it is in a unique position to barter water for the costs associated with building storage that can be used to benefit water users in the Green River Basin.

2. *Evaluate Water Rights Leasing*[^224]

Under Wyoming law, a water right can be transferred either temporarily or permanently to a new water user without losing its priority date.[^225] Typically, transfers require the new water user to petition the Wyoming Board of Control for permission for the transfer of the water right after demonstrating compliance

[^216]: Id. at ch. 8-161.
[^217]: Id.
[^218]: Id.
[^220]: WYO. WATER DEV. COMM’N., supra note 2, at ch. 8-162.
[^221]: Id. at ch. 8-161.
[^222]: Id. at ch. 8-162.
[^223]: Id.
[^224]: Id. at ch. 8-163.
[^225]: See WYO. STAT. ANN. § 41-3-104 (2012); see WYO. STAT. ANN. § 41-3-110 (2012).
with the statute allowing the transfer.226 Temporary transfers of water rights are available for a period of up to two years.227 As discussed earlier, the overwhelming majority of pre-1922 water rights in the Green River Basin are surface rights for irrigation purposes.228 As the Basin diversifies and the population increases, junior priority industrial and municipal water users can look to these senior and dependable water rights for transfer to provide a more predictable supply of water.229

Water rights perfected prior to November 24, 1922 are valuable to Wyoming water users because, under the plain language of the 1922 and 1948 Compacts, they will not be curtailed. Current Wyoming law allows permanent transfers of water rights, but this process has limitations in practice.230 Thus, any municipal or industrial entity that transfers an agricultural right will only be able to use the water during the traditional time it was used, which is the irrigation season, and will also be subject to the no injury rule.231 The process to change the water right to the new use is an onerous process typically requiring a hydrologic consultation to ensure compliance with the statutory requirements.232 Wyoming law also allows for the temporary change of use that is much less burdensome to the parties but is still subject to the no injury rule and is only effective for two years.233 Water right transfers, either on a temporary or permanent basis, can be a good way for water users to ensure that they have sufficient water in a curtailment, depending on their individual situation.

226 See WYO. STAT. ANN. § 41-3-104 (2012). The State Board of Control is composed of the Wyoming State Engineer and the Superintendents for the four Water Divisions in the State. WYOMING STATE ENGINEER’S OFFICE, http://seo.wyo.gov/agency-divisions/board-of-control. The State Board of Control is a quasi-judicial body with sole jurisdiction in the adjudication, administration, and amendment of water rights. Id.

227 WYO. STAT. ANN. § 41-3-110 (2012).

228 See supra notes 209–13 and accompanying text.

229 See supra note 2, at ch. 8-163.

230 Section 41-3-104 of the Wyoming Statutes allows transfers provided that the quantity of water transferred does not: (1) exceed the amount of water historically diverted under the existing use, (2) does not exceed the historic rate of diversion of the existing use, (3) does not increase the historic amount of consumptive use under the existing use, (4) decrease the historic amount of return flow, or (5) injure existing lawful appropriators in any manner. WYO. STAT. ANN. § 41-3-104 (2012).

231 WYO. STAT. ANN. § 41-3-104 (2012). The “no injury rule” requires that the water transfer not injure existing lawful appropriators in any manner. See Brian C. Shuck, Change of “Place of Use” Petitions Before the Wyoming Board of Control, 20 WYOM. LAW. 21, June 2004.

232 See WYO. STAT. ANN. § 41-3-104 (2012).

233 WYO. STAT. ANN. § 41-3-110 (2012). A temporary change of use typically only requires filling out a form with the Wyoming State Engineer’s Office (and not the other requirements of the permanent transfer) and the consumptive use is determined by presuming a 50% return flow.
3. Using Fontenelle Reservoir Water

The 2010 GRB plan also suggests water right holders can improve their water supply using unleased water, currently available, from Fontenelle Reservoir. The Fontenelle Reservoir storage right, held by the Bureau of Reclamation, has a priority date of January 22, 1962 to store 345,397 acre-feet of water. Through contracts with the United States signed in 1962 and 1974, Wyoming has the right to perpetually market 120,000 acre-feet and the first right of refusal to purchase water from the remaining capacity. The state currently has four active contracts for Fontenelle water. Combined, these contracts could result in the use of 46,550 acre-feet per year of Fontenelle storage water, but currently these contract holders are only making “readiness-to-serve” payments, and there has never been a request for water delivery for use.

The possibility of storage water in Fontenelle Reservoir serving as an interim supply during water rights curtailment was reviewed in the Consultant Report commissioned by the State Engineer in 2005. The report concluded that without changes in operations, Fontenelle would not be useful in mitigating the effects of a curtailment. First, the Consultant Report noted the state’s water rights associated with the reservoir are relatively junior. Next, the report states that the Bureau of Reclamation may be restricted from storing water if there is basin-wide curtailment of use under the Compact. Furthermore, the Report reviewed Wyoming’s contracts with the United States and found “that the [Bureau of Reclamation] may only be obligated to ensure that there is a reliable water supply for the water obligated by the state through exercised contracts.” The Report explains that under the current operations, the Bureau of Reclamation is only carrying enough water to meet the demands of the state’s only long-term contract for 35,000 acre-feet per year, indicating that the historic operations of the reservoir do not consistently carry over sufficient storage water to assist water users in the event of a curtailment. The Consultant Report concluded that changes

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234 WYO. WATER DEV. COMM’N., supra note 2, at ch. 8-169.
236 Id.
237 Id.
238 Id. at 1, 2.
239 PURCELL CONSULTING, supra note 186, at 7–8.
240 Id. at 8.
241 Id.
242 Id.
243 Id.
244 Id.
in operations, including temporary use agreements, could result in additional carryover storage that could be used to mitigate the effects of curtailments.245 Taking this all into consideration, for Fontenelle water to be useful in mitigating the effects of a future curtailment, water users must determine if the priority date of the reservoir will likely allow the water to be of use in a curtailment situation.

4. Continue to Evaluate Storage

The 2010 GRB plan further calls for the state to evaluate water storage in the Basin.246 Additional storage is beneficial to the Basin, as it is a way to capture and store water for use in the state without sacrificing another beneficial use.247 In addition, storage can help ensure reliable supplies, which may help meet compact calls with as little impact to individual water users as possible, and provide ecological benefits through minimum flows and pools.248 Unfortunately, under Wyoming law, it is necessary to show a need for storage before a reservoir can be built or enlarged and, currently, both Fontenelle and Flaming Gorge Reservoirs have unleased water.249 Thus, except in areas that these reservoirs cannot serve, it will be hard to demonstrate a need for additional storage. In areas where need can be demonstrated, additional storage can serve as an important mitigation tool for a possible curtailment situation.

5. Use Other States as an Example250

As previously discussed, it is the low-priority municipal and industrial water users who will need the most protection in the event of curtailment of use.251 The 2010 GRB Plan references concepts used by other states facing curtailment issues to allow these municipal and industrial water users to augment their existing water supplies.252 The Plan identifies concepts, such as rotational land fallowing and dry year leasing, as strategies which have been used in other states to keep agricultural water rights tied to the water user’s land, but also give the water right holder the flexibility to make agreements with more junior water right holders in need of a dependable water supply during times of water shortage.253 The benefit of these concepts is that they provide water to those in need of water only in the years

245 Id.
246 WYO. WATER DEV. COMM’N., supra note 2, at ch. 8-164.
247 Id.
248 Id.
249 Id.
250 Id. at ch. 8-163.
251 See supra notes 209–13 and accompanying text.
252 WYO. WATER DEV. COMM’N., supra note 2, at ch. 8-157.
253 Id. at ch. 8-164.
when their other usual water supplies are insufficient or subject to curtailment.254 As the 2010 GRB Plan discusses, some relatively minor changes in water right law could allow Wyoming water users more flexibility to adapt to the demands from the Colorado River Compacts.255

Moving forward, water users in the state will likely continue to develop Wyoming’s remaining allocation under the 1922 and 1948 Compacts. Both the state as a whole and individual water users can make use of the strategies outlined in the 2010 GRB Plan. The recommendations in the Plan provide the means for water users to minimize the impacts that are likely to be experienced in a curtailment situation. Planning and preparation will allow the state and individual water users to put themselves in a position where curtailment will result in minimal adverse consequences. In addition to the strategies suggested under Wyoming law, small changes to Wyoming law could help mitigate the effects of curtailment.

IV. Conclusion

The supply and demand imbalance in the Colorado River Basin represents a current dilemma that will be exacerbated in the future. The negotiators of the 1922 Compact assumed there would be ample supply for the Upper Basin to guarantee the availability of 75 maf passing into the Lower Basin over consecutive ten-year periods, to allow the Lower Basin to consume up to 8.5 maf per year while permitting 7.5 maf of consumptive use in the Upper Basin, and also to contemplate a future delivery requirement to Mexico.256 As the consumptive use of Colorado River water in the Lower Basin increases, the Lower Basin states will be adamant about the 75 maf per ten-year aggregate supply coming from the Upper Basin, as well as the Upper Basin’s responsibility for one-half of the water under the Treaty with Mexico. Currently, the shortfall between supply and demand has not resulted in a curtailment situation because of the immense amount of storage available and the fact that the Upper Basin has not developed its full allocation under the 1922 Compact. As the storage of the Basin is depleted and the Upper Basin continues to develop its water resource, a curtailment situation becomes much more likely.257

Wyoming’s position in the Colorado River Basin will be subject to both the future interpretations of the Law of the River and likely changes in the River’s hydrology. The State of Wyoming has been diligent in keeping abreast of the issues facing Wyoming users of Colorado River water. Based on the hydrologic

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254 Id.
255 Id.
256 See 1922 Compact, supra note 18.
257 See Hobbs, supra note 43, at 22; See Kenney et al., supra note 156, at 127.
estimations in the Supply and Demand Study, it appears likely that Wyoming has sufficient water for current uses under the Compact allocations. However, as the Upper Basin as a whole continues to develop its Compact allocations and the shortfall between supply and demand becomes more pronounced, it is important to realize this water is not guaranteed and can be subject to curtailment, even if Wyoming has not used its full compact apportionment. Hotter and drier conditions decreasing supply and increasing demand for water in the Colorado River Basin will likely result in the continued depletion of storage in the Basin, making the availability of water in the future less predictable. Under this scenario, the water users with more junior priority dates will be affected by a curtailment.

As the supply and demand imbalances are likely to be exaggerated in the future, Wyoming users of Colorado River Basin water must be vigilant to protect their water. Wyoming must continue to argue the Upper Basin states are not responsible for one-half of the obligation under the 1922 Compact. Continued consumptive use monitoring will allow the state to know which uses would have to be curtailed in the event of a call on the river by the Lower Basin. By planning ahead and acknowledging which users will likely be affected, Wyoming water users can determine the strategies that will lessen the impacts of a curtailment.
APPENDIX I—Current Water Use In The Green River Basin

The 2010 Green River Basin plan lists water use information for the fourteen Green River Basin cities, towns, and joint power water boards (JPB) that supply water to their citizens or customers. Table A-1 lists those that obtain their primary water supply from surface water and their surface water sources.

Table A-1. Municipal Use of Colorado River Water in Wyoming

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Source</th>
<th>Storage Right</th>
<th>Permit No.</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Town of Baggs</td>
<td>Little Snake River</td>
<td>None</td>
<td>620 Enl.</td>
<td>2/9/1901</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>28995</td>
<td>11/5/1984</td>
</tr>
<tr>
<td>Bridger Valley JPB</td>
<td>Smiths Fork and Blacks Fork Rivers</td>
<td>1500 acre-feet</td>
<td>26356</td>
<td>6/29/1978</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>26355</td>
<td>6/29/1978</td>
</tr>
<tr>
<td>Town of Dixon</td>
<td>Little Snake River</td>
<td></td>
<td>23143</td>
<td>11/7/1967</td>
</tr>
<tr>
<td>Town of Granger</td>
<td>Ham's Fork Green River</td>
<td>None</td>
<td>Territorial</td>
<td>1882</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4104 Enl.</td>
<td>3/23/1920</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6674 Enl.</td>
<td>11/8/1978</td>
</tr>
<tr>
<td>Kemmerer-Diamondville JPB</td>
<td>Kemmerer No. 1 Res.</td>
<td>1,770 acre-feet</td>
<td>5302 Res.</td>
<td>5/24/1935</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9776 Res.</td>
<td>1/12/1990</td>
</tr>
<tr>
<td></td>
<td>Hams Fork River</td>
<td></td>
<td>1601</td>
<td>10/13/1897</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3825 Enl.</td>
<td>10/01/1917</td>
</tr>
<tr>
<td></td>
<td>Kemmerer Springs</td>
<td></td>
<td>19392</td>
<td>5/27/1940</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>18392</td>
<td>7/30/1934</td>
</tr>
<tr>
<td></td>
<td>Ham's Fork</td>
<td></td>
<td>1674</td>
<td>11/19/1897</td>
</tr>
<tr>
<td></td>
<td>Little Canyon Drainage</td>
<td></td>
<td>30760</td>
<td>12/27/1989</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>31809</td>
<td>3/22/1996</td>
</tr>
</tbody>
</table>

258 WYOMING WATER DEV. COMM’N., supra note 2, at ch. 5-66, 67.


260 Id.

261 Id.

262 Id.

263 Id.
<table>
<thead>
<tr>
<th>Town of LaBarge River</th>
<th>None</th>
<th>24979</th>
<th>12/8/1975</th>
</tr>
</thead>
<tbody>
<tr>
<td>Town of Pinedale Lake Dam acre-feet</td>
<td>17,439</td>
<td>1817</td>
<td>5/6/1898</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1817</td>
<td>5/6/1898</td>
</tr>
<tr>
<td></td>
<td></td>
<td>392 Enl.</td>
<td>12/1/1898</td>
</tr>
<tr>
<td></td>
<td></td>
<td>626 Enl.</td>
<td>2/25/1901</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1631 Enl.</td>
<td>11/8/1906</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1631 Enl.</td>
<td>11/8/1906</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18601</td>
<td>1/30/1935</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5289 Enl.</td>
<td>1/2/1941</td>
</tr>
<tr>
<td>Green River/ Rock Springs/ Sweetwater County Joint Powers Water Board 3</td>
<td>None</td>
<td>Territorial</td>
<td>1871</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4620 Enl.</td>
<td>9/4/1928</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6415 Enl.</td>
<td>10/27/1971</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6672 Enl.</td>
<td>5/31/1978</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9682 Enl.</td>
<td>11/30/1989</td>
</tr>
</tbody>
</table>
Table A-2. Industrial Use of Colorado River Water in Wyoming

<table>
<thead>
<tr>
<th>Source</th>
<th>Principle Water Right and amount of diversion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electric Power Generation</strong>&lt;sup&gt;266&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Jim Bridger Power Plant (PacifiCorp)</td>
<td>Green River</td>
</tr>
<tr>
<td>Naughton Power Plant (PacifiCorp)</td>
<td>Hams Fork River</td>
</tr>
<tr>
<td><strong>Soda Ash Production and Related Products</strong>&lt;sup&gt;267&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>FMC Wyoming</td>
<td>Green River</td>
</tr>
<tr>
<td>General Chemical</td>
<td>Green River</td>
</tr>
<tr>
<td>OCI Wyoming</td>
<td>Green River</td>
</tr>
<tr>
<td>Solvay Minerals Inc</td>
<td>Green River</td>
</tr>
<tr>
<td>Church and Dwight</td>
<td>Green River</td>
</tr>
<tr>
<td><strong>Miscellaneous</strong>&lt;sup&gt;268&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Exxon Shute Creek Plant</td>
<td>Green River</td>
</tr>
<tr>
<td>Simplot Phosphates&lt;sup&gt;269&lt;/sup&gt;</td>
<td>Green River</td>
</tr>
</tbody>
</table>


<sup>265</sup> Id. at 3.

<sup>266</sup> Id. at 1.

<sup>267</sup> Id.

<sup>268</sup> Id.

<sup>269</sup> Id. at 7. The current operation used an annual average of 605 acre feet from 2004 to 2008. Id.

<sup>270</sup> Id.
Map of the Colorado River Basin