



# Reviewing reservoir operations in the North American West: an opportunity for adaptation

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## Abstract

Storage reservoirs are an important part of the water infrastructure in both the USA and Canada. Their operations are important not only for water supply but also for downstream aquatic and riparian ecosystems. Public agencies operate some of the most important water supply reservoirs in both nations: the federal Bureau of Reclamation in the western USA and the provincial Alberta Environment and Parks in Canada's South Saskatchewan River Basin. This paper examines legal and policy issues affecting potential changes in reservoir operations as an adaptation strategy in the western USA and southern Alberta and considers the two agencies' policies and practices on reviewing dam operations. Although both agencies appear to recognize the potential value of reviewing and revising their reservoir operating plans, neither makes a practice of doing so. Thus, there is no program to review the operations of water supply projects; by contrast, hydropower project operations have been reviewed and revised in both nations. The two agencies have similar approaches even though federal laws and institutions are important for reservoir operations in the USA, but have little influence in Alberta. Whether federal or provincial, these agencies have operated their projects primarily to benefit local interests.

**Keywords** Reservoir operations · Water management · Environmental flows · Climate adaptation · Alberta · United States

## Introduction

Water supply reservoirs are particularly important in regions where precipitation is limited and highly variable across seasons and years. This is true both in the western USA and the Canadian province of Alberta, where reservoirs store and release water for agricultural irrigation and other purposes. This article considers laws, policies, and practices regarding reservoir operations in these two regions of North America, focusing on water supply reservoirs that are owned and operated by government agencies. It also examines the federal government's role in determining the operation of existing reservoirs, comparing the minimal federal role in Alberta with the greater role of federal laws and institutions in the western USA.

The interior western USA and the South Saskatchewan River Basin of Alberta face similar challenges regarding their water resources and have generally similar legal regimes at the

state and provincial levels for allocating and managing water. But the federal presence in reservoir operations is greater in the western USA, because a federal agency operates most of the region's major water supply reservoirs, and because federal law has a greater influence on water management than it does in Canada. Despite this contrast in the role of federal laws and institutions, there is little practical difference in the approach to reservoir reoperations, as public agencies in both countries avoid reopening the operating plans for water supply projects.

Reservoir operations are an extremely important factor in water management for at least three reasons. First, reservoirs provide important human benefits such as storage for water supply, hydropower generation, and flood control, and each dam's operating practices directly influence the nature, value, and reliability of the benefits it produces. Second, reservoirs have major impacts on downstream rivers, and reservoir operations strongly affect the quality of downstream aquatic and riparian ecosystems (along with other values such as river recreation). Third, because a change in operations can improve a reservoir's performance in response to changing conditions—whether those conditions involve climate, water demands, public values, or other factors—reservoir operations

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offer an important means of helping water management adapt to such changes (Collier et al. 2000).

Thus, existing reservoirs may help water management adapt to new scientific information, to evolving local priorities, or to the potential impacts of climate change. Maximizing adaptive capacity, however, requires flexibility in the reservoir's operating regime. If the entity responsible for a reservoir insists on maintaining its established operating rules and practices, that reservoir will be limited in how well it can respond to relevant changes. This situation currently prevails across western North America, as there is no established program or practice of reviewing and revising the operating plans of water supply reservoirs in either nation.

This article begins with a brief overview of the physical and legal infrastructure of water supply in the western USA and southern Alberta, looking generally at water allocation systems, water supply reservoirs, and the primary legal factors affecting the operation of those reservoirs. The next section examines agency policies and practices for review of operating plans of existing reservoirs and contrasts the approaches regarding water supply with those for hydropower reservoirs. The final section offers some observations regarding federal influence on reservoir operating decisions in the two regions.

## Methods

The information and analysis in this article is based on research that focused on three types of sources. The first source was published works, mostly in the legal and social science literature, examining issues of water management in the region. The second was primary legal sources, including statutes, water project licenses, judicial decisions, and various administrative materials relating to reservoir operations. The third was semi-structured interviews with people directly or indirectly involved in reservoir operating decisions, including current and former officials with the agencies responsible for operating water supply projects in the western USA and Alberta.

The author conducted about 20 interviews with Alberta water professionals in order to gain a more complete understanding of the factors influencing Alberta Environment and Parks' decisions regarding the operation of its projects. Interviewees included current and former Alberta Environment and Parks (AEP) officials involved with project operations, water management, and environmental flows; irrigation district managers; and representatives from municipal water supply, hydropower, and environmental NGO interests. The author selected these interviewees based primarily on the recommendations of water-related faculty members at Alberta's research universities (see acknowledgment footnote). The interviews were semi-structured, based on a list of questions regarding the factors and approach involved in reservoir operations decision-making. On the US side, the

author interviewed about 10 officials with the Bureau of Reclamation regarding the agency's policies and practices in operating its projects. The author selected the US Bureau of Reclamation (USBR) interviewees based on recommendations of current and former USBR officials, along with some snowballing. The format and content of the US interviews were generally similar to those in Alberta.

## Water supply in the western USA and Canada: physical and legal infrastructure

In both the western USA and Alberta, reservoirs play very important roles in storing and supplying water for irrigation and other purposes. These reservoirs, however, operate within a complex system of laws and institutions that govern water allocation, development, supply, and management. This section briefly introduces the two regions, then summarizes each one's basic legal framework for water supply—most of which consists of state or provincial law—before turning to the relevant public agencies and the reservoirs they operate.

The western USA, as used in this article, refers to the 11 Rocky Mountain and West Coast states.<sup>1</sup> Major river systems in this region include the Colorado, Columbia, Missouri, Rio Grande, and Sacramento, although others—such as the Arkansas, Klamath, and Truckee—have been the focus of serious conflicts over water management. Most of this region is arid or semi-arid, and natural runoff relies heavily on snowmelt from mountainous areas. The fastest-growing states in the nation are found in this region, primarily due to population increases in major urban areas such as Denver, Las Vegas, Los Angeles, and Phoenix (Western Water Policy Review Advisory Commission 1998). By far the largest water use in this region, however, is irrigated agriculture, accounting for roughly 80% of the water withdrawals across these states (Maupin et al. 2014).

The South Saskatchewan River Basin (SSRB) covers nearly all of southern Alberta and a portion of western Saskatchewan. The South Saskatchewan River is formed by the confluence of the Bow and Oldman rivers in southeastern Alberta; it then flows northeast, and shortly after crossing into Saskatchewan, it is joined by another Alberta tributary, the Red Deer River. The Bow, Oldman, and Red Deer are fed primarily by snowmelt from the eastern slope of the Canadian Rockies, although the "southern tributaries" of the Oldman—the Belly, St. Mary, and Waterton Rivers—arise in Montana and flow north into Canada. The SSRB includes most of Alberta's largest cities (including Calgary), but here too, the dominant category of water use is agricultural irrigation (AEP 2006).

<sup>1</sup> These states are Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

## Legal infrastructure of water supply

### Western USA

Water law in the western USA is primarily state law, and with certain exceptions, the western states allocate and manage water under the Prior Appropriation Doctrine. Under classic Prior Appropriation, a person who diverts water from a particular source and applies that water to a “beneficial use” (e.g., irrigation or municipal supply) receives a permanent right to use water for that purpose. Thus, water rights are established by putting water to some beneficial use, and such rights are generally quantified based on the amount of water reasonably needed for that specific use; while such water rights do not guarantee any particular water supply, they are recognized as a form of property. The other core principle of Prior Appropriation is “first in time, first in right,” whereby the oldest water rights get priority access to water in times of shortage, as “junior” water rights may receive no water to ensure that “seniors” receive their full supply (Tarlock 2000). Especially during dry seasons and dry years, the exercise of water rights can, and often does, dry up streams in the western USA. Classic prior appropriation did not allow for protection of water left flowing in its natural course, and although several states eventually revised this aspect of their water law, many streams across the region still suffer the effects of dewatering caused by the use of pre-existing water rights (Gillilan and Brown 1997).

Decades ago, the western states adopted more-or-less comprehensive water codes that incorporated Prior Appropriation principles, while modifying them in some significant ways (especially in requiring a state-issued permit to authorize any major new water use). These water codes typically gave significant power to a state water agency to make decisions on proposed new water uses, changes to established uses, and distribution of water supplies among existing users, as well as additional powers. But these codes invariably retained the core principles of prior appropriation, including tying water rights to a particular beneficial use; quantifying such rights based on the amount needed for that use; recognizing such rights in perpetuity as a form of property; and giving priority to the oldest rights in times of shortage (Benson 2012). Over the past 60 years, most western states changed their laws to allow for protection of environmental flows, but where such protections exist, they are subject to pre-existing water rights and thus often ineffective in practice.

Despite the primacy of state law in this field, federal law controls some key aspects of water supply and management in the western USA. It governs the allocation of waters that are shared by two or more states; many interstate rivers in the West are governed by “compacts,” negotiated agreements that cannot take effect until they have been approved by Congress. Federal law ensures that lands reserved by the US government

for particular purposes—such as national parks, wildlife refuges, or homelands for indigenous tribes—have rights to the water needed to fulfill those purposes. Federal law also controls hydropower development and requires that non-federal hydropower projects operate under a detailed license issued by a federal agency. And reservoirs built by federal agencies are governed by federal statutes that authorized their construction and largely dictate their operational priorities, as explained in “[Western USA: authorizing statutes and other factors.](#)”

### Alberta

Water law was federal law in Alberta and the other prairie provinces until 1930, when Ottawa transferred control of water and other natural resources to the provincial governments. Alberta’s system of water law is often called “Prior Allocation,” which is similar to the US system, but differs in that the law always required Alberta users to obtain a government allocation of water for their proposed use.<sup>2</sup> Such a water allocation “license” is similar in many respects to a water right in the western USA, but in contrast to Prior Appropriation, a water license in Alberta does not create a property right to use the allocated water (Kwasniak 2010). This system has long relied on an administrative agency to make decisions about water licenses, and in Alberta, the agency responsible for allocating and managing water is AEP.<sup>3</sup> Licenses issued by AEP and its predecessors have allocated most of the SSRB’s water supply, including more than two thirds of the average annual flows of the Bow and Oldman Rivers and 75 to 118% of the Oldman’s southern tributaries (Pentney and Ohrn 2008).

As in the western USA, Alberta water law has been evolving away from a single-minded focus on development and consumptive uses to address a broader array of issues and interests. The Alberta Water Act of 1999 brought notable reforms, encouraging water resources planning, allowing for greater flexibility in the use of licensed allocations, and increasing the emphasis on environmental values (Percy 2005). As provided in the Water Act, and following an extensive public process, AEP developed an Approved Water Management Plan for the SSRB (SSRB Plan). The SSRB Plan closed the Bow, Oldman, and South Saskatchewan sub-basins of the SSRB to new allocations for most purposes; approved the transfer of existing water allocations, thus providing a mechanism for new users to obtain a reliable water

<sup>2</sup> In the early days of Prior Appropriation, users could obtain a water right with no government approval, simply by diverting water from its natural course and applying it to a beneficial use. Beginning in 1890, the western states began moving toward requiring a state-issued permit for all new water uses (similar to an Alberta license), and today, all the western states except Colorado require a permit for any significant new use of water.

<sup>3</sup> This agency has had several names over the years, but for the sake of clarity, this article always refers to it as AEP, even in describing the agency’s actions at a time when it had a different name.

supply; and established “Water Conservation Objectives” (WCOs), expressed as volumes or flows necessary to protect the SSRB’s aquatic and riparian ecosystems. The new WCOs called for higher flow levels than those previously established, but the SSRB Plan provided that the old levels would continue to apply to all existing allocations and facilities, making it unlikely that the more protective WCO levels would actually be met (AEP 2006).

Today, federal law plays a limited role in water allocation and management within Alberta. Most important in this regard is the Master Agreement on Apportionment, established in 1969, which apportions the water of rivers flowing from Alberta into Saskatchewan and from Saskatchewan into Manitoba (similar to a US interstate water compact). Other than the Master Agreement, however, federal law has limited relevance to water management in the SSRB today; other potentially relevant federal laws include the Fisheries Act (Olszynski 2015) and the Species At Risk Act (Bankes 2010), and while these laws could become more influential in the future, to date, neither has had much practical impact on water in Alberta (Horbulyk 2014).

In short, the laws of both Alberta and the western states have always sought to promote water development and use, allocating most of the available water (and sometimes more) for irrigation and other uses. But legally secure water allocations only go so far in western North America, where naturally available water supplies are highly variable over time and space. Thus, in both the western USA and Alberta’s SSRB, public entities built dams to store and release water, helping ensure that water supplies would be reliable in practice.

### Public agencies and their reservoirs

Although this paper focuses on water supply reservoirs, there are many dams in both the western USA and Canada that are operated for other purposes. Many dams, especially in British Columbia and the US Pacific Northwest, are owned by electric utilities and operate chiefly to generate hydropower. In the western USA, dams operated by the Army Corps of Engineers provide hydropower, flood control, and other benefits, but typically have little or no direct role in supplying water for consumptive uses. Some government dams have multiple functions, which may include water supply, flood control, hydropower, and recreation. This paper, however, focuses on reservoirs that operate primarily or solely for water supply and more specifically on those that are owned and operated by a federal or provincial agency.

### Bureau of Reclamation

The USBR is an agency of the Department of the Interior, within which is located multiple other federal agencies with diverse and sometimes conflicting missions, including the

Fish and Wildlife Service, Bureau of Indian Affairs, and National Park Service. USBR traces its history to the Reclamation Act of 1902, which authorized the Interior Department to build and operate water projects in 16 western states. Originally, these projects were to store and deliver water only for agricultural irrigation; over time, the USBR’s role expanded to include municipal water service, hydropower generation, and other purposes. The agency today states that its mission is “to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public” (Benson 2011b).

USBR became famous as a prolific dam builder, eventually constructing roughly 600 of them throughout the western USA. The oldest projects are now about a century old, but the major boom in USBR construction came in the middle third of the twentieth century, when the agency built most of its largest and most important dams. The “big dam era” ended around 1980, but by then, federal water projects had dramatically altered many parts of the West (Pisani 2008). USBR reservoirs dominate some of the region’s major river systems, including the Colorado, the Snake and other key Columbia River tributaries, and the Sacramento-San Joaquin, along with other important western rivers such as the Klamath, the North Platte, and the Truckee. Nearly every significant river basin in the western USA has at least one reservoir built by USBR.

According to its website, USBR today continues to operate 337 of the reservoirs it built, and collectively, they can store over 300 billion m<sup>3</sup>, supply irrigation water for over 4 million ha of farmland and drinking water for 31 million people, generate an average of 40 billion kWh of hydropower, and provide about 90 million annual visitor days of recreation. The agency also touts its environmental efforts, especially restoration of fish and wildlife, as it seeks to be viewed as a modern water management agency that delivers a variety of benefits to the region and the nation.

### Alberta Environment and Parks

AEP is an Alberta provincial agency with wide-ranging jurisdiction regarding environmental protection and natural resource management. Its responsibilities include water allocation and management, but also extend to fish and wildlife; provincial parks and other public lands; environmental quality (air, water, and waste); and climate change mitigation. Thus, this provincial agency has authority that would typically be spread across three to five agencies in most western US states. Its website declares that AEP, “as proud stewards of air, land, water and biodiversity, will lead the achievement of desired environmental outcomes and sustainable development of natural resources for Albertans.”

One of the AEP’s major water management duties is operating certain reservoirs, and related infrastructure such as

diversion weirs, in the SSRB. Water development was a high priority throughout the twentieth century, and several entities (including Canada's federal government) built major dams in the SSRB for various purposes (Klassen and Gilpin 1999). AEP now owns and operates some reservoirs that it took over from the national government, and others that the provincial government constructed (see Fig. 1, showing major AEP projects in the SSRB).

The AEP's reservoirs greatly influence flows on the SSRB's major rivers, although the Bow is also regulated by several important reservoirs operated by other entities. On the Bow, AEP diverts water from the river at Carseland Headworks and conveys it to McGregor and Travers Reservoirs, which release water to irrigate lands between the Bow and Oldman rivers. One of AEP's largest systems is the St. Mary Project, which stores water from the Oldman's southern tributaries in a set of reservoirs (the largest of which are St. Mary and Waterton) and releases it to supply irrigation districts south of the Oldman River. The Oldman River Dam, built by the provincial government amidst great controversy in the 1980s (deLoe 1999), forms a major reservoir that releases water to the upper Oldman River for various purposes. On the Red Deer, the AEP's Dickson Dam stores water and releases it to meet a variety of downstream needs, including sufficient winter flows for aquatic health, and also provides a measure of flood control for downstream communities (especially Red Deer and Drumheller). Each of these projects also provides some additional benefits, including boating and fishing on the reservoirs (Alberta WaterSmart 2015).

This brief description of AEP reservoirs brings up an important point, which applies equally to USBR projects: each

dam serves a particular purpose (or set of purposes) and is operated accordingly. Thus, while a single agency controls many dams, each of those dams has its own operating priorities and protocols. The next section considers some of the legal factors that determine how USBR or AEP operates particular dams.

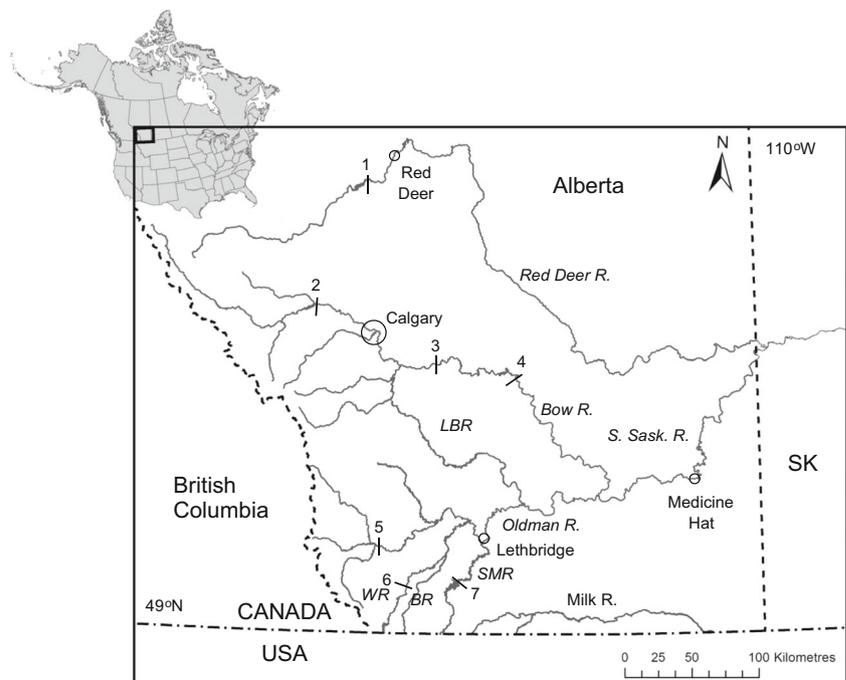
## Legal factors bearing on reservoir operations

### Western USA: authorizing statutes and other factors

Nearly all federal water projects were individually authorized by Congress, and the primary governing law for each USBR reservoir is its authorizing statute. These site-specific statutes identify the purpose(s) to be served by a particular project; most USBR projects are authorized for irrigation and one or more additional purposes, such as hydropower generation, municipal/industrial water supply, or recreation. Authorizing statutes may also address additional issues such as project features, repayment terms, and restrictions on the use of project water, but rarely address the details of reservoir operations. Once the project is built, Congress may revise the project authorization, such as by adding fish and wildlife as project purposes. Congress may even amend the authorization in a way that significantly changes a project's benefits and operational priorities, but has rarely if ever done so apart from a controversial law that partially repurposed the giant Central Valley Project in California (Benson 2017).

Authorizing statutes are federal law, but state water laws and water rights also affect USBR's project operations. When it created the legal framework for federal irrigation projects in

**Fig. 1** Map of southern Alberta showing the major tributaries of the South Saskatchewan River Basin, including WR Waterton R., BR Belly R., LBR Little Bow River, and SMR St. Mary R. Numbers indicate major dams: 1 Dickson, 2 Ghost, 3 Carseland, 4 Bassano, 5 Oldman, 6 Waterton, 7 St. Mary. Other significant dams exist, especially in the Bow River sub-basin. The South Saskatchewan and Red Deer Rivers both flow out of Alberta into Saskatchewan (SK) (note: a water project diverts water from the Bow River basin to the Oldman River basin via the LBR) (figure courtesy of S. Rood, University of Lethbridge)



the West back in 1902, Congress directed the Interior Department to “proceed in conformity with” state laws “relating to the control, appropriation, use, or distribution of water used in irrigation, or any vested right acquired thereunder ....” Congress changed many elements of the federal framework over the next century, but retained the requirement that USBR follow state water laws. Thus, each project has one or more water rights, recognizing the project’s appropriation(s) of water within the state where the project is located. These water rights specify when and how a USBR reservoir may store and release water, along with where and how its water may be used for irrigation or other purposes. Thus, the relevant federal law gives significant power to states regarding the USBR projects. The US Supreme Court has stated that Congress showed “deference” to the western states by preserving this role for state water laws and water rights, but the Court has also made it clear that states cannot impose restrictions or requirements on a USBR project that would be inconsistent with federal statutes regarding that project (Benson 2006).

Contractual arrangements for water supply and for hydropower are also major factors in the operations of USBR projects. Most USBR projects deliver water to one or more water supply entities such as irrigation districts or municipal water utilities, which in turn provide water service to their patrons. These entities receive project water under a contract with USBR, and while these contracts vary in several ways, the basic exchange is that USBR provides an agreed water supply in exchange for an agreed payment (which includes a charge for operation and maintenance of the project and typically also covers a portion of the costs of building it). In addition, USBR projects that generate hydropower operate under contracts to supply electricity to certain entities on specified terms.<sup>4</sup> Such contractual commitments greatly influence short-term operating practices in storing and (especially) releasing water at a particular project; that is, the timing and rate of USBR’s releases from a particular reservoir are largely determined by the demands of those who have contract rights for the water or power from that reservoir (Benson 2017).

Some USBR projects operate subject to another type of contract: compacts that allocate the water of interstate rivers. Such compacts become effective only after approval by Congress, giving them the status of federal law. On interstate river systems, compacts may effectively impose operating requirements or constraints on federal projects. For example, USBR’s Glen Canyon Dam on the Colorado River serves multiple purposes, but its most important operating requirement is releasing an annual volume of water to meet “Upper Basin” commitments to the “Lower Basin” and to Mexico,

consistent with the Colorado River Compact.<sup>5</sup> The Rio Grande Compact restricts storage by reservoirs (including USBR’s) on Rio Grande tributaries when storage falls below a specified level downstream at USBR’s Elephant Butte Reservoir. Thus, USBR reservoirs help ensure that states can manage and use water in accordance with the terms of interstate compacts, most of which focus primarily or exclusively on allocating water for irrigation and other consumptive uses (Benson 2014).

Federal environmental laws play a limited role at USBR projects, reflecting the courts’ narrow views of how these laws apply to reservoir operations. The most important federal law in this context is the Endangered Species Act (ESA), which protects species listed by the federal government as threatened or endangered. Federal agencies must avoid taking any action that would jeopardize the survival or recovery of a listed species and that substantive duty has effectively forced USBR to revise its operation of certain projects to improve the habitat for such species—typically, fish that live in rivers below USBR dams (Benson 2013). Apart from the ESA, however, seemingly relevant environmental laws have had little impact on USBR’s projects. The Clean Water Act has a primary objective “to restore and maintain the chemical, physical, and biological integrity of the nation’s waters,” but the courts have interpreted the law to leave most reservoir operations essentially unregulated regardless of their effects on water quality (Blumm and Warnock 2003). The National Environmental Policy Act (NEPA) requires federal agencies to assess the environmental consequences of their proposed actions before making a decision, to consider alternatives, and to involve the public in the process. The courts have held, however, that these well-established NEPA requirements do not apply to “routine” operations of USBR projects despite their environmental impacts. Ironically, NEPA has effectively *discouraged* USBR from reviewing project operations, because preserving the operational status quo allows the agency to avoid the expense, controversy, and litigation risk that an environmental review would entail (Benson 2011a).

### Alberta: license conditions

In Alberta, each reservoir has a water allocation license that sets forth the basic operating priorities for that reservoir, making the legal framework for water project operations

<sup>4</sup> Hydropower generated at federal water projects is marketed by power marketing administrations located within the US Department of Energy: Bonneville Power Administration in the Pacific Northwest and Western Area Power Administration in the other western states.

<sup>5</sup> The Colorado River Watershed includes parts of seven states, and the 1922 Colorado River Compact divides that watershed into an “Upper Basin” and a “Lower Basin” at a point on the Colorado River just below the Utah-Arizona state line (and just below Glen Canyon Dam). The Compact allocates a certain volume of water to the Lower Basin (Arizona, California, and Nevada) each year, and nearly all of that water is released from Glen Canyon Dam over the course of the year. In addition, the Compact requires the Upper Basin and the Lower Basin to share equally the burden of supplying water owed to Mexico, and Glen Canyon Dam must also release the Upper Basin’s share of Mexico’s water (USBR 2010).

somewhat simpler than it is for USBR projects. The water license states, with varying specificity, the purpose or purposes the reservoir serves. For example, the license for St. Mary and Waterton reservoirs states that they will be used to “impound and divert water for water management, flood control, erosion control, flow regulation and recreation.” The AEP’s Dickson Dam has a less specific license that simply states a purpose of “storage,” and refers to “the water resources management purposes of the project” without ever stating what they are. Some of these projects primarily benefit one or more irrigation districts, and although the AEP’s licenses do not require that the projects serve those districts, in practice, AEP operates them largely in response to the water supply needs and management preferences of the relevant districts (Jean and Davies 2015).

Water project licenses also contain various terms and conditions regarding the features and operations of the project. One common term requires a reservoir to release water for the benefit of the river (or certain uses of it) below the dam. Downstream flow requirements may specify a particular flow, such as 2.3 cms in the Waterton River below Waterton Dam, or may provide for downstream flows under a more complex formula, such as “80 percent habitat fish rule curve” for diversions at the Carseland Headworks.<sup>6</sup> Some water project licenses specify that AEP may revise instream flow requirements, while others recognize a more general authority to alter the terms and conditions of the license. In addition, several AEP water projects have license conditions relating to their operations. For example, the St. Mary Project and Carseland Headworks licenses both require development of an operating plan that addresses certain requirements, including releases for river flows below the dam. More detailed is the Oldman River Dam license, which requires that the dam be operated according to a strategy laid out in three specified reports and allows AEP to review and revise the operating strategy.<sup>7</sup>

The only significant federal influence on AEP’s project operations is the Master Agreement on Apportionment, which dictates the quantity of water that must flow into Saskatchewan (Prairie Provinces Water Board 2009). The basic rule is that Alberta must deliver annually to Saskatchewan an amount equal to one half the natural flow of each river that crosses the provincial border; Alberta may exceed that

percentage on the South Saskatchewan River, however, provided that the flow at the provincial line never falls below 42.5 cms during the year. AEP coordinates the operation of its reservoirs throughout the SSRB so as to ensure that apportionment requirements are met and impacts on Alberta users are minimized, but provincial reservoirs rarely have had to release water solely to ensure compliance with these requirements.

As discussed in this section, there are significant differences between the western USA and Alberta in the legal and institutional arrangements for water supply reservoirs. Within Canada’s decentralized system for water allocation and management, the Alberta government has nearly complete control of provincial reservoirs in the SSRB, with AEP having great authority regarding their operations. The federal role is much stronger on the US side, with USBR operating projects under both federal and state laws. Despite these legal and institutional differences, one thing is the same on both sides of the border: neither AEP nor USBR makes a practice of reviewing and revising the long-term operating plans for their reservoirs.

## Revising reservoir operations: policies and practices

Both USBR and AEP operate their water supply projects under long-term plans that provide a framework for daily and seasonal decisions about reservoir storage and releases. These plans outline various operational requirements and objectives, which may include target reservoir levels for all times of year (typically expressed as elevation curves); minimum and maximum releases during periods of high, low, and normal runoff; and minimum reservoir levels for purposes such as fish and wildlife or hydropower generation. These plans generally establish the outer bounds for storage and releases, but the reservoir operator retains discretion to make operational choices based on such factors as the snowpack in the watershed above the dam, any “carryover” storage in the reservoir from 1 year to the next, short- and long-term weather forecasts, expected demands for stored water, and potential flood risks (Benson 2017; Jean and Davies 2015).

There are good reasons to regularly review and revise these long-term operating plans to address changing conditions and evolving science (Richter and Thomas 2007; Pittock and Hartmann 2011). Thus, the US Army Corps of Engineers—which operates hundreds of dams across the nation, for flood control and many other purposes—has a rule requiring that the “water control manuals” for its reservoirs be reviewed and updated at least every 10 years, “to conform with changing requirements resulting from developments in the project area and downstream, improved understanding of ecological response and sustainability, new legislation and other relevant

<sup>6</sup> The license itself only makes certain diversions subject to the “Instream Objective established for the reach of river between the diversion weir and Bassano Dam.” The license did not specify the level of that Instream Objective, but AEP would later tie it to the “80 percent habitat fish rule curve.”

<sup>7</sup> This unique operating regime for the Oldman River Dam grew out of political and legal opposition to the dam’s construction. The dispute reached the Supreme Court of Canada, which issued a nationally significant ruling on the federal government’s interests and responsibilities regarding the proposed project. Although the provincial government succeeded in completing the dam, the controversy led to an operating plan geared toward sustaining downstream riparian and aquatic ecosystems, as well as irrigation water supplies (Rood and Vandersteen 2010).

factors ...” (Benson 2017). Climate change, of course, is another compelling reason to review operating plans in light of projected changes in precipitation, runoff, and other factors (USBR 2016). Despite these reasons to review and revise long-term operating plans, however, neither USBR nor AEP makes a practice of doing so.

## Water supply projects: no regular review of operations

### US federal projects

Unlike the Corps of Engineers, USBR has no established policy of periodically reviewing and revising its reservoir operating plans.<sup>8</sup> The agency does not make a regular practice of conducting such reviews, but it has revised the operating regimes for several of its projects over the past several years, primarily to comply with the ESA’s mandate to avoid causing jeopardy to a threatened or endangered species. Other than the ESA, however, no generally applicable law has prompted USBR to proceed with reviews of its reservoir operating plans. For a few projects, notably including Glen Canyon Dam on the Colorado River, Congress has directed USBR to review and revise its operating plans to address specified concerns.

USBR has not taken the position that there is no point in revisiting its operating plans; to the contrary, it seems to recognize the potential value in reviewing and revising them. The first stated goal of USBR’s *Climate Change Adaptation Strategy* is to increase water management flexibility, and one of the key means to this end is to “[i]dentify opportunities to adapt reservoir operations to improve flexibility.” To begin implementing this strategy, USBR in 2014 launched a Reservoir Operations Pilot Initiative to evaluate climate change impacts on reservoir operations and assess ways that operational flexibility can assist with climate adaptation. USBR is now proceeding with pilot studies involving one river system in each of the agency’s five regions, but it is not clear the extent to which these studies will go beyond technical matters (such as improved use of weather and climate data) to include a broader range of interests and values affected by its project operations (USBR 2016).

USBR recently took a positive step at one major project, updating its operating regime for Glen Canyon Dam, which provides important storage for major water users and generates considerable hydropower. Along with the National Park Service,<sup>9</sup> USBR developed a Long-Term Experimental and

Management Program (LTEMP) that will serve as Glen Canyon Dam’s operating framework for the next 20 years. The LTEMP process considered seven alternatives, presenting a range of potential operating regimes for Glen Canyon Dam and evaluating them against interests ranging from water supply and hydropower, to recreational boating and fishing, to archeological, cultural, and tribal resources. The process took 7 years to complete and provided multiple opportunities for public participation in developing, analyzing, and selecting alternatives. Although federal agencies took the lead, the seven states of the Colorado River Basin were key players in the review process, proposing a plan that was very similar to the one that was finally adopted. The LTEMP updated a Glen Canyon operations plan from the mid-1990s, which had been required by Congress under the Grand Canyon Protection Act of 1992 and which substantially reduced daily and hourly fluctuations in river levels caused by hydropower releases. While the second update was not similarly required by law, USBR and the Park Service stated that the LTEMP would ensure that operations would remain consistent with the 1992 statute (USDI 2016).

### Alberta provincial projects

AEP has no general program or practice of reviewing and revising the operating plans for its water supply projects. Such reviews are not required by Alberta water law, by project license conditions,<sup>10</sup> or by agency rule or policy. The Approved Water Management Plan for the SSRB, however, clearly recognizes the potential value in revising reservoir operations. This plan, adopted by AEP after an extensive public process in 2006, notes the environmental benefits that could result from even “minor changes in dam operating practices” and recommends that the agency “hold discussions with Government and other dam owners to investigate opportunities to optimize operation of the facilities ...” (AEP 2006).

AEP has sometimes acted to revise formal operating requirements for its water supply projects, where the agency has identified that downstream flows were clearly inadequate for environmental or other purposes. For example, the agency significantly increased minimum releases from the St. Mary Project in the early 1990s after recognizing that the previous levels did not leave enough water in the St. Mary and Waterton Rivers to satisfy downstream licenses and support fish life. Later in the 1990s, the agency imposed a new regime on the provincial Carseland Headworks in connection with an expansion of the project’s capacity to transport water diverted from the Bow River; the new regime boosted downstream flows on the Bow for the benefit of fish habitat. In these instances, AEP was willing to impose new restrictions or

<sup>8</sup> Despite this policy, however, the Corps also does not regularly review and revise the “water control plans” for its projects (Benson 2017).

<sup>9</sup> USBR shared the lead with the National Park Service, because the latter agency is responsible for managing Glen Canyon National Recreation Area (the popular Lake Powell, formed by Glen Canyon Dam) and Grand Canyon National Park. Tribal, state, and local government entities also participated as “cooperating agencies” in the review.

<sup>10</sup> This is true of the AEP’s larger water supply projects, except that the Oldman River Dam license does require a review of the dam’s operating strategy after 10 years.

requirements on water supply in order to reduce the downstream impacts of project operations and to translate these mandates into conditions of the project licenses. With these actions, AEP apparently was responding solely to local needs and concerns, and while the resulting flow increases in the Bow and Oldman river systems may have led to slightly higher deliveries to Saskatchewan, these revisions were not driven by the Master Agreement on Apportionment or other federal law.

AEP also has a record of fine-tuning its reservoir operations to reduce impacts on downstream fish populations and improve conditions for riparian forests. Providing such flows for ecosystem needs is not included in the dams' operating plans, and there is no official policy for doing so; rather, AEP officials have described their approach as "we do what we can, when we can." They have employed this approach most notably at St. Mary Dam, where they have ramped down flows after peak releases in wetter years for purposes of helping to regenerate riparian forests downstream (that had been in poor condition due to historic operations) (Rood and Mahoney 2000). This practice slightly increases the risk of future shortages for irrigation districts that receive St. Mary stored water, but at least in regard to riparian forests the districts have come to accept the practice.

### Alternatives: review of hydropower project operations

Federal law in the USA does require periodic operational review of dams in one category: non-federal hydropower projects. The Federal Power Act requires such projects to maintain a license issued by the Federal Energy Regulatory Commission (FERC). Because such licenses expire after a period of 30 to 50 years, the owner/operator of a hydropower project must apply to have the license reissued. The "FERC relicensing" process gives state and federal agencies an opportunity to attach new conditions to a project license, which may include higher minimum flows or other changes to the operating regime for purposes of reducing environmental impacts (Owen and Apse 2015). Federal law generally controls decisions regarding hydropower project licenses, leaving a very limited role for states, which have sometimes strongly opposed the FERC's actions in this realm. In a key case involving a challenge to conditions imposed through relicensing, the court upheld the FERC's power to require significant changes in operations even if they go so far as to make the project uneconomic to operate, because the law requires the new license to comply with current legal requirements (D.C. Circuit Court of Appeals 2006). While relicensing may be time-consuming and controversial, and certainly may not fully resolve all issues surrounding a project, the process does provide an official forum for addressing concerns associated with existing operations (Amos 2014).

British Columbia, Alberta's western neighbor, undertook a conceptually similar effort to revisit hydropower operations.

Beginning in the late 1990s, the major provincial utility BC Hydro engaged in a complicated but ultimately successful effort to address issues posed by its hydropower facilities and operations across the province. This "water use planning" (WUP) process reached consensus in developing recommendations for operations and other changes at all but one of 23 projects (or project systems) reviewed. The WUP process involved intensive stakeholder engagement through teams representing various interests in the area affected by the project and consideration of various operational changes through the use of modeling runs and other analytical tools. WUP also provided for public involvement, with the resulting recommendations subject to final review and approval by the relevant provincial agency (Mattison et al. 2014). "Previously the water management planning process had been confrontational and acrimonious; the new plan turned it into one of the most successful in Canada" (Locke et al. 2008). Ironically, the federal government had failed in its effort to use Canada's Fisheries Act to force changes in BC Hydro operations (Olszynski 2015), but such litigation was one factor that pushed authorities in British Columbia to seek a better approach to addressing these issues (Locke et al. 2008).

In Alberta, concerns about existing hydropower dams have focused on the upper Bow River system, where the utility TransAlta owns and operates a network of facilities built in the early to mid-twentieth century. Stakeholders in the Bow basin have sought various operational reforms of these projects since at least the 1990s, but TransAlta has sought compensation for such reforms, and until recently, the provincial government proved unwilling to produce sufficient funds (or apply sufficient pressure) for TransAlta to make changes. In 2015, however, the provincial government did pay TransAlta for a temporary change in operations at Ghost Reservoir in order to provide a measure of flood control for Calgary, which had endured significant flood damage in 2013. AEP and TransAlta announced a similar but broader 5-year agreement in 2016, extending beyond Ghost to the utility's reservoirs on the Kananaskis River, a major tributary of the Bow. The agreement, which was not released to the public, gives AEP limited control of operations in more of the Bow River system, primarily for flood control, but also considering recreational and environmental values.

Thus, in both the USA and the western Canada, hydropower operations have been reviewed and revised to address a variety of downstream concerns. There has been no similar effort to revisit water supply project operations in any systematic way, either for federal projects in the USA or for provincial projects in Alberta.<sup>11</sup> The concluding section offers

<sup>11</sup> The absence of periodic review in this context raises a question: does any nation, or sub-national government, have a program of periodic review of water supply project operations? Further research might identify one or more jurisdictions that conduct such reviews and might produce useful lessons regarding the design and implementation of operations reviews for water supply reservoirs.

analysis and observations regarding this inertia on water supply reservoirs and on the significance of federal laws and institutions in this regard.

### Concluding remarks about the federal role in reservoir operations

Federal institutions and laws play a much greater role in determining reservoir operations in the western USA than in Alberta. In the USA, a federal agency, USBR, operates major water supply projects; federal authorizing statutes largely dictate operating priorities by specifying each project's purpose(s); and the federal ESA imposes particular duties on the actions of federal agencies, including USBR's reservoir operations. These federal dimensions are missing in Alberta,<sup>12</sup> where the provincial agency AEP is not only the operator of major water supply projects but also the water manager and regulator, with authority to establish new requirements through the project licenses.

Despite this disparity in federal influence, there is little difference between the western USA and Alberta in their approaches to reviewing the operations of water supply reservoirs. Neither has a legal mandate for periodic review of operating plans for these projects, unlike the relicensing requirement for hydropower dams in the USA. Neither USBR nor AEP has established an official policy of periodic review of its operating plans. And despite some indications that both agencies see potential value in reviewing and revising project operations, neither agency has a program or regular practice of doing so.

Because the US Government has retained control over its reservoirs, USBR certainly could engage in regular reviews of its operating plans. It has not done so, not because it lacks authority for such a program, but because the main purpose of most USBR reservoirs has been to assure a reliable water supply for specific beneficiaries, primarily irrigators. From the beginning, USBR reservoirs have operated subject to *state* water law and have been contractually obligated to deliver water to *local* suppliers and users. Thus, these "federal" projects have always been viewed primarily as serving local rather than national interests. In direct contrast, even *private* hydroelectric projects have always been subject to federal licensing and periodic review because of the important national interest in controlling and regulating hydropower development (US Supreme Court 1990).

While USBR generally prioritizes local water supply needs, federal policy has sometimes required operational

changes for the sake of addressing national interests. Thus, Congress in 1992 ordered USBR to review its Glen Canyon Dam operations to address downstream concerns in the Grand Canyon, and to change its Central Valley Project operations to improve conditions for fish and wildlife (especially salmon). More generally, the ESA has required USBR to review its practices at numerous projects, effectively forcing operational changes for the benefit of imperiled species. Where such mandates have conflicted with local water demands, they have been intensely controversial, producing both legal challenges and political arguments that the federal government cares more about fish than about people. These ESA controversies reflect the friction that results when federal priorities conflict with local demands, especially when the federal policy would change the water management status quo.

Reservoir operations in Alberta involve the same kinds of local interests, but not the same kinds of federal decision-makers and legal requirements. The federal mandates are largely missing, but so is the kind of legal and institutional complexity seen on the US side—not to mention the resentment and resistance to the actions of federal bureaucrats carrying out orders from the distant national capital. No federal law has required AEP to review and revise its reservoir operations, in the way that the ESA has forced USBR's hand at many projects. Even without a federal push, AEP has acted on its own, both formally and informally, to make notable operational changes at some facilities. The agency has not made a practice of reviewing its operating plans, however, despite the SSRB Approved Water Management Plan's call to pursue reservoir "optimization." By generally maintaining the status quo and making modest, incremental changes on an ad hoc basis, AEP largely avoids serious conflicts with the local interests that rely on provincial reservoirs for water supply.

Reviewing reservoir operations could lead to improved water management in both the western USA and Alberta's SSRB, helping these water-stressed regions adapt to changing conditions. On the US side, federal agencies, laws, and policies will largely determine how major water supply reservoirs are operated; in Alberta, such decisions will be made at the provincial level with little direct federal influence. The reservoirs may be federal or provincial, but because USBR and AEP base their operating decisions primarily on the demands of particular water users, the most important influence on these projects is local.

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<sup>12</sup> AEP does have one federal obligation affecting project operations—ensuring compliance with the Master Agreement on Apportionment—that is parallel to the USBR's responsibilities regarding interstate water compacts. As noted above, however, AEP has very rarely had to release water from its reservoirs solely for this purpose, so even this factor is less important in practice than it is for USBR.

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