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Restoring the West's Waters: Opportunities for the Bureau of Reclamation, Volume I: Section One: Summary of Findings, Section Two: Case Studies

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RESTORING THE WEST'S WATERS:
OPPORTUNITIES FOR THE BUREAU OF
RECLAMATION

VOLUME I

SECTION ONE: SUMMARY OF FINDINGS

SECTION TWO: CASE STUDIES

Natural Resources Law Center
February 1996
FOREWORD

This two-volume report sets out the results of a research project under taken by the Natural Resources Law Center examining opportunities to change the manner in which water demands in the West, traditionally served by Bureau of Reclamation projects, are satisfied. In the first phase of the project, we looked at 15 Bureau of Reclamation projects located throughout the West where some type of change was under way to address environmental concerns. Volume 1, Section One, sets out a summary of our findings from phase one, and the preliminary conclusions in which we identified several types of opportunities for changes in Reclamation projects that have the potential to produce environmental benefits without necessarily reducing traditional economic benefits. We refer to these as first generation changes. The details of our 15 case studies are set out in Volume 1, Section Two.

Volume 2 contains the results of the second phase of the project. Incorporating many of the smaller geographic settings included in the 15 earlier studies, these broader, basinwide studies focused on six rivers or river segments in which Reclamation operations play a significant role in river management. Not only do they cover a larger geographic area, they also include a much more complex set of legal and institutional issues that must be considered in any proposals to modify traditional water management for environmental benefits.

This report represents the work of several current and former staff members of the Center, including former Director Lawrence J. MacDonnell, former Associate Directors Sarah Bates (now Sarah Van de Watering) and Judith Jacobsen, and Senior Staff Attorney Teresa Rice. Several Center student research associates drafted the 15 case studies in Volume 1, Section Two, and their names are acknowledged at the beginning of each case study.

The contents of this report were developed under a joint grant from the U.S. Environmental Protection Agency and the Bureau of Reclamation, U.S. Department of the Interior. Support from the Ford Foundation also contributed to the research conducted in the second phase of the project.

This publication is a product of the Natural Resources Law Center, a research and public education center at the University of Colorado School of Law. The Center alone is responsible for the opinions and conclusions in this publication. Thus, interpretations or conclusions in Natural Resources Law Center publications should be understood to be solely those of the authors and should not be attributed to the Center, the University of Colorado, the State of Colorado, or any of the organizations that support Natural Resources Law Center research.
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1.1 Introduction

The Bureau of Reclamation (Reclamation) played a major role in transforming the rivers of the western United States into economically productive assets. To accomplish this objective, Reclamation built over 600 storage and diversion dams, more than 16,000 miles of canals and 37,000 miles of laterals, 280 miles of tunnels, and 52 hydroelectric powerplants. It is a remarkable achievement — an extraordinary example of a government agency successfully delivering on its mission. Because of Reclamation facilities, 30 million people in the West received water for irrigation, municipal, industrial, and other uses in 1991; agricultural crops valued at nearly $9 billion were produced; 48 billion kilowatt hours of electricity valued at $727 million were generated; over 50 million recreational visitor days were recorded.

Now, more than 90 years after its creation, Reclamation faces a different challenge: restoring a functional level of ecological integrity to the rivers its facilities transformed. Increasingly, it has become evident that many water-based natural systems in the West are not functioning in a manner that supports and maintains their biotic communities. In retrospect, this loss of functionality is not surprising since so many of West's rivers and streams have been drastically altered in character.

In one sense, there is no going back. For the most part, these alterations are effectively permanent. At least they are permanent in the sense that human demands on the limited water resources of the West are not going to diminish. To be sure, people in the West now value water in ways that differ considerably from the dominant values that existed when much of the water development physical and legal infrastructure was established. Perhaps the most dramatic change is the far greater value now attached to instream or in-place uses of water, including its ecological functions.

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1 Bureau of Reclamation, Department of the interior, 1991 Summary Statistics, at 1.

2 Id. at 1-2.
But there is nothing immutable about the manner in which human demands are satisfied. Much can be done to work with the existing water development infrastructure to make it operate in a manner that supports essential ecological functions and helps to restore these functions where they have been lost. Moreover, this can be done in many cases without uncompensated loss of the economic benefits historically generated through operation of water development facilities. In the vernacular of our times, these are "win-win" or, at least, "win-not lose" opportunities.

This project explored opportunities to change the manner in which demands are satisfied, in the context of Reclamation water development. We wanted to provide a better understanding of the kinds of environmental concerns affecting the rivers of the West, particularly related to the existence and operation of Reclamation facilities, and to more carefully analyze the issues involved in making changes that could produce greater environmental benefits (e.g. are there physical constraints? operational constraints? legal constraints?). In Phase One, we investigated 15 Bureau of Reclamation projects located around the West, identified as having changed in some manner because of environmental concerns. In Phase Two, we focused on six rivers/river segments in which Reclamation operations play a significant role in river management. The detailed findings of these two phases are provided in parts two and three of this report. The first part of the report provides a summary of our findings and the preliminary conclusions from our analysis. In general, we find five types of opportunities for changes in Reclamation projects that can produce enhanced environmental benefits without necessarily reducing traditional economic benefits: (1) structural changes in project facilities; (2) changes in project operations; (3) improvements in project efficiency; (4) changes in water delivery arrangements; and (5) water transfers. We discuss examples from our case studies of each of these approaches, the issues they raise, and how these issues either were or could be overcome.

We begin with a summary of our findings from the phases one and two case studies.

1.2 Summary of Phase One Findings

In Phase One we contacted Reclamation personnel in all six regions, as well as EPA representatives, seeking recommendations of case studies. In particular, we asked for help in
identifying Reclamation projects that had been changed in some manner because of environmental problems or concerns. We took the initial list of 26 projects that emerged from this process and narrowed it down to 15, based on preliminary research and telephone calls. We then initiated detailed studies of these 15 examples. The 15 projects are listed in Table 1; their location can be seen in Figure 1.

For each of the case studies we organized our research around six questions: (1) what is the nature of the environmental problem(s) involved and the environmental benefit(s) sought? (2) what is the relationship between the Reclamation project and the environmental problem? (3) what changes were made or are proposed to be made? (4) what issues were raised by the changes? (5) how were these issues resolved (or are proposed to be resolved)? and (6) what is the present status of the case example? The results are summarized next.

1.2.1 Environmental Concerns

As shown in Table 2, protection and enhancement of the fishery resource were the dominant environmental concerns in most of the case studies. Most commonly, this involved protection of the instream fishery located below a Bureau of Reclamation storage facility. In a few cases it also involved the quality of the fishery in the reservoir itself. The most common need involved the timing and amount of water instream to meet the needs of the fishery. For example, minimum releases in the wintertime, low-flow season were important to protect the fishery in several cases. Water needs at the time of spawning also were critical. In addition, the temperature of water released from facilities was critical in two cases. Other environmental concerns encountered included: recreational interests, water quality, wetlands, and — in one case — bird nesting habitat.
Figure 1. Location of Phase One Case Studies.
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<th>Phase One Case Studies</th>
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<td>2</td>
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<td>4</td>
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<td>7</td>
<td>Upper Arkansas River, Fryingpan-Arkansas Project, CO</td>
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<td>Dolores Project, Dolores River, CO</td>
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<td>9</td>
<td>El Vado Dam, Middle Rio Grande Project, Rio Chama, NM</td>
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<td>Fort Sumner Dam to Brantley Dam, Pecos River, NM</td>
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<td>11</td>
<td>Meeks Cabin Reservoir, Blacks Fork River, Stateline Reservoir, East Fork -</td>
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<td></td>
<td>Smiths Fork River, Lyman Project, WY - UT</td>
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<td>12</td>
<td>Payette Division, Boise Project, Payette River, ID</td>
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<td>13</td>
<td>Yakima Project, Yakima River, WA</td>
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<td>14</td>
<td>Newlands Project, Truckee and Carson Rivers, NV</td>
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<td>15</td>
<td>Shasta Dam, Central Valley Project, Sacramento River, CA</td>
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<tr>
<td>CASE STUDY</td>
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<td>1. Rapid Valley Unit and Project, Rapid Creek, SD</td>
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<td>2. Nelson Reservoir, Milk River Project, MT</td>
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<td>6. Seminoc Dam to Pathfinder Dam, N. Platte River, WY</td>
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<td>12. Payette Division, Boise Project, Payette River, ID</td>
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<tr>
<td>15. Shasta Dam, Central Valley Project, Sacramento River, CA</td>
<td>Endangered fish</td>
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</tbody>
</table>
1.2.2 Project Changes

Table 3 sets out the project changes that either have been or are being proposed in response to environmental concerns. In several cases, the desired environmental benefit required structural changes in Bureau of Reclamation facilities. For example, new outlets were necessary in several cases to facilitate wintertime minimum releases, or to enable improved temperature control.

A second kind of change involved storage operations. In one case it was necessary to fill the reservoir earlier in the year than before; in another the change involved maintaining a higher level of permanent storage throughout the year.

The most common need involved some change in the pattern or amount of releases of water from storage facilities. Typically, release patterns have been determined solely by economic uses of the water resource. Environmental needs necessitated some change in the release regime — for example, increased releases in the wintertime, or to more closely approximate the natural hydrograph.

In several cases the change involved coordinating releases from reservoirs on the same system, typically upstream and downstream. In these cases, the lower reservoir was able to capture water necessary for delivery to consumptive users while allowing the upper reservoir to make releases more beneficial for environmental purposes.

1.2.3 Major Issues

As indicated in Table 4, most of the case studies raised few, if any legal or contractual issues. Changes could be made without directly affecting legally-protected rights and benefits from operation of Reclamation facilities.

In a few cases there were losses in hydropower benefits. In several cases, water users perceived an increased risk of water availability because of change in project operations. For example, increased minimum flow releases reduce the storage otherwise potentially available for delivery to consumptive users. In only one case were diversions to users reduced. In several situations there was some question about who would pay to make possible the change. Most commonly, the U.S. paid for some or all of the necessary improvements.
<table>
<thead>
<tr>
<th>CASE STUDY</th>
<th>MAJOR CHANGE(S)</th>
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<tbody>
<tr>
<td>1. Rapid Valley Unit and Project, Rapid Creek, SD</td>
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<td>New outlet works allowing minimum winter releases</td>
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<td>14. Newlands Project, Truckee and Carson Rivers, NV</td>
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<th>MAJOR ISSUE(S)</th>
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<td>Water for fish/risk to irrigators/loss of hydropower/cost of outlet works</td>
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<tr>
<td>13. Yakima Project, Yakima River, WA</td>
<td>Court-ordered requirements</td>
</tr>
<tr>
<td>14. Newlands Project, Truckee and Carson Rivers, NV</td>
<td>Not achieving expected efficiency results/water rights</td>
</tr>
<tr>
<td>15. Shasta Dam, Central Valley Project, Sacramento River, CA</td>
<td>Loss of hydropower benefits/federal-state conflicts</td>
</tr>
</tbody>
</table>
Several of the case studies raised the question of the authority of the Bureau of Reclamation to make the desired changes. Since most of the cases involved no loss of historical benefits there was little actual dispute about the Bureau's authority. In Phase Two we looked at situations in which the authority of Reclamation is less clear. A related issue involved how the decisions to make changes were made.

1.2.4 Innovative Approaches

Out of Phase One we have tentatively identified five types of approaches found in the case studies: (1) technical solutions; (2) system management approaches; (3) collaborative, interactive approaches; (4) efficiency oriented approaches; and (5) market-based approaches. Some case studies involved more than one method.

Installation of new outlet works made possible desired reservoir releases in several cases. Most typically this involved the ability to make minimum releases in the wintertime. Better control of the temperature of reservoir releases was necessary in two cases.

Perhaps the most common innovation involved some new approach to operation of the facility or joint operation of the facility with other Reclamation facilities. As a general matter, these examples illustrate the possibilities for meeting a broader set of objectives through more comprehensive system analysis and operation.

Several cases illustrated the development of new cooperative approaches to managing and operating Reclamation facilities. Typically these involved several agencies in addition to Reclamation, including state agencies as well as water users and other interests. In some cases, this non-Reclamation group acted more as a technical advisor than a decision-making entity.

In a few cases, efforts focused around making more efficient use of water resources. Improvements in project delivery facilities are an example.

In one case Reclamation itself is seeking to acquire contract water from one of its facilities to enhance releases for instream flow needs. In another case, a market-based program is proposed to enhance changes already made.

Phase One analysis showed considerable progress toward reorienting the operation of Reclamation water storage and delivery facilities to provide increased environmental benefits.
The 15 case studies provide a diverse view of the issues and approaches. Most of these cases represent what we are calling first generation changes: that is, changes that can be made without any direct effect on traditional project beneficiaries. A few of the cases raise more difficult problems. In several instances these issues are driven by endangered species concerns. The second phase of the project focused on situations where the benefits involve greater complexity or potentially more controversy.

1.3 Summary of Phase Two Findings

In Phase Two we turned our analytical focus to a larger scale, moving beyond the immediate impacts of Reclamation project operations to a consideration of water basins or river segments, the effects of water development — including Reclamation facilities — on the ecological health of these river systems, and efforts underway to improve that ecological health. Our purpose here was to test the idea that natural systems operate at an integrated, ecosystem level and that natural resources management to promote sustainability of all resources accordingly should operate at this level. Under such an approach, decisions respecting operation of Reclamation facilities would be made in relation to the ecosystem(s) they affect and of which they are a part.

The areas studied are listed in Table 5 and are more fully discussed in Volume II of this report. We selected the six study areas, primarily from information developed during Phase One. Except for the Upper Colorado River, we had already examined at least one Reclamation project within each of the study areas during the first phase and thus were familiar with the areas. The areas were selected because of their geographical diversity, because they presented significant evidence of ecological degradation — commonly typified by endangered species problems, and because Reclamation facilities play an important role in regulating the water resources. Given the complexity of existing environmental problems, these are areas in which the process of change will be long-term and the best mechanisms for accomplishing this change are still under active consideration.

These studies present general hydrological and physical information about the water basin, historical information about water development, a discussion of water-based environmental concerns, and a summary of efforts to change historical water management
practices — including those associated with Reclamation facilities. Special attention is given to legal issues associated with making what are often substantial changes in historical practices. Several of the studies advance proposals for change beyond those presently under consideration in the areas.

The water resources of the six study areas all have been intensively developed over the years, with important economic development based both directly and indirectly on the water development. In all of the study areas, Reclamation constructed important water regulation and delivery facilities relatively early in its existence, reflecting the importance of the areas and their history of water development. The purpose of Reclamation in these areas, as in other places throughout the West, was to build the facilities that private developers and local interests could not afford to build. Federal Reclamation facilities generally are large, on-stream dams and "highline" canals — those needed to get water to the lands further away from the river, often the "bench" lands.

In all of the study areas, the original Reclamation projects were built exclusively to provide a water supply for irrigation. In most cases, the enlarged water supply served to firm up supplies already developed as well as to make possible irrigation of new farmlands. The agricultural economy of each of the areas expanded and became dependent on the availability of the good supply of low-cost water from Reclamation facilities. In turn, to support the national goal of providing this low-cost water for western economic development, Reclamation typically sought and obtained dominant control of the available water supplies and then managed those supplies in a professional but single-minded manner to maximize their use in irrigation.
Table 5. Phase Two Area Studies

1. **The Yakima River Basin, Washington**
2. **The Upper Snake River Basin, Idaho**
3. **The Truckee and Carson River Basins, California and Nevada**
4. **The North Platte River Basin, Wyoming**
5. **The Upper Colorado River Basin, Colorado**
6. **The Middle Rio Grande Basin, New Mexico**

Maximizing the availability of water for irrigation use dramatically changes the natural rhythms of a river. Storage is used to hold as much as possible of the high flows typically available in the spring, for delivery to irrigators in the middle-to-late part of the growing season when natural streamflows are inadequate to meet irrigation demands. Peaks flows are reduced, and low flows are increased. If considered necessary to assure that available storage space in reservoirs will fill, wintertime stream flows may be captured as well. Decision and management principles are relatively straightforward: build as much storage as possible; fill the storage as full as possible; spill as little water as possible from storage that cannot be used for some economic benefit; deliver as much of the available water to users as they demand.

With the advent of "multipurpose" federal Reclamation projects in the 1930s, management objectives became somewhat more complicated. In particular, hydroelectric power generation became an important source of revenue — often providing the economic justification for building a project and helping to pay for project costs associated with providing water to irrigation. The trick was to be able to utilize stored water as much as possible both to spin turbines and to grow crops. Often the best way to accomplish this objective was to build another storage or "reregulation" facility downstream of existing storage but above irrigated agricultural areas. Releases of water for hydroelectric power generation are driven by demand for electricity — corresponding to things like heating needs in the wintertime, cooling demands in the summer, and lighting needs in the morning and at night. As with storage and delivery of water for irrigation, there is little relationship between water releases for hydroelectric power purposes and the natural hydrograph of a river.
River-related environmental problems are longstanding and significant in each of the study areas. Most prominent are the decline of native fish species: the salmon in the Yakima and the Snake, the cui-ui in the Truckee, the squawfish in the Colorado, and the silvery minnow in the Rio Grande. Bird habitat is most at risk in the broad, shallow Platte River and the desert wetlands of the Carson River. In each case, there have been severe declines in the populations of these species. In each case, the river conditions that produced the habitat upon which these species depend have been so altered that this habitat has been severely diminished or lost. In each case, efforts are now being made to retain those qualities of the river systems that support remaining species populations and to make changes that will improve river conditions for the benefit of the species.

The diminishment of biodiversity is itself an enormous loss. Imagine a world in which our children could no longer see the flash of silver moving back and forth across a gravel bed in a mountain stream in Washington, Oregon, Idaho, or California as a female salmon prepares to spawn. Who would feel better off in a world in which whooping cranes no longer joined their sandhill cousins in the annual migration from Texas to Canada?

More fundamentally, however, the loss of biodiversity is symptomatic of the dysfunctionality of these river systems. In some cases, ecological functions have been lost altogether. In other cases, these functions are severely degraded or diminished. Species unable to adapt to the dramatically altered conditions of the rivers are disappearing while others are struggling to survive. With an improving appreciation for the functioning of ecological systems, and with an increasing understanding of the manner in which human support systems depend on these ecological systems (either directly, as in the quality of the water we drink and the composition of the atmosphere that regulates ambient air temperatures, or indirectly, as in the quality of the environment in which we live) the dysfunctionality of these important rivers of the West is real cause for concern.

The extraordinary manipulation of the water resources of the West occurred to produce benefits for people. In the process of producing these benefits, destruction and severe degradation of natural systems occurred. The Reclamation movement represented a widely shared view that resources were to be exploited whenever to do so would produce economic
gains. Whatever other values and purposes resources might serve, they were secondary to this economic development imperative.

Now this simple imperative no longer dominates. Instead, resources are seen in a broader, more multidimensional manner. In some cases, natural resources may be most valuable to people in a totally undeveloped state. In other cases, development may still be viewed as their best use. In all cases, however, development decisions are made only after full consideration of the range of benefits and costs/consequences associated with the proposed development, and the development action, if it is taken, is likely to be conditioned in a manner that is regarded as environmentally acceptable.

Reclamation water development provides real benefits. In addition to the undeniably impressive statistical measures such as numbers of people served, acres of land irrigated, value of crops produced, and kilowatts of electricity produced, Reclamation projects supported the development of communities in many parts of the West. In some places, urbanization has long overtaken the agricultural origins of the area; in other locations, however, the agricultural economy remains an important part of the community. In any event, the beneficiaries of Reclamation projects are found all around the West. Dependency on the continuation of project benefits is likely to be greatest in rural parts of the West where there are fewer economic options. Actions requiring that existing project benefits be involuntarily taken from someone, even with compensation, are likely to meet with strong, and perhaps justified, opposition.

Fortunately, there appear to be a large number of options to existing water management practices that can reduce adverse environmental effects and can improve the ecological condition of rivers throughout the West. Moreover, many of these approaches can be accomplished without loss of existing project-produced benefits — though not without sometimes considerable additional cost and considerable effort. The area studies provide a good look at some of the options and at the kinds of issues they raise.

For those problems that turn on the amount and timing of water needed to sustain a healthy river ecosystem (and most of the problems do), the issues fundamentally come down to what water (often stated as "whose" water), who decides, and who pays. In all of the study areas, as in most of the West, the water resources are fully claimed by existing interests. The
kinds of changes needed to restore ecosystems can only come about through some alteration of the nature and structure of these existing claims.

In many cases, this is the most difficult issue. Westerners long are accustomed to thinking in terms of control of water as control of the future. Large numbers of important activities depend on the availability of water; in an arid environment, the critical importance of access to a water supply is even more evident. Those who hold legal and physical control of water are reluctant to give up that control, even if their actual economic needs don’t necessarily match the extent of control they maintain. Such people are understandably reluctant to trade this apparent power without some clear sense that they will benefit or, at least, that they will not be harmed.

To a considerable extent, the dominant theme throughout the area studies is the search for mechanisms that will allow some change in existing claims to water in a manner that is acceptable to those holding the claims or that is otherwise legally required. In the Phase One cases the mechanisms almost always were within the control of Reclamation. The systems had enough play in them, and the desired changes were sufficiently modest, that changes could be made without directly implicating legally protected claims to water or other project benefits. Such is not the case with the Phase Two studies.

1.4 Selected Illustrations From Area Studies

Perhaps because the water reallocation process has been underway there for more than 25 years, the Truckee-Carson is a good place to start. For much of this century, the Newlands Project laid claim to the lion’s share of the water of both the Truckee and Carson rivers. At the time this project was built (and it was one of the earliest Reclamation projects authorized) irrigated agriculture was viewed as the highest and best use of these two rivers. In keeping with the Reclamation vision, development of this water would transform an essentially barren area of the Great Basin of Nevada into productive farmlands. Since the better lands were located in the Carson River basin, a canal was constructed from the Truckee

\[1^\text{For a more complete discussion of this area, see "The Truckee and Carson River Basins, California and Nevada," Vol. II, Chapter 3.}\]
River to make this water supply available. The concerns of the Pyramid Lake Paiutes whose reservation was downstream on the Truckee around Pyramid Lake would be met by providing a relatively modest supply for their irrigable lands. The needs of the lake itself and its resident fish simply never were considered.

So dominant was the irrigation use of water that, as of 1967, diversions of Truckee River water for the Newlands Project had never been regulated — irrigators simply took all they needed. By this time, the elevation of Pyramid Lake had dropped as much as 80 feet, the Lahontan cutthroat trout had disappeared, and the cui-ui was listed as an endangered species. Unique desert wetlands at the terminus of the Carson River lived largely on return flows from project lands.

The responses to this situation are instructive. The first, and one that is still ongoing, was to look more closely at the apparent commitment of water to project users. Initially the Secretary of the Interior determined that project diversions should not exceed 406,000 acre-feet per year. A federal district court subsequently determined that amount to be 288,000 acre-feet per year. The Pyramid Lake Paiute Tribe argues for an even smaller amount of water. Under present operating rules, project irrigators can divert up to 320,000 acre-feet.

As a matter of legal right, irrigators in the Newlands Project can apply up to 3.5 acre-feet of water on each acre of "bottom" land authorized to be irrigated and up to 4.5 acre-feet of water on each authorized acre of "bench" lands. Years of litigation have tested which lands are either bottom or bench and which lands (and which portions of lands) are legally authorized to be irrigated. These quantities of water are "headgate" entitlements — an amount to be available at the farm. In addition, some amount of "carriage" water is necessary to deliver irrigation water to the headgates. Much of the effort of the Department of the Interior has been directed to searching for ways to reduce the amount of carriage water in order to limit the total amount of water diverted from the Truckee River.

Thus, a dominant focus of the efforts in the Truckee-Carson has been to more precisely define the allocation of water to which project irrigators can claim legal entitlement. The actual amount of water, it turns out, depends on a number of fact-specific determinations including the efficiency with which water can be delivered, the physical location of the lands and the composition of the soils, the actual amount of land physically being irrigated, and
whether that land is legally authorized to be irrigated with project water. Certainly it is a total quantity of water much less than project irrigators had assumed and, in fact, far less than they historically diverted.

While the specifics of the Truckee-Carson differ in many ways from other settings around the West, the basic reality discovered during 25 years of litigation would likely prove true in other places. Irrigation historically has used more of the West’s water than physically necessary to accomplish its purposes. It has done so because, at the time, it made sense to do so. It made sense to construct the lowest possible cost systems that could deliver water to fields. It made sense to take as much water as was available, even if the same crops could have been produced with less water.

It no longer makes sense to use water in this way. Nor will the legal structure that allocates water shield these uses from scrutiny in the face of competing demands for the resource. The Truckee-Carson experience suggests that, in the face of direct and continuing challenges to water use practices by strong competing claimants, courts (and administrators) will seek to reduce water diversions to the degree possible while still meeting the direct economic needs of the traditional users. Moreover, as demonstrated in the case of the Newlands project, historical diversions of water for use in surface water irrigation systems in the West typically can be reduced considerably without directly impacting the ability to grow crops.

The Truckee-Carson study also provides some interesting illustrations of the use of administrative authority. Perhaps most dramatic was the decision to dedicate the use of the storage water of Stampede Reservoir to the recovery of the cui-ui. This was an unusual situation in which a project facility had been authorized and built without contractually committing the water to users who would help pay for the costs of building (and operating) the facility. Two things can be said about this example nonetheless: one is that the courts upheld the discretion of the Secretary of the Interior to decide the use of this unallocated storage; the second is that the courts suggested the Secretary must use all available authority to help recover a listed endangered species.

At a minimum this precedent suggests that, potentially, any presently unallocated storage water in Reclamation facilities should be considered for dedication to water-related
needs of listed species. Certainly it suggests that, before such water could be contracted to users, an environmental assessment under the National Environmental Policy Act would be required; a presumption against such a contract may exist where there is a protected species whose recovery could be benefitted from the dedication of the water. Less obviously, however, this precedent may suggest that the Secretary, through Reclamation, has a duty to evaluate the operations of all Reclamation facilities to determine whether, within the framework of existing legal commitments, they can be operated in manner that is more beneficial to the needs of protected species. Even more far-reaching is the possibility that the Secretary's responsibility reaches to ensuring that the water delivered to Reclamation project beneficiaries is the minimum legally obligated to be delivered so that any water not absolutely necessary to meet the legal obligation to traditional project users becomes available for dedication to meet the recovery needs of protected species.

Such an interpretation of the Secretary's responsibility would suggest the need for detailed examinations of water use in each Reclamation project to make this determination. An examination of this kind would probably follow the pattern in the Newlands project of determining a water "duty" for the particular category of lands, carefully limiting the irrigable land areas to those on which crops are actually grown, assuring that the lands irrigated are legally authorized to be irrigated under the federal contract and by state law, and assuring that the lands have in fact been irrigated. Moreover, it would probably force consideration of ways to improve the efficiency with which headgate entitlements of water are delivered to users in order to reduce the total amount of water dedicated to project irrigation uses.

Total irrigated lands in the Newlands Project are roughly 60,000 acres, with another approximately 12,000 acres authorized for irrigation. The extended history of litigation, and the associated expenses of that litigation, suggest that such an approach, while perhaps legally warranted, would make little policy sense. Reclamation project water irrigates over 9 million acres of land. The process of examining water use on all of these lands would be enormously time-consuming and expensive with, at best, uncertain results.

Nevertheless, the exercise of this Secretarial responsibility may be highly appropriate in particular circumstances where there is an identified need and some information suggesting that project operations may, in fact, be altered without loss to the legally protected rights of
project beneficiaries, or that there has been use of project water beyond that legally obligated for delivery. In the case of the Truckee-Carson, the Secretary's trust responsibility to the Pyramid Lake Paiute Tribe, together with the responsibilities to protect the cui-ui, were regarded as warranting two types of actions: one to dedicate unallocated storage water to the cui-ui and the other to establish "operating criteria" intended to require improvements in the efficiency with which project water is delivered to users in the Newlands Project.

Reclamation's experience in implementing the operating criteria suggests both the benefits and weaknesses of this approach. Without question, the 1967 decision by the Secretary to impose limitations on water diversions for the Newlands project was long overdue. But the subsequent 20-year process to establish "final" operating criteria (and the now seven-year period of implementation) is a tale of warring interests each seeking to gain advantage (or, in the case of the Truckee-Carson Irrigation District, minimize losses) that is still without resolution. Reclamation's expectations about improvements in project efficiency from implementation of a number of actions under the 1987 operating criteria have not been realized. While it is too early to reach definitive conclusions about the effectiveness of the water management measures taken in the Newlands project, experience to date suggests that improving the efficiency of Reclamation water delivery systems may be more difficult than originally assumed.

The other major approach that is being utilized in the Newlands Project is market-based reallocation of project water supplies. Spearheaded by The Nature Conservancy and the Environmental Defense Fund, the federal government — through the Fish and Wildlife Service — is now the primary proponent of this approach. Water is being purchased from willing sellers in the Newlands Project and then reallocated to use in the Lahontan Valley wetlands. Here too the experience is useful in suggesting some of the potential problems and limitations of water marketing.

First, the Pyramid Lake Paiute Tribe has been concerned that only water that has been legally and beneficially used be permitted to be transferred. Thus there has been a considerable amount of litigation clarifying which water rights may be transferred and under what conditions. Second, water marketing is a random process: sellers can come from anywhere within the project. Sorting out the implications of removing water from that part of
the irrigation system in which the seller's lands are located is itself a somewhat complicated process. In some locations the removal of a share of water in a lateral may not have a significant effect on the ability to deliver water to other users; in other locations, the reduction of water could impair delivery ability. Alternatively, there could be significant gains in project efficiency from drying up some lands within a project (for example, lands at the end of a very leaky lateral), but the owners of those lands may not be interested in selling the water or, at least, may not be interested at the prevailing market price.

Moreover, there are the very real concerns of people in the Fallon and Fernley communities that local irrigated agriculture cannot compete in a market for water and that, eventually, so much of the irrigated land in the Newlands Project will lose its associated water rights to such market sales that agriculture in the area will disappear. These communities are in an inevitable transition from their original dependence on agriculture as their economic base. Further loss of agricultural activity in the area isn't as much an economic issue as it is a quality of life concern. Nevertheless, there is an understandable uneasiness on the part of at least some members of the community about "the market" making these decisions with little or no ability for reflection of public and community concerns and interests.

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The scale of the Upper Snake River Basin, compared to the Truckee-Carson, is perhaps the first thing that comes to mind. The average annual yield of the Upper Snake River is over 9 million acre-feet, roughly nine times the yield of the Truckee and Carson Rivers combined. Storage capacity of the reservoirs in the Upper Snake totals over four million acre-feet, more than three times the storage capacity in the reservoirs of the Truckee-Carson Basin. Total irrigated acreage in the Upper Snake is about 2.3 million acres, compared to 130,000 acres in the Truckee-Carson Basin. Reclamation operates the Minidoka and Palisade projects in the Upper Snake, providing "full service" water to over 230,000 acres and "supplemental" water to nearly 1 million acres.

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*For a thorough discussion see "The Upper Snake River Basin, Idaho" Vol. II, Chapter 2.
The Upper Snake Basin comprises a land area of over 17,000 square miles. It includes internationally renowned national park and resort country around Jackson Hole, Wyoming, a world class trout fishery in the Henry’s Fork and along the Snake River Plain, some of the most productive agricultural lands in the West. As with the Truckee-Carson, irrigation uses of water long have dominated water management in the Upper Snake. The first substantial effort to control the water of the Snake River for irrigation in this area was the construction of Milner Dam in 1905 by the Twin Falls Land and Water Company. At this point, during the irrigation season, virtually the entire flow of the Snake River is diverted into two very large canals — one on the north side of the river and the other on the south — for use on about 365,000 acres of land. Reclamation storage and delivery facilities made possible a substantial expansion of irrigated agriculture in the Upper Snake by greatly increasing the amount of water that could be captured and delivered to lands in the area.

The character of the Snake River has been totally transformed by Reclamation water development. Jackson Lake operates as a reservoir, storing up to 800,000 additional acre-feet of water, and then releasing that water according to the demands of downstream users. Palisades, American Falls, and Minidoka dams back up the river into large reservoirs — turning the free-flowing river into placid pools for many miles. The existence of this considerable water storage capacity enables Reclamation to actively manage the water resources of the Upper Snake. In general, the management principle is to store as much water as possible as high in the system as possible. In this way, evaporation losses can be minimized, and the water is available to serve as many downstream uses as possible at the time of demand.

Despite this major transformation of the natural patterns of the Snake River, the major environmental concerns are not directly associated with the effects of this transformation. Rather, at least at this time, they have to do with the downstream needs of the salmon and with the depletion of the massive Snake River Plain groundwater aquifer and the consequent reduction of discharges from springs near the river that are critical habitat for several species of plants and animals. Unlike the dramatic drop in the elevation of Pyramid Lake caused by Newlands Project diversions from the Truckee River, there is no obviously observable link
between Reclamation water development in the Upper Snake and harmful effects within the adjacent watershed.

The salmon issue is difficult because of the massive, cumulative nature of the activities that are endangering its continued existence. It is not possible to say, as it is with the cui-ui in Pyramid Lake, that, but for the water diversions of federal Reclamation projects in the Upper Snake, the salmon would not be in danger of extinction. Nor is it possible to say with certainty that, by changing patterns of water use in the Upper Snake, the salmon will recover.

Two federal court decisions in 1994 reflect a growing sense of exasperation with the incremental approaches attempted to date to protect the salmon in the Columbia River Basin.\(^5\) Difficulty in assigning responsibility for the dire condition of the salmon plagues efforts throughout the basin to make the kinds of changes that now appear to be necessary if the salmon are to have any real chance of survival and recovery. In the face of a growing consensus that major efforts are needed to protect the salmon, it seems likely that water uses in the Upper Snake will come under increasing pressure for change.

Initially, Reclamation sought to provide additional water for the downstream needs of the salmon through rentals of water from the Upper Snake Water Bank and the banks in the Boise and Payette River basins. Although the banks depend on use of storage space in Reclamation facilities, they are operated by local water users who set the rules, under general state law guidelines, for their operation. Upper Snake bank rules strongly favor irrigation uses of bank water within the Upper Snake Basin. Users of water below Milner Dam pay almost three times as much to rent the water, and the storage space from which the water comes is given the most junior refill priority the following year. In 1994, none of the irrigation districts owning space in Reclamation reservoirs offered any water for rental below Milner Dam.

Reclamation has allocated uncontracted storage water to help meet downstream water deliveries for salmon. Not surprisingly, this allocation process turns out to be more difficult.

than anticipated. For example, use of uncontracted storage water in Payette Reservoir for delivery to salmon provoked a strong reaction from a number of interests who preferred that the water remain in Payette Reservoir. These interests included the Fish and Wildlife Service who pointed to the importance of the reservoir for the significant resident bald eagle population. Moreover, there is a question about the manner in which state law governs federal releases of uncontracted water. Absent clarifying federal legislation, it may be necessary for Reclamation to obtain a state water right or go through other state processes to put uncontracted space to use. In most western states, Reclamation would not be permitted to hold a water right for what are regarded as "instream" water uses. Only designated state agencies are authorized to directly hold water rights for these purposes.7

Still another approach utilized by Reclamation in the Upper Snake to find water for releases on behalf of salmon involves the release of what is termed "power head" water. This is water held in storage in federal reservoirs to maintain the reservoir elevation at a level that will permit releases of other water through federal hydroelectric generating facilities at the dams. Reclamation's authority to make this water available to the salmon remains uncertain under Idaho law. Presently, power head water to be released for salmon must go through the water bank and comply with bank rules, including payment of the administrative charge of $0.75 per acre-foot of water. Since the water is to be used below Milner Dam, the space from which it came is to be the last to fill in the following year.

The irrigators are legitimately concerned about the release of this water because, in many cases, it is the availability of this water in the reservoir that makes the reservoir elevation high enough to assure full supplies of irrigation water throughout the irrigation season. If this space does not refill, irrigation deliveries could be implicated.

Several studies have investigated opportunities associated with changes in operations of the water regulation facilities in the Snake River. While these studies suggest possible

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7MacDonnell and Rice, "The Federal Role in In-Place Water Protection," in Instream Flow Protection in the West (Natural Resources Law Center, 1993) at 5-1.
beneficial changes in operations of facilities in the Lower Snake, apparently there could be relatively little gained through changed operations in the Upper Snake.

Improved efficiency in the water delivery systems of the irrigation projects supplied with Reclamation water could help to reduce diversions in the Upper Snake. At present, diversions total about 8.85 million acre-feet per year for use on 1.43 million acres of land—an average of more than six acre-feet per acre.\(^6\) Total annual consumption is estimated to be about 3.5 million acre-feet. The surface water irrigation systems in the Upper Snake River are typical of those constructed in places where water is relatively abundant. They are generally gravity systems that maintain a large, constant flow of water in the main canals and laterals so that irrigators can divert water at their headgates at any time. They are designed to divert large quantities of water, and they expect to return much of this water to the stream or to other users. From an engineering and water management standpoint, there are many changes that could be introduced to such systems that would reduce the total amount of project water needed to serve the full water needs of the crops on all presently irrigated lands. The cost of making such changes, however, far exceeds the value of the water that would be saved in many cases—certainly the value of that water to the irrigators in the Upper Snake. Moreover, because of the hydrology of the basin, much of the "excess" water currently diverted for irrigation use recharges the river below Milner Dam, opening to question the quantity of water that would actually be "saved" by delivery improvements.

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The dominant environmental concern in the Yakima Basin also is salmon.\(^9\) Unlike the Upper Snake, however, the Yakima Basin is important spawning habitat for the salmon. Improvements in water management in the basin can directly improve habitat conditions for

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the salmon in the basin. Thus, the objective in the Yakima is not so much to get more water out of the system into the Columbia as it is to alter traditional in-basin water use practices to better benefit the fish.

Much of the work in this basin has focused on the installation of elaborate and expensive structures to facilitate fish passage through dams and past diversion structures. An interesting example of project reoperation, known as the "flip-flop", also has come into use to improve spawning conditions for salmon in a segment of the upper Yakima River.\footnote{See "Yakima Project, Yakima River, Washington," Volume II, Chapter 1.} Perhaps even more important than the implementation of the flip-flop itself is the creation of a "Systems Operating Advisory Committee", comprised primarily of fisheries people also representing their respective entities or interests (project water users, the Yakama Indian Nation, the State of Washington, and the U.S. Fish and Wildlife Service). This committee has a direct, though advisory, role to Reclamation in its water management decisions in the basin.

The Yakima Basin provides an interesting illustration of the limited effectiveness of a state water adjudication in addressing water problems. The adjudication process in the Yakima Basin has been underway for more than 25 years. The only major issue addressed to this point concerns the treaty-based water rights of the Yakama Nation, which were found to be "the minimum instream flow necessary to maintain anadromous fish life in the river, according to annual prevailing conditions." Though presented with the opportunity to examine such matters as the actual beneficial use needs of irrigated agriculture in the Yakima and the historical use of water in the basin, the court has chosen instead to review only the broad outlines of the existence of water rights in the basin. Little change in the present understandings of water rights in the Yakima seems likely to emerge from this lengthy and expensive process.

As in the Truckee-Carson, Congress has weighed in with a legislative response to water management problems in the Yakima. The approach followed in the Yakima is a modest, incremental one, aimed at encouraging the implementation of measures that will reduce the need for irrigation diversions in order to improve instream flows at certain key
locations in the basin. The legislation provides some financial incentives to encourage adoption of more efficient water use practices. While the expenditure of funds is authorized under this bill, no funds have yet been appropriated and there is some question whether they will be.

The Yakima Basin is one of the most productive agricultural areas in the West. High value crops such as fruit and hops grow well in the basin. A number of small to medium-sized communities in the basin derive a significant part of their economic base from agriculture. Yet there is a sense in which irrigated agriculture in the Yakima has expanded beyond the long-term ability of the water resources of the basin to support it. Physically there is enough water to meet irrigation needs in most years, though the recent drought years bring even this assumption into question. There is not enough water for irrigation, however, if the needs of the salmon and steelhead are taken into account.

Processes for voluntary marketing of water in the Yakima are extremely limited at present. The Environmental Defense Fund has developed a detailed outline of a water leasing program for the Yakima. The recently enacted congressional legislation for the Yakima Basin should provide a boost to the possibility of implementing such a program. More flexible access to the water supply in the basin is sorely needed because of the unique water allocation arrangement under which users hold either "proratable" or "nonproratable" rights. Nonproratable rights are virtually assured of a full water supply each year, while water deliveries to proratable rights vary widely depending on the amount of water available.

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Reclamation water development in the Upper Colorado River Basin of Colorado occurred in two distinct phases. The first was in the Grand Valley where Reclamation constructed a diversion dam and canals that made possible more than a two-fold increase in irrigated acreage. The second was the construction of two projects that take water out of the Colorado River Basin, primarily for irrigation use on the Front Range of Colorado. These

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projects have an important effect on the flows of water in the Colorado River, though in
different ways. The Grand Valley Project requires a considerable amount of water to reach
the diversion point upstream of this valley on the western border of Colorado during the
irrigation season. The two transmountain projects, on the other hand, reduce the amount of
natural flow water that might ordinarily be in the Colorado River in the Grand Valley but
include "compensatory storage" reservoirs on the West Slope to provide water needed to meet
the demands of West Slope water rights, including those in the Grand Valley.

The dominant water-based environmental concern in the Upper Colorado River is the
effort to recover four species of native fish listed as endangered. A cooperative program,
launched in 1987, seeks to improve the habitat conditions for these fishes, including their
streamflow-related needs. Perhaps the best single opportunity for improving streamflows,
particularly in an important segment of the Colorado River known as the 15-Mile Reach,
would result from reducing irrigation diversions in the Grand Valley — both at the federal
Reclamation project and by a private ditch company.

Physically, as in the case of the irrigation diversions in the Snake River, there are a
number of changes that could be made to the irrigation delivery systems in the Grand Valley
that would reduce the total amount of water diverted without necessarily reducing the amount
of water available to crops. But, as with the Snake, it is a question of who pays and who
benefits. The Colorado example is interesting as well because it brings into focus the legal
status of any water that would be saved from diversion.

There is a basis to argue that the irrigation systems of the Grand Valley are wasteful
and, as a matter of state law, the senior water rights that now permit the diversion of this
water should be reduced, with the saved water simply remaining in the stream to the benefit
of junior appropriators. Despite language in many Colorado court decisions declaiming the
wasteful use of water, there are no reported decisions in which a water right has actually been
reduced because of a finding of waste. Indeed, the standard that has emerged to this point in
decisions from other states generally measures the adequacy of particular irrigation practices
with reference to those commonly employed in the area under consideration — not on the
basis of what is technically possible. Moreover, Colorado has adopted an "economic reach"
test that appears to limit the duty to improve water use practices according to the financial
means of the irrigator. Given the marginal nature of irrigated agriculture in many parts of Colorado, such a standard is unlikely to require dramatic changes in existing water diversion and delivery systems.

Alternatively, efforts to legislatively declare that saved water would be available for use by the owner of the water right subject to a no-injury requirement have failed in Colorado. Junior appropriators have strenuously resisted what they regard as a potential windfall to senior users who, under the proposed legislation, would have been able to sell water that they no longer needed.

The result is a kind of legal standoff in which the senior Grand Valley users continue to divert large quantities of water during the irrigation season while upstream users search for opportunities to challenge (and hopefully reduce) these diversions. In fact, there appear to be sufficient potential water savings that the three primary competing interests for this water — the Grand Valley irrigators, the fish, and the upstream water users — should be able to find solutions that will serve their respective interests.

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The North Platte River provides an interesting illustration of responses to environmental concerns at several different levels. Like the Grand Valley in the Upper Colorado River, irrigation demands at one primary location — at the state line in Wyoming and Nebraska — dominate management of the river.

Beginning in the 1960s, Reclamation started to manage the storage systems in the North Platte for fishery benefits as well as for irrigation and hydroelectric power purposes. This expansion of purposes resulted from reaction to the construction and peaking power operation of Kortes Dam, with a consequent loss of a blue ribbon trout fishery in the "Miracle

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Mile.\textsuperscript{13} Reclamation agreed to maintain a minimum 500 cfs release from Kortes in 1964, and Congress made this release a statutory duty in 1971. While losses of hydroelectric power resulted, the water is captured in Pathfinder Reservoir and remains available for irrigation delivery. More recently, Reclamation installed a new outlet works at Glendo Reservoir to enable minimum releases of water during the winter months to maintain the fishery in the river between Glendo and Guernsey.\textsuperscript{14}

Now water uses in the North Platte are under scrutiny because of environmental concerns centered several hundred miles downstream on the Platte River in Nebraska. Particularly in an area known as Big Bend, the river is habitat to a number of protected endangered species — perhaps most prominent of which is the whooping crane. The water-related needs of these species and their habitats are forcing attention to ways in which the flows of the Platte and its upstream sources, the North Platte and the South Platte, can be better managed.

While Reclamation has enjoyed some success in managing the operations of its facilities to benefit fish in the North Platte, providing water for downstream needs is likely to prove more challenging. This is a situation somewhat like the Upper Snake in which the major water uses occur upstream while the major environmental needs for water are downstream. Existing irrigation water uses in the North Platte are based on traditional, low-cost, low-efficiency surface water delivery systems. From an engineering perspective, these systems could readily be made more efficient. Of course, cost is a major issue. Another consideration is that water presently diverted but not consumed returns to the river and is captured downstream in Lake McConaughy. Improvements in irrigation system efficiency could have water quality benefits, but they generally would not make much more water available in the Big Bend reach.

Potentially much more important in the North Platte are approaches that encourage irrigators to reduce their demands on the river and to either temporarily or permanently forego some of their consumptive uses. As presently operated, water management of the North Platte


\textsuperscript{14}\textit{See} "Glendo Dam, North Platte River, Wyoming," Vol. I, § 2, No. 2.5.
is heavily driven by the irrigation demands of the North Platte Project. Upstream of these irrigated areas, the North Platte is actively managed for hydropower and for fishery benefits — but always within the constraints of maximizing the water supply for irrigation use. The dominance of this constraint needs to be relaxed if this area is to be able to provide water in the manner desired for downstream environmental needs.

To date, little progress appears to have been made in defining ways in which this irrigation demand can be better managed. It seems likely that there is room for more carefully defining the supply of water that Reclamation is obligated to deliver. Except in dry years, irrigation water demands are essentially fully supplied. With a better understanding of the minimum quantity of water it is obligated to supply, Reclamation could begin to look for ways to utilize some of its substantial storage capacity to manage water for release to downstream environmental needs.

Moreover, with a clearer sense of the maximum quantity of water they are likely to receive, irrigators can begin to make judgments about the best use of the water. They can better define their own entitlements and consider the need for efficiency improvements in their delivery systems or on-farm. They can begin to consider water marketing options. The North Platte, with its considerable water storage capacity, provides excellent possibilities for the operation of a water bank. North Platte Project irrigators may want to explore the creation of such a bank to provide greater flexibility for the use of the water that is available to them.

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The upper and middle Rio Grande presents still different water-related environmental concerns.¹⁵ Reclamation’s Elephant Butte Reservoir dominates water management of the Rio Grande. This reservoir, completed in 1916, provides water for irrigation to about 160,000 acres of land in New Mexico and Texas. So dominant is the call of the water rights for this reservoir that upstream water storage on the Rio Grande in Colorado was completely precluded and only in 1975 was Cochiti Reservoir constructed by the Army Corps of Engineers.

Engineers, primarily as a flood control operation. Other upstream water development occurs on the Rio Chama, including a transbasin diversion project, completed in 1971, bringing water into the Rio Grande Basin from the San Juan River Basin.

Environmental concerns in the upper and middle Rio Grande above Elephant Butte are not related only to the construction and operation of water storage facilities but also to the effects of manipulation of the river for flood control purposes and the effects of diversion and consumptive of water, primarily for irrigated agriculture. Naturally fluctuating sediment loads have historically played a crucial role in the channel patterns of the Rio Grande. Even before man-induced changes to the river, dramatic changes in river flows caused the river to struggle at times in order to maintain a condition of "dynamic equilibrium" in which its sediment load is proportional to its flow or discharge. When streamflows become regulated by dams the river must adjust to changed sediment and flow conditions. Heavy sediment loads, for example, were delivered by tributaries into a reduced volume of discharge. The river responded with such changes as altered channel patterns (from meandering to braided), and deposition of sediment which reduced channel capacity. In turn, federal agencies seeking to maintain an open channel imposed additional alternations to the river, implementing a series of channel-straightening and bank-stabilization projects. The agencies' goal was to reduce water losses and deliver water more efficiently to reservoirs, primarily for irrigation use.

The secondary impacts of this history of alternations to the river's geomorphology are evident today as state and federal river managers attempt to address shallow groundwater levels, losses of riparian habitat, and impacts of river patterns on endangered species. Recently, the silvery minnow has been listed as endangered; so little is known about the habitat needs of this species that it is not yet clear what actions are needed to make its recovery possible.

A highly visible victim of the flood-control levees that have been constructed along the Rio Grande is the cottonwood tree. Large bosques or groves of cottonwoods grow along the Rio Grande, particularly outside the levees in reaches where the riverbed broadens out into valley floors in the vicinity of Albuquerque. It turns out that the regeneration of cottonwoods is a product of floods, the very thing the levees are there to prevent. Efforts now are underway to search for approaches that will enable the bosques to survive and flourish.
1.5 Overview of Changes Under Way

Impressive as the economic benefits provided by Reclamation facilities are, their environmental costs are at least equally impressive. Increasingly, it is apparent that the extent and nature of these costs need not be as great as it is. There are numerous ways in which the economic benefits of Reclamation-controlled water can be provided with less harm to the water-based environment. As stated at the outset of this part of the report, we have categorized these approaches in the following way: (1) structural changes in project facilities; (2) changes in project operations; (3) improvements in project efficiency; (4) changes in water delivery arrangements; and (5) water transfers. A summary of what we learned about these approaches from the case and area studies is presented in this section.

1.5.1 Structural Changes

Much of the Reclamation water storage and delivery infrastructure was constructed with little or no consideration of the downstream environmental impacts of their operation. Thus, for example, outlet works were designed to make the kind of large-scale releases needed for irrigation deliveries but were not intended to be operated at the lower rates appropriate for minimum streamflow releases to maintain a fishery during the winter months. Moreover, outlets were designed to allow the fullest possible drainage of the reservoir; thus, water is released from the deepest part of the storage — typically, the coldest water.

One of the most common responses encountered in our studies was to make structural changes in Reclamation dams so that their operation would be more environmentally friendly. Thus, for example, a new jet flow gate is proposed for installation at Deerfield Dam in the Rapid Valley Project to enable wintertime releases of water to maintain a fishery in Castle Creek.¹⁶ Reclamation tunneled through 800 feet of shales adjacent to the right abutment of Glendo Dam in Wyoming and installed a pressurized pipe system enabling low-flow releases during the winter months.¹⁷ At Shasta Dam in California¹⁸ and Hungry Horse Dam¹⁹ in

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¹⁶See "Rapid Valley Unit and Project, Rapid Creek, South Dakota," Vol. I, § 2, No. 2.1.


¹⁸"Shasta Dam, Central Valley Project, Sacramento River, California," Vol. I, § 2, No. 2.15.
Montana, Reclamation is working on ways to be able to release water from different reservoir elevations to provide better temperature control in accordance with the needs of the downstream fishery.

Retrofitting existing facilities can be very expensive. The work at Glendo cost $1.5 million. The selective water release system at Shasta Dam could cost $50 million to install. To this point, the U.S. has been paying the costs of making these changes. At Deerfield, the financial arrangement includes some state and local contributions, but the U.S. will still pay for the lion’s share of the cost of the changes.

These are significant investments, ones that ought not to be undertaken lightly if there are any better alternatives. In these situations, however, it seems clear that the only viable way to make these facilities operate both to provide economic benefits and to do so in a manner that is acceptable environmentally requires structural changes. In short, we have not yet finished the construction of Reclamation projects. Until these facilities are capable of being operated in a manner that is environmentally acceptable, they should be regarded as incomplete.

Obviously, a harder question is who should pay. Certainly, there is an argument that project beneficiaries should bear at least some share of the costs. These facilities are generating important economic returns to these beneficiaries, as it turns out — at the expense of the environment. A general principle of environmental law is that the polluter pays. The basis for this principle is that one whose activities create the pollution bears the responsibility for controlling the pollution or mitigating its effects.

With Reclamation facilities, the issue is murkier. These facilities were, in fact, built by the U.S. Many are still being operated by the U.S. The beneficiaries are sometimes users originally drawn to the benefits because of a strong public policy interest in their participation — e.g. small farmers induced to settle in the rural West; businesses induced to come to an area because of low electricity costs.

Making structural changes in Reclamation facilities not only is unlikely to benefit existing project users, it raises the possibility of diminishing benefits historically enjoyed, or

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10"Hungry Horse Dam, South Fork Flathead River, Montana," Vol. I, § 2, No. 2.4.
at least expectations about benefits that might be available. For example, installing an outlet works that allows releases of water in the winter months means that reservoir water not previously released in this period will leave storage. Irrigators wanting water delivered to them during the summer unsurprisingly ask "whose water is being released?" In the Glendo situation, water released during the winter is reregulated at Guernsey Reservoir where it remains available for delivery to irrigators the following summer. At Deerfield, Reclamation hopes to satisfy the irrigators by means of an operations model that demonstrates the continued availability of contract water even with the increased wintertime releases under most conditions.

Such situations necessarily force more careful examination of the water delivery commitment between Reclamation and project irrigators. Sometimes, as at Glendo, this problem can be sidestepped; in other cases, it may not. Ultimately, there will be a process of discussion and negotiation in making changes of the kind discussed here. In the consideration of payment it may be useful to search for ways by which the financial obligations of existing project users are waived or reduced in return for cooperation in developing flexible management of project water supplies.

1.5.2 Changes in Project Operations

Easily the most common response to adverse environmental effects associated with Reclamation facilities was to search for ways to change the historical manner of project operations. Just as the physical structures rarely were designed with the environment in mind, project operations were developed to best serve the needs and interests of traditional project beneficiaries — not the environment. In fact, the operation of water storage and delivery facilities typically is quite flexible, at least within certain limits, and a great deal of change in the use of Reclamation facilities now is occurring to take advantage of this flexibility.

Examples emerged in virtually all of the Phase 1 case studies. Perhaps the most common need involved managing releases of water from Reclamation storage facilities in a manner more reflective of the needs of the fish living downstream. Thus, Reclamation has worked out a plan for maintaining flows in Rapid Creek below Pactola Reservoir to protect the trout fishery — changing its historic practices of sharply reducing releases during a
drought and working to establish a pool of water dedicated to ensuring its ability to maintain minimum releases while still providing water to its traditional project users, primarily irrigators. At McPhee Reservoir on the Dolores River in Colorado, Reclamation has shifted from a rigid, three-tiered minimum release pattern to the creation of a pool of water that can be released in a flexible manner according to the biologically-determined needs of the fish. At Meeks Cabin Dam and Stateline Dam, features of the Lyman Project, Reclamation changed its winter release operations in a manner that was determined to be more beneficial to the fish and to other interests in the area.

Changes in hydroelectric power operations occurred in several of the case studies. Perhaps the best known example of the effects of releases for hydroelectric power needs is provided, however, by the operations of Glen Canyon Dam — not one of our studies. Concerns about effects on the Grand Canyon of the rapid and large-scale changes in releases of water from Glen Canyon Dam, particularly those involved in generating peaking power, led to a lengthy and detailed study in the search for options. As a result, both the maximum rate of the releases and the timing with which those releases are achieved (the "ramping" rate) have been changed. We found similar problems at Hungry Horse Dam on the Flathead River in Montana. Here Reclamation has moderated the ramping rate to reduce adverse effects of its operations on the downstream fishery. At Kortes Dam in Wyoming, Reclamation shifted operations from one that ran either peaking power flows or released essentially no water, to one that maintained at least a minimum year-round release of 500 cfs to benefit the downstream fishery in the "Miracle Mile." At Shasta Dam in California,

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24 "Hungry Horse Dam, South Fork Flathead River, Montana," Vol. I, § 2, No. 2.4.
Reclamation has been releasing cooler water from outlets below the one that carries water through the powerplant in order to benefit the salmon.  

Perhaps the most unique operational change occurred at Nelson Reservoir in Montana. Here the environmental concern was not fish but birds — the piping plover. The piping plover is a protected endangered species. The exposed, gravelly lakebed in the unfilled reservoir turns out to be desirable nesting habitat for the plover which typically establishes its nest between April and June and finishes nesting about 60 days later. Traditionally, Reclamation filled Nelson in the high spring runoff period — potentially inundating piping plover nests in the process. In an attempt to accommodate the needs of the birds, Reclamation now begins filling the reservoir in the fall and tries not to increase the reservoir elevation between May and July.

In the Upper Arkansas River of Colorado and the Rio Chama in New Mexico, Reclamation projects have changed operations primarily to benefit recreational interests. The Fryingpan-Arkansas Project includes storage in the headwaters of the Arkansas River to hold water brought from the western slope of Colorado. This water is released downstream and captured again at Pueblo Reservoir, upstream of the dominant irrigation uses of the water. Between these two locations, the Arkansas River supports a high-demand whitewater rafting industry during the summer months. Reclamation now regulates its releases of water between its two primary storage areas in a manner that assures at least a 700 cfs flow in the river, the minimum necessary to support commercial whitewater rafting, until August 15th of each year.

In the Rio Chama, the availability of additional water imported from the San Juan Basin allowed the parties to work out an operating plan that provides for releases from upstream storage on weekends during the summer of sufficient water to support high-quality rafting use of the river. Water released for this purpose can be captured in Abiquiu

26"Shasta Dam, Central Valley Project, Sacramento River, California," Vol. I, § 2, No. 2.15.
Reservoir and remain available for downstream consumptive demands on the Rio Grande. Legal rights to the ultimate use of the water are tracked by Reclamation through an accounting process.

We were surprised by how few legal issues arose in the process of making the various operational changes. In several cases, conflict was avoided by the ability to maintain physical control of the water even after it was released for the environmental purpose. In such cases, two dams proved better than one.

There were real losses of traditional project benefits as a result of some of the changes, however, and there were other situations where traditional beneficiaries had a reasonable basis to be concerned about potential loss of benefits. The most clear-cut examples of measurable losses involved reductions of hydroelectric power generation. Bypassing power releases from Shasta Dam, for example, required the Western Area Power Administration to purchase replacement power at a cost of $26 million between August 1987 and December 1992. The Montana Power Company gave up its peaking power use of Holter Dam, located just downstream of Reclamation’s Canyon Ferry Dam on the Missouri River. The Bonneville Power Administration has lost some of the peaking power benefits from changed operations at Hungry Horse Dam on the Flathead River. Peaking power benefits were lost at Kortes Dam on the North Platte River.

It is easier to find replacement electricity in the West than replacement water, at least in recent years. Electricity moves through an interconnected grid and is completely fungible. The major issue is not the availability of alternative supplies but the cost of those supplies and who pays if the cost is higher than the supply that has been curtailed or reduced for environmental benefits.

30"Shasta Dam, Central Valley Project, Sacramento River, California," Vol. I, § 2, No. 2.15.

31"Canyon Ferry Dam, Missouri River, Montana," Vol. I, § 2, No. 2.3.

32"Hungry Horse Dam, South Fork Flathead River, Montana," Vol. I, § 2, No. 2.4.

Not surprisingly, there is resistance to operational changes that appear to threaten the security of the water supply presently enjoyed by Reclamation project water users. Typically, if water is released for the environment in the non-irrigation season and cannot be recaptured for subsequent diversion and use, it either directly diminishes the water supply relied on by the traditional users or it diminishes the carryover water supply that helps to ensure a full supply during the following irrigation season. In other words, it increases the risk that there will be less water available to consumptive users. There may be resistance to change even where the water can be recaptured, just because of the fear of change and the belief that the next change will directly take water.

Reclamation systems typically are designed and operated conservatively, with the purposeful intention that those holding contracts can count on the services provided for in those contracts except in serious drought conditions. In most cases, there is some play in the systems — water released that does not have to be released or that can be released in a different pattern than has been the case. To this point, most of the changes documented in our cases have taken advantage of the slack in the system. As this slack is taken up, the next generation of changes is likely to direct attention to the more difficult issues of project management control and legal claims to the benefits from Reclamation projects.

1.5.3 Improvements in Project Efficiency

The design and construction of Reclamation projects commonly represent a balance between utilization of the best engineering techniques available at the time, and the cost of building and operating the system. Particularly the early Reclamation projects that were designed exclusively for providing water to irrigation had to be relatively low-cost. Consequently these systems typically utilize facilities and approaches that today are regarded as inefficient. The large, primary delivery canals are unlined, dirt structures likely to lose substantial amounts of water during transit to the adjacent ground and to phreatophytes growing along their banks. They are likely to be designed to operate on a continuous flow basis, with laterals able to divert water at any time according to demand. Even the laterals often operate on a continuous flow basis, with water not diverted for irrigation use flowing back into the river or to another ditch system.
From an irrigator’s perspective, especially in a watershed context, these systems are not inefficient. Assuming there is a good water supply (and Reclamation storage facilities generally ensure such a supply even where natural flows would not), it is desirable to be able to irrigate on demand. The costs of maintaining such systems are low. Unused water simply returns to the river to be used by the next irrigation system downstream.

From the river’s perspective, however, such systems impose important costs. They require the very substantial dewatering of a segment of the river between the diversion dam and the points where return flows restore at least some of the flow of the river. Water temperatures in these segments increase; there is less dilution for any quality-degrading substances entering the stream. And, as a portion of the water diverted for irrigation use returns to the stream, it carries with it sediment, salts, fertilizer and pesticide additives, and other contaminants affecting stream water quality.

Improved project efficiencies do not, of course, create new water. Their benefits depend on the project setting. They should make possible reduced diversions of water from the stream. The environmental value of those reduced diversions could be in allowing that water to stay in the historically dewatered segment of stream below the diversion dam. It could be in reducing the storage releases needed to supply historical diversions so that the releases can be made at a more environmentally advantageous time. It could be in providing an increased downstream supply of water if the water diverted did not return to the river (for example, if it was diverted out of the watershed or water basin).

Moreover, there are potential environmental costs associated with improving project water use efficiency. The water that leaks out of dirt ditches and laterals may help to recharge groundwater supplies. It can be the source of supply for an incidental wetlands area. The phreatophytes growing along the ditches or along the border of irrigated fields may provide aesthetic benefits as well as valuable habitat for a number of species. In short, efficiency is not an end in itself but, in certain circumstances, it could be a valuable means to a desirable end.
Perhaps the most substantial effort to date to improve the efficiency of a Reclamation project involves the Newlands Project in Nevada.\textsuperscript{34} Over the last 25 years, and particularly since 1988, Reclamation has imposed on the Truckee-Carson Irrigation District (TCID) an increasingly detailed set of operational requirements, known as Operating Criteria and Procedures (OCAP), regarding its diversion and use of Newlands Project water. In general, the OCAP establish efficiency "targets" that are adjusted according to the total number of acres of land to be irrigated and the available water supply. These targets increase over time under the assumption that TCID will make improvements in the project water delivery system expected to increase the efficiency of the project. If TCID exceeds the target in a given year, it is credited with the right to use two-thirds of the amount of water involved. If it fails to meet the target, it must repay the amount of water in later years.

A series of dry years during the phased-in implementation of the OCAP have complicated efforts to increase project efficiency. One thing is clear: some of the expected savings associated with implementation of particular measures were too optimistic. Dissatisfaction with this administratively required approach to improved water management, among other factors has prompted the search for alternative approaches.

Without question, reduction of diversions from the Truckee River for use in the Newlands Project has benefitted Pyramid Lake. This is the atypical situation where essentially all water not diverted provides an environmental benefit. To the chagrin of environmental interests, however, it became increasingly apparent that what was good for Pyramid Lake was harmful to the wetlands in the Lahontan Valley. The relatively inefficient use of water in Newlands Project irrigation provided a significant portion of the water supply that replenished the Lahontan wetlands each year. The response rightly was not to maintain historical water use practices but to search for other options that would improve the water supply for the wetlands — to date, primarily through water marketing.

Improved water use efficiency is a major part of the approach proposed to help remedy some of the water conflicts in the Yakima Basin.\textsuperscript{35} Under the recently enacted


Yakima River Basin Water Enhancement Project Act, federal funds potentially are to be available to develop "conservation plans" and to help implement measures identified through the planning process that will reduce the need for irrigation diversions within the five divisions of the Yakima Project. For every 27,000 acre-feet of reduced diversions achieved through the implementation of such measures, instream flow "targets" at two key points in the basin are to be increased by 50 cfs.

Improved water use efficiency in the Grand Valley Project potentially provides a major opportunity for improving streamflows in the Colorado River at a location thought to be valuable habitat for at least two endangered fish species. At present, the Grand Valley Project diverts about 230,000 acre-feet of water during the irrigation season for use on lands within the Grand Valley Water Users Association; of this amount diverted, about 121,000 acre-feet is delivered to water users. Reclamation is studying ways that structural and management changes in the Grand Valley Project could reduce the need for diversions to serve existing project beneficiaries. Implementation of such measures likely depends on clarifying the legal status of the water potentially available for other uses.

Several states now have taken up the issue of the legal status of water that is conserved, saved, or salvaged. The California approach is perhaps the most straightforward. It simply declares that conserved water should not be regarded as having been used nonbeneficially. The availability of this water for a new or different use, however, may still be subject to a determination of whether this water was used "wastefully." Oregon moved in 1987 to allow water users to "salvage" water historically diverted, with approximately 75 percent of this water then available for transfer to new uses (and the other 25 percent returned to the stream). Salvaged water, however, was defined to be only consumptively used water. In 1993, this definition was broadened to "the amount of water no longer needed for diversion," subject to no injury to other water rights. Montana law allows the transfer of water made available "through the application of water-saving methods" so

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long as there is no injury to other water rights. The State of Washington has established a "trust" water rights program by which saved water can be transferred to new uses by the Washington Department of Ecology.

These states have recognized the potential value of providing water users with an incentive to save water. Rather than seeking to reduce water use through imposition of regulatory programs, these laws encourage water users to find others to pay for the costly improvements necessary to reduce the amount of water diverted from streams. Perhaps the most dramatic example to date of the benefits that might be available is provided by the arrangement between the Imperial Irrigation District and the Metropolitan Water District of Southern California, under which MWD is paying for improvements to the IID system that is expected to yield 100,000 acre-feet of water for MWD's use.

As illustrated in the Upper Colorado area study, absent clarifying state legislation allowing such transactions, there is considerable legal uncertainty about the ability to transfer saved water to new uses in states such as Colorado. It may be possible to achieve this objective for Reclamation projects as a matter of federal law, but there are several important limitations — most notably, whether the project authorization provides for the desired new use of project water. This area deserves legislative attention.

1.5.4 Water Delivery Arrangements

Reclamation has entered into thousands of contracts with water districts and other users of the benefits produced by Reclamation projects. While the general kinds of provisions are similar in these contracts, they were negotiated individually between the U.S. and the water district and their specific provisions can be quite different. Most fundamentally, the purpose of the contract is to specify the charges to be paid by those receiving project benefits and the benefits they are to receive. The contracts are for a term of years, most commonly 40. In a standard repayment contract, this is the period during which the share of project construction
costs for which the contractee is responsible are to be repaid. Typically, for projects still operated by Reclamation, the contractee also must pay an operation and maintenance charge.

For purposes of this research, the most interesting question centers on the commitment made by the U.S. to the contractee in terms of project benefits — in particular, the quantity of water that must be provided under the contract. Commonly, an irrigation contract provides for the delivery of some maximum amount of water to the lands of the irrigators within the boundaries of the water district. Presumably this amount of water is based on some assumptions about the total number of irrigable acres within the water district and the amount of water necessary to grow crops on these lands — the "duty" of water. In most cases, the U.S. itself holds the appropriative state water right in its name (legal title), but the U.S. Supreme Court has made it clear that the U.S. acts on behalf of the water users who complete the act of appropriation by applying the water to beneficial use (beneficial title). Thus, at least with respect to the water that has been legally applied to beneficial use by authorized irrigators, the U.S. has a continuing obligation to deliver water — so long as the contract has been validly maintained by, for example, making all required payments.

As illustrated by the Truckee-Carson area study, the actual legal commitment of water may in fact be less than the water district and the water users assume. For example, court decisions in that situation have suggested that the duty of water is a maximum commitment and that, in determining the actual amount of acreage irrigated, only that portion of the land actually growing crops should be included. Particularly in situations where there are water needs for such things as meeting trust responsibilities to Indian tribes or for helping a listed endangered species to recover, the Secretary of the Interior may have a duty to establish a water duty on lands served with Reclamation project water if a duty has not been established under state processes. Moreover, the U.S. may retain some discretion over the project water needed to "carry" water to the farmlands for irrigation. So long as irrigators receive a

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sufficient amount of water at their system headgates to grow crops, they may have little basis
to object to changes that are made in the manner in which that water is delivered.

Water spreading provides an example of a situation in which Reclamation may have
the legal authority to reduce deliveries of water to some contractees. Water spreading refers
to the practice of using Reclamation project water on lands not legally authorized for this use.
In some cases, these lands simply were never properly characterized or were not reclassified
after improvements made them irrigable under Reclamation standards. In other cases, the
lands never were contemplated to be irrigated with project water — for example, lands
outside the boundaries of the project and the contractee. This is a widespread and
complicated problem that is receiving considerable attention from Reclamation and water
users throughout the West. It seems likely that, in some situations, water deliveries to certain
contractees may end up being reduced. Subsequent use of this water remains uncertain,
however.

Another prominent example of ways in which project commitments may be altered is
through Congressional action. The best known illustration is the Central Valley Project
Improvement Act which dedicated about 800,000 acre-feet of the yield of the Central Valley
Project to fish and wildlife use. Strictly speaking, all Congress did was to dedicate the
uncontracted-for portion of the CVP yield to environmental uses. In fact, however, existing
project users benefitted from the availability of this previously uncontracted-for project
capacity even if they were not regarded as directly paying its costs. They benefitted because
of the availability in dry years of carryover water stored in this space in high-flow years. In
the recent drought period, CVP users suffered sharp curtailments in supply. Such curtailments
will be more common in the future with the commitment of project water to environmental
uses.

The only direct example of a contract-centered change in project operations
encountered in our study was in the Newlands Project. In that situation, the Truckee-
Carson Irrigation District was found to have violated its contract responsibilities, and the
contract was terminated. TCID remains the project operator on a year-to-year basis, but

Reclamation could contract with a different entity to operate the project if it chose. In fact, Reclamation has considered a number of possible approaches for restructuring the composition of the project operator — ones that would broaden the representation of interests in the Lahontan Valley.

There are likely to be other circumstances in which entities holding contracts with Reclamation are not meeting the requirements of the contract. For example, there are instances in which water districts are knowingly delivering project water to users not legally entitled to receive that water. There are instances in which districts have not kept up with contract payment commitments. There are project contractees who have not complied with the requirements of the 1982 Reclamation Reform Act. Traditionally, Reclamation has been forgiving of these contract violations. In situations where it has a legal responsibility to use its authority to meet other obligations, such as to a tribe or to help recover an endangered species, it may no longer be able to overlook such contract violations.

Contract renewals present another situation in which Reclamation will be faced with questions regarding its legal authority and responsibility to make changes that, among other things, seek to provide greater environmental benefits from project operations. Once again, the Central Valley Project is the setting of the most focused effort to date in examining options for renewing or extending contracts with project users. Our studies did not get us into the deliberations taking place in this contract process. Assumedly, many of the concerns that are addressed in this report are under consideration in this process. CVP contracts, however, are "service" contracts rather than the "repayment" contracts that are more common in Reclamation projects. The potential legal consequences of the differences between these contracts (and the consequences of "Warren Act" contracts) need to be carefully considered.

Of the options examined in this project, this reevaluation of Reclamation’s legal commitments is perhaps most in need of additional study. Based on our work, it appears that this option is little utilized at this point. In all likelihood, litigation will be required to answer some of the questions likely to emerge. There may be need for congressional action as well. Given the contentiousness of these issues it seems likely that the use of this approach will be

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4For a discussion of the differences see Facilitating Transfers, supra.
1.5.5 Water Transfers

Voluntary reallocation of Reclamation project water to environmental uses is occurring in the Newlands Project and in the Upper Snake. It is under consideration at several other places and is likely to become even more important in the future. Transfers of project water have not been common in the past. Projects were planned and built with specific uses and users in mind. The costs of the projects were highly subsidized for the purposeful intention of encouraging these uses. Understandably, there has been resistance to allowing project users to sell their water allocations to others at what many would regard as a windfall gain. In the end, the necessity for some reallocation of project water, and general acceptance of the idea that market-based approaches are the best mechanism for achieving this reallocation, outweighed concerns about private interests gaining what might be viewed as public benefits.

The best developed example of this approach in our studies is provided by the Newlands Project. Here the U.S. Fish and Wildlife Service operates a water right purchase program buying entitlements to project water from irrigators and transferring the use of the water to support the Lahontan wetlands. The Environmental Defense Fund and The Nature Conservancy actively promoted this approach in the mid 1980s and were successful in persuading Congress to embrace it in the 1990 Truckee-Carson Settlement Act. Under the FWS program, over 12,000 acre-feet of irrigation water had been transferred to the U.S. to benefit the wetlands by October 1993.

There are a number of legal issues presented in making transfers of Reclamation project water, particularly to environmental uses. In some cases, the original authorization for the project may not specifically recognize fish and wildlife purposes; this raises the question whether project water can be transferred to such uses absent explicit congressional authorization. There are questions about whether the new use must be within the existing

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\[^{42}\text{Id.}\]

\[^{43}\text{The Truckee and Carson River Basins, California and Nevada," Vol. II, Chapter 3.}\]
project service area. There are questions about whether the existing contract arrangement between Reclamation and the water users allows transfers and, if so, under what terms. There are questions about the repayment obligation that should attach to project water transferred to environmental uses. And so on. None of these questions necessarily prevents such transfers, and there is growing experience with making transfers that is helping to answer many of the questions. Nevertheless, under existing federal law there are a number of substantial hurdles to be crossed before voluntary transfers of water from existing uses to new, environmental uses can occur. And, of course, this does not even consider equally important state law questions that affect water transfers.

These legal issues have been addressed and largely resolved in the Newlands Project. Still unresolved, however, are the concerns of the remaining project irrigators and others in the communities that are within the Newlands project about the short- and long-term implications of the loss of an important part of the agricultural base of the area. What becomes of the lands previously under irrigation? What happens to those businesses in the area dependent on the existing level of agriculture? What replaces the economic benefits of agriculture in the area?

In part, these concerns arise out of the traditional process utilized to transfer agricultural water to new uses. Purchasers typically buy the water rights associated with entire farm and, to maximize the transferrable quantity of water, dry up all of the lands previously irrigated. While there is a legal proceeding in which the interests of other water rights are considered and protected, there is no real opportunity for broader community concerns to be addressed. A number of interesting ideas have been broached by EDF and TNC including some kind of classification system that would seek to target the purchase of water from lands with less productive soils or which are difficult to serve with irrigation water to, and creating land banks through which dried-up but productive agricultural lands could be purchased by others and put back into agricultural use.

Another approach would be to create a water bank into which Newlands Project irrigators could deposit some or all of their water rights in any given year, providing them

with the option of not farming at all, farming less than all acreage historically irrigated or, of course, farming in the same manner as before. Moreover, the water bank would give the farmer the ability to alter that choice, at least within certain constraints, on a year-to-year basis. Most importantly, it would offer the farmer a potentially valuable option to permanently selling his water rights and going out of farming.

A water bank long has existed in the Upper Snake River. Reclamation has utilized the bank to obtain water for releases downstream to provide additional water for salmon. The Upper Snake bank is run by the irrigation water interests in the area. There are several features of the bank that put these fish-related purchases at a disadvantage. The cost of water that is to be utilized outside of the bank service area is about three times the cost for use of water within the service area. The storage space from which this water comes is regarded as the lowest priority space during the next filling period. If runoff is low the following year this space may not fill, and the holder of the rights to that space will have nothing to use or sell that year. And, of course, the owners of the storage space may simply choose not to make water available through a water bank — a situation that occurred in 1994 in the Upper Snake.

Our work on another research project persuaded us that water banks offer many possibilities for facilitating voluntary reallocation of water with potentially fewer adverse consequences to the irrigated agricultural community. Based on our analysis of water banking experience to date in the western states, we support state-authorizing legislation that provides general guidelines under which water banks can be established, that empower banks to establish transfer procedures separate from the traditional state-level process, and that insulate banked water rights from forfeiture. For banks that involve Reclamation facilities, Reclamation may need to develop its own guidelines and then empower area managers to develop more specific requirements on a case-by-case basis.

Environmental uses of water often provide diffuse benefits, not readily represented through the market by interests able to purchase water. For voluntary transfers to play a real

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role in meeting ecological needs in rivers across the West, money will need to be available to purchase water rights associated with Reclamation projects. Given the tightness of federal budgets, it will be difficult to obtain direct appropriations from Congress for purchases such as being made in the Newlands Project. Yet federal funds are needed and should be pursued. In addition, other creative approaches will be required such as the development of trust funds for purchases of water for the environment. Consideration should be given to assessments on project water deliveries and on the generation of hydroelectric power from Reclamation facilities. States should be encouraged to participate in purchase programs that provide enhanced environmental benefits through voluntary arrangements. And private organizations such as The Nature Conservancy should continue to promote such approaches and bring their own financial resources to the table when possible.

1.6 Conclusion

Very likely, there are opportunities at every Reclamation project across the West to make changes that would provide some enhanced environmental benefits. As our study documents, many such changes already have been made — particularly in the last 10 to 15 years. Much more needs to be done.

Fortunately, a considerable number of changes apparently can be made without adversely affecting the benefits upon which traditional project users have depended, or they can be accomplished with the participation and support of those users. Change is never easy, and there is the very real consideration of the time and budget commitment that would be required by Reclamation to identify and pursue such actions. As always, it is a question of priorities.

Given Reclamation's emphasis on more decentralized management it would seem that priorities will be established in an interactive, collaborative manner, with general policy direction still formulated at the Commissioner's (and Secretary's) level but based on active consultation with regional directors and area managers. There may be some value in devoting a portion of one of the quarterly area manager workshops to a discussion of these issues to assess perspectives from those closer to the problems and to consider possible approaches.
In addition, we have identified a number of issues that clearly require additional analysis. Several of these issues may be suitable for consideration by the Solicitor’s Office. We have identified issues potentially warranting congressional consideration. Discussions could be held with appropriate committee staff members to assess interest. Finally, we have identified issues that bear directly on Reclamation policy. It may be useful to assign "issues" people in the Commissioner's office to begin considering approaches.

Among the "new" responsibilities for Reclamation as it moves away from project construction and toward area management is one as steward for the rivers of the West in which it operates. While continuing to meet its traditional commitments, Reclamation now is broadening its view of its role and the interests that its projects should seek to serve. Reclamation should set for itself a goal of restoring and maintaining the ecological integrity of the western rivers that its facilities regulate. In some of these rivers, Reclamation so controls the river's flows that changes in Reclamation facilities alone could be the key to achieving this goal. In most cases, however, there are many factors affecting the ecological viability of a river in addition to those more or less under Reclamation's control. Nevertheless, Reclamation should assume a position of leadership — through partnership — in taking steps necessary to assure the long-term sustainability of western waters. In those rivers with Reclamation projects, probably no one better understands how they operate. Armed with this unique knowledge, and sometimes with the direct ability to make necessary changes, Reclamation is well suited to play this role.
SECTION TWO: CASE STUDIES

2.1 RAPID VALLEY UNIT, AND PROJECT, RAPID CREEK, SOUTH DAKOTA
Daniel Reimer*

2.1.1 Introduction

The Bureau of Reclamation (BOR) presently operates two projects, the Rapid Valley Unit and the Rapid Valley Project, in the Black Hills west of Rapid City, South Dakota. The Rapid Valley Unit includes the Pactola Dam and Reservoir on Rapid Creek, while the Rapid Valley Project encompasses Deerfield Dam and Reservoir on Castle Creek, a tributary of Rapid Creek (see Figure 1).

The Rapid Valley watershed can be divided into two distinct portions. The waters of Rapid Creek and Castle Creek originate in the Black Hills, and both creeks are typical fast-running mountain streams. Below Pactola and Rapid City the terrain is defined by the Missouri Plateau, and Rapid Creek becomes a river of the Plains. Project water is diverted in the area below Rapid City to serve the irrigation needs of the Rapid Valley Water Conservancy District. Undiverted water and return flows eventually converge with the Cheyenne River 42 miles southeast of Rapid City (Preliminary Evaluation, p. 5).

In 1939 President Roosevelt granted authorization for the construction of facilities at Pactola, 15 miles west of Rapid City. However, the presence of a highway and railroad track on the site forced the Bureau to alter its plans in favor of the smaller Deerfield project located 25 miles west of Rapid City. Construction began in 1942, and water became available from Deerfield Reservoir in 1949. The total capacity of the reservoir is 15,700 acre-feet (AF) (Project Data, pp. 1041-43).

Subsequent water demands by Rapid City and local irrigators prompted the construction of Pactola Dam and Reservoir at the earlier authorized site. Construction began in 1952 and was completed in 1956. Pactola Reservoir has a capacity of 99,000 AF (Project Data, pp. 977-80).

Deerfield and Pactola reservoirs are currently operated on a pooled storage basis (Deerfield and Pactola Reservoir Operating Criteria, para. 2). This operation involves keeping Deerfield Reservoir at its maximum capacity and releasing excess flows into Pactola, from

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Figure 2. Rapid Valley Project
which water is diverted to meet all contract requirements. Deerfield can therefore be used to assure consumptive users of a supplemental water supply.

Water commitments extend to four primary entities. Rapid City has a priority commitment of 7,000 AF from Deerfield and an additional 7,000 AF from Pactola. The Rapid Valley Water Conservancy District can receive a maximum of 8,000 AF from Deerfield with an option to purchase additional water from Pactola. An additional contract provides 600 AF from Pactola for the Rapid Valley Service Company, and a fourth contract is with C&J Sanders for 60 AF from Pactola (Facilitating Voluntary Transfers, p. 289).

Prior to the construction of facilities at Deerfield and Pactola, cold water wild trout fisheries were present in Castle Creek and Rapid Creek. These fisheries remained viable in the creeks after construction of the BOR projects, but the flows in both creeks have been dramatically altered. For example, in Rapid Creek prior to construction at Pactola, natural mean winter flows averaged 25 cubic feet per second (cfs) (Preliminary Evaluation, p. 5). In contrast, the BOR’s Operating Criteria for Pactola calls for regulating winter releases at 7 to 15 cfs (Standing Operating Procedures, IV-4).

Notwithstanding the reduction in winter releases wild trout fisheries in Castle Creek and Rapid Creek are in good condition for most of the year, and maintain a high economic value. The fishery in Rapid Creek has been declared "blue ribbon," a state designation for high quality fish and fish habitat. In addition, annual fisherman expenditures are estimated at $666,475, based upon 26,659 user days at $25 per day (Koth, 1/15/90).

2.1.2 Environmental Problem

A drought in the mid 1980s resulted in significant decreases in the storage levels at Deerfield and Pactola: While Pactola typically stores 55,000 AF, levels in the summer of 1989 were below 25,000 AF. In order to insure that irrigation requirements would be satisfied, the BOR prepared to reduce the discharge for the winter of 1989-90 from 15 to 7 cfs (Brohl, 8/9/89). The BOR took its authority from Pactola’s Standing Operating Procedures which state that BOR can reduce the minimum release to 7 cfs when the reservoir level drops below 29,000 AF (Standing Operating Procedures, IV-4).
The South Dakota Department of Game, Fish, and Parks (GF&P) strongly objected to this proposal. GF&P asserted that the proposed reduction in minimum flows would reduce adult fish spawning and rearing habitat by as much as 80 percent. This reduction in habitat would increase stress and susceptibility to disease. If the low flows were coupled with freezing conditions, GF&P maintained there would be further habitat loss and significant fish kills (Beringson, 9/12/90).

The projected reduction of trout habitat might have resulted in significant economic loss. The total projected losses could have reached $2 million (Beringson, 9/12/90). Moreover, the inherent value of a wild trout fishery, while difficult to quantify, was in danger.

In addition to the fishery below Pactola, a second cold-water trout fishery, in Castle Creek below Deerfield, was also threatened. Deerfield’s problem was not caused by the drought but, rather due to Deerfield Dam’s lack of facilities needed to provide adequate winter releases to support the Castle Creek fishery. The bypass pipe used for low level releases is 4 inches in diameter. The constricted size of the pipe only allows for a maximum release of 2 cfs. In contrast, high level releases are provided by a 27 inch hollow jet valve in Deerfield’s outlet works. The valve can only be operated in excess of 5 percent of its total capacity, which corresponds to a minimum release of 12 cfs.

The original plans for the Deerfield project called for a minimum winter release of 3 cfs to provide for the Castle Creek fishery (Preliminary Evaluation, p. 4). This requirement would have necessitated the use of a bypass pipe with a diameter of 8 to 10 inches (Koth, 6/7/93). The decision to install a 4 inch pipe in 1942 was likely a result of the fact that instream flow values were not considered a high priority at the time.

As between the 12 cfs minimum release from the outlet works and the 2 cfs maximum release from the bypass pipe, the BOR has been using the bypass pipe. The result of a 2 cfs release on the reach of Castle Creek below the dam has been severe. The 2 cfs release is insufficient to keep a steady flow of water in Castle Creek. Reduced flows allow the creek to either dry up or turn to ice at certain times during the winter. This situation results in a reduction in trout habitat, an increase in stress, and fish kills (Koth, 6/7/93). Had a bypass
pipe of greater diameter been installed (even with the original plan to provide a 3 cfs release) these dangers could have been avoided.

2.1.3 Physical and Operational Changes Made

2.1.3.1 Pactola

In response to GF&P's objection to the proposed 7 cfs release at Pactola Reservoir, the BOR altered its release program for the winter of 1989-90. The Bureau agreed to provide an average release of 11.5 cfs throughout the winter, but the water needed had to be taken from storage. In the spring of 1988 and 1989 minimum streamflow requirements were reduced from 20 cfs to 15 cfs because the supply of water for irrigation was threatened by the drought. The water which would have been used to provide the 5 cfs difference was therefore still available and used to supply the release of 11.5 cfs for the winter of 1989-90. In addition, Rapid City agreed to augment these flows with its own contract water during periods of extreme cold in order to compensate for the formation of ice in the stream channel (Kruger, 1989).

The following winter (1990-91), the BOR implemented a minimum release schedule in excess of 7 cfs even though the reservoir level was again below 29,000 AF. During the winter, the BOR maintained an average winter release of 11.5 cfs and established a minimum release of 11 cfs, which was increased to 15 cfs during times of extreme cold. The water needed for the minimum release schedule was converted from an undeveloped irrigation claim for full service irrigation lands which were part of the conservancy district's contract for Deerfield.

In both years water was made available from sources which were originally supposed to be used for other purposes. Although the probability was high that the reservoir level would again drop below 29,000 AF and additional water would be required for minimum flows, there was no similar assurance that an alternate source of water would be available to provide such flows. Thus, GF&P proposed guidelines in 1992 for the creation of an incremental release program which would assure the fishery of adequate minimum releases even during drought conditions. The proposal calls for a pool to be set aside for the fishery
with the volume determined by the total storage level of the reservoir measured in September. The scale for the program would be as follows:

<table>
<thead>
<tr>
<th>Release</th>
<th>Reservoir Cap.</th>
<th>Total AF</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5 cfs</td>
<td>&lt;20,000 AF</td>
<td>5140</td>
</tr>
<tr>
<td>15.0 cfs</td>
<td>20-30,000 AF</td>
<td>6120</td>
</tr>
<tr>
<td>17.0 cfs</td>
<td>30-45,000 AF</td>
<td>6850</td>
</tr>
<tr>
<td>20.0 cfs</td>
<td>45-50,000 AF</td>
<td>7840</td>
</tr>
<tr>
<td>20.0+ cfs</td>
<td>50,000+ AF</td>
<td>7840+</td>
</tr>
</tbody>
</table>

In addition to the minimum flows provided, the proposal calls for an additional 3 to 4 cfs to be available during periods of extreme cold weather (Hansen, 1/28/92). Other factors, such as riparian habitat, went into the formula, but the primary concern was the fishery (Kjar, 7/26/93).

The BOR has accepted this proposal and is attempting to incorporate the guidelines into the operations at Pactola. The BOR contends that the program can be incorporated into Project operations because the original authorization recognizes protection of the fisheries as a legitimate use of Project water (Laymon, 7/26/93). As the program would entail providing more water than is currently set aside for minimum winter releases, however, present contracts with other consumptive users may be affected. The contract which requires the BOR to supply water to Rapid City expired in October, 1992 and therefore required renegotiation (Rapid City Contract). The renegotiation process provides an opportunity to further develop the release program, establish support for the proposal, and include the program in a new contract.

A primary concern about altering water commitments is the possible reduction of water delivery to consumptive users during future years of sustained drought (Laymon, 6/3/93). Towards this end the BOR is creating a computer operations model that will analyze historic data from Rapid Creek and predict future reservoir levels. The operations model will provide a better assessment of the BOR's probable capacity of meeting commitments under the new allocation system (Laymon, 6/3/93).
The operations model is now functionally complete, and the first set of results is being analyzed. This process will be completed during the summer of 1993. If results from the computer model indicate that all commitments can most probably be satisfied then an informal agreement between the parties is more likely.

The BOR will produce an environmental assessment to explain their program for increasing winter fishery flows. The BOR might also be required to go before Congress to request authorization to reallocate volumes of water in the reservoirs and alter the terms of various contracts. Congressional authorization will likely be required because the BOR cannot unilaterally alter the allocation of water established in the Project's Definite Plan Report (Kjar, 7/26/93). Such authorization will likely come either this Congressional session or the next. Finally, a new contract between Rapid City and the BOR may be formed recognizing the new allocation for the fishery (Laymon, 6/3/93).

The BOR's service contract with the conservancy district for Pactola does not expire until 2001, but their contract will likely be renegotiated soon as well. In addition to the reallocation of water for the fishery, the conservancy district is also affected by potential water transfers from irrigation to municipal and industrial uses (Kjar, 7/26/93).

**2.1.3.2 Deerfield**

While the proposed changes to be made at Pactola are operational, the related proposal for Deerfield entails physical alteration of the dam's facilities. As mentioned, the bypass pipe is too small and the outlet works too large to provide winter releases sufficient for the viability of a downstream fishery. To alleviate this problem, the BOR explored several alternatives to change either the bypass pipe or the outlet works. Possible scenarios included increasing the diameter of the bypass pipe, creating new spillways, and other structural modifications (Kjar, 6/2/93).

The BOR has settled on a plan to replace the 27 inch hollow jet valve with a 30 inch jet flow gate. Both devices are used to provide high level releases from a dam. The new jet flow gate would be able to match the present maximum capacity but would not have a minimum capacity as does the present hollow jet valve. The jet flow gate would allow the
BOR to discharge water at 6 to 8 cfs during the winter, which is regarded by the BOR as a target flow (Kjar, 6/2/93).

Funding for the new jet flow gate will come from a variety of sources. Rapid City is contractually obligated to pay for operation and maintenance (O&M) expenses at the Deerfield project. As the hollow jet valve is in need of repair, installing the new jet flow gate falls under this O&M contract. Thus Rapid City will be responsible for contributing to the overall cost of the device (Kjar, 6/2/93).

Total cost is estimated at $450,000 and will come from the BOR ($335,000), the State of South Dakota ($75,000), Rapid City ($35,000), the Black Hills Fly Fishers chapter of Trout Unlimited ($5,000), and possibly the Forest Service. The plan is presently in the design phase with anticipated construction to begin in Fiscal Year 1995. Plans for the jet flow gate will be included in the environmental assessment concerning the proposal to increase winter fishery flows from Pactola.

Data indicates that an increase in the discharge at Deerfield from 2 to 8 cfs will double the biomass, the dry weight of all living material, in Castle Creek (Estimated Trout Populations). Such an increase will raise the economic value of Castle Creek as well as inherent values associated with the trout population.

No major opponents have as yet come out against the proposal. Indeed, the Black Hills Fly Fishers are even making a contribution to the construction of the new gate. The absence of conflict is largely due to the fact that no consumptive users take water from Deerfield. Rather, all contract requirements are diverted from Pactola, leaving Deerfield to serve as an upstream storage facility. In addition, all releases from Deerfield flow into Pactola and therefore no water would actually be lost with increased releases (notwithstanding any evaporative losses caused by the transfer or storage of the water at lower elevations). Thus no water rights are affected by the transfer of water from Deerfield to Pactola, which makes the project appealing.

2.1.4 Issues Raised by the Changes

Both of these programs appear to meet pressing environmental problems facing the fisheries on Rapid Creek and Castle Creek. With new facilities at Deerfield and a new
contract for Pactola, the opportunity is available to establish guidelines to support the fish population. However, GF&P believes that the fishery still remains a low priority for water and, in case of a prolonged drought, the pool set aside for the fishery would likely be diminished or completely sacrificed (Koth, 6/7/93).

GF&P contends that the fishery should not be considered such a low priority. Rather, the BOR should interpret South Dakota water law and the BOR’s Rapid Valley operating principles to compel the BOR to manage the entire resource for the public trust (Koth, 6/7/93). This principle is embodied in the Public Trust Doctrine.

The Public Trust Doctrine employs the proposition that "simply by virtue of our status as members of the public, we have rights in the environment on par with traditional private property rights" (Gordon, p. 496). These rights have been protected in a number of situations, typically limiting the alienability of water rights and riparian lands to assure members of the public assess to navigation and use of water resources. The Public Trust Doctrine has been recognized by the Supreme Court (see Illinois Central Railroad Co. v. Illinois, 146 U.S. 387 (1892)) and the high court of many states, but has never been recognized by a high court in South Dakota.

However, there is support in South Dakota statutes for the recognition of the Public Trust Doctrine. Proponents find such recognition in South Dakota’s environmental protection act which authorizes legal action to protect "[T]he air, water, and other natural resources and the public trust therein from pollution, impairment or destruction" (Gordon, p. 498). In addition, although the Public Trust Doctrine has historically been applied in a narrow setting, primarily concerning navigation, proponents insist that the doctrine’s scope can be expanded. The State’s responsibility in protecting irreplaceable natural resources, once established, can readily be extended to other areas, including the protection of fish and wildlife resources (Gordon, p. 306).

GF&P contends that the Public Trust Doctrine should be applied at Pactola to provide an equitable apportionment of water resources. In addition to allowing all parties to benefit in times of plenty, the Public Trust Doctrine would also entail that equitable cutbacks are made in times of drought. Such an equitable apportionment would insure that the pool set aside for the fishery would not be the first sacrifice made in a period of sustained drought.
While proponents of the doctrine find examples in South Dakota statute, recent South Dakota decisions side with the consumptive user and indirectly reject the Public Trust Doctrine (Koth, 6/7/93). Yet the debate continues, primarily because South Dakota water law is itself unclear. South Dakota is presently a hybrid of prior appropriation and riparian law, and the confusion over such a system is still being worked out (Garton, 1976). Such confusion provides the opportunity to continue debate over the proper role of the state in protecting water resources.

Although there has been no legal imperative to protect the fisheries, the BOR has been making "a good faith effort" to satisfy the requirements of the Castle Creek and Rapid Valley fisheries (Koth, 6/7/93). Perhaps the largest impediment to a cooperative agreement is the perpetuation of old habits. For example, although the BOR accepted GF&P's proposal for an incremental release program in its entirety, GF&P has not been asked to attend any of the meetings which present the data derived from the operations model (Koth, 6/7/93). This apparent contradiction might be mere oversight or it might indicate that the BOR is simply not accustomed to including GF&P in the decision-making process.

2.1.5 Present Status

While GF&P appreciates the effort being made to support the Rapid Creek and Castle Creek fisheries (Beringson, 9/12/90; Koth 6/7/93), GF&P believes that more could be done. The proposals adopted by the BOR will serve to stabilize the two fisheries, but will do little to optimize their potential.

The cold-water trout fishery present before construction at Pactola was sustained by average winter flows of 25 cfs. Furthermore, evidence suggests that the optimum discharge in support of all ages of brown trout is between 25 and 40 cfs, depending on the age of the fish (Koth, 1/15/90). Thus, in order to return the fishery to its original conditions, GF&P maintains that discharge from Pactola should be made at 20 cfs or more (Koth, 6/25/93).

GF&P considers its proposal for an incremental release program to be a reasonable request in light of this evidence concerning historic and optimum levels (Koth, 6/7/93). Yet other demands placed upon the resource make the present proposals seem almost generous.
Population increases in Rapid City and drought conditions which only relented in 1992 have created significant pressure on an already limited resource.

Population increase may prove a valuable benefit to the fisheries, however, because more water during the winter months may be required to supply municipal and industrial needs and the amount of water taken from the fishery pool could thereby be decreased. In addition, the recent drought has ended and the reservoirs are full again, postponing any major threats to the water supply.

Within the next few years both plans will likely be in place. The new facilities at Deerfield and the incremental release program will likely alleviate the environmental problems associated with low winter releases. The stability, if not the optimization, of the Castle Creek and Rapid Creek fisheries will be assured for future years.
2.1.6 References

"Contract for Purchase of Water Between the United States of America and the City of Rapid City, South Dakota", Rapid Valley Unit, South Dakota, Contract No. 14-06-W-51 (Sept. 10, 1952) (Rapid City Contract).

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2.2 NELSON RESERVOIR, MILK RIVER PROJECT, MONTANA

Roberta Hoy

2.2.1 Introduction

Nelson Reservoir is a relatively small, shallow, off-stream reservoir in north-central Montana (see Figure 3). This Bureau of Reclamation (BOR) reservoir, as traditionally operated, provides both beneficial and detrimental conditions for a bird species, the piping plover, listed as "threatened" under the federal Endangered Species Act (ESA) (50 Fed. Reg. 50726-34, Dec. 11, 1985). Plovers are attracted to the reservoir in the spring by available nesting habitat on gravel beaches, more exposed when the water level in the reservoir is relatively low, and by food sources. Without any gravel beaches, it is doubtful that plovers would have nested in the immediate area. However, depending on how close to the water the plovers nest, filling of the reservoir during nesting may inundate the nests. Therefore, the reservoir, part of a BOR irrigation project, has resulted in a potential benefit for the plovers, but the operation of the reservoir may cancel that benefit. The BOR and the U.S. Fish and Wildlife Service (USFWS) have been working on a program to modify reservoir operations to accommodate both the plovers and the irrigators, and to continue monitoring of the plovers for evaluation of such modifications and the development of alternative solutions.

2.2.2 Physical and Historical Settings

Nelson is an offstream reservoir in the BOR's Milk River Project. The Project provides water for irrigation of about 121,000 acres of land along 165 miles of the Milk River, from Havre to Nashua, Montana (BOR Comments). The Milk River originates in the Rocky Mountains in northern Montana and flows through Alberta, Canada before re-entering the United States above Havre, Montana (see Figure 4) (Project Data, p.4).

Homesteading of the Milk River Valley was encouraged primarily by the railroads in the late 1800s, after subjugation of the indigenous Indians (Wolfe, p. 62). One railroad company even asserted that irrigation in the valley was not necessary, and the argument was used in the company's water right claim for its steam engines (Wolfe, p. 64). However,
Figure 3. Milk River Basin

Figure 4. Milk River Project

Source: BOR Project Data, p.2.
studies to supplement the low, summer river flows began in 1891. The Milk River Project was conditionally approved in March 14, 1903. Complete approval was dependent on the outcome of negotiations with Canada because the two principal rivers in the project, the St. Mary and Milk Rivers, originated and flowed into Canada, respectively (Project Data, p. 4).

Nelson is one of the earliest units completed in the Milk River Project and is one of the older BOR reservoirs, constructed in 1914-15 and enlarged in 1921-22. It is located southeast of the Milk River and provides total storage for 79,224 acre-feet (AF) of water (Project Data, p. 6). The storage works are a series of five dikes, with a maximum structural height of 28 feet and crest length of 9,900 feet (Project Data, p. 6). The principal sources of water for Nelson are transfer of water from Fresno Reservoir, which is about 100 miles upstream of Nelson, and natural runoff below Fresno (BOR Comments). Fresno's active storage capacity was originally 127,288 AF (Project Data, p. 6). However, due to sedimentation, the current storage capacity is 102,853 AF (BOR Comments). Fresno was constructed several years after Nelson, in 1937-39, and modified in 1943 and 1950-51 (Project Data, p. 6). Fresno has an outlet tunnel with a capacity of 2,180 cfs, controlled by high pressure slide gates, and an uncontrolled spillway with a capacity of 51,360 cfs. Because of the distance between Fresno and Nelson and the river characteristics, the time required for water released from Fresno to reach Nelson is relatively long, on the order of 10 to 15 days (Guenthner).

A decided advantage to the 'plover project', in terms of both expertise and resources, is the presence of Bowdoin National Wildlife Refuge (Bowdoin Refuge) about 5 miles southwest of Nelson (see Figure 5). The 15,500 acre refuge uses a system of dikes and ditches, constructed when the refuge was first established, to control water flow among four large, shallow lakes and adjoining marshlands and ponds. Some of the funds for the original construction of Fresno came from the USFWS in exchange for 3,500 AF per year of project water for the Bowdoin Refuge (Lambing, p. 4).

The refuge was established in 1936 by Executive Order 7295. Because the refuge was established on land originally withdrawn for reclamation purposes, the refuge objectives were subordinate to reclamation objectives. However, in 1972, the reclamation withdrawal was revoked but the refuge withdrawal continued (Public Land Order 5162, 36 Fed. Reg. 4916).
Figure 5. Map Showing Bowdoin National Wildlife Refuge

Source: Lambing, p. 5.
Therefore, the refuge objectives are now predominant. This may be the only instance in which a reclamation withdrawal was revoked with continuation of a refuge withdrawal. Usually, all withdrawals for a given site are revoked or changed simultaneously.

At Nelson, the Malta Irrigation District performs operation and maintenance (even though these responsibilities were never officially transferred from the BOR), and is reimbursed for reservoir operations by the irrigation districts which use Nelson (Guenthner; BOR Comments). The Dodson South Canal, with a capacity of 500 cubic feet per second (cfs), conveys water from the Milk River, past Bowdoin Refuge, to Nelson (refer to Figure 5) (Project Data, p. 7).

The Malta and Glasgow Irrigation Districts operate the distribution system (Project Data, p. 5). For Malta, water from Nelson Reservoir which does not have a spillway, may be diverted into the Nelson South Canal through slide gates with a capacity of 500 cfs. For Glasgow, water is diverted back to the Milk River via the Nelson North Canal, through slide gates with a capacity of 250 cfs (Project Data, p. 6). Historically, the Malta Irrigation District served about 65,655 acres; about 17,500 acres are supplied by Nelson (BOR Comments). The Glasgow Irrigation District has served about 22,133 acres (BOR 1940).

2.2.3 Beneficial and Detrimental Conditions for the Piping Plover

Piping plovers winter in the southern United States, along the Gulf and southern Atlantic Coasts, and migrate north to nest in the northern United States and southern Canada (50 Fed. Reg. 50726), where irrigation projects are common. As more information about the birds becomes available, the beneficial and detrimental impacts of irrigation projects also become more apparent. For perspective on the importance of operations at sites such as Nelson to sustaining the plover population, general information about the birds is presented first, followed by discussion of site-specific information.

2.2.3.1 Piping Plover Distribution

The population of piping plovers has been severely impacted for years by a variety of human activities. At the turn of the century, hunting for food and fashion greatly reduced the plover population (Gray, p. 21). More recently, habitat loss and degradation, human and
vehicular disturbance associated with recreation and development, and predation by feral cats and dogs as well as natural predators have reduced the population (Sidle, pp. 350-53). The Nelson situation is of specific concern because "habitat deterioration brought about by upstream dams and irrigation diversion was a factor in the USFWS's decision to add the piping plover to the endangered species list." (Sidle p. 353).

The outlook for the birds is critical. This year's floods in the Midwest have undoubtedly exacerbated the situation because the beaches and sandbars favored by plovers for nesting and forage are inundated. One projection of the population viability predicts extirpation of the piping plover from the northern Great Plains in about 70 years (Sidle, p. 355). Recognition of the "deteriorating status" of the birds began in 1972 when the National Audobon Society included the plovers on their "Blue List" of North American breeding birds in potential danger. In 1978, a group of Canadian government and private specialists, the Committee on the Status of Endangered Wildlife, "assigned the status 'Threatened' to the piping plover," and subsequently, in 1985, "assigned endangered status" (50 Fed. Reg. 50726). In the United States, the USFWS proposed listing in 1984, and finalized the listing in 1985.

2.2.3.1.1 Overall Distribution An estimated 4,000 piping plovers are distributed between the United States and Canada (Sidle, p. 349). For purposes of the ESA1, the plovers in the United States have been divided into three populations: Atlantic Coast, Great Lakes, and northern Great Plains (Slide p. 350). In the Great Lakes, the plovers are listed as an "endangered" species; along the Atlantic Coast and northern Great Plains, they are listed as "threatened" (Goossen, p. 139). The plover population in the Great Plains of both Canada and the United States is estimated at 1,000-1,300 breeding pairs, with 600-800 of those pairs in the Untied States (Sidle, p. 353).

2.2.3.1.2 In Montana In 1986, a new piping plover nesting area was discovered in Montana, which is at the western edge of the plover breeding range in the United States. That new area was Nelson. Eleven adult plovers, including three nesting pairs, and five

1Because a jeopardy biological opinion can only be issued if a proposed federal action jeopardizes the entire species, which occurs over a large geographical area with different problems, the USFWS established a limited exception to the jeopardy standard in 1986. That exception allows for division of wide-ranging species into distinct populations for purposes of evaluation of their status (Sidle, p. 350).
fledglings were sighted. Prior to this find, only four breeding pairs were documented at three locations in Montana, although when the species was listed it was estimated ten pairs nested annually in the state. Interestingly, two of the three locations documented prior to the Nelson find were also in the Milk River Basin, at areas in one way or another dependent on the Milk River Project, specifically: Bowdoin Refuge and Fork Peck Reservoir, which is about 100 miles downstream of Nelson (refer to Figure 3). The third location was at Medicine Lake National Wildlife Refuge in northeastern Montana (Prellwitz, p. 84). Even though the nesting areas at Nelson constitute a significant number of the Montana nesting sites, Nelson is not considered 'critical habitat' under the ESA definition, in part because it is a man-made structure (Prellwitz, 1993).

The sighting of the nesting pairs was significant for two reasons, in addition to the presence of a relatively large number of pairs nesting in a new area. The finders "had spent considerable time at Nelson while involved in other projects" (Prellwitz, p. 86). Therefore, the find at Nelson was thought to represent actual discovery of a new nesting area, not just realization that the birds nested at Nelson. Also, plovers had not been sighted at Bowdoin Refuge since 1967 (Prellwitz, p. 84).

2.2.3.2 Conditions at Nelson Reservoir

The difficulties with the plovers' presence at Nelson (or a similar reservoir), within a given nesting season and from season to season, arise due to the plovers' preferences for nesting locations and the timing of nest construction. The plovers select for their nests gravelly surfaces devoid of vegetation, such as beaches or even roads, near bodies of water, and they usually nest in early May. At Nelson, nesting may start up a month earlier or later than this average (BOR Comments). "Nests are simple depression scraped into the sand into which two to four eggs are laid from mid-May through July" (Gray, p. 21). Even though eggs are laid every other day, they usually all hatch about 30 days later. The young plovers, which can leave the nest within a few hours of hatching, fledge (have enough feathers to fly) about 30 days after hatching (Gray, p. 21).

Under the traditional reservoir management operations at Nelson, the reservoir levels were at their lowest from the end of one irrigation season (in the fall) to the beginning of the
next (in late spring and early summer). Therefore, the greatest exposure of gravelly beaches coincided with the time when plovers selected nest sites. However, as soon as the spring runoff started, the reservoir would be filled and maintained as full as possible (Guenthner). Consequently, depending on exactly when and where a nest was located, it could be flooded as the reservoir filled.

In addition to the problems within a given nesting season, the birds exhibit homing behavior, returning to the same nesting site from year to year (Wiens and Cuthbert, p. 545). If a reservoir level remains low one year, a plover pair may establish a successful nest. However, if that reservoir is full the next year and less beach is exposed, either because of a plentiful water supply or because of a change in reservoir operations to avoid flooding, that nesting pair could bypass the reservoir entirely (Gray, p. 21), or face more competition for nesting sites. Either the complete lack of space or competition for less space could have a negative effect upon nesting success.

Another concern relates to access to the reservoir, primarily access for recreation (BOR Comments). The nests are difficult to see and can easily be destroyed. Also, plover reproductive success declines as human activity in the vicinity increases (Sidle, p. 351). Although recreational use of Nelson is not a priority, fishing and hunting are allowed, and people have built cabins in the area (Christopherson). Given that the plovers have already nested on a gravel road at Nelson (Prellwitz, p. 86), encounters between the birds and people are inevitable. However, to date, human access to the reservoir has not posed the same threat to the birds as fluctuations in the reservoir.

A concern at Bowdoin Refuge (and possibly at Nelson) for all fish and wildlife, and consequently humans, is the effect of increased concentrations of naturally-occurring substances in irrigation return flows. The Bowdoin Refuge was one of nine locations selected for reconnaissance investigation of water and sediment quality and biota concentrations after the toxicity problems at Kesterton National Wildlife Refuge (Lambing, p. 2). Fortunately, no immediate, serious, refuge-wide problems were detected, although some seemingly random concentrations were unusually high (Lambing, pp. 1-2). Although contaminants do not appear to pose an immediate threat at Nelson, the USFWS has evaluated contaminant concentrations in plover eggs and chicks of the Missouri River, South Dakota (Ruelle).
2.2.4 Changes Made in the Reservoir Operations

Between 1986 and 1989, the BOR did not significantly change operations other than to increase monitoring for the plovers. Indeed, no change was warranted because the plovers were attracted to the reservoir under conventional operating conditions. However, in the spring of 1989, a plover nest was flooded as the reservoir filled. As a result of this inadvertent "taking," the USFWS requested a formal consultation with the BOR under section 7 of the Endangered Species Act (Guenthner). The consultation was completed and resulted in a 'non-jeopardy' biological opinion (Christopherson). In 1989-90, the BOR and USFWS worked out a tentative agreement for changes in the BOR reservoir operations at Nelson. A principal aspect of the agreement is to fill (or at least begin to fill) the reservoir in the fall, at the end of the previous irrigation season, rather than waiting until spring. This should reduce the risk that the plovers will nest on gravelly areas later inundated, although it also reduces available habitat. Another key aspect is to avoid raising the water level in the reservoir between May 1st and July 15th, if possible. In addition, the BOR has entered a cooperative agreement with Bowdoin Refuge for weekly surveys of the plovers to document information such as where nests are located and hatching/fledging times. To support refuge personnel, the BOR is providing partial funding for a summer assistant at the refuge (Fuller).

Continuing informal discussions between the BOR and USFWS are aimed at developing a long-term arrangement that will attract but not subsequently imperil the plovers. Although piping plovers as a whole have received significant attention, the data base on plover habits at reservoirs such as Nelson, and the species' responses to conventional and modified reservoir operations, is relatively sparse. Such data is necessary for continuing discussions of options to avoid additional "takings." One advantage is that the data is useful not only for plovers but for other birds with similar habits such as least terns (Gray). For short-term decisions, the current procedure appears to have the BOR as the go-between for the USFWS and irrigation personnel (Prellwitz, 1993).

2.2.5 Analysis of the Changes Made

Classic endangered species questions, such as "Do people or birds have priority?" and "To what extent must accommodations be made?" illustrate the basic issues at Nelson.
Unfortunately, the provisions of the tentative agreement have not eliminated the threat of flooding the plover nests. One nest had to be moved during the 1992 nesting season and, as of June 1993, one nest was flooded, even after it was moved twice (Fuller). Based on historic data provided for the biological opinion, the flooding of a nest should only occur about once every 15 years. However, the amount and timing of precipitation in the last three years has resulted in more frequent problems with nest flooding (Prellwitz, 1993).

One potential saving factor is that refuge personnel have moved nests to avoid flooding, and chicks hatched from the relocated nests. However, the ultimate impact of this maneuvering on the plovers has not been completely assessed. Information on the total number of eggs laid, year-to-year breeding success, and similar information is not available. In the wild, plovers have been known to renest up to four times after successive nests were destroyed. Again, little information as to the ultimate impact of the renesting is apparently available.

2.2.5.1 Water Availability

Nelson operations are complicated in that the reservoir is a small part of an intricate, international river system, and the reservoir is off-stream, primarily dependent on diversions rather than natural inflow or overland flow. Also, the usual difficulties due to variable precipitation amounts and timing, so common in western waterways, are characteristic of this basin. Not surprisingly, "water supplies in the Milk River basin are stretched to their limits" (Wolfe, p. 58). For the irrigators, it is critical that Nelson is full of water prior to the beginning of irrigation season. The BOR prefers to keep Nelson as full as possible early in the irrigation season to provide water later. Even under 'normal' circumstances, it is apparently difficult to fill the reservoir early in the spring (Guenthner). However, prior to the operational changes made to benefit the plovers, storage of water in the reservoir over the winter was not considered, in part because the dike system leaks (Christopherson).

In terms of the quantity and timing of water deliveries, the goals of the agreement between the BOR and the USFWS are to move about 6,000 AF of water from Fresno to Nelson in the fall, if water is available in Fresno, to begin filling Nelson as early as possible in the spring (BOR Comments), and to avoid filling the reservoir at all between May 1st and
July 15th (Guenthner). The later the water becomes available at Fresno, the more risk there is to the plovers because of the 10 to 15 day transit time between Fresno and Nelson. For example, water is not available for release from Fresno until April 28th. That water will not arrive at Nelson until May 7th, when nesting may already have started. In 1993, 2,000 AF of water was available but could not be stored because of timing constraints (Mavencamp).

The Malta irrigators do not mind accommodating the birds, although they do not want to inhibit farming operations. The primary concern is, of course, water availability. There is also concern about the 'experimental' nature of the project because, to the irrigators, information about the plovers seems scarce. However, the irrigators have an interest in the birds' recovery and have suggested other recovery measures such as predator control and artificial incubation (Mavencamp).

The goals of the tentative agreement may well change after it has been in operation for a few years. First, if Nelson is filled in the fall, the amount of available nesting space is reduced. This reduction could result in birds bypassing Nelson to try to find other suitable nesting habitat. Therefore the risk of nest flooding due to late filling might be preferable to not attracting birds at all. Second, additional information on the water conditions and plovers is expected to become available each year, so projections of water needs and availability can be improved.

Although not related to the plover project, water allocation in the Milk River Basin is being evaluated by the State of Montana, and the Milk River Basin is reportedly closed to further private appropriations (Wolfe, p. 75). Of all the irrigation districts in the basin, the Malta Irrigation District, dependent on Nelson, apparently has not yet agreed to participate (Wolfe, at n. 95). However, no additional information about the basin-wide allocation was collected as a part of this case study.

2.2.5.2 Structural Changes

Two possibilities, largely independent of the Nelson water users, exist for 'creating' additional nesting habitat. One simple proposal involves removing vegetation. A similar proposal involves construction of artificial islands or similar structures, relying on engineering expertise within the BOR. One difficulty with both of these proposals is that new vegetation
must continue to be removed (Christopherson). Another possibility involves increased cooperation between managers of Bowdoin Refuge and Nelson. The water scheduled for Bowdoin Refuge could be turned to Nelson so it could be filled early (Christopherson).

2.2.6 Status of the Reservoir

Because the plover discovery and subsequent proposals for operational changes are relatively recent, the data base to determine the effectiveness of these changes is correspondingly limited. Therefore, flexibility is a requisite part of the tentative agreement. The ability of the plover to recover under protection has been documented (50 Fed. Reg. 50726). Therefore, the work at Nelson has a reasonable chance to contribute to the recovery of the piping plover.
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2.3 CANYON FERRY DAM, MISSOURI RIVER, MONTANA
Daniel Reimer*

2.3.1 Introduction

The Bureau of Reclamation (BOR) operates the Canyon Ferry Unit, including the Canyon Ferry Dam, Reservoir, and Powerplant, about seventeen miles northeast of Helena, Montana on the Missouri River (see Figure 6). Authorized by the 1944 Flood Control Act, Public Law 534, construction on the Canyon Ferry Unit began on May 24, 1949 and was completed on June 23, 1954.

Canyon Ferry is a multi-purpose project benefiting power supply, flood control, and irrigation in the Upper Missouri River Basin. The powerplant has a generating capacity of 50,000 kilowatts, and the reservoir has a total capacity of two million acre-feet (AF) (Project Data, p. 815).

Montana Power Company (MPC) operates two power generating plants downstream of the Canyon Ferry Unit. Immediately below the Canyon Ferry Dam is Hauser Lake and MPC's Hauser Dam. Approximately one mile below the Hauser facility is Holter Lake and Holter Dam. The Missouri River then runs 80 miles until it is regulated again by five dams at Great Falls. In addition, MPC operates the Hebgen Powerplant, located upstream from Canyon Ferry in the headwaters of the Madison River, which regulates water prior to its inflow at Canyon Ferry Reservoir.

The Montana Department of Fish, Wildlife, and Parks (FW&P) manages a trout fishery in Canyon Ferry Reservoir and two cold-water fisheries on the Missouri itself, one in the mile stretch between Hauser and Holter and one in the eighty-mile stretch between Holter and Great Falls.

Environmental Problem

During the 1960's and early 1970's, MPC satisfied high energy demands by "peaking" its operations at Holter Dam. Peaking involves running water through a powerplant according

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Figure 6. Canyon Ferry Unit

to the changing power demands over the course of a day. Thus, MPC might have been releasing 7,000 cubic feet per second (cfs) from Holter during the day when demand is high and then reducing the release to 2,000 cfs at night when less power is required (Pascoe, 6/28/93).

This operation created daily fluctuations in the water levels below Holter and negatively impacted the rainbow and brown trout populations. The fluctuations disrupted fish habitat, food production, feeding patterns, and spawning and recruitment activities in the downstream fisheries. An overall reduction in numbers and biomass was recorded (Peterman, 7/2/93).

FW&P actively dissented to MPC's peaking operation, citing the deleterious effects on the fishery. In response to this pressure, MPC reverted to a base load operation to reduce the fluctuations.

The base load operation made Holter a "run-of-the-river" powerplant in which water flows through a plant without substantial regulation. A small reservoir behind the powerplant allows MPC to make very gradual changes in the flows released from Holter and reduce even natural fluctuations (Pascoe, 6/28/93). As a result of MPC's base load operation, the fish population below the dam regained its former stability and became a "blue ribbon" trout fishery, which is the state designation for a fishery with high quality fish and fish habitat.

MPC, however, was still left with the problem of satisfying high energy demands. Towards this end, MPC explored several alternatives during the late 1970's and early 1980s. Two less inviting alternatives involved replacing the energy by buying it from other plants or not making the sales at all and losing that revenue (Pascoe, 6/28/93). In order to generate sufficient power at Holter, MPC experimented with a peaking operation once again but stopped after protests began anew.

In the early 1980's, MPC explored the possibility of peaking at Hauser Dam by building a 23 megawatt generator to handle a peaking operation. FW&P and many fishermen became concerned about the possible effects on the cold-water fishery below Hauser and more protest resulted. After substantial conflict, MPC dropped its plans to build the new generator (Pascoe, 6/24/93).
In addition to these conflicts between MPC and FW&P over flows, the Bureau of Reclamation was also embroiled in its own controversy with FW&P. In September, 1983 (during the fishing season) BOR released 10 to 12 thousand cfs from the Canyon Ferry Dam. Water is often "spilled" from Canyon Ferry during the summer and fall when inflows raise the reservoir level above a predetermined point.

BOR was not aware, however, that just prior to the spill FW&P had stocked the reservoir with trout. As a result of the spill, a sizable number of these trout were flushed through the system and moved downstream. This event disrupted the downstream fishery and reduced the number of fish which were supposed to be located in the reservoir. As the strain of trout planted in the reservoir at that time did not have a long lifespan, any reduction in population was deemed critical. Although the total effect of the spill was not measured at the time, a spill’s ramifications on the reservoir fishery are currently (1993) being studied in greater detail (Peterman, 7/2/93).

All of these problems seemed to revolve around an absence of communication between the various bodies. In 1984, members of MPC, the BOR, and FW&P decided to create a communications link to remedy the situation.

2.3.3 Physical and Operational Changes Made

To begin the necessary information transfer, FW&P provided recommendations of flows necessary for the trout fishery’s viability. In addition, FW&P identified certain periods where spills would not harm the fishery. Finally, FW&P established 4,100 cfs as a target flow, with 3,000 cfs to serve as a minimum and 2,800 cfs as an absolute minimum (Peterman, 6/9/93).

In addition, FW&P and MPC entered into an informal agreement over river flows. MPC agreed to avoid peaking operations that would cause dramatic fluctuations and negative impacts on the cold-water fisheries (Pascoe, 6/24/93).

The principal change in operations was the establishment of the Upper Missouri River Water Advisory Council in late 1984 to coordinate annually the activities of each of the three groups (Advisory Group). This working group is chaired by FW&P and also includes the Bureau of Reclamation and MPC. Each April the group meets to analyze snowpack.
measurements, power requirements, maintenance schedules, and other data to develop a strategy for the upcoming year. In addition, these meetings are open to the general public and thus serve to address the demands of those individuals or organizations affected by such management strategies. This broader group generally includes the reservoir's marine operators, rafters, downstream irrigators, conservation groups, and fishermen (Felchle, 6/4/93).

The Advisory Council has operated since 1984 in a consistent fashion without any formal agreement. Typically, only one meeting is required during the year to accommodate all the interests. In 1987 and 1989, however, severe droughts forced the group to convene more times per year in order to meet the acute pressures associated with a drought (Lambertson, 6/25/93). During the drought Canyon Ferry Reservoir did not fill by mid-summer and the Bureau of Reclamation was periodically forced to reduce flows to 2,800 cfs, the level considered the absolute minimum by FW&P. The MPC serves largely as "observer" on the Advisory Council, providing information about power demands and expected flows from Hebgen Dam into Canyon Ferry and listens to comments made by other interested parties (Lambertson, 6/25/93).

The BOR maintains the ultimate authority to establish its own release schedule. Such authority is regarded as necessary because at times the decisions of the Advisory Council may contradict the mandate of the BOR to manage for downstream flood control or the like. In such a situation, the BOR must have a means to operate independently of the Advisory Council (Felchle, 6/4/93).

2.3.4 Issues Raised by the Changes

Although the BOR does have the authority to disregard the Advisory Council, the council has effectively set guidelines for flows over the past decade. This cooperative arrangement is lauded by each of the group's members and others (Felchle, 6/4/93; Peterman, 6/9/93).

The Advisory Council has been able to address the myriad of issues it has faced. One of the greatest challenges has been a drought over the past five to six years which has resulted in decreased snow-pack and a resultant decline in reservoir levels. Of the seven years in which Canyon Ferry Reservoir has not filled by late June, five were between 1987 and
1992 (Council Meeting Minutes). The participation of the council during this critical period facilitated the BOR’s efforts to meet the many demands that water users place upon the resource during all periods.

Another challenge to the Advisory Council was a conflict over whether to manage releases for the fishery in the reservoir or the fishery downstream. A fluctuation of a few feet can significantly disrupt fish habitat downstream but have little effect on habitat in the reservoir. Thus, BOR generally adjusted flows based upon the needs of the downstream fishery without great concern for possible fluctuations in the level of Canyon Ferry Reservoir. This strategy angered some marine operators whose docks were directly affected by fluctuations in the reservoir level. Some complained that lowering the reservoir made boat docking impossible and substantially reduced their summer season (Perry, 6/24/93). BOR recognized these legitimate concerns and adopted a management strategy to avoid significant drawdowns during the summer recreation season. Some marine operators are still not satisfied with the resolution of the issue, however, and continue to protest (Perry, 6/24/93). A valuable result of the controversy was that it forced the marine operators to bring their concerns to the Advisory Council and engage in the cooperative arrangement themselves (Peterman, 6/9/93).

The primary shortcoming of the present arrangement is that the Advisory Council is no better than the sum of its parts. The level of cooperation has been extremely high to date because the individuals involved are apparently committed to coordinating their activities. People from each of the agencies have gone to the facilities of the other bodies to view first-hand the operations and requirements of the other groups (Felchle, 6/4/93). However, without some formalization, such as including the Advisory Council in BOR’s operating criteria, contracts, or other agreements, the council is susceptible to the changing agendas of the various members.

It is difficult to account for the level of cooperation. Certainly the personalities of the participants can explain some of the Advisory Council’s success. In addition, a shared regard for the resource may help to explain their commitment. Perhaps the time was ripe for a coordinated effort. Simple communication would have helped to avoid the fish flush in September, 1983, and could likely have facilitated a compromise with regard to MPC’s
peaking operations. Whatever the reason, the Advisory Council has served to provide a measure of cooperation and information transfer where none had existed before.

2.3.5 Present Status

An agreement was reached at the Advisory Council’s meeting in April 1993 regarding the appropriate time to stock Canyon Ferry Reservoir with eagle lake trout, a wild strain of trout with a greater lifespan than those currently planted. FW&P had been preparing to plant young trout in the spring until BOR remarked that some of the fish might be flushed if a spill were required during the summer (Council Meeting Minutes). The agreement to plant trout later in the year is illustrative of the Advisory Council’s success in that the absence of communication about stocking the reservoir was a precipitating factor in the formation of the Advisory Council. The Advisory Council has thus accomplished the task for which it was formed.

In 1992 MPC applied for relicensing of its Upper Missouri River facilities with the Federal Energy Regulatory Commission. Although MPC’s present license does not expire until 1998, the company would like to increase power generation capabilities and a new license can provide the required authorization (Pascoe, 6/28/93).

Relicensing also provides the opportunity to formalize some of the guidelines adopted by the Advisory Council. While the group itself will not be incorporated, agreements regarding target flows, minimum flows, and release scheduling will be formalized in the new license (Pascoe, 6/24/93). In addition, many of the participants of the Advisory Council are also part of the technical working group aiding in the relicensing preparations (Lambertson, 6/25/93). Thus, the communication lines will remain open.

The Advisory Council will likely remain in its present form. The group has effectively handled problems it has faced and has served as a model for other cooperative arrangements in Montana at Yellowtail Reservoir on the Bighorn River and at Tiber Dam (Peterman, 7/2/93). The appeal of such an arrangement can extend much more widely, however, and serve as a model to other areas faced with the same deficiencies in communication and cooperation.
2.3.6 References

Telephone interview with Tim Felchle, Bureau of Reclamation (June 4, 1993).

Telephone interview with Sheryl Lambertson, Senior Engineer, Montana Power Company (June 25, 1993 and June 28, 1993).

Telephone interview with Bill Pascoe, Manager, Montana Power Company (June 24 and June 28, 1993).

Telephone interview with Bruce Perry, Marine operator, Helena, Montana (June 24, 1993).

Telephone interview with Larry Peterman, Administrator of Fisheries, Washington Department of Fish, Wildlife, and Parks (June 9 and July 2, 1993).


"Upper Missouri River Advisory Council Meeting Minutes," April 8, 1993 (Council Meeting Minutes).

2.4 HUNGRY HORSE DAM, SOUTH FORK FLATHEAD RIVER, MONTANA

Roberta Hoy*

2.4.1 Introduction

The Hungry Horse Dam and Reservoir (Hungry Horse) are on the South Fork of the Flathead River in northwestern Montana (see Figure 7). The project was authorized as a multi-purpose project, serving hydropower, flood control, and irrigation needs, but the project has generally been operated with an emphasis on power generation and flood control (Reller, pp. 30-31). The importance of Hungry Horse to power generation is in its location in the Flathead River basin at the 'top' of the Columbia River system (see Figure 8). Not only can power be generated at Hungry Horse, but release of water from Hungry Horse 'multiplies' the potential for power generation as the water moves downstream through successive storage reservoirs and dams (BOR HH Brochure). For example, in 1976, nearly 1.2 billion kilowatt hours of electricity were generated at Hungry Horse, but the water releases also accounted for about 5 billion kilowatt-hours of power generation at 18 powerplants downstream (BOR Montana, p. 30). However, the strategic location of Hungry Horse, and the subsequent emphasis on power generation, has created problems for meeting other objectives, particularly those related to recreation, fish, and wildlife, both locally and throughout the Columbia River system.

The adverse impacts on the other water-dependent objectives are not due simply to power generation, rather they are due to: (1) the timing of water releases from Hungry Horse to supply peak power demands; and (2) the large drawdowns in the reservoir levels. 'Peaking' operations require large fluctuations in the rate of the water release through the dam which, in turn, result in large fluctuations in the river flow rates and temperatures below the

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1"For the purpose of irrigation and reclamation of arid lands, for controlling floods, improving navigation, regulating the flow of the South Fork of the Flathead River, for the generation of electric energy, and for other beneficial uses primarily in the State of Montana, but also in downstream areas, the Secretary of the Interior is authorized and directed to proceed as soon a practicable with the construction, operation, and maintenance of the proposed Hungry Horse Dam. . . ." 16 U.S.C. § 593a (1988).
Figure 7. Hungry Horse Project

Source: Stanford, p. 36.
Figure 8. Major Hydroelectric Dams in the Columbia River Basin

Source: Stanford, p. 42.
dam. These fluctuations are not naturally damped to any great extent; therefore, conditions in the river below Hungry Horse and even in Flathead Lake, about thirty miles downstream of Hungry Horse, are directly impacted by peaking operations at Hungry Horse. The heavy reliance of users much farther downstream in the Columbia River system on water stored in Hungry Horse results in large drawdowns in the reservoir level. These users are not limited to power companies. For example, water has been released from Hungry Horse to "satisfy reservoir elevation for efficient boating access and other recreational opportunities on Lake Roosevelt," which is behind Grand Coulee Dam (BPA, p. 11; Stanford, pp. 43, 49) (refer to Figure 8).

This case study presents information on three changes that have been implemented or proposed for Hungry Horse operations and the observed or potential impact of those changes on both the Flathead River basin and the Columbia River system. Because Hungry Horse was intended to serve several uses, the Bureau of Reclamation (BOR) officials responsible for Hungry Horse operations generally have experience in working with other agencies and organizations. However, processes for deciding which users have priority during what time of year, who pays for any operational change, and who evaluates the effectiveness of those changes are being evaluated and sometimes changed. This case study also presents information on some of the objectives for water distribution throughout the Columbia River system that would affect Hungry Horse operations.

2.4.2 Physical Setting

Information on both Hungry Horse and Flathead Lake is necessary to evaluate the impact of Hungry Horse operations. Hungry Horse is the largest project, federal or private, on the tributaries of the Flathead River (Stanford, p. 36, Fig. 1) and is entirely within the Flathead National Forest (Project Data, p. 4). Flathead Lake was a natural lake, enlarged by installation of Kerr Dam (Marotz). Kerr Dam and the southern half of Flathead Lake are on the reservation of the Confederated Salish and Kootenai Tribes (Tribes), established under the Treaty of Hell Gate, July 16, 1855. The northern half of the lake is surrounded by private land and the Flathead National Forest (MPC v. FPC, p. 741).
2.4.2.1 Hungry Horse

When completed in 1953, the Hungry Horse Dam was the third largest and second highest concrete dam in the world (Project Data, p. 1). The dam is an arch-gravity type structure, depending on its weight and arching thrust against the rock abutments on either side to resist the pressure of the water. The reservoir has a total storage capacity of 3,468,000 acre-feet (AF), but it is extremely long and narrow, 34 miles long and only 3.5 miles wide at the widest point. It is also quite deep, with a maximum depth of 500 feet. Because of this topography, the surface area of the reservoir is only 23,750 acres (BOR HH Brochure).

Generation capacity at Hungry Horse originally was 285 megawatts (MW), although peak loads of 328 MW could be met (Project Data, p. 1). BOR recently rewound the generators at Hungry Horse to gain an extra 100 MW of power (ENR, 8/30/93). Four penstocks, each 13.5 feet in diameter and 450 feet long, carry water from the reservoir to the turbines. The penstock entrances are in the upstream face of the dam, 246 feet below the crest (see Figure 9). If all the water released is not needed for power generation, it can be released through a spillway or outlet works, rather than through the penstocks. The spillway at Hungry Horse is the world's highest 'glory hole' type spillway, and water cascades over its circular rim and drops a total of 490 feet through a concrete lined tunnel with a maximum diameter of 35 feet. The spillway 'starts' 118 feet upstream from the dam and carries water through a bedrock tunnel under the right abutment and returns it to the river channel 550 feet downstream of the dam. The maximum discharge capacity of the spillway is 53,000 cubic feet per second (cfs), and the discharge rate is controlled by a ring gate which can move 12 feet vertically (BOR HH Brochure). If the reservoir level drops below the spillway crest, water can still be discharged through three outlet pipes, each 660 feet long and 8 feet in diameter with a maximum discharge capacity of 4,680 cfs. The openings to the outlet pipes are in the upstream face of the dam, 365 feet below its crest, and the outlets discharge through a valve house on the right bank of the river channel below the dam. Flow through the outlets is controlled by hollow jet valves.

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2 Conduits that convey water from the reservoir to the power generating turbines. The rate of water flow through the conduits is controlled by valves.
Figure 9. Hungry Horse Dam and Powerplant, Plan and Sections

Source: BOR Project Data, p. 6.
2.4.2.2 Kerr Dam

This dam was completed in the mid-1930s and allows for control of only the upper ten feet of the lake level (Marotz). The present storage capacity is 1,217,000 AF (Stanford, p. 43), and at full pool, the river backs up 22 miles above the lake (Marotz). Until the mid-1980s, the 180-MW generating station at Kerr Dam was operated by a private concern, Montana Power Company (MPC) or its wholly owned subsidiary, Rocky Mountain Power Company, pursuant to the Federal Water Power Act of 1920 and the Act of March 7, 1928 (MPC v. FPC, p. 741). In 1985, a joint operating agreement between MPC and the Tribes was approved by the Federal Energy Regulatory Commission (FERC) (Inside FERC, 7/29/85).

2.4.3 Historical Setting

Before the construction of Hungry Horse, projects were proposed at two other locations on the Flathead River. Rather than construct a dam at Hungry Horse, one proposed project included raising the level of Flathead Lake and subsequently increasing the potential for power generation at Kerr Dam (Hearings, p. 7). However, this proposal met with adamant opposition from the people of Montana because they had not been part of the planning process (Reller, p. 29) and because of numerous adverse impacts, such as flooding several towns, including Kalispell, decreasing the recreation value of the lake and its vicinity, and flooding of 43,000 acres of agricultural land. A different project, proposed by agricultural interests, included a diversion dam at Bad Rock, but a suitable location could not be found for the dam’s foundation (Hearings, pp. 8, 12).

As early as 1928, plans for Hungry Horse included multiple uses for irrigation, flood control, and power generation. In congressional hearings for projects throughout the Columbia River system, Hungry Horse was described as serving "a threefold purpose, irrigation of Kalispell Valley and around Flathead Lake, an acreage of perhaps 50,000 to 100,00 acres; second, power at the dam site and stabilizing the flow for potential power development on Flathead River below Flathead Lake; and third, the reduction of flood heights on Flathead Lake and Pend Oreille Lake" (Hearings, p. 54).

By 1944, the emphasis had shifted to power production, in large part because of manufacturing needs arising during World War II. Even so, the justifications still included
multiple purposes. In acknowledging the strategic location of Hungry Horse for power, the chairman of the Federal Power Commission questioned such justifications:

[T]he multiple-purpose potentials of the project have not yet been fully explored with respect to the feasibility of furnishing supplement water for presently cultivated land and irrigation of new lands, in addition to its use for stream regulation and incidental flood control. These determinations should be made as early as possible to permit the completion of plans for construction of the project in the early post-war period.

Considering, therefore, the time required for construction of the project and the probability that power available from other sources will meet the requirements of the war program, it does not appear that the Congress would be justified in authorizing immediate construction of Hungry Horse Dam as a war emergency project.

(Id. at 4)

The dam was authorized by Congress in 1944 (Public Law 329, 78th Congress, 2d session, 58 Stat. 270). The construction project was contracted in 1948 and completed in 1953 (Project Data, p. 4).

2.4.4 Description of the Environmental Problems

Hungry Horse, along with other dams in the Columbia River system, has altered the natural system to the point where numerous environmental problems have been identified. Efforts by federal, regional, state, tribal, and local government agencies and private organizations to address these problems are directed toward preserving what remains of the natural system, both locally and throughout the system, and reestablishing it where possible, while recognizing the dependence of hydropower and other users on the artificial system. Therefore, evaluation of Hungry Horse project is complicated by the need to evaluate not only the impact of existing and proposed operations in the Flathead River basin but also in the Columbia River system as a whole.

The emphasis in this case study is on the environmental problems associated with fish because the difficulties of reestablishing stable fish populations illustrate the tensions between local and system-wide concerns. This emphasis is not intended to discount other concerns, such as wildlife, but most of the work by various agencies and organizations has been directed
toward reducing the impact of the artificial system on fish (Brown, p. 578). In addition, any operational changes made by BOR will affect fish directly.

2.4.5 Fish Species Affected by Hungry Horse Operations

Because of the complexity of the Columbia River system, proposed changes in Hungry Horse operations to restore fish populations include changes to benefit ‘resident’ fish in the Flathead River basin and downstream fish in the Columbia River system, even though these downstream fish may never enter the Flathead River basin.

2.4.5.1 Resident Fish

The term ‘resident’ fish applies to those within the Flathead River basin, whether they remain within a relatively small territory or travel over 100 miles within the basin to spawn (Stanford, p. 45). In the basin, only 12 native fish species have been found. Non-native species were introduced in the early 20th century and several became well-established by the 1930s (Stanford, pp. 37-38). In particular, kokanee salmon were introduced in the basin in 1916 by game managers (NYT, 12/5/82). This salmon is not a distinct species but a variant of the sockeye salmon (Walden, p. 98). Although most sockeye live their adult lives in the ocean and migrate hundreds of miles up freshwater rivers to lakes for spawning, kokanee live in freshwater lakes such as Flathead Lake and migrate upstream of the lakes to spawn (Walden, pp. 97-98). Recently, another aquatic species, the Mysis shrimp, was introduced into Flathead Lake as a food source for the kokanee. However, the shrimp may actually compete with the kokanee for food (NYT, 12/5/82) and serve instead as a food source for bottom-oriented fish such as lake whitefish, lake trout, and yellow perch (Stanford, p. 38; Prange Comments).

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3 Native species include westslope cutthroat trout, bull char, pygmy whitefish, mountain whitefish, northern squawfish, peamouth, redside shiner, largescale sucker, and longnose sucker.

4 Well-established non-native species include kokanee salmon, yellow perch, lake trout, and lake whitefish.

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2.4.5.2 Anadromous Fish

In contrast to resident fish, who spend their lives in fresh water, anadromous fish spend most of their lives in the sea and migrate up fresh water rivers to spawn. There are no anadromous fish in Montana (PR Newswire, 7/9/92). However, their importance to Hungry Horse operations cannot be overlooked because water stored in Hungry Horse has been released and captured in downstream impoundments and released again to restore various species of anadromous fish, such as chinook and sockeye salmon and steelhead trout, downstream in the Columbia River system (Keys, p. S12518).

2.4.6 Environmental Conditions Adverse to Fish

The adverse environmental conditions created by the construction and peaking operations of Hungry Horse include isolation and flooding of spawning grounds, temperature fluctuations in the river below the dam, fluctuations in the river flow and reservoir level, and numerous other consequences such as erosion. These conditions have primarily affected resident fish. However, other conditions adverse to resident fish have been created by two operation patterns which are considered, at least in part, as necessary to sustain anadromous fish in the lower part of the Columbia River system. These two operation patterns are the repeated, significant drawdown of the Hungry Horse reservoir level and the shift in water releases from the fall/winter season to the spring/summer season. The drawdown has occurred primarily because of power demands and drought conditions and adversely affects both fish and wildlife dependent on Hungry Horse. The shift in the timing of water releases has occurred in part to provide water for migration of juvenile anadromous fish (smolt) to the sea. However, at least one attempt using Snake River dams to improve migration conditions simply by releasing more water was not successful (ENR, 7/19/93, p. 24). Spring/summer releases would seem to resemble natural spring runoff, but the temperature and timing of the releases are not necessarily beneficial for resident fish (see Figure 10).

2.4.6.1 Isolation of Spawning Habitat

Although all species in the Flathead River basin have been affected by Hungry Horse operations, the effect on trout and kokanee salmon are of particular concern. Many of these
Figure 10. Discharge in the South Fork of the Flathead River during a pre-regulation year (1945), and as regulated by Hungry Horse Dam (1956, 1972, 1989).

Source: Stanford, p. 44.
fish live in Flathead Lake and migrate upriver to spawn. However, Hungry Horse cut off about 40 percent of the spawning habitat above Flathead Lake (Reiter, p. 30). Although no changes have been suggested that would correct this situation, it has been mentioned to illustrate the importance of preservation of the remaining habitat.

2.4.6.1 Temperature

At Hungry Horse, the combination of the topography of the lake, the dam design, and the short- and long-term timing of the releases, contribute to the temperature problem. Because the lake is very deep, the still waters in the depths of the reservoir are cold, about 40 degrees Fahrenheit (F) year-round (Reiter, p. 30). For comparison, under natural conditions, the temperature in the river was over 50 degrees F in late summer (Marotz). Unfortunately, the dam design is such that water outflows drawn primarily from the lower levels in the lake where water is colder than at the surface (Stanford, p. 45). Although some water can be withdrawn from the surface through the ‘glory hole’ spillway, water is usually withdrawn through the penstocks or the outlet works, located 245 and 300 feet, respectively, below the crest of the dam (Christenson Comments). When the water levels in the lake drop significantly, as they have the past few years, the spillway cannot be used and the penstock and outlet work withdrawal depths may still be well below the lake surface.

Over the short term (ten minutes or less), releases from the reservoir can result in a temperature drop in the river of up to 14 degrees F. Although such a drop may not directly result in fish deaths, changes of only 4 degrees F can cause physical stress. Over the long term (a year), the average water temperature in the river is significantly colder than it was before installation of the dam. Under natural conditions, the average river temperature would exceed 50 degree F for five months of the year (Marotz). Now, the average river temperature exceeds 50 degrees F only two months of the year, and releases may shock the system by reintroducing cold water. The long-term low temperatures affect fish directly and also affect their spawning habits and food sources.

The growth potential for fish increases exponentially between 50 and 60 degrees F, assuming all other factors are equal. Therefore, the lower average river temperatures slow growth and result in a shorter growing season. The effect on spawning habits is complicated.
because different species migrate and spawn at different times of the year. Spring spawners, such as cutthroat trout, are prompted in part by rising temperatures and increasing flows in the river during spring runoff. However, the relatively constant, cold temperature of any water releases from Hungry Horse and the low volume of such releases if the reservoir is refilled with spring runoff negate the natural seasonal indicators. Fortunately, the effect of Hungry Horse on spring spawners is damped because the two other forks of the river are not dam controlled. The effect of Hungry Horse on fall spawners, such as the rare bull trout, is more noticeable. The fall spawners are prompted in part by decreasing flows of fairly warm water. During the fall, Hungry Horse releases generally increase and the released reservoir water is colder than river water would be (Marotz).

Numerous studies have shown that the cold water releases from Hungry Horse retard the normal growth of river insects as well as fish. In addition, any assessment of the temperature impacts is complicated because temperature and water level in the river also affect ground water (Stanford, p. 48, 49). Under natural conditions, the spring runoff would probably recharge ground water, and during a later season when the river flow was lower, ground water would probably discharge to the river. With short- and long-term fluctuations, the cycle is much less predictable.

2.4.6.2 River Flow and Reservoir Level

Peaking operations at Hungry Horse have resulted in wide, short-term fluctuations in the river level below the dam, and water demands for downstream of the Flathead River basin have resulted in significant, long-term drawdowns of Hungry Horse reservoir level. Rapid river fluctuations of up to several feet per day (Reller, p. 31) could strand downstream fish or drown wildlife and, and as discussed in the previous section, may result in confused spawning prompts. In addition, fish may spawn in locations that are later flooded or left above water. Large, rapid releases from Hungry Horse have even resulted in problems with controlling the level of Flathead Lake (Stanford, p. 49).

Fluctuations in the level of Hungry Horse reservoir also confuse spawning prompts for fish within the reservoir and wash away or strand spawning areas. The dramatic drawdowns of recent years however have exacerbated the problem. In 1988, the water level was drawn to

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178 feet below full pool (Reller, p. 31). In 1993, the water level was 140 feet below full pool even earlier in the year than usual (USA Today, 2/4/93), and a drawdown of 200 feet was expected. Because of the deep drawdowns, the surface area of the lake may be reduced as much as 75 percent, and the reservoir does not refill in some years (Reller, p. 31).

2.4.6.3 Erosion

The adverse consequences due to changes in erosion patterns are the result of both lack of erosion where it had previously occurred and increased erosion in areas which had previously been subject to little or no erosion. In the tailwaters below Hungry Horse, the river channel is covered by algae and exhibits the uniform conditions characteristic of a springbrook, rather than the variations of a mountain stream. The lack of flood flows has reduced the biodiversity, although some select species may thrive. Without the dam, the algal coating would have been periodically scoured by flood flows and the characteristics would be less uniform, but more suitable for the resident fish (Stanford, p. 47).

In contrast, at Flathead Lake, shore erosion by wind-generated waves has increased. Before installation of Kerr Dam, the lake level was seldom at full pool (Stanford, p. 49). However, because the dam now keeps the lake level at or slightly above the natural full pool (Barnett, p. 4), areas of the shoreline previously exposed to wave action only rarely are now exposed more frequently. More recently, the high volume discharges from Hungry Horse have exacerbated the problem (Stanford, p. 49).

2.4.7 Changes in the Project

To date, the BOR has made one change (‘ramping’) and proposed two other changes (a selective withdrawal system and a reregulating dam) in their operations of Hungry Horse. In addition, the Northwest Power Planning Council (NPPC) has specific objectives (such as drawdown and release requirements) that would require changes in the BOR operations. These changes are not mutually exclusive although some require installation of new facilities. Also, the NPPC objectives include systematic evaluation of the effectiveness of any changes in the operations. Therefore, the changes may best be thought of as part of an ongoing process for improvement of the river system rather than a conclusive action.
2.4.7.1 Ramping

The change that the BOR has already made is commonly referred to as 'ramping.' As the term implies, ramping involves gradual, rather than instantaneous, changes in the outflow rates from the reservoir. Although it requires somewhat more planning in terms of power generation, it does not require any construction or fundamental operational change. The ramping operation was started about two years ago (Christenson Letter). The benefit from this change is that it reduces both temperature and water level fluctuation rates but not to the extent necessary for suitable conditions for the fish.

2.4.7.2 Selective Withdrawal

A change which has been approved, though not yet completed, is the installation of a selective withdrawal system. The concept of selective withdrawal, as its name implies, involves releasing water from selected depths of the reservoir. At Hungry Horse, this would allow for release of warmer water from the upper levels of the reservoir, rather than just constant colder water from the reservoir's lower levels. The selective withdrawal system would allow reservoir releases to mimic the natural, warmer water temperatures during the spring, summer and fall. This same concept is used at Flaming Gorge Dam on the Green River in Utah. Installation of the selective withdrawal system would only affect downstream river temperature conditions, not river flows or reservoir level fluctuations (Christenson Letter: Prange Comments).

The system would be built inside the four existing penstock trashrack structures. Within each of the structures, the selective withdrawal equipment will include three sections of steel gates. The sections will all be half circles in shape but of differing diameters so they can be raised and lowered past one another as needed (BOR Draft EA, p. II-1). In addition, the design of each of the three sections is different to allow for as much operational flexibility as possible.

The uppermost section (control gate) will be 100 feet high and 21 feet, 8½ inches in diameter (Prange Comments). It will be suspended from steel cables which will be operated from an electric hoist on top of the penstock trashrack structure. It could be raised to within seven feet of the hoist deck or lowered to the same depth as the center section. The control
gate will also be equipped with five slide gates, each about five feet long and seven feet high. These slide gates, which will be about halfway between the top and bottom of the control gate, will be operated hydraulically to provide additional temperature control and minimize loss of zooplankton from the upper levels of the reservoir (BOR Draft EA, p. II-1). The water temperature data needed for management on the system will be obtained from sensors in the reservoir, at the turbine discharges, and at stream gauges downstream.

The center section (the stationary gates) will also be 100 feet high, but 20 feet, 7 inches in diameter. This section will include three separate gates stacked on top of one another. Normally these gates will be left in position and will extend from 100 feet to 200 feet below the surface elevation of the reservoir. However, the top and middle sections could be lifted from the reservoir using the electric hoist and stored beneath the hoist deck. This design allows for a wider range of withdrawal depths in those years in which the reservoir surface elevation remains low (BOR Draft EA, p. II-2).

The lowermost section (the relief gate) will be 38 feet high and rest at the bottom of the trashrack structure. This gate will be equipped with relief panels which will open only if a malfunction occurs resulting from an excessive pressure differential due to misoperation. This gate will be removed during the winter and spring, when the selective withdrawal system is not needed. A mobile crane will be needed to remove and install this gate, which will be stored beneath the hoist deck (BOR Draft EA, p. II-1; Prange Comments).

The estimated cost for construction of this system is $7 to $8 million—an estimate developed by the BOR after an intensive element-by-element study of the system. Original estimates ranged from $12.5 to $17.8 million for a selective withdrawal system using five separate gate panels in each outlet tower. To refine the estimates, the BOR evaluated each of the major elements of the system and worked on reducing the costs of the most expensive items. To ensure the proposed design changes would work, the BOR constructed a physical hydraulic of the system at their Denver research facilities (Marotz; Prange Comments).

2.4.7.3 Reregulating Dam

A proposed change included construction of another, significantly smaller dam just downstream of Hungry Horse, specifically to smooth the fluctuations in the river levels below
the dam. In 1980, Congress authorized a feasibility study for Hungry Horse Powerplant Enlargement and Reregulating Reservoir (P.L. 96-375, 94 Stat. 1505). The potential for this enlargement and dam were first evaluated in a Western Energy Expansion Study. The proposed reregulating dam would be 60 feet high (Hungry Horse is over 500 feet high), with a pool capacity of about 5,000 AF, and would allow for control of both temperature and flow rates to benefit downstream fish (Senate Report 96-890, 99th Cong., 2nd Sess., Aug. 5, 1980, pp 38-39). For even more refined temperature control, it could also include a variable level intake structure (Id.). Interestingly, Congress wanted the potential power generation capacity of the reregulating dam, as well as Hungry Horse powerplant enlargement, taken into account (Id. at 4).

Although a reregulating dam could significantly reduce river fluctuations, its effectiveness would still depend in part on the scheduling of the releases from Hungry Horse. The proposal for construction of the dam is essentially ‘on hold’ while the objectives for water distribution throughout the Columbia river system are evaluated (Marotz).

2.4.7.4 Minimum Stream Flows and Maximum Reservoir Drawdowns

To benefit resident fish, express objectives of the NPPC for Hungry Horse operations include minimum flows at specific times of year in the Flathead River at Columbia Falls (refer to Figure 8). In addition, there are express objectives for Hungry Horse Reservoir level. The flow specifications include: for spawning, flows between 3,500 and 4,500 cubic feet per second (cfs) from October 15th through December 15th; and for incubation (December 15th through April 30th), emergence (May 1st through June 30th), and throughout the rest of the year, a flow of at least 3,500 cfs should be provided 24 hours per day (NPPC Amend § 9.3B(1), p. 9-13). Reservoir level specifications include enforcement of the drawdown limit of 85 feet, except as needed for flood control, until rule curves can be developed (NPPC Amend § 9.3B(2), p. 9-14).²

²Rule curves graphically illustrate appropriate timing for use of stored water and can be developed as guidelines for specific uses, e.g., biological rule curves.
2.4.7.5 Water Budget

The Water Budget is an NPPC plan to increase river flows during the spring to facilitate downstream migration of anadromous smolt (Blumm, p. 293). On the Columbia River, the target flow is measured at Priest Rapids Dam (refer to Figure 8) (Lee, p. 769). Although NPPC apparently no longer requires that BOR release water from Hungry Horse to comply with the Water Budget (Reller, p. 31), releases from Hungry Horse have apparently been a portion of that effort in the past (Stanford, pp. 43-45).

2.4.8 Analysis of the Changes

As with so many multi-use projects, the main questions raised by changes in the operation of Hungry Horse are how to: (1) balance conflicting uses; (2) select who pays for the direct and indirect costs of achieving a balance; and (3) designate those responsible for implementing and evaluating the changes. In the case of Hungry Horse, these questions are further complicated by the potential geographic scope of the assessment (the Flathead River basin or the Columbia River system).

2.4.8.1 Balancing Conflicting Uses

At Hungry Horse, establishing a balance involves not only deciding which problems need to be addressed but also deciding who has the authority to address the problem. Even if the assessment of Hungry Horse operations is limited to the Flathead River basin, the list of parties with some form of authority is extensive (BOR, Bonneville Power Authority, NPPC, Montana Power Company, the Tribes, the Flathead Basin Commission, the Montana Department of Fish, Wildlife and Parks, and the Federal Energy Regulatory Commission), and if the list includes those with some type of interest, it becomes unmanageable.

In the Columbia River system, Hungry Horse is unusual in that it is operated by the BOR rather than the Corps of Engineers, which operates most of the dams in the Columbia River system (Carlough, p. 1195, n. 16) and is involved in the system-wide decisions (Blumm, p. 296, n. 80). To complicate the issue further, Kerr Dam is regulated under a separate federal program (FERC) from Hungry Horse (Stanford, pp. 36 and 41). However, the Hungry Horse and Kerr operations are becoming more closely coordinated. For example,
the Tribes, who are involved in the NPPC, are partially responsible for Kerr operations (Inside FERC, 7/29/85).

The motivation for change in Hungry Horse project has come about relatively recently, as part of the work on the whole Columbia River system. In the Northwest Power Act, the BPA, BOR, FERC and Corps of Engineers were directed to take into account the fish and wildlife measures developed by the NPPC "to the fullest extent practicable" (Blumm, p. 296, n. 80). In preparing the measures for the Columbia River system, the NPPC "has not attempted to distinguish between those measures where the Council believes it has direct authority and those measures where that authority belongs to others." (NPPC Strategy, p. 9) Even though the overall effectiveness of the Northwest Power Planning Act and its implementation have been questioned (see generally: Blumm & Simrin; Lee), the impetus for specific projects, such as the selective withdrawal system at Hungry Horse, and coordinated efforts has proved beneficial.

Fortunately, although sorting out the relative authority of the various agencies and organizations is difficult, the selection of which physical problem to address has been less complicated. Given the existing operations, "[t]he most pervasive problem of stream regulation in the Flathead is the effect on temperature of hypolimnal discharges from Hungry Horse Dam during the warm months" (Stanford, p. 53). This does not reduce the need for flow regulations, but at least the proposed change which seems most likely to be implemented in the near future, the selective withdrawal system, should also be the most effective.

2.4.8.2 Paying for the Changes

In the Columbia River system, the question of who pays depends on how the necessary payment is calculated. For the selective withdrawal system at Hungry Horse, BPA contributed $500,000 during the design phase. BOR subsequently requested from Congress $3.5 million and $2 million for fiscal years 1994 and 1995, respectively, for installation of the system (Christenson Letter; Christenson Comments). According to at least one author, the construction funds should also come from BPA, not Congress. BPA can generate money for fish and wildlife measures through its power rate structure (Blumm, pp. 346-49). However, BPA has reportedly "insist[ed] that it possesses the authority to decide whether or not to fund
program measures, based on its interpretation of 'sound business practice' and 'cost-effectiveness.' The result is that "BPA has refused to include funding for certain measures in its rate base because it anticipates that the measures will be funded through congressional appropriations" (Blumm, p. 346). At Hungry Horse, payment calculations are less of an issue because BPA will fund operation and maintenance and 70 percent of the costs were allocated to power (Christenson Comments).

A potentially interesting complication in selecting who pays for the fish and wildlife measures may arise from the fact that Montana has a preference for power generated at Hungry Horse (Redman, p. 790). However, because Hungry Horse operations are critical to both resident and downstream fish, the question as to who benefits from the power may be moot.

### 2.4.8.3 Evaluating the Effectiveness of the Changes

Assessments of the impact of the various fish and wildlife measures, or lack thereof, seem to be the point in the process at which local input is most effective. Regional assessments are required as part of the NPPC measures, however, the NPPC states:

> Because of scientific uncertainties, the Council feels that monitoring and evaluation are essential features of program implementation. Nonetheless, a balance between funding of the measure and funding for monitoring and evaluation is important. Accordingly, absent special circumstances, funding for monitoring and evaluation activities should comprise no more than 20 percent of the total budget for any individual fish and wildlife measure. (NPPC Amend, § 7).

### 2.4.9 Status of the Project and the River

Efforts to reduce the adverse impacts of temperature fluctuations in releases from Hungry Horse are well underway. The recent federal budget included $3.5 million to start construction of the selective withdrawal system, which is expected to cost $7 million total. However, plans to control the river and reservoir level fluctuations and limit the substantial drawdowns, while minimizing disruptions to existing users and trying to restore anadromous fish populations throughout the Columbia River system, are still being developed (Marotz).
'Water distribution' plans are being developed by the NPPC and, in addition, the BPA, Corps of Engineers, and BOR have formed a consortium which is performing a System Operation Review Process. The process includes ten work groups of about twenty people each, and each group has expertise on a particular set of concerns, such as those for resident fish or irrigation. A draft EIS is being developed as part of the process although the time frame was not sufficient for some of the evaluations. Even so, at least partial agreement has been reached between some of the groups (Marotz).

In the meantime, the Tribes and the State of Montana will reportedly bill BPA for $500 million in fish losses due to excessive drawdowns at two Montana reservoirs, one of which is Hungry Horse. The calculated losses do not include indirect losses such as reduced recreation opportunities (Utility, 9/24/93, p. 15).
The helpful editorial comments of Richard Prange, Dennis Christenson, and others at the Bureau of Reclamation Pacific Northwest Regional Office are gratefully acknowledged.


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2.5  **GLENDO DAM, NORTH PLATTE RIVER, WYOMING**  
Beth Doherty*

2.5.1 Introduction

The North Platte River enters Wyoming west of Cheyenne and flows northerly to Casper where it turns east and south and flows into and across western Nebraska (see Figure 11). In Wyoming, three different Bureau of Reclamation (BOR) projects, the North Platte River Project, the Kendrick Project and the Pick Sloan Missouri Basin Project (PSMBP), have operations on the North Platte River. Glendo Dam, part of the PSMBP, is located in the southeastern corner of Wyoming approximately 75 miles before the river enters Nebraska. Glendo dam is a zoned earthen dam (its center is made with impermeable clay, but as you move upstream or downstream the materials used to build the dam become more and more permeable). Glendo Dam forms a reservoir 14 miles in length and has a total storage capacity of 789,402 acre-feet (AF) (Project Data, p. 879).

Glendo Dam, Reservoir and Powerplant were authorized for construction under the Flood Control Act of 1944. It was reauthorized by Congress in 1954 and construction began that same year. Glendo is operated in conformity with a River Definite Plan Report, approved in the 1954 reauthorization. The report states the "Glendo Unit will be operated in conformance with plans set forth in the approved definite plan report and with the North Platte River Decree. It will serve the purposes of irrigation, flood control, power generation, fish and wildlife conservation, recreation, sediment retention, pollution abatement, and improvement of quality of municipal and industrial water supply." (Glendo Definite Plan).

Glendo Dam was also constructed for the purpose of capturing for restorage water released from Pathfinder Dam, located 140 miles upstream and part of the North Platte River Project. Pathfinder Dam has a storage capacity of 1,016,000 AF (Project Data, p. 701). Glendo Dam allocates 335,000 AF for restorage of Pathfinder water, but only 100,000 AF for storage of new water (Lawson).

Guernsey Dam is located 25 miles downstream from Glendo Dam. Guernsey was authorized for construction in 1925 as part of the North Platte River Project, authorized in

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*University of Colorado School of Law, class of 1995.
Figure 11. North Platte River Basin

1903 by the Secretary of the Interior (Project Data, pp. 701, 704). It was built for purposes of hydroelectric power and irrigation (Mead Letter). Although Guernsey has a limited storage capacity of 45,612 AF, 1.1 million AF of water flows through Guernsey in order to reach the irrigated lands of the North Platte River Project, all of which are located below Guernsey (Project Data, p. 705; Lawson).

2.5.2 Nature of Environmental Problem

Glendo Dam, as originally built, cannot release water at a rate less than 250 cubic feet per second (cfs) without causing cavitation damage to the release gates. In order to accomplish a release flow as small as 250 cfs, the gates can only be opened three inches. The escape force of the water through the release gates at openings less than 3 inches is too great and causes erosion of the gates, a consequence known as cavitation damage (Environmental Assessment, p. 1).

Downstream storage capacity is limited to Guernsey Dam, which holds 45,000 AF. Even though Guernsey is completely empty at the end of an irrigation season, it is not large enough to store the accumulation of a continuous winter flow of 250 cfs. Since the water would be "lost" downstream instead of stored for the next season, no releases could be made from late September when the irrigation season ended until early April when releases are resumed.

During the time no releases were made, the portion of the North Platte River between Glendo Dam and Guernsey Dam was essentially dewatered (Environmental Assessment, p. 1). Seepage from the dam (2 to 5 cfs) did escape and enter the river bed. Farther down the river a few small tributaries added to the flow so that, by the time the river entered Guernsey, there was a small flow of 30 to 40 cfs (Environmental Assessment, p. 18).

The river between Glendo and Guernsey is primarily a trout fishery, supporting large trophy type trout, although walleye, perch and other species of fish can be found there as well. Wyoming Game and Fish biologists identify the river as one of the most biologically productive stream reaches in the state when flows are being released from Glendo Reservoir. The minimal water flow enables trout inhabiting the river to survive in deep pools near Guernsey during the winter, although they are under great stress. During really dry winters
the area experiences fish kills. Little other aquatic life survives. Also, the limited flow provides an open water habitat for the bald eagle during its winter migration (Environmental Assessment, pp. 18-20).

During the late 1980s, in an effort to improve the flows, a local flycasters group began working with their local congressional office and the Wyoming Department of Game and Fish. Although that particular effort died, the Bureau of Reclamation later initiated its own study to improve the flow conditions. Ultimately, many environmental and recreational groups, including Wyoming Game and Fish Department, Audubon Society, Wyoming Wildlife Federation and Wyoming Flycasters, supported the change (Environmental Assessment p. 5; Wichers).

2.5.3 Physical and Operational Changes Sought

In 1990, the North Platte River Projects Office of the Bureau of Reclamation conducted a Glendo to Guernsey continuous flow study to determine if a low flow program was possible. The results of the study indicated that throughout Guernsey’s history, Guernsey never surpassed the 35,000 AF storage limit allocated to the reservoir for natural flow. The 35,000 AF storage space never completely filled because in April of every water year, water accumulated in Guernsey is moved to a non-Bureau operational storage facility downstream known as Inland Lakes. Since much of the water on the North Platte is generated by the spring run-off in May and June, the natural flow caught before water is moved to a downstream storage facility in April never surpassed 25,000 AF, leaving 10,000 AF available storage space to store water from the low flow releases made from Glendo Dam (Lawson).

Given this annual unused storage space of 10,000 AF, BOR managers calculated that a continuous release of 25 cfs could be made during the dry river months, late September to early April, without jeopardizing any of their water delivery commitments (Environmental Assessment, p. 4). In other words, a 25 cfs low flow from Glendo Dam could be accomplished without frustrating the project purposes, without losing any ownership water for which they had contracts to store, and without violating any state permits. In addition, the BOR decided to begin monitoring storage space at Guernsey for the purpose of determining if
the flow may be increased up to 40 cfs during the winter months when more storage space was available.

Since Glendo Dam was incapable of making low flow releases, the BOR needed to make physical changes in the dam in order to accommodate the newly devised operational changes. Glendo is an earthen dam whose spillway is located on the right abutment. Near the spillway, the BOR tunneled 800 feet through the naturally occurring shales in the right abutment and inserted a pressurized pipe system which release flows into the spillway. The cost of the change was $1.5 million and it took approximately one year to complete. (Environmental Assessment, p. 5; Lawson).

2.5.4 Issues Raised by the Changes

Although the BOR was faced with no legal challenges to the low flow program, the agency was faced with a general opposition to the change, or at least concerns about the change, on the part of the irrigation community.

There was general animosity toward a changing environment, an environment in which non-traditional water uses, such as instream flows, were being recognized. Among the various irrigation districts and individual irrigators, there was a perception of a snowball effect. "There was a fear that this is only the beginning . . . that if they [irrigators] give an inch, we will take a mile." (Lawson). This animosity and fear was funneled into various objections to the project. The irrigators raised arguments regarding violation of the project authorization and state permits, the possible spillage of ownership water to which they have a contractual right and spillage of excess water to which they do not, increased evaporation and transportation losses, and the effect the low flow program would have on the silt run, an annual flushing out of Guernsey Dam (Environmental Assessment, Attachment C: public comments and BOR response).

Irrigators also argued the low flow program violated project authorizations (Lawson). As indicated in the introduction to this chapter, Glendo is authorized for multi-purposes, including protection of fish and wildlife. Guernsey Dam is authorized only for purposes of irrigation and hydropower. The BOR, in order to comply with project authorizations, allocated all costs of running the low flow program to Glendo Dam. North Platte Project
irrigators argued that Guernsey nevertheless has no authorization for fish and wildlife protection purposes. The BOR countered that, as long as the low flow program did not injure the authorized purposes at Guernsey, managers were acting within their legal authority in maintaining the low flows. This legal issue was avoided because irrigators did not press the issue any further, assured that program costs would be borne by the Glendo Project (Lawson).

Power generation was another issue that arose in this context. As water is released from Glendo it passes through a hydroelectric power plant that provides energy for the local area. Farmers were concerned that a low flow stream would reduce the overall power generating capacity of the plant, and therefore reduce power revenues, a primary purpose for which Glendo had been authorized. In fact, however, there was no additional loss in power generation. The word "additional" is used because Glendo Powerplant has a maximum capacity of 3,000 cfs. Any releases greater than 3,000 cfs must flow through a bypass outlet. In the height of the irrigation season, the releases greatly exceed the powerplant capacity. For example, on July 14, 1993, a flow of 5,300 cfs was released to meet irrigation demands, exceeding powerplant capacity by 2,300 cfs. The additional 10,000 AF now released through the low flow pipes would not generate any additional power. Also, the BOR argued that Glendo's authorization was multi-purpose, favoring no one particular use to the exclusion of another (Environmental Assessment, Attachment C; Lawson).

Glendo and Guernsey dams operate under water rights permits issued by the State of Wyoming. The irrigators claimed the low flow program violated the state permits in that the state permits did not authorize water use for instream flow purposes. However, the 25 cfs low flow is not released for the sole purpose of improving instream flow. For irrigation purposes, the water used in the low flow program must move downstream to Guernsey anyway. The low flow program simply changed the timing of the downstream movement. Therefore, the state permits were not violated (Environmental Assessment, Attachment C).

One of the irrigators' greatest concerns was that the low flow program would cause spillage of ownership water (Environmental Assessment, Attachment C). Any water within the BOR operated dams on the North Platte River is owned by the federal government and provided to irrigators under contract. Ownership water is water to which irrigators have a contractual right. Ownership water could only be lost if natural flow not in excess to storage
rights in the 25 miles between Glendo and Guernsey was great enough to exceed the historical maximum of 25,000 AF natural flow, previously calculated in the BOR’s 1990 continuous flow study. The study indicates that no adverse impact would occur. Then, the 10,000 AF from the low flow program would displace the natural flow to which Guernsey Dam has allocated 35,000 AF and to which the irrigators have a legal right. However, the continuous flow study proved this was a negligible risk. Therefore, the low flow practice of moving 10,000 AF at a rate of 25 cfs over the winter months should not infringe upon the storage of any other water.

The irrigators were also concerned about the possibility of losing "excess" water (Strauch). Glendo Dam is the only dam on the North Platte that has not allocated all its reservoir space for new water (natural flow). Recall that Glendo has a large amount of reservoir space (335,000 AF) for restorage of water from upstream Pathfinder Dam. When the restorage space is not being used, Glendo has room to catch excess natural flow that other dams are not capable of catching. This extra water in Glendo is known as excess water.

Guernsey is downstream of Glendo and is the last dam upstream of the project’s irrigated lands. Moving water downstream to Guernsey limits the BOR’s ability to catch excess flow because the previously available 10,000 AF in Guernsey could be used to hold excess water caught in Glendo. In fact, because 1991 was a very wet year, Guernsey did have to spill such excess water (Lawson; Strauch).

Excess water, while sometimes available for their use, is not legally the property of the irrigators. They have no contract right to it. Additionally, when water spilled in 1991, the reservoirs along the North Platte were already holding a combined total of 100,000 AF of excess water available for irrigators’ use (Lawson). Loss of excess water concerns irrigators because, when water is released for irrigation, natural flow is depleted first, excess water available in the BOR account (100,000 AF in 1991) is used next, and not until both those water sources are depleted is the stored water to which irrigators have contract rights tapped for use. Excess water has also historically been available to irrigators to replace evaporation losses (Lawson; Strauch). While the irrigators may be correct in stating that excess water might be spilled, they have no legal basis for their claims. If irrigators did have a contract right to that water, they would likely have tried to block the low flow program (Strauch).
Ownership water could also be affected by changed transportation and evaporation costs, the irrigators argued (Environmental Assessment, Attachment C). However, those costs are unaffected by the new low flow practice. Dam operations on the North Platte are very complex. The BOR already juggles water from one dam to another in order to keep water as far upstream as possible, thus maximizing operational flexibility along the entire stretch of the river. This juggling of water is managed through a detailed and thorough accounting system. Regardless of the actual location of the water in the system, proprietary and contractual interests in the water are identified and calculated at all times as though the water remained in the reservoir of its storage right. Computations such as evaporation loss are based on where the water is water righted, not from where the water is ultimately delivered. In this way the BOR can account for any changed evaporation and transportation losses (Lawson).

Lastly, the irrigators argued the new low flow program would affect the annual silt run (Environmental Assessment, Attachment C). When Guernsey was first built it had a storage capacity of 73,810 AF. Within ten years that capacity was reduced to 46,000 AF, its current size, because it filled up with silt (Project Data, p. 701). In order to provide silt laden water to irrigators to reduce canal seepage and minimize delivery during peak demands, each year on July 7 the BOR stops making releases from Glendo and meets irrigation demands from Guernsey storage until it is virtually empty. Then it starts meeting its demands from Glendo which causes the water to rush through Guernsey, removing the silt at the bottom of the reservoir. This practice helps to maintain Guernsey’s storage capacity, and also serves to line the delivery canals. The silt settles in the canals and helps to prevent seepage (Lawson).

Guernsey is also a state park that enjoys about 400,000 visitor days, or 100,000 visitors a year. Recreation at Guernsey provides a major economic benefit to the local community (Lawson). Since it takes approximately one week to drawdown Guernsey and approximately one week more to refill it with the silt run being approximately three weeks, the recreation industry is shut down for five weeks during the silt run. Irrigators and the BOR are already under tremendous pressure from the community to discontinue the silt run. Irrigators believe the low flow program will be an impetus for recreational interests to increase their efforts to abolish the silt run (Environmental Assessment, Attachment C). The BOR has not expressed an interest in discontinuing the silt run. The silt run concerns indicate
irrigators' general fear of change, as pressures increase from many different directions to expand the traditional use of water for irrigation to include other uses such as recreation and fish and wildlife.

Although the BOR was able to meet every challenge to the low flow program with a sound and legally sufficient answer, this did not translate to an easy program implementation. Community relations with the irrigators were strained and needed to be protected and developed as much as possible. BOR staff from the North Platte River Projects Office, including the Project Manager, attended local irrigation district meetings to explain the change. Irrigation districts were encouraged to become more active with the BOR in all areas. For example, districts were encouraged to hire, collectively, a consultant to be part of a new river hydrology team, a task force that will be studying BOR operations on the North Platte in relation to the Endangered Species Act.

Importantly, BOR staff and other advocates for the low flow program recognize that the irrigators and their families have much at stake when discussing water use issues. Many of the irrigators' grandfathers and great grandfathers lived and died on the land. They built canals and developed farms, helping to create the very communities that now want to use the water for other purposes. At the same time, the irrigators recognize that they must come to the table and work with the groups advocating for changes in water use or they will be left out of the process, a result they perceive has happened in other states such as California, with the passage of the Omnibus Water Bill (Lawson).

### 2.5.5 Present Status of the Case

In early 1993, the low flow program began. The river between Glendo and Guernsey now runs at an average flow of 25 cfs during the non-irrigation season. Since the program is new, the low flows have not been released through a full winter yet. As a result, the overall benefits of the continuous flow are still unknown, but the first results should be seen in the spring of 1994. It is hoped that the new flows will improve the quality of the trout fishery, especially by providing additional assurance the trout will be protected during very dry winters. The program is expected to benefit the bald eagle and other wildlife that feed on the river during the winter and increase aquatic life throughout the year.
2.5.6 References


**Missouri River Basin Project, Glendo Unit, Wyoming.** A plan of development for the Glendo Unit, modifying the approved comprehensive plan for the Missouri River Basin Project, Region 7, Bureau of Reclamation, U.S. Department of the Interior, Denver, Colorado (February, 1952) (Glendo Definite Plan).

Letter from Elwood Mead, Commissioner of Reclamation to Hubert Work, Secretary of the Interior (signed and approved by Calvin Coolidge, President of the United States (April 30, 1925) (Mead Letter).


Telephone interview with John Lawson, Project Manager, North Platte River Projects Office, Bureau of Reclamation (June 18, 28, and July 13, 1993) (Lawson).

Telephone interview with Bill Wichers, Area Fisheries Supervisor, Casper District Office, Wyoming Department of Fish and Game (July 16, 1993).

Telephone interview with Dennis Strauch, General Manager, Pathfinder Irrigation District, Mitchell, Nebraska (June 24, 1993) (Strauch).
2.6 SEMINOE DAM TO PATHFINDER DAM, NORTH PLATTE RIVER, WYOMING
Beth Doherty*

2.6.1 Introduction

The North Platte River enters Wyoming west of Cheyenne and flows northerly to Casper where it turns east and south and flows into and across Nebraska (see Figure 12). In Wyoming, the Bureau of Reclamation (BOR) operates three different projects on the North Platte, the Pick-Sloan Missouri Basin Project, the North Platte River Project, and the Kendrick Project. In places, all three operations are located within thirty river miles of each other. The North Platte River is first caught behind Seminoe Dam, seventy-two miles before it reaches Casper. Seminoe Dam, Reservoir and Powerplant are part of the Kendrick Project and were authorized under that project in 1935 by the President of the United States for purposes of irrigation, storage and hydropower (Situation Paper, p. 1). Seminoe Reservoir has a storage capacity of 1,017,280 acre-feet (AF) (Project Data, p. 557).

Water released from Seminoe is caught again just two miles downstream in Kortes Reservoir. Kortes Dam, Reservoir and Powerplant were constructed in 1951 in the 1,000 foot gorge of the North Platte River's narrow Black Canyon as part of the Pick-Sloan Missouri Basin Project (Project Data, p. 929). The Kortes Unit was authorized under the 1944 Flood Control Act for the sole purpose of generating power (Authorizing Act). Water released through Seminoe Dam passes through the Kortes Powerplant on its way to Pathfinder Dam, 8 miles downstream. Kortes Dam has a very limited storage capacity, 4,700 AF, but generates 140 million kilowatt hours annually (Project Data, p. 929). At 1,016,000 AF storage capacity, Pathfinder Reservoir is just slightly smaller than Seminoe Reservoir. Pathfinder was completed in 1909 as part of the North Platte Project, the first federal project located on the North Platte River in Wyoming (Project Data, p. 701).

The Miracle Mile is the nickname for the stretch of the North Platte River that extends from Kortes Dam downstream approximately 5.5 river miles to the boundary of the southern unit of the Pathfinder National Wildlife Refuge, on the upper reaches of the Pathfinder

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Figure 12. North Platte River Basin

Reservoir (Situation Paper, p. 1). When Pathfinder Reservoir is not full, the area can stretch downstream 15 miles (Lawson). The Miracle Mile is so named because of its national importance as a "blue ribbon" trout fishery. "Blue ribbon" is the state designation for a stretch of river that has high productivity, accessibility, and aesthetic value (Situation Paper, p. 3). The State of Wyoming's Department of Environmental Quality also designated the area as a "Class I Waterbody" a surface water classification affording protection from further degradation by pollution or other discharges into the river. The terrain surrounding Miracle Mile is very steep and rocky on the upper one mile reach near Kortes, but opens to more gentle slopes on the downstream Pathfinder reaches. Average annual precipitation is about 12 inches, including approximately 60 inches of snowfall (Situation Paper, pp. 1-2).

2.6.2 Nature of Environmental Problem

When Kortes Dam and Powerplant was completed in 1951, it was immediately used as a peaking power plant. A peaking power plant supplies energy for peak energy need times such as 5:00 PM when families first come home and turn on televisions, stoves, air conditioning, and other appliances. Peaking power supplements base power. Base power is the minimal continuous power supply to the community, which in this case is provided by coal fired generators located throughout the region of Southern Wyoming and Northern Colorado. Peaking power plants, therefore, generate power on demand, accomplished by large fluctuations in the flow level passing through the power plant. Releases from Kortes Powerplant, for example, change the flow level in the North Platte immediately below the dam from 500 cubic feet per second (cfs) to 3,000 cfs in a matter of minutes (Lawson).

In the late 1950's, the Bureau of Reclamation operated the power plant in such a manner that flows, during low demand hours, would be reduced to nearly zero. This practice allowed the Bureau to maximize peaking power by withholding a maximum amount of water for future use. When the flow release was reduced to zero, the river would be reduced to a flow of only eight to ten cfs caused by reservoir seepage (Lawson). When this happened, there was substantial kill of fish. As a "blue ribbon" fishery, many of the fish lost in the first fish kills were of excellent quality, weighing between eight and fifteen pounds (Wichers). At the time, the river was heavily fished with upwards of 50,000 use days each year. These
local anglers were the first to take action. They contacted the Bureau of Reclamation, Wyoming Department of Game and Fish and their U.S. representatives in Congress (Peterson).

2.6.3 Physical and Operational Changes Made

The angler’s inquiries prompted the Congressional representatives to request specific factual information regarding the fishery (Peterson). As a result, the Bureau of Reclamation, Wyoming Game and Fish Commission, and the U.S. Fish and Wildlife Service (then known as the U.S. Bureau of Sport Fisheries and Wildlife) undertook studies to determine the effects of the fluctuating powerplant releases on the fishery in the Miracle Mile area. The studies included a series of test releases at Kortes to determine minimum flow conditions and maximum fluctuations required to protect the fish. With the results of these tests in hand, in 1964 the Bureau of Reclamation agreed to modify operations at Kortes Powerplant and release a minimum 500 cfs minimum flow throughout the year. The Bureau continued the voluntary continuous releases of 500 cfs every year thereafter (Sen. Rep. No. 317).

The minimum flow produced remarkable results. The supply of many natural fish foods within the Miracle Mile stretch of the North Platte River returned to great abundance which allowed rainbow and brown trout to increase notably in size. Brown trout even can maintain themselves by natural reproduction. Unfortunately, however, the large flow fluctuations exceed the tolerance levels for egg survival in other trout species which are therefore dependent on stocking operations on the river (Situation Paper, p. 2).

2.6.4 Issues or Problems Raised by the Changes

Only one issue arose when the 500 cfs minimum flow was instituted: loss of power generation. Since Kortes Powerplant is a peaking power station, a continuous flow of 500 cfs means that sometimes the energy generated through Kortes duplicates the base energy level produced by the coal fired generators. In addition to the duplication issue, peaking power has a higher market value than base power and the revenue loss was estimated at the time to be $19,000 per year (1971 dollar value) (Sen. Rep. No. 317). Since Kortes was authorized solely for power generation, the project authorization needed to be addressed.
No issues arose regarding water supply because any continuous flow through Kortes could be restored below in the mammoth Pathfinder Reservoir, located above irrigation project lands (Lawson).

Although the Bureau was providing a minimum flow on a voluntary basis, Congress wanted a guarantee that the Miracle Mile would be protected and that the 500 cfs minimum flow could not be discontinued at the choice of the Bureau of Reclamation (H. Rep. No. 555).

2.6.5 How Problems Were Resolved

There was tremendous public support, especially from the local anglers, that pushed Congress to pass Public Law 92-146. It was enacted on October 29, 1971 by the 92nd Congress. It directed and authorized the Secretary of the Interior to modify the operation of the Kortes Unit "so as to maintain a minimum streamflow of five hundred cubic feet per second in the reach of the North Platte River between Kortes Dam and the normal headwaters of Pathfinder Reservoir" (Pub. L. No. 92-146).

The law also changed the project authorization to allow for conservation of fishery resources, although should the two water uses conflict, power generation remains a priority. "When sufficient water is not available to operate in this manner, water will be reserved for hydro-electric peaking power operations on a four-hour daily, five-day week basis and any remaining water will be released for conservation of the fishery resources." (Pub. L. No. 92-146). However, the conflict between the two uses has never been great enough for the Bureau to invoke this congressional language and interrupt the minimum flow of 500 cfs (Lawson).

2.6.6 Status

While the conflict between power generation and fishery protection was resolved a long time ago, the Miracle Mile does experience current resource management problems because the area has many conflicting uses. Fishing has increased due to the 1988 construction of a fishing access road. Other recreational use is heavy, supported by 11 campgrounds, 60 picnic tables and 16 restrooms in the area. Ranchers graze cattle in the Miracle Mile area; at least one of the ranchers uses the river as a source of winter water for
the cattle. The bald eagle, a federally-listed endangered species, uses the area from mid-
December through March. Traditional uses of the water, such as power generation and
downstream irrigation, municipal and industrial service, also place demands on the area
(Situation Paper, pp. 1-4).

As a result, managing the river has become more difficult. Among other disputes,
fishing and camping interests believe cattle overgrazing is degrading the fish habitat by
eroding the river banks and preventing the growth of vegetation (Situation Paper). Camping
interests believe the cattle compromise the river's beautiful setting (Lawson). The Miracle
Mile is comprehensively managed under a 1985 Reservoir Area Management Plan developed
by the BOR, Wyoming Department of Game and Fish, and the Bureau of Land Management
(BLM). Also, one quarter mile of land along each side of the entire 5.5 mile stretch of the
Miracle Mile was withdrawn and managed by the BOR, although the BLM is currently under
contract to administer grazing rights for that area.

The 1985 Plan has proved inadequate to manage the increasing use of the Miracle
Mile area. The plan acknowledged that various uses existed, but it was primarily a tool to
develop recreation in the area. As the popularity of the area has grown, the various uses have
come into conflict, whereas in the past, all uses could exist at the same time. In response to
these conflicts, the BOR is presently developing an updated Resource Management Plan and
Environmental Assessment for the area. The final plan, which has involved extensive
community input, is expected to be completed by the end of 1993 (Public Involvement
Booklet).
2.6.7 References


Telephone interview with John Lawson, Project Manager, North Platte River Projects Office, Bureau of Reclamation (July 14, 1993) (Lawson).

Telephone interview with Bill Wichers, Area Fisheries Supervisor, Casper District Office, Wyoming Department of Fish and Game (July 8, 1993) (Wichers).

Telephone interview with Larry Peterson, former Area Fisheries Supervisor, Casper District Office, Wyoming Department of Fish and Game (July 12, 1993) (Peterson).


2.7 UPPER ARKANSAS RIVER, FRYINGPAN-ARKANSAS PROJECT, COLORADO
Daniel Reimer

2.7.1 Introduction

The Bureau of Reclamation (BOR) presently operates the Fryingpan-Arkansas (FRY-ARK) Project in southeastern Colorado. This project serves to regulate flows along the Upper Arkansas River on the eastern slope of the Rocky Mountains and to supplement such flows with water diverted from the western slope. Project water is sold to irrigators, municipalities, and industrial users and also benefits recreation, fish, and wildlife resources in the Arkansas Basin (BLM, 1979).

The FRY-ARK Project encompasses six storage dams and reservoirs. Ruedi Dam and Reservoir is located on the western side of the Continental Divide on the Fryingpan River. On the eastern slope Sugar Loaf Dam forms Turquoise Lake, Mt. Elbert Forebay Dam and Reservoir, Twin Lakes Dam and Reservoir and Clear Creek Dam and Reservoir. In addition, Pueblo Dam and Reservoir, the largest FRY-ARK storage facility, is located on the Arkansas River west of the city of Pueblo (Project Data, p. 485). The total storage capacity of the six project reservoirs is 750,000 acre-feet (AF) (BLM, 1979).

Authorization for the FRY-ARK Project, Public Law 87-590, was passed in 1962. Construction of both east and west slope facilities began in 1964, and the project was largely complete by 1982.

With these facilities, western slope waters are gathered by the North and South Collection Systems and conveyed via the Charles H. Boustead Tunnel across the Continental Divide. Turquoise Lake and Sugar Loaf Dam provide storage and regulation of project water transferred through the Boustead Tunnel. Project water is then diverted along the Mt. Elbert Conduit to the Mt. Elbert Forebay for use in power generation (see Figure 13). The Mt. Elbert Pumped-Storage Powerplant is located in the northeast corner of Twin Lakes, where water is stored after flowing through the powerplant. The powerplant has a generating

*University of Colorado School of Law, class of 1995.
Figure 13. Arkansas River Basin

capacity of 200,000 kilowatts and the ability to reverse its turbines to pump water back through the plant and generate power for periods of low demand (Project Data, p. 491).

A portion of project water is diverted from Twin Lakes via the Homestake pipeline into the South Platte Basin for use by the cities of Colorado Springs and Aurora. The balance of project water is released into the Upper Arkansas River and eventually moved 150 miles downstream to the Pueblo Reservoir. The Bureau of Reclamation controls water resources in the Upper Arkansas from Twin Lakes to Pueblo while the Southeast Water Conservancy District, the organization charged with overseeing the project's repayment contract (Repayment Contract), manages water diversions from Pueblo Reservoir.

From the reservoir, project water is either released into the Arkansas River below Pueblo Reservoir for use by the city of Pueblo and downstream irrigators or diverted via the Fountain Valley Conduit and channeled to: the City of Colorado Springs, west Pueblo, irrigators, mine operators, and other contracting parties.

The Bureau maintains a flow regime in the Upper Arkansas which largely coincides with natural levels. As the irrigation season occurs simultaneously with spring and summer snowmelt, flows are maintained at high levels, between 700 and 3,500 cubic feet per second (cfs), from the end of May to the beginning of August for both flood control and irrigation. During the month of August, when both irrigation needs and snowmelt volume declines, flows are reduced to between 300 and 600 cfs. The Bureau maintains flows at this level (between 300 and 600 cfs) throughout the winter and early spring in order to supply the municipal and industrial requirements of downstream areas.

The stretch of the Upper Arkansas from Twin Lakes to Pueblo provides excellent brown trout fishing and white-water rafting opportunities. The Upper Arkansas witnesses 400,000 fishermen days each year primarily concentrated in the summer months with some fishing year round (Broder, p. 12). In addition, commercial and private boating accounted for an additional 250,000 user days on the river in 1992 (Bayless).

2.7.2 Environmental Problem

The Upper Arkansas has gained recognition over the past decade as a premiere location for whitewater boating or rafting. The varied stretches of the river provide rafting...
opportunities for all skill levels and are quite accessible to Colorado's Front Range communities, including Denver and Colorado Springs.

Increased recognition has resulted in a dramatic rise in the number of commercial and private recreational users present during the rafting season. Thus, the 250,000 user days witnessed in 1992 was a considerable increase from 1979, when user days totaled 22,000 (Broder, p. 16).

Boating on the Upper Arkansas has been economically beneficial to the towns located along the river, including Buena Vista, Salida, and Canon City. With each commercial boater spending approximately $60 per day, commercial rafting injects a total of $30 million into the local economy each year (Naeser, p. 14).

Although boating activity offers increasing economic benefits, large numbers of people in and around the Upper Arkansas potentially threaten fish, plant, and animal welfare in the river basin. Several management alternatives have been explored to recognize increased boating demands while considering impacts on these other environmental values.

The first was the formation of the Arkansas Headwaters Recreation Area (AHRA), the body currently charged with managing the public's use of the Upper Arkansas. The AHRA is a cooperative entity comprised of individuals from both the Colorado Division of Parks and Outdoor Recreation and the Bureau of Land Management. These agencies, who both have jurisdiction over the river and adjacent lands, believed that a coordinated arrangement could manage the river for both recreational use and environmental protection. The Upper Arkansas Recreation Management Plan of 1988 and the Cooperative Management Agreement of 1989, both a product of the AHRA, each call for significant improvements along the Upper Arkansas to accommodate increasing numbers of recreational users while preserving the environmental values associated with the Upper Arkansas basin (Recreation Management Plan; Cooperative Management Agreement).

Another effort undertaken to provide for increasing recreational use is to provide assurance that the rafting season will last to the end of the summer season, around Labor Day. Such assurance required cooperation with the BOR, to augment base flows in the upper river with FRY-ARK Project water when flows drop below a certain level.
The BOR’s flow regime during the spring and summer of 700 cfs or higher that make rafting possible on the Upper Arkansas typically diminish at the beginning of August, signalling the end of the rafting season. Once the water level drops below 400 to 500 cfs, rafting is no longer economically viable. While flows do remain high enough for boating through Labor Day in some years, commercial and private rafters would like assurance that flows will be maintained at 600 to 800 cfs or better through middle to late August in every year. Towards this end, rafters have, since 1987, formally requested that the Bureau of Reclamation maintain high flows through Labor Day.

Lengthening the rafting season provides economic benefits to commercial rafting operations as well as to the local economies. Commercial operators can guarantee that customers will have the high water necessary for a rafting trip, and nearby towns will take in additional revenue because of the extension of the rafting season. For these reasons, the State Department of Natural Resources was in favor of such an augmentation program, and the Bureau of Reclamation was willing to comply.

Rafters, however, are not the only interest on the Upper Arkansas. As mentioned, fishermen are present in large numbers during the summer months seeking brown trout. Fishermen are generally opposed to high flows because of the difficulties high water presents to fishing. Flows above 600 cfs can make wading dangerous or impossible, and may affect the riparian habitat where anglers stand. In addition, fishermen assert that the disturbance of the surface water caused by boating disrupts local habitat and makes fishing more difficult.

Fishermen and fishery biologists also assert that high flows impact the brown trout growing season and produce negative effects on the size of the fish. This claim has created a controversy over the implementation of an augmentation program by the BOR.

Brown trout require shallow, gentle water for feeding on the insects which float past. Suitable habitat is typically available during August and September when the Spring run-off has subsided. This late summer period is critical because without sufficient growth during the late summer the trout will not have the strength to spawn in October (Scanlon, 10/27/92). In addition, if the flow is too great then the trout will have to expend great amounts of energy in the feeding process and growth will be negatively affected. As a 1992 Colorado Division of Wildlife study indicates, "Flows during August/September account for 90 percent of the
variation of growth for age 1 brown trout and 73 percent of the variation for age 2 brown trout" (Krieger, p. 1). Flow levels can therefore have a dramatic impact on the health of brown trout.

Concern for the welfare of the brown trout is partially a result of a previously identified threat to that species, namely the impact of historic mining operations around Leadville, Colorado. When the mines were closed in the 1920's, tunnel entrances were sealed with dirt, but water from within the tunnels has managed to escape during the past decades. This water, which is laden with mill tailings containing heavy metals, seeps down the mountains and eventually into the Upper Arkansas (Scanlon, 10/25/92).

The brown trout population has been deleteriously affected by heavy metals in these mill tailings. Although BOR treatment facilities remove 50 percent of these heavy metals, cadmium from the California mine, which enters the river via Colorado Gulch, accumulates in the trout's internal organs and reduces the average lifespan from 7 to 8 years to 3 years and limits the average trout's length to 13 to 14 inches (Krieger Interview). The danger posed to the brown trout by the mill tailings makes the potential threat posed by an augmentation program a greater concern.

2.7.3 Physical and Operational Changes Made

During the 1980's the Bureau of Reclamation planned to vacate approximately 44,000 AF of water from Twin Lakes in order to remove a piece of equipment that had remained in the lake since construction of the dam facilities in the 1960's. Because of continued pressure by commercial outfitters to augment late summer flows, BOR decided to coordinate their maintenance drawdown with the outfitters' request (Garner Interview, 6/8/93). As a result, in 1989, BOR's release schedule had the effect of augmenting late summer flows, and the rafting season was extended. This event was especially beneficial for the commercial outfitters because, due to a below average snow-pack the previous winter, the 1989 rafting season would likely have been cut short without the supplemental water.

The following year the commercial outfitters again sought a late summer flow augmentation from BOR. BOR agreed to add 50 cfs to the natural flows through August 15, 1990 (Garner Interview, 6/8/93). In order to provide the supplemental water that year, it was
necessary to make an early release of 23,000 acre-feet of stored water from Twin Lakes (Krieger, p. 2).

In the Spring of 1991 a plan was formulated by the Colorado Department of Natural Resources, the BOR, and the Southeastern Colorado Water Conservancy District to create more structured release guidelines (1991 Plan) (Salazar Letter; Clark Letter, 4/29/91; Thomson Letter). The 1991 Plan established a year-round minimum flow of 250 cfs for the protection of the fishery. In addition, the plan called for a minimum late summer flow of 700 cfs through August 15. A pool of 10,000 AF was set aside by the BOR for flow augmentation. The Plan also prevented dramatic fluctuations harmful to the fish population, by limiting changes in the flow to the rate of 10 to 15 percent per day. The plan was to go into operation in 1991 and continue annually if deemed appropriate.

The water used to augment flows comes from making early releases of water that would have eventually been moved or transferred down to Pueblo Reservoir to satisfy downstream water rights. There was, however, some concern about evaporative loss caused by the early transfer downstream, and the plan therefore included the means to compensate the Southeastern Colorado Water Conservancy District for any such loss. A clause in the plan provided that the Colorado Division of Parks and Outdoor Recreation would supply water to compensate for evaporative loss.

In the Summer of 1991 the BOR scheduled its releases in accordance with the 1991 Plan, but opposing the plan, Trout Unlimited (TU) filed a claim against the Bureau seeking to enjoin the BOR from augmenting flows. The BOR continued making releases under the plan until a preliminary injunction was granted on August 12, 1991. In November 1991, TU’s claim was dismissed without prejudice. This meant that the Bureau could implement an augmentation program in the future if the BOR found it appropriate, but also that TU was not restricted against bringing the same or similar claim to try and stop any future augmentation program (Craig Interview).

In 1992 the BOR, in cooperation with the Colorado Department of Natural Resources, again resolved to augment flows through August 15 (1992 Plan). Once again, the augmentation program was instituted for one summer and was not elevated to a formal policy. In 1992, 6,100 AF was required for the augmentation (Garner Interview, 6/8/93).
Some concern was expressed during the 1991 and 1992 plans’ formulations about evaporative loss. Yet only 26.48 AF and 5.98 AF were actually lost to evaporation in 1991 and 1992, respectively. At $8 per AF, the FRY-ARK Project contract price, this loss amounted to a total of approximately $250. Because of these minimal losses, the BOR is considering removing the provision of the program requiring compensation for evaporative losses from any future augmentation program (Garner Interview, 6/8/93).

2.7.4 Issues Raised by the Changes

The controversy over this late summer augmentation program has become highly politicized and state and federal agencies disagree over the appropriate course of action. Support for the program comes from: the Colorado Department of Natural Resources and both members of the Arkansas Headwaters Recreation Area (AHRA), the BLM and the Colorado Division of Parks and Outdoor Recreation. Parties opposing the program include the Colorado Division of Wildlife (DOW), the U.S. Fish and Wildlife Service, and Trout Unlimited.

DOW contends that the flow augmentation: reduces brown trout feeding habitat, causes the trout to expend excessive energy in the feeding process, and impedes growth. A 1992 DOW study concludes that "[A]ugmenting flows in the Arkansas River to a minimum flow of 700 cfs during the month of August reduces trout biomass by an estimated 13.6 percent." This would be the equivalent of 11,000 pounds of biomass, which is a measure of the dry mass of all living organisms in a specified area (Krieger, p. 1).

Using evidence compiled over a ten year period, which represents the only data currently available, individuals within DOW have continuously opposed BOR’s augmentation program. DOW cannot officially oppose the augmentation program, however, because that division is a part of the Colorado Department of Natural Resources, which officially supports the program.

TU has used the DOW findings in its own fight against BOR’s flow augmentation program. In addition to the statistics, TU also points to BLM’s Recreation Management Plan as further evidence that the BOR’s decision to augment flows is not proper. At the time of the management plan’s creation, TU requested a clause be inserted which states, "Where
flexibility in manipulating flows exists, recognize biological requirements as the primary consideration, i.e., maintain requirements for fisheries and natural ecosystems first" (Recreation Management Plan). TU claims that the augmentation program is a violation of this mandate.

The BOR is in an unusual situation on the Upper Arkansas. While the project authorization does call for the use of project water to support recreational and biological interests (Project Authorization, at § 1(a)), these interests have not historically been accorded a high priority for water. Thus, the BOR is caught between two non-traditional customers of regulated water. In such a situation it would seem that the Bureau might adopt a policy of non-interference and avoid the conflicts which have resulted from such an augmentation program. Yet that has not been the case.

One explanation for the BOR’s conduct is an informal policy of the project Manager that once all of the needs of the traditional users have been met, including irrigation contracts and municipal and industrial requirements, the needs and desires of other authorized uses should be addressed. For this reason, the Bureau is not opposed to instituting controversial programs provided there is potential benefit to other authorized uses (Garner Interview, 6/8/93).

Indeed, the Bureau contends that the flow augmentation program is a beneficial program that can provide a significant advantage to recreational and economic interests along the Upper Arkansas, while meeting the needs of traditional users. Assertions about the negative effects of the augmentation, according to the agency, are misguided.

The BOR forecasts that relatively little water will ever be needed to augment late summer flows. As evidence, the Bureau points to statistics indicating that the natural flows of the Upper Arkansas are normally sufficient to extend the rafting season through August 15. Between 1968 and 1988 there were 123 days in the period between July 1 and August 15 (900 days total) where the flow was less than 700 cfs. Eighty-five percent of these below-700 cfs days occurred in three years, 1977, 1981, and 1988. The remaining 15 percent of the below-700 cfs days occurred in six other years (Flow Data).

The minimal scope of the summer augmentation program asserted by the BOR is also the basis of the agency’s decision not to produce an environmental impact statement. The
BOR claims that the augmentation is "well within its normal day-to-day operational discretion for the Fryingpan-Arkansas Project" (Clark Letter, 7/19/91).

The real benefit of the program, according to the BOR, is the implementation of a 250 cfs year round minimum release which will provide for the incubation and hatching of the brown trout. DOW responds that, since winter flows almost never decline below 250 cfs naturally, little is actually achieved by this provision of the program (Krieger, p. 6).

Finally, the BOR was not satisfied with the 1992 DOW study on the impacts of the augmentation program, believing that the area of study was not broad enough to offer a conclusive evaluation. The BOR maintains that conclusive evidence can only be derived from a study comparable to the BLM Needs Assessment (Needs Assessment), scheduled to be completed by the BLM about 1997 (Garner Interview, 7/1/93).

Operations are now underway, with funding from the EPA and state agencies, to solve the problems caused by the mill tailings from the mines near Leadville. Pumps, holding ponds, and earth moving equipment are being used to either remove the heavy metals from the soil or remove the soil from near the banks of the Upper Arkansas. The clean-up will take a good deal of time, money, and energy but is predicted to reduce pollution in the Upper Arkansas caused by the tailings and consequently to improve fish populations (Scanlon, 10/25/92). The success of this effort could be undermined, however, if the augmentation program indeed reduces brown trout growth or otherwise impacts the population.

### 2.7.5 Present Status

In May, 1993 the BOR declared at a public meeting in Pueblo, Colorado that the agency was prepared to implement the flow augmentation policy for the late summer of 1993. The BOR also stated, however, that the snowpack measurements from the Spring of 1993 seem to indicate that no augmentation would be required because natural accretions would likely be sufficient to continue the rafting season through August 15.

With this announcement, Trout Unlimited (TU) became concerned that the BOR was institutionalizing or "rubber stamping" its augmentation policy without formally doing so. If the BOR does not foresee the need in 1993 for flow augmentation, TU asserts, then why would the agency even suggest the possibility of augmentation unless the agency is adopting...
the practice on a long-term basis (Doperalski). TU would prefer that the Bureau make some
effort to adopt the augmentation program in the permanent operating criteria for the FRY-
ARK Project, which would allow greater public participation and debate over the biological
impacts of the program. TU has not filed a lawsuit since the November 1991 and has no
plans to do so. Rather, TU contends, the organization would prefer to work out a form of
compromise with all interested parties (Craig Interview).

Pending developments may force the Bureau to alter its stance on the augmentation
program. The first is a proposal, by the City of Colorado Springs, for the construction of a
dam and reservoir on the Upper Arkansas at Elephant Rock, near Buena Vista. This project
may be blocked, however, by the possible designation of the Upper Arkansas under the Wild
and Scenic Rivers Act. Pressure by developers is intense, and a decision on the fate of the
project is expected in the Summer or Fall of 1993 (Kroc). Any new dam outside the FRY-
ARK Project could potentially reduce or alter the flows on the Upper Arkansas to the
detriment of fishery, recreation, and other resources.

In addition, the BOR is presently waiting for the results of the Needs Assessment
being conducted by the Bureau of Land Management (Garner Interview, 6/8/93). This
evaluation, which will take another few years to complete, will provide hydrologic data on
water quality, sediment, flow, and reservoir characteristics for the Upper Arkansas (Garner
Letter). The Needs Assessment, at a minimum, will shed light on the potential impact of the
augmentation program on the brown trout population, and thus may help to resolve the
present debate.

Because the BOR has not formalized its policy of augmenting flows the BOR can
discontinue its flow augmentation program if evidence comes to light, either from the Needs
Assessment or from a different source, that augmentation is harmful to the fishery.
Alternatively, if no significant impacts are found, the BOR can continue to aid the local
economies and recreation interests associated with the Upper Arkansas by augmenting flows
while continuing other efforts to protect and enhance the brown trout population.
2.7.6 References

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Telephone interview with Doug Krieger, Senior Aquatic Biologist, Colorado Division of Wildlife (June 10, 1993) (Krieger Interview).

2.8 Introduction to the Dolores River
Sharyl Kammerzell

2.8.1 Introduction to the Dolores River, Colorado

The Dolores River, a tributary of the Colorado, begins in the San Juan Mountains of Colorado and flows southwest then northwest to its confluence with the Colorado River, just over the Utah state line (see Figure 14). During its journey the river crosses a variety of landscapes, from alpine meadows at its headwaters to Sonoran desert near its end. The Dolores is noted for its scenic beauty, as well as fishing and boating opportunities. Historically, irrigation demands have taken precedence over recreational demands as agriculture dominated the local economy. The completion of McPhee Dam and Reservoir in 1987 increased irrigation and recreational opportunities and demands on the river. McPhee Dam and Reservoir is the principal feature of the Dolores Project, a Bureau of Reclamation (BOR) project in southwestern Colorado, authorized to regulate flows "for irrigation, municipal and industrial use, and fish and wildlife purposes and . . . provide recreational opportunities, flood control, and redevelopment" (DPR, p. 20). This case study traces a conflict concerning the amount of water to be released from McPhee to benefit the downstream fishery; a fish and wildlife benefit recognized in the project authorization.

Prior to the completion of McPhee, annual diversions by senior water rights holders typically turned the riverbed below the town of Dolores into a series of pools fed by an underground flow (Porter, 6/9/93). There are many small senior water rights holders on the Dolores; however, the Montezuma Valley Irrigation Company (MVIC) is the dominant and most senior owner of water rights. They have an absolute right for 707.7 cubic feet per second (cfs) for irrigation, 100 cfs for other uses, and a conditional right for 592.3 cfs for irrigation, all with a priority dating back to 18851 (Instream Flow Assessment, p. 51; DPR, p. 67). Average pre-project annual diversions for the MVIC through Main Canals 1 and 2 (their main diversion systems) has been estimated to be 143,000 acre-feet (AF). The MVIC

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1 University of Colorado School of Law, class of 1995.

1 In 1989 the MVIC transferred 505 cfs of their conditional water rights to DWCD. These rights take a priority lower than the 87.3 cfs retained by the MVIC (Instream Flow Assessment, p. 57).
also owns three storage facilities: Totten, Groundhog and Narraguinnep reservoirs, operated in conjunction with the Dolores Project (DPR, p. 22). All water used by MVIC is used in the San Juan River basin; thus, once removed, water is permanently lost to the Dolores River Basin, with all return flows going to the San Juan River (Instream Flow Assessment, p. 51).

With a capacity of 381,000 AF, McPhee Reservoir fundamentally changed the Dolores River, and brought substantial water storage opportunities to this arid region, which translated into increased agricultural opportunities through irrigation (Instream Flow Assessment, p. 18). The average annual flow into McPhee is 349,900 AF. Approximately 70,000 AF of the annual flow spills over the dam (usually during Spring runoff) and continues downstream (Instream Flow Assessment, p. 19). Another 126,600 AF is allocated as project yield according to Table 6, while the remainder is stored in the reservoir (Instream Flow Assessment, p. 19). All of the irrigation and M & I use is out of basin, causing the Dolores to be depleted by an annual average of 105,200 AF, with estimated return flows of about 24,300 AF going to the San Juan River (DPR, p. 117).

The Dolores Water Conservancy District (DWCD) is the primary contracting entity for all project water except for water committed to the Ute Mountain Ute Tribe (including Towaoc): Established in the early 1960s as the repayment entity to the BOR for the Dolores Project, DWCD is also responsible for management of McPhee Dam, including sub-contracting, and for management of the delivery systems to DWCD lands (DPR, p. 22). Irrigation water is delivered from McPhee via tunnel or dike, on a call basis, requiring a one to two day advance notice (Powers). DWCD irrigated lands (arable acres in Montezuma and Dolores Counties) under the project total 27,920 acres full service (irrigated 100 percent by project water), in Dove Creek and 26,300 acres supplemental service (partially irrigated by project water) for the MVIC (Instream Flow Assessment, pp. 51-55, 57). In 1977 the DWCD subcontracted with the MVIC to provide project water to augment late season irrigation on 26,300 acres. This amount is estimated to be 13,700 AF per year, as reflected in Table 6.

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2| Dove Creek, Cortez, MVIC and the rural domestic allotment are within the DWCD (Schumacher, 7/12/93).

3| This return flow figure incorporates the fact that the Dove Creek land is irrigated by sprinkler systems, thereby significantly reducing the return flow. It does not include MVIC non-project water return flows (Porter, 8/4/93).
Table 6. Dolores Project Water Yield by Type of Use In Acre-Feet

<table>
<thead>
<tr>
<th>Type of Use</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation</td>
<td></td>
</tr>
<tr>
<td>MVIC</td>
<td>13,700</td>
</tr>
<tr>
<td>Dove Creek</td>
<td>54,300</td>
</tr>
<tr>
<td>Ute Mountain Utes (Utes)</td>
<td>22,900</td>
</tr>
<tr>
<td><strong>Total Irrigation</strong></td>
<td><strong>90,900</strong></td>
</tr>
<tr>
<td>MUNICIPAL AND INDUSTRIAL (M&amp;I)</td>
<td></td>
</tr>
<tr>
<td>Cortez</td>
<td>6,200</td>
</tr>
<tr>
<td>Dove Creek</td>
<td>600</td>
</tr>
<tr>
<td>Rural domestic</td>
<td>900</td>
</tr>
<tr>
<td>Towaoc</td>
<td>1,000</td>
</tr>
<tr>
<td><strong>Total M&amp;I</strong></td>
<td><strong>8,700</strong></td>
</tr>
<tr>
<td>Stream Fishery</td>
<td>25,400</td>
</tr>
<tr>
<td>Future fish and wildlife&lt;sup&gt;4&lt;/sup&gt;</td>
<td>1,600</td>
</tr>
<tr>
<td><strong>TOTAL PROJECT YIELD</strong></td>
<td><strong>126,600</strong></td>
</tr>
</tbody>
</table>

above, although it fluctuates yearly (Instream Flow Assessment, p. 57; Schumacher, 7/12/93). In return the MVIC agreed to limit their total annual diversion (both project and non-project water) to 153,400 AF, including water for stock (DPR, p. 67; BOR Comments).

McPhee operations have significantly affected river hydrology below the dam. River flows are more uniform since natural high spring runoff flows are reduced to fill the reservoir, and storage releases for the fishery and downstream senior water rights holders increase summer and fall flows. Winter flow changes are not as dramatic, being adjusted according to runoff and storage needs. In effect, the project has altered the pattern of natural flows to make more water available in the stream below McPhee in the summer while also increasing the amount of water diverted out of the basin (DPR, p. 117).

Generally, these more uniform flows have increased recreational opportunities on the river. Although a smaller spring runoff decreased the number of whitewater boating days,

<sup>4</sup>The future fish and wildlife allocation includes 800 AF for the Ute Mountain Utes and 800 AF to be used at Totten Reservoir once it is no longer needed for irrigation purposes by the MVIC.
whitewater rafting and kayaking in the upper canyon (Bradfield Bridge to Slickrock) and the lower canyon (Gypsum Bridge to Bedrock) continues to increase in popularity. This is partly due to the fact that the reservoir is managed to provide a rafting season during normal and wet years (Instream Flow Assessment, pp. 40-41; BOR Comments). Similarly the beauty of both trips, as they wind through desert canyons, together with the guaranteed summer flow and extended spring flow, is attracting a larger number of scenic boaters. Finally, the fishery in the 13 river miles between McPhee Dam and Bradfield Bridge, managed by the Colorado Division of Wildlife (DOW), has gained national attention due to its improved quality as a result of the new flow regime (Towry, 6/9/93).

2.8.2 Nature of the Environmental Problem

Under the Definite Plan Report (DPR), 25,400 AF per year of water was reserved in the Repayment Contract with the DWCD for release to the downstream fishery (BOR Comments). This was the average annual amount of project water required to be released from storage to meet the Final Environmental Statement (FES) mandated flow management. The flow management for the fishery allocation guaranteed a minimum flow of 78 cfs in wet years, 50 cfs in normal years, and 20 cfs in dry years (DPR, p. 68). The 20-50-78 cfs releases included water released to satisfy senior downstream water rights and water released in anticipation of spill in addition to the average of 25,400 AF of project water (BOR Comments).

In the 46 year (1928-1973) hydrology model on which the flows were based, the Dolores had 13 wet years, 23 normal years, and 10 dry years (DPR, pp. 68-69). According to the DPR a wet year began on May 1, if the active capacity of McPhee Reservoir exceeded 82 percent at the end of April. A dry year "would begin on March 1 and extend for a year if the March 1 prediction of the content of McPhee Reservoir at the end of June was less than or equal to 45 percent of the active capacity." (DPR, p. 69). A normal year occurred if the March 1 prediction of the end-of-June content was greater than 45 percent of the active

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5The Definite Plan Report describes the plan of development for the Dolores Project. The final Environmental Statement provides National Environmental Policy Act (NEPA) compliance for the construction and operation of the project, thus a change in the FES would require additional NEPA compliance.
capacity and the end-of-April content was less than 82 percent of the active capacity (DPR, p. 69). It is important to note that once the type of year was determined it lasted until the next year's readings, regardless of the actual water available later in the year, i.e. no "lookback" was allowed (Mutz).

The drought of 1990 emphasized the inflexibility of the DPR fishery flow scheme. In the winter of 1989-90 both DWCD and MVIC wrote to the BOR expressing their concern about the current 78 cfs wet year release, given the snowpack and the predicted drought. BOR replied that management plans under the DPR prevented changing the flow until the March 1 reading (Porter, 6/9/93). Based on the March 1, 1990 reading the BOR declared 1990 a "dry" year, while agreeing to re-visit the issue May 1, 1990. The May 1 reading was a borderline "dry" (20 cfs) determination, which undoubtedly would have been declared "normal" (50 cfs) six days later, following a large storm. However, since the year had been declared dry the flow would remain at 20 cfs until the following March (Porter, 6/9/93).

Fishery specialists at the DOW soon realized that the 20 cfs dry year flow threatened the health of the fishery. A flow of 20 cfs allows the water temperature to rise to a level unsuitable for trout. The increased temperature results from smaller volume and, more importantly, from the longer period of time it takes the water to move from the dam to Bradfield Bridge. "At 20 cfs a ‘plug’ of water is exposed to two full days of sun and warm to temperatures exceeding 70 degrees. As a result fish will move upstream or sometimes die" (Lyons Letter).

Realizing the inadequacy of the flow and the BOR’s reliance on the FES/DPR, Trout Unlimited (TU), with the support of DOW, immediately requested the BOR to modify the DPR to include more realistic figures than those available when the DPR was written (Towry, 6/9/93). Thus began the lengthy process of modifying the management of McPhee Dam to incorporate increased recreation, fish, and wildlife benefits.

Although the project operating criteria in the FES does not allow the dry year determination to be re-visited, the BOR agreed to re-examine the snowpack in an effort to avoid the 20 cfs release (BOR Comments).
2.8.3 Physical and Operational Changes Made

Although most water users either had or would have realized the inflexible criteria under the DPR, the impetus for change came from TU (Porter, 6/9/93; Towry, 6/9/93; Mutz). As early as January 1989 TU had recommended modifications for the instream fishery flow (Lyons Letter). The BOR, at this early stage, was unwilling to change the management of the instream flow, maintaining that "the Dolores Project plan and intent is to provide a viable fishery below McPhee Dam, not an optimal fishery." Moreover, according to the BOR "there [was] no water available to increase the minimum streamflows below McPhee dam"7 (Stodolski Letter, 1/89). While 1989 was a "wet" (78 cfs) year, allowing for extended discussions, the drought of 1990 demanded more immediate action.

A series of tense negotiations between TU, management agencies and water users throughout the summer of 1990, resulted in a three year interim management agreement, signed October 31, 1990. The interim agreement established a pool management as opposed to the DPR flow management. Under pool management a set amount of water is managed on a yearly basis with releases being adjusted according to seasonal needs; there is no specific flow for any given time. The only constraint placed on management is allocating the pool throughout the year.

The interim agreement established a fishery pool of 30,100 AF, an 800 AF increase from the average annual volume of water released under the original DPR/FES criteria. In addition to the 25,400 AF fishery allotment, the pool included 3,900 AF of downstream senior water rights, and 800 AF reserved for fish and wildlife (Interim Agreement). Under the agreement the pool is neither subject to reduction due to shortages of other water users, nor are reservoir spills counted against the fishery allotment. The agreement also established guideline flows of 65 cfs for the summer (June 1- August 31) and 34 cfs for the remainder of the year. In practice flows have averaged 70-80 cfs in the summer (Schumacher, 6/9/93). However, flows are flexible and rates are adjusted according to the perceived needs of the river and the fishery (Towry, 7/23/93).

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7When/if the project is finally developed the BOR's figures show that releasing more than 20 cfs during dry years will adversely affect the water supply of other project water users (BOR Comments).
The temporary nature of the interim agreement committed the parties involved to continued problem solving and research, in order to reach a permanent agreement in the fall of 1993. With the deadline, parties continued to work to address both unresolved issues remaining from 1990, and issues presented by the next phase of negotiation.

2.8.4 Issues Raised by the Change

Change did not come easily to McPhee. The local BOR office was hesitant to make any change from operations required under existing documents and processes. Perceiving the BOR’s reticence as a refusal, and seeing little local response, TU went to Washington to meet with BOR Commissioner Underwood with their requested modifications. This action caused local friction but was seen by some as the necessary catalyst for change at the local level. Yet, even after national recognition, TU and other parties felt they were not getting cooperation from the local BOR office (Mutz; Porter, 6/9/93; Towry, 6/9/93; Carder Interview, 6/4/93).

Nevertheless, having gained the attention of the local BOR office, TU, through its own computations, was able to question the BOR about their models and assumptions relating to the size of the historical instream flow (Carder Interview, 6/4/93). TU’s numbers indicated that the fishery instream allocation should have been higher, and that the 25,400 AF allotment was weighted in favor of the irrigators (Towry, 6/9/93).

Because of the initial local resistance some interests feel that the interim agreement only happened because (1) TU was able and willing to go to Washington; and (2) they had the expertise to question discrepancies between the numbers in the water operations study and the release commitments (Carder Interview, 6/4/93; Porter 6/9/93). Undoubtedly TU’s persistence was instrumental for beginning the process of change; however, success would not have been possible without the eventual cooperation of all parties.

Once the players began to listen to one another and understand their concerns and limitations a level of trust developed which was essential to progress (Schumacher, 6/9/93). During the initial period of education the BOR realized that fishery and irrigation concerns were not mutually exclusive, rather they could co-exist with effective management.

Moreover, the BOR acknowledged the numerical discrepancies and the limitations of the
release criteria set out in the FES/DPR (Porter, 6/9/93). At the same time, TU and other fishery advocates became more cognizant of BOR's legal constraints within their repayment contract with the DWCD and the constraints of the FES/DPR (Mutz; Schumacher, 6/9/93).

The repayment contract legally commits the BOR to providing the yield of the reservoir minus specific reservations—one of which is the 25,400 AF for the fishery—to the DWCD. Since, between the project and existing senior water rights, the Dolores is a fully appropriated river, the BOR did not have the option to "give" more water to the instream fishery (Instream Flow Assessment, p. 51). Additionally, the release criteria set out in the FES was the only legally usable criteria. Any change from the FES requires compliance with the National Environmental Policy Act (NEPA) and the Endangered Species Act (ESA) (BOR Comments).

In fact, once the water had been identified, the interim agreement did not require serious operational changes at McPhee. The non-project senior water continued to be passed through the reservoir, while the Totten Reservoir project water was already allocated to fish and wildlife; thus, only its destination changed. Following a NEPA assessment resulting in a categorical exclusion (see 516 DM 6, Appendix 9.4-A.3 - research activities), DWCD reservoir operations continued as normal, except for pool management⁸ (BOR Comments; Powers). Although BOR and the DWCD, as reservoir managers, technically manage the pool, their direction comes from a biology committee established through the interim agreement process. State and federal agencies as well as TU are represented on the committee, which meets as needed to discuss flows, taking into account spills, temperature etc. The committee forwards their recommendations to the BOR who, together with the DWCD, is responsible for their implementation (Towry, 7/23/93).

2.8.5 Present Status and Future Concerns

The interim agreement expires October (1993) and many remaining issues need to be addressed prior to reaching a permanent resolution of the fishery instream flow. Participants

⁸The Fish and Wildlife Service concurred with the BOR's analysis that operation under the interim agreement would not adversely affect the endangered species in the Colorado River (BOR Comments).
will be faced with three choices: extend the interim agreement, return to the original DPR, or agree on a new management plan (Porter, 6/9/93). Apart from issues relating to the pool, modifications being discussed include changing the date for the water year determination (wet, dry, normal) from March 1 to around June 30. By June 30 snow melt is nearly finished and water managers are better able to allocate water. Although the wet/dry flow system would not be in use with a pool management, the analysis of water supply is essential to the related proposal of shared water shortages. Under the current priority system of M & I, irrigation, then fish and recreation, the fishery loses in dry years. Fishery advocates and irrigators see the logic of operating on a equal basis and sharing a water loss in a dry year (Carder Interview, 7/27/93). If downstream release criteria is changed from the flow criteria described in the FES to a pool of water available for release, the pool would share shortages in equal percentages with agricultural users of project water, while M & I water would retain first priority (BOR Comments). Finally, the parties have requested continuing the policy of not counting spills against fishery allocation (Schumacher, 6/9/93). Other details, such as management of the pool and riparian concerns, have yet to be addressed, as all parties remain focused on the larger issues (Towry, 7/23/93; Carder Interview, 7/27/93).

Currently, the foremost issues are whether to have a pool and, if so, how much water to have in the pool, where is the water going to come from, how is it going to be paid for and what are the legal ramifications. Under the interim agreement the fishery has nearly recovered from the devastation of 1990. However, DOW and TU are requesting a larger fishery pool of 36,500 AF, in the final plan (Towry, 6/9/93). DOW believes that it would take this amount to warrant a permanent change from the DPR flows of 78 cfs, 50 cfs and 20 cfs, for more water is provided in the wet and normal years under the DPR than is currently in the pool. As for wet years, DOW would be willing to accept the consequences given their average occurrence (Towry, 6/9/93).

The current priority system is: 1) M & I water uses will be delivered in full; 2) Irrigation and other uses (except fish and wildlife) will share in equal percentages such shortages as may occur; 3) the fishery release criteria of 30-50-78 cfs will be delivered, considered as a predetermined shortage; 4) the 1,600 AF reserved for future fish and wildlife development will be delivered in full. Senior water rights have priority (see DPR, Appendix B, p. 30).
The BOR has indicated a willingness to acquire an additional 3,900 AF of water to add to the base pool of 25,400 AF of project water reserved for the fishery in the repayment contract. In addition to this pool, up to 3,900 AF of water will be released annually to satisfy senior downstream water rights. The 800 AF from Totten Reservoir is no longer available to the fishery as it is now being called on for fish and wildlife use. Thus, there would be a total of up to 33,200 AF of water available for downstream release. To acquire the remaining 3,300 AF needed to reach DOW and TU’s goal of 36,500 AF, former BOR Commissioner Underwood stipulated that the benefits associated with this additional "enhancement" water must at least equal the cost, and that the costs must be shared. It is expected that the current commissioner will also favor this approach (Schumacher, 6/9/93).

The DWCD has identified a number of possible water sources within the district. One option is for the MVIC to limit their diversions and use the extra money to line their canals; theoretically there would be no net water loss to the MVIC. Although MVIC’s proposal is neither termed a sale of their senior water rights nor a sale of their project shares, it will likely result in a loss of non-project water, such that their diversion cap will be reduced by the amount "purchased." To date the MVIC has offered to limit their diversions by 3,900 AF, in perpetuity, in return for $6.4 million¹⁰ (Schumacher, 7/12/93). The BOR has countered the offer and is awaiting a reply. Although it is likely that the BOR will pay cash rather than in-kind improvements, the method of purchase and payment is unknown given the constraints of a government budget. The BOR’s payment options include a payment plan, incremental purchases or a buy/lease combination, all of which are contingent upon MVIC’s cooperation (Powers). Currently the MVIC is a willing "seller," however, any sale or lease of MVIC water is contingent upon stockholder approval. Among MVIC members the transfer of water from irrigation to instream use is a volatile issue; there is no guarantee that the stockholders will agree to the transaction (Schumacher, 7/12/93).

Alternatively or additionally, both Dove Creek and Cortez have excess M & I water, due to overly optimistic growth projections at the time the water was contracted for. Both

¹⁰MVIC arrived at this figure by estimating the cost of lining their canals in order to conserve 3,900 AF (Porter, 8/4/93).
communities are willing to consider a relatively long term (20 year) lease to aid in paying off their roughly $600,000/50 year (total for both towns) repayment contract, which is due to begin soon. Moreover, Cortez has modified its offer to include up to 40,000 AF of M & I water in perpetuity. However, this option does not guarantee water beyond the terms of the lease, but rather it is subject to trends in local population growth. Similarly, although Cortez has offered water in perpetuity, current BOR contracting policy may limit the agency to securing the use of water for 25 years unless they are able to get Washington’s approval for a longer term (BOR Comments). Subject to the same limitation is the option of leasing 500 AF of senior water rights for 10 to 20 years from the Montezuma Water Company, the domestic equivalent of MVIC. Finally, the 300 AF remaining from the dryland farmers/ Jr. Hollen case, wherein farmers claiming misrepresentation as to the costs and profits of the project caused DWCD to take back 3,600 AF, may be available for sale (Porter, 6/9/93). Ute water has not been considered as a possible source for instream water, as they are scheduled to begin irrigation this fall; once their system is fully on line it is expected that the Utes will use their total irrigation allocation (Porter, 8/4/93).

Once available water has been identified the next issues are cost and the order of purchase. In an effort to solve the order of purchase issue, the BOR met with the water users (DWCD, MVIC, Dove Creek, Cortez, etc.) and asked who they should purchase from first. Since MVIC has offered 3,900 AF, DWCD is currently awaiting the outcome and negotiations will proceed from there. With regard to the additional 3,300 AF stipulated as a cost sharing, willing sellers have been identified but cost sharing partners have not (BOR Comments).

Finally, the legal ramifications of the proposed water transfers must be examined. Neither MVIC’s bylaws nor their articles of incorporation place limitations on the transfer of water rights held by MVIC. Moreover, a 1983 amendment to MVIC’s bylaws allows the company to sell surplus water under short term contracts with no express limitation on the form of use (Instream Flow Assessment, p. 59). However, if the water "sold" is identified as part of MVIC’s 13,900 AF of project water there may be a problem related to their contract with the DWCD. The contract states "[MVIC] agrees not to sell the use of project water purchased under this contract to any person other than an irrigation water user for use on lands classified as irrigable by the Bureau of Reclamation within the boundaries of the
Other concerns include the impact of changing the water use and protection of the instream water once it is released. Meetings with the State Engineer have led the BOR to believe that, although the water use will change, the change will not have to be approved by a state water court since the water reverts to being project water (Powers). Eventually, though, the BOR believes the fishery water will need to be protected by an instream flow water right. Discussions with the Colorado Water Conservation Board (CWCB), the only Colorado agency authorized to hold such rights, have already been initiated (Powers). Alternatively, at least one state water court has recognized a nonconsumptive water right. The court determined that diverting water and then releasing it for recreational purposes, including fishing and wildlife, qualified as a beneficial use under state law, thereby recognizing an instream flow right separate from a CWCB instream right (Instream Flow Assessment, p. 61).

Legal and technical issues may also arise due to the environmental compliance required by the proposed changes. Although the changed water use is allowable under the project’s broad multi-use authorization, the changes must also comply with NEPA and the Endangered Species Act (ESA). The NEPA environmental assessment is not likely to be a problem, however, the ESA compliance is an unknown. The transfer of a possible 7,200 AF from irrigation and M & I use to instream use will decrease return flows to the San Juan. Currently, the Colorado squawfish is a federally listed endangered species known to occur in the San Juan. Thus, the proposed changes will require section 7 consultation (meetings between the agency and the FWS to assure that the proposed agency action will not further harm the fish). Additionally, three federally listed endangered species and one proposed for listing are known to exist in the Colorado River from the confluence with the Dolores to Lake Powell (Powers; BOR Comments). Likely, even if the water transfers are successful, negotiations will not end there.

Although the momentum has moved towards greater cooperation some parties are still frustrated by a perceived lack of progress, and there remains a lack of trust among the players (Towry, 6/9/93; Carder Interview, 6/4/93). Most believe that a final plan will not have been agreed upon by the October 31, 1993 deadline, requiring an extension of the interim
agreement (Porter, 6/9/93). In particular, it is unlikely that the additional 3,300 AF will be acquired by October given the nature and logistics of acquiring water through cost-sharing agreements (Schumacher, 7/12/93).

The BOR is subject to national political shifts, and the DWCD is subject to local political shifts. In Dove Creek, for example, some farmers still resent the transfer of 25,400 AF originally intended for irrigation to instream fishery use in the early 70's, even though the change was made prior to finalizing the project and the DWCD's vote for the project. Additionally, BOR national bureaucracy has slowed down the local office, which has been working hard to resolve the issue locally. Staff changes have also negatively impacted the process, as familiarity and trust is slowly gained (Porter, 6/9/93 and 7/27/93).

Finally, while the interests of the boating community have not been highlighted here, it should be noted that they are a continual, though not vociferous player (Schumacher, 6/9/93). Their concerns revolve more around management of the river corridor and the size of spring releases—summer flows do not significantly affect their operations because they need flows of 800 to 1,500 cfs as opposed to 80 cfs (Schumacher, 6/9/93). Even the prospect of 36,000 AF for summer release does not concern them as the volume produced by this release would be inadequate for their needs (Towry, 7/23/93).

With demand on the Dolores from irrigators and recreationists continuing to increase, inter-agency and citizen cooperation becomes more imperative. Although it took outside pressure to initiate change, there now exists a committed group of agency and citizen representatives, willing to work together to get the most out of their river and give the most back to the river.
2.8.6 References


Letter from Roland Robison, Regional Director Upper Colorado Region, U.S. Bureau of Reclamation, Salt Lake City to James Carder, Trout Unlimited (Fall, 1991).

Telephone interviews with James Carder, Representative, Trout Unlimited (June 4, and July 27, 1993) (Carder Interview).

Telephone interview with Dave Mutz, Chief of Land and Water Division, U.S. Bureau of Reclamation, Grand Junction, formerly Chief of Dolores Project, Durango (June 7, 1993).

Telephone interviews with John Porter, Manager, Dolores Water Conservancy District (June 9, July 27, and Aug. 4, 1993).

Telephone interview with Stan Powers, Planning Team Leader, Bureau of Reclamation, Durango (July 27, 1993).

Telephone interviews with Pat Schumacher, Chief of Land and Water Division, U. S. Bureau of Reclamation Durango (June 9, and July 12, 1993).

Telephone interviews with Bob Towry, Regional Manager of the Southwest Regional Office of Colorado Division of Wildlife, Montrose (June 9, and July 23, 1993).


Bureau of Reclamation comments on the 1993 draft case study (Fall 1993) (BOR Comments).
2.9 EL VADO DAM, MIDDLE RIO GRANDE PROJECT, RIO CHAMA, NEW MEXICO
Sharyl Kammerzell

2.9.1 Introduction to the Rio Chama

The Rio Chama begins in southern Colorado and flows into New Mexico, feeding into the Rio Grande northwest of Santa Fe. Flows on the river are influenced by the operation of the San Juan-Chama (SJC) Project and dams on the Rio Chama, operated together with the SJC Project. There are two dams on the Rio Chama within New Mexico, Abiquiu and El Vado. Just above El Vado on Willow Creek in New Mexico lies Heron Reservoir, the storage facility for SJC water, "imported" (not naturally occurring in the Rio Grande Basin from the San Juan Basin (see Figure 15). Traditionally, El Vado and Heron Reservoirs have been managed by the Bureau of Reclamation (BOR) for municipal and industrial (M&I), and irrigation purposes, and the Corps of Engineers (COE) has managed Abiquiu for flood and sediment control. The BOR manages native and SJC Project water in Abiquiu as well as all COE reservoirs in the basin. This paper examines how these and other water managers have worked with federal and state resource managers and water users on the Rio Chama expanding their traditional river management to incorporate environmental and recreational benefits.

The SJC Project authorization provides for additional flows from the San Juan Basin into the Rio Grande Basin of 110,000 acre-feet (AF) per year. Water is diverted from upper tributaries of the San Juan River, in accordance with New Mexico's Colorado River Basin allocation, into the Rio Grande Basin. Once diverted, the water moves through a series of tunnels to Heron Reservoir, built in 1971 (Addendum, p. 4). The 10-year average (1984-1993) annual diversion from the San Juan Basin is 87,000 AF. SJC Project water is released from Heron downstream to El Vado, Abiquiu, Cochiti, Jemez or Elephant Butte reservoirs. Estimated SJC Project yield is about 96,200 AF per year (Martin).

Water releases from Heron are controlled by two basic principles. First, more demand on native flows causes river depletions. This annual depletion of the Rio Grande must be

*University of Colorado School of Law, class of 1995.

9-1
Source: Dialogue, published by the Regional Water Planning Dialogue, Western Network and the Natural Resources center, University of New Mexico, Vol 1, No. 1 (June 1993), at 7.
offset by equivalent releases of SJC Project water from Heron to ensure that no "residual effect occurs to Rio Grande Basin water due to project operations" (Addendum, p. 5). The second operational limitation is derived from the BOR contracts which prohibit carryover storage from one diversion season to the next. In addition, there are no provisions for storage of native water in Heron Reservoir. All native water must be released from Heron as expeditiously as possible. Native flows are the result of snow melt and rainfall runoff in the area around Heron Reservoir. All SJC Project contractors call for their water prior to December 31. However, as will be discussed below, the BOR has, with mutual consent from the contractors, recently allowed extensions of this date (Addendum, p. 5).

The BOR, as managing agency of the SJC Project, holds several contracts to provide project water, as set out in Table 7. This SJC Project water is used for municipal, industrial, irrigation, and recreation purposes (Resource Management, p. 518).

### Table 7. Annual San Juan-Chama Project Contract Allocations

<table>
<thead>
<tr>
<th>Entity</th>
<th>Quantity (acre-feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cochiti Reservoir</td>
<td>5,000</td>
</tr>
<tr>
<td>City of Albuquerque</td>
<td>48,200</td>
</tr>
<tr>
<td>Middle Rio Grande Conservancy District</td>
<td>20,900</td>
</tr>
<tr>
<td>Town of Bernalillo</td>
<td>400</td>
</tr>
<tr>
<td>City and County of Santa Fe</td>
<td>5,605</td>
</tr>
<tr>
<td>Department of Energy</td>
<td>1,200</td>
</tr>
<tr>
<td>Village of Los Lunas</td>
<td>400</td>
</tr>
<tr>
<td>Town of Taos</td>
<td>400</td>
</tr>
<tr>
<td>Twining Water and Sanitation District</td>
<td>15</td>
</tr>
<tr>
<td>Jicarilla Apache</td>
<td>6,500</td>
</tr>
<tr>
<td>Pojoaque Valley Irrigation District</td>
<td>1,030</td>
</tr>
<tr>
<td>Town of Red River</td>
<td>60</td>
</tr>
<tr>
<td>City of Belen</td>
<td>500</td>
</tr>
<tr>
<td><strong>TOTAL CONTRACT ALLOCATIONS</strong></td>
<td>91,210</td>
</tr>
</tbody>
</table>


In addition, another 4,990 AF is allocated for use but presently uncontracted (Martin). The City of Albuquerque (City), like all SJC M&I contractors, currently holds contract rights to
more project water than it uses. However, recent data indicates that the City's anticipated increased demand for SJC water will occur sooner than expected (Daves). Depending on their contracts and available storage space downstream, SJC contractors may call for deliveries from Heron to downstream reservoirs, including El Vado, Abiquiu, and Elephant Butte.

El Vado Dam and Reservoir, now operated by the BOR, was originally constructed in 1935 by the Middle Rio Grande Conservancy District (District) to provide conservation storage for District members (Addendum, p. 7 and Instream Flow Assessment, p. 57). Today, it is also used for storage of District SJC water and SJC water of others who have contracted with the District (Shah). Although reservoir management was transferred to the BOR, the MRGCD retained ownership and storage rights.

Several operational constraints are placed on native water in El Vado. First, El Vado operations are subject to restrictions contained in the Rio Grande Compact (Compact), as enforced by the Rio Grande Compact Commission (Commission). Article VII of the Compact "prohibits storage of native water in post-Compact reservoirs (after 1929) upstream of Elephant Butte when usable water in storage at Elephant Butte and Caballo Reservoirs is less than 400,000 af." This provision has occasionally limited or completely restricted storage during low runoff years (Addendum, p. 7). The Compact also requires "that any native water stored in El Vado must be held in storage to the extent of New Mexico's accrued debit under the Compact" (Addendum, p. 7, Article VI). Additionally, the storage rights of the Six Southern Indian Pueblos of the Middle Rio Grande may affect operations. The Pueblos' water, which is not subject to Compact restrictions, is released when natural flows are insufficient to irrigate their 8,847 acres of land. The amount of water released varies since it is a function of irrigation demand and available supply. Finally, the dam must not be operated to the detriment of senior water rights holders below Abiquiu Dam entitled to a minimum natural flow of 100 cubic feet per second (cfs) on the Rio Chama (Addendum, p. 9).

Thirty miles downstream from El Vado Reservoir lies Abiquiu Reservoir, built by the Army Corps of Engineers in the 1960s for flood and sediment regulation on the Rio Chama and the Rio Grande. Abiquiu's authorization was expanded in 1981 to include storage of up to 200,000 AF of SJC Project water, and again in 1988 for storage of up to 200,000 AF of
Rio Grande water, to the extent that the space is not needed for SJC Project water (Addendum, p. 23). The primary SJC Project contractor with storage rights in Abiquiu is the City, which has the right to store water annually up to an elevation of 6,220 feet. In 1990 the City stored 188,976 AF (Kreiner; Addendum, p. 11). The remaining approximately 10,000 AF of storage space has been contracted out pro rata to other interested SJC water contractors, with the City of Santa Fe being the primary contractor (Hamman, 7/26/93).

The other major reservoirs impacting Rio Chama management are Cochiti, Elephant Butte and Caballo (refer to Figure 15). Elephant Butte and Caballo reservoirs are BOR conservation storage projects on the Rio Grande in south-central New Mexico. Cochiti Reservoir is a COE flood control project on the Rio Grande about 35 miles below the Rio Chama confluence. Cochiti and Abiquiu are operated together, such that irrigation releases and flood control storage in Abiquiu are subject to storage conditions and inflow rates at Cochiti (Instream Flow Assessment, pp. 57-58).

Water is stored in these reservoirs according to space availability and hydrologic conditions. Heron is filled as much as possible, El Vado storage is driven by Compact concerns and irrigation demands, and space is managed in Abiquiu for water supply for the city and other SJC contractors. Required deliveries to Cochiti for maintenance of the recreation pool are managed to maximize benefits (Hamman, 7/26/93). Other considerations include storage contract obligations, flood control storage and irrigation needs.

Flows in the Rio Chama below El Vado include irrigation releases, SJC deliveries and natural flows. The combined flows provide abundant recreational opportunities, from El Vado to Abiquiu, for rafters, kayakers and fishermen, as well as ecological benefits from minimum stream flows (Resource Management, p. 518). Recognized as a naturally beautiful area, this 30 mile reach of the river was given Wild and Scenic designation in 1988.

Rivers are chosen for Wild and Scenic designation because they "possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values." Once designated as Wild and Scenic the existing flow regime of the river is preserved and the "immediate environments protected for the benefit and enjoyment of present and future generations" (Instream Flow Assessment, p. 62, quoting The Wild and Scenic Rivers Act, 16 U.S. C. §§ 1271-87). The Rio Chama's designation as "wild and scenic" is
unusual because flows through the designated reach are controlled by man-made facilities at both the upper and lower terminus of the designated segment.

As indicated by the preceding discussion, water management on the Rio Chama is very complex, involving both the BOR and COE. Other participants include the Rio Grande Compact Commission, the New Mexico State Engineers office, and the major water rights holders and SJC contractors — primarily the District and the City. These water management and user groups must work with the two resource management agencies: the Bureau of Land Management (BLM), responsible for managing the upper reaches of the Rio Chama’s Wild and Scenic River segment including boating management; and the U.S. Forest Service (USFS), responsible for land adjacent to lower reaches, including campgrounds and fishing access (Management Plan, p. 25; Hamman, 6/16/93). Another player is the New Mexico Department of Game and Fish (DGF), responsible for fishery management.

2.9.2 Environmental Problem

Management changes on the Rio Chama have been precipitated by a number of environmental concerns. Historic use of the Rio Chama for fishing was minimal because erratic flow conditions did not support a viable fishery. Similarly, boating opportunities were not abundant due to a limited water supply and erratic flows. With the addition of SJC water, and enhancement of a brown trout fishery, the river’s popularity and use for recreation has significantly increased in recent years (Hamman, 7/26/93; Hanson). With increased use came increased demands and concerns for the riparian environment.

In the early 1980s the U.S. Fish and Wildlife Service (FWS) and the DGF recognized that dam operations were negatively affecting the brown trout fishery below El Vado (Resource Management, p. 519). Due to contract provisions prohibiting carryover of SJC water, large releases of 500 cfs or more were being made during brown trout spawning season from mid-October to mid-November, in order to meet the December 31 delivery deadline. Natural river flows during this time range from 75 cfs to 150 cfs. The eggs are deposited in whatever flows exist at the time of spawning. Larger flows either cause the trout to lay eggs higher in the stream profile or dislodge eggs and redeposit them higher in the stream profile.
In either case, the eggs may be left stranded when El Vado releases are reduced to base flow levels of generally less than 100 cfs from January to March (Resource Management, p. 518).

The boating community also became increasingly aware of flow management. Increased demand for boating opportunities highlighted limited opportunities resulting from random summer deliveries to the District and SJC contractors. The sporadic pattern did not allow enough notice to be given for rafters to get on the river. Finally, with the federal Wild and Scenic designation came a greater concern for preserving and improving the riparian and endangered species (bald eagle) habitats, and maintaining the scenic qualities of the river corridor (Instream Flow Assessment).

2.9.3 Changes Made

In 1984, realizing that the current management process was not successfully addressing all demands on the Rio Chama, representatives from the state and federal management agencies began to discuss the situation. Agency representatives committed to changing operations to maximize resource benefits to the extent possible under physical and legal constraints. As a result, a number of informal inter-agency agreements were made - largely through the BOR, who acted as communicator, facilitator, planner and water accountant (Mottl; Kreiner).

The City’s abundant SJC water supply made them amenable to creative water management, designed to maximize resource benefits. Prompted by resource management agencies, they entered into a number of separate agreements. In 1984, the City and the New Mexico Department of Natural Resources (DNR), with the support of the BLM, executed an agreement advancing recreational opportunities on the Rio Chama and at Elephant Butte Reservoir. The two-pronged agreement provides for releases of 800 to 1,000 cfs of City SJC Project water from Heron to Abiquiu on specific dates, and for the maintenance of an existing 50,000 AF recreational pool at Elephant Butte, with City SJC Project water. This agreement, signed in 1984, is effective for 25 years or from 1986 to 2010 (Daves; Instream Flow Assessment, p. 64).

Albuquerque has also entered an informal agreement with the District to cooperatively manage their SJC Project deliveries to benefit the boating industry. Prompted by the BOR
and their willingness to perform the necessary water accounting, the City agreed to "loan" their project water stored in Abiquiu, to the District for mid-week deliveries (Hamman, 7/26/93). The District then releases the appropriate volume of its project water from El Vado during the weekend at raftable rates, which is about 1,000 cfs (Resource Management, p. 521). Although essentially an accounting change by the BOR, this agreement increases whitewater boating opportunities on the river and symbolizes each party's good will (Hamman, 6/9/93).

In response to the fishery problem the BOR suggested a waiver for SJC contract delivery dates. The waiver requires sending a yearly letter to the contractors asking if they are agreeable to extending their December 31 delivery date until the end of April. This extension allows for the gradual release of SJC water from Heron through the winter. Subsequent research has shown, as a result of this change, an increased brown trout population as well as an increased size variation, indicating a good spawn and hatch rate (Resource Management, p. 521). Due to the success of this arrangement among the water managers and water users the BOR has continued this process since 1984 (Hamman 6/9/93; Daves).

Overall, fisheries management has become a vital part of river management planning (Kreiner). Increased knowledge of fishery needs, and increased awareness of fishing popularity has also caused the BLM to incorporate fishery needs in their planning process, which had previously centered on recreational boating (Mottl). This awareness of fishery needs and concerns culminated in a 1992 Instream Flow Assessment, which examined fishery, recreation, and riparian needs in relation to water availability and management options.

The foregoing changes illustrate how cooperative, progressive management has allowed the BOR to play a pivotal role in increasing environmental and recreational opportunities on a nationally designated Wild and Scenic River, while preserving traditional uses.

2.9.4 Issues Resulting from Change

Management changes on the Rio Chama were truly done in a cooperative style. This cooperative atmosphere is largely a result of managers recognizing additional opportunities and working to maximize benefits. Since the key resource management agencies are
concerned about the river and its ecosystem, they have been able to promote change that results in increased environmental and recreational benefits. For example, within the authorization and storage parameters of Abiquiu, SJC water is easily exchanged and moved (Kreiner).

Moreover, the various managers see the benefits of working together, even when money is not an issue. One example is the City’s cooperative efforts with the District. The City recognizes that each group needs to work together, for even though the District’s agricultural land value is small, the District land has a high cultural and aesthetic value, in addition to its agricultural value. As a result, the City is willing to "loan" their excess SJC water to the District at no cost (Daves).

However, all parties realize the limitations of current informal short term solutions, and are working together to come up with a formal framework with the flexibility to address future issues. Towards this goal, a flow dependent resources study group was formed, following the completion of the 1992 Instream Flow Study. The study group, comprised of federal and state agencies, commercial rafting representatives and a private natural resources group was formed to finalize the recommendations made in the study and incorporate additional fishing, riparian, and rafting concerns (Hamman, 6/9/93). Recommendations in the study included continuing cooperative management, formalizing the process, outlining respective agency roles and responsibilities, and creating a strategic planning group — possibly through a Memorandum of Understanding (MOU) (Instream Flow Assessment, p. 71).

2.9.5 Present Status and Future Concerns.

The move to formalize the management process is partly a result of the 1988 Wild and Scenic designation. The Wild and Scenic Rivers Act (16 U.S.C. §§ 1271-87 (1988)), includes a provision allowing for federally reserved water rights to enhance and protect the river (§ 1284(c)). The water right is for the "amount [of water] necessary to preserve the free-flowing condition of the river and to preserve the values for which the river was protected" (Instream Flow Assessment, p. 63). The priority date for the Rio Chama is the date the river was designated Wild and Scenic, on November 7, 1988. However, by that date the Rio Chama
was fully appropriated, according to the State Engineer. Thus, if filed for either by the USFS or the BLM, the federal reserved water right would provide little protection for stream flows (Hamman, 6/9/93; Instream Flow Assessment, p. 63).

The study group intends to recommend a cooperative management plan as an alternative to filing for federal reserved water rights (Mottl; Hamman, 6/9/93). The current approach, in which agencies plan independently for resource management, would be replaced with one in which the various agencies manage the river in a truly integrated manner, considering many resources. Under the study group’s strategy, flow models for specific flow scenarios will be provided that incorporate yearly variables of available storage, water and climate. If necessary, compensation measures for evaporation loss will be built into the plan. Compensation may come from the federal government or possibly from river fees. If compensation is generated from fees it would be necessary to restructure the federal accounting procedures in order to maintain a source of funds that can carry over each fiscal year. Finally, the study group hopes to form a committee to meet on a semi-annual or annual basis to implement the plan. Potential members of this committee will include BLM, BOR, USFS, COE, State Parks, the District, the City and possibly the USFWS and State Engineer (Mottl).

Such an inter-agency approach will likely incrementally benefit environmental and recreational constituents while meeting irrigation needs. That is, 95 percent of the river’s potential (maximum benefits) may be achieved rather than the current 80 percent (Mottl). Moreover, this approach, if successful, may supplant the need to file for federal reserved water rights, thus avoiding anticipated local conflict. Currently, local irrigators, in particular the acequias (local ditch corporations), are cautious of "instream rights" regardless of the affect on their water supply. Even if a reserved water right is initiated in the future, study group participants believe that the upcoming months of group negotiations will convince the water rights holders that the action is mostly on paper and that the river will be managed according to what has already been agreed upon (Mottl).

Regardless of how river management changes in the future, federal agencies will need to address how to allocate and account for costs associated with Rio Chama management issues distinct from the question of compensation for evaporation losses, discussed above.
Increased recreational use of the river has increased associated BOR costs. These costs are currently passed on to all SJC contractors. BOR may need to reallocate their budget or request additional funding (Hamman 6/16/93; Leutheuser). Similarly, the BLM is facing escalating costs and may increase boating fees from the current $5 per user per trip. (Mottl).

In addition to the direct management of the Rio Chama there are a number of side issues that will ultimately affect the river. Of great concern are endangered species potentially impacted by river operations. The silvery minnow in the Rio Grande was listed as an endangered species in the summer of 1994. The fish's habitat lies between Cochiti Dam and Elephant Butte Reservoir. The listing may impact the District by requiring a "live" stream through particular reaches of river (Shah). The squawfish in the San Juan River also is expected to be listed. In response, the BOR is exploring the idea of water banking for SJC contractors. Finally, the last stand of Bosque cottonwoods is located along the Rio Grande below the City of Albuquerque. Cottonwoods require periodic flooding for continued growth. Since flows necessary to achieve bosque flooding are limited, some agencies are considering the use of SJC Project water to accomplish the task (Hamman, 6/16/93).

The City is facing its own problems. Studies conducted by the U.S. Geological Survey and the New Mexico Bureau of Mines and Mineral Resources in 1992 and 1993 challenged existing assumptions about the nature of Albuquerque's groundwater aquifer. The projected water supply in the aquifer is much less, according to these studies, than previously believed. In addition, there is a weaker connection between the aquifer and the river than had been assumed, so that there is little recharge replacing pumping withdrawals. The City is considering several strategies in light of these findings, including increasing its use of SJC Project water (Dialogue, pp. 4-5).

Water managers are concerned about the decreasing flexibility in SJC Project water management once the City begins to use its allocation to offset Rio Grande depletions resulting from groundwater mining. Originally the City projected a need to "offset" water beginning in 2030 but this could now begin as early as 1995. Once the City begins to fully use their SJC Project water it will limit the flexibility to manage flows for the benefit of boating.
Another concern of the City arises out of their liability for SJC Project water stored in Abiquiu Reservoir. The federal authorization allowing for storage of SJC Project water in Abiquiu requires that contractors with storage rights pay the portion of operating costs not covered by the COE (about $.25/af). For the City, this amounts to $55,000 per year. However, under COE practices, operating costs include repairs resulting from water storage. Both the City and COE realize that this figure could jump as high as $5 million in the event of significant maintenance costs. The City’s position is that the State of New Mexico (and not the City’s water users) benefit from recreation provided at Abiquiu. Thus, the state should share the costs and liability of storage at Abiquiu, even though the storage rights belong to the City (Kreiner; Daves).

Projected decreases in availability of SJC Project water has prompted the BOR to consider the possibility of increasing the efficiency of the District’s water delivery system in return for the saved water going to benefit the fishery. Presently this proposal faces two major obstacles: money and New Mexico state water law. Money needed to cover the costs of irrigation improvements is not readily available in BOR’s budget. More importantly, state law provides that the junior water right holders are entitled to use any water saved by irrigation improvements, eliminating any incentive to undertake the improvements (Hamman, 6/16/93).

In conclusion, although present operations with informal water release arrangements and year-to-year contract extensions are working well, Rio Chama water managers face potentially difficult future decisions (Mottl).
2.9.6 References

A draft of this chapter was reviewed by Karl Martin and others at the Albuquerque Area Office, Bureau of Reclamation, in October 1994.


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2.10 SUMNER DAM TO BRANTLEY RESERVOIR, PECOS RIVER, NEW MEXICO
Sharyl Kammerzell

2.10.1 Introduction to the Pecos River

The Pecos River flows from the north central mountains of New Mexico 755 miles south to the Rio Grande near Comstock, Texas (see Figure 16). The river crosses a wide range of landscapes and, as a result, changes its character along the way. In many reaches, geology limits the river’s course. Outcrops — along the channel bed or along the bluffs — restrict the channel and the floodplain. A few remnant channels and abandoned meanders throughout the Pecos River valley provide evidence that the historic active channel was much larger, with historic flood events spanning the width of the valley floor (Field Trip Report).

Today’s river exhibits changes brought about by decades of artificial controls intended to improve the functioning of the river for specific purposes including irrigation and flood control. Between Santa Rosa Dam and Sumner Reservoir the river flows through alternating narrow canyons and wide valleys. Below Sumner Dam the river traverses a wide flood plain through a braided channel with pronounced bank erosion and channel incision. The channel bed through most of this reach has been stripped of sand-size sediment and today consists of cobble and gravel-size sediment. Just above Fort Sumner Park, a sandy bed replaces the courser material for a short distance. Below Fort Sumner Park the river, at low flows, becomes slightly braided, moving through about half the channel width. Several artificial controls affect the channel, banks, and flows below Roswell. Channelization, reservoir impoundment, bridge crossings, and bank stabilization confine the river to a single, narrow, well incised channel that efficiently transports water and sediment. By the time the river reaches Brantley Reservoir its waters are highly saline, as the river traverses a number of small salt flats. This saline water is used to irrigate highly alkaline, heavy clay-loam soil in the Pecos Valley (Biological Opinion, p. 3; Davis, 6/29/93; Field Trip Report).

This case study considers changes to reservoir operations in the Carlsbad Project, a Bureau of Reclamation (BOR) project on the Pecos River, in response to concerns for an endangered species. Santa Rosa Reservoir, the most northerly point of the study, is managed

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by the Army Corps of Engineers (COE), for irrigation, flood control, and sediment control. Carlsbad Irrigation District (CID) operates the river from Santa Rosa Dam to Avalon Dam which is a reregulation reservoir about six miles downstream from Brantley Dam. Although the COE operates Santa Rosa Dam, non-flood control releases and dates are scheduled by CID. Sumner Dam and Reservoir, (formerly Alamogordo Dam and Reservoir, re-designated by Public Law No. 93-447), is about 20 miles downstream from Santa Rosa Dam. It is a BOR dam built as part of the Carlsbad Project and is operated by CID. Both Sumner and Brantley are managed by the COE for flood control, and by the BOR for irrigation, recreation, and fish and wildlife purposes. Approximately 220 miles downstream from Sumner Dam lies Brantley Dam and Reservoir, another BOR dam operated by CID (Project Data, p. 113). Aside from small tributaries, these three facilities allow for almost complete regulation of this stretch of the Pecos.

Storage rights at Santa Rosa, Sumner and Brantley are held jointly by BOR and CID. In addition, BOR holds direct flow rights for the project. Through a 1971 Memorandum of Understanding (MOU) between the BOR, State Engineer, and the COE, CID and BOR were able to transfer a portion of their Sumner irrigation storage capacity upstream to Santa Rosa (Biological Opinion, p. 1). This transfer allowed CID to benefit from the higher quality water resulting from the dam’s location nearer the headwaters, while providing a recreational body of water for area residents at what had previously been a dry dam authorized only for flood control. In addition, in the 1930s, CID contracted with the BOR for rehabilitation of the Carlsbad Project delivery systems and, in the late 1980s, for operation and maintenance of Sumner and Brantley Dams (Davis, 6/29/93). As a result, CID controls the storage and delivery of project water in the Pecos from Santa Rosa Reservoir, 230 miles downstream to their delivery point below Brantley Dam.

Historically, flows on the Pecos have been regulated to meet the needs of CID. Based on the amount of water available, CID allocates from 1/2 to 4 feet of water per acre to each constituent. During an average year water is released in blocks (large flows for a short period) from Santa Rosa or Sumner Reservoirs to Brantley Reservoir, two to three times during the year. In a drought year there may be only one release (Hamman, 7/26/93). CID must also make releases to satisfy other water rights recognized under New Mexico law.
The Fort Sumner Irrigation District (FSID) is another major water user along the Pecos River below Sumner Dam. FSID's water right has a priority date of 1903 and is for a direct diversion of up to 100 cfs of the natural flow of the river above Sumner Reservoir. Diversions are taken from FSID Diversion Dam located approximately 17 miles downstream from Sumner Dam (BOR, 9/30/94).

Another major downstream constituent is the State of Texas. The Pecos River Compact (Compact) governs the allocation of water to New Mexico and Texas, requiring a percentage of the "flood inflows" as determined by the 1947 condition (Compact, Art. III (a)). The annual "flood inflows" are a function of computed flows versus actual flows as measured at several Pecos River gages (BOR, 9/30/94).

2.10.2 Nature of the Environmental Problem

Since 1978 the Rio Grande Fishes Recovery Team (RGFRT) has been concerned about the species Notropis simus. While there is fear that much of the species is extinct, a 1982 study (Chernoff et al.) determined that a previously unnamed fish in the Pecos River was a valid subspecies, the Pecos blunt-nose shiner or Notropis simus pecosensis (shiner). The shiner historically inhabited the reach of river from Santa Rosa Dam downstream to just below Carlsbad. In the early 1900s the species was plentiful, with a 1939 collection exceeding 1,400 near Sumner Dam. Within 50 years, the number had dropped dramatically — only four shiners were collected in 1981 (Recovery Plan, p. 3). Following the 1982 study, the shiner was recommended for listing under the Endangered Species Act (ESA) by both the RGFRT and the New Mexico Department of Game and Fish (NMGF). Additionally in 1983, the U.S. Fish and Wildlife Service (FWS) was petitioned by the Desert Fishes Council to list the shiner.

Agency and individual effort culminated in 1987 with the listing of the shiner as a threatened species under the ESA (Federal Register, pp. 5295-96). Threatened species are those likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Once a species is listed as threatened or endangered, the ESA mandates that federal agencies use their authority to conserve the species. The ultimate goal is to
increase the species' population, so it is no longer threatened and can be delisted (Rohlf, pp. 26-27).

In conjunction with the listing, two reaches on the Pecos were identified as critical habitat: from a point approximately 10 miles south of Fort Sumner, New Mexico extending 64 miles downstream into Chaves County, and between Hagerman and Artesia in Chaves and Eddy counties, a distance of approximately 37 miles. These areas lie between Sumner Dam and Brantley Reservoir. Research associated with the listing found that "the most important factor in the species' decline is reduced flow in the main channel of the river due to water storage, irrigation, and water diversion" (Federal Register, p. 5295). Other variables possibly affecting the shiner, in addition to the flow regime, include predator fish such as white bass which thrives in higher flows, and channel catfish. Introduced species may also affect shiner populations since they compete for food and habitat. While contaminants such as mercury are in the river and may be a problem for the species, its impact on the shiner is not yet well understood (Martin, 10/11/94).

Subsequent to the listing, the FWS in 1990 requested the BOR to enter into the formal section 7 consultation process under the ESA (Biological Opinion, p. 1). Section 7 consultations are initiated to insure that actions carried out by a federal agency "do not jeopardize the continued existence [of the listed species] or result in the destruction or modification of habitat of such species" (16 U.S.C. § 1536). Accordingly, in 1991 the BOR performed a Biological Assessment, as required under section 7 of the ESA, to identify whether agency operations affect listed species, including: (1) the threatened shiner; (2) the endangered bald eagle *Haliaeetus leucocephalus* (eagle); and (3) the endangered interior least tern *Sterna antillarum* (tern) (Rohlf, p. 113). The BOR's assessment concluded that their operations "may affect" the shiner while they found it unlikely that other species were affected.

The BOR's "may affect" conclusion triggered, under the ESA, the FWS's subsequent Biological Opinion (Rohlf, p. 114). In the Biological Opinion the FWS, in response to the BOR's assessment, concluded that operations of the Carlsbad Project are "likely to jeopardize the continued existence of the [shiner] and to adversely modify critical habitat of this species" (Biological Opinion, p. 2). Specifically, the FWS found that rapidly increasing flows from
Sumner Dam flushes the shiner from desired habitats, while instantaneously ceasing flows strands fish in isolated habitats, leaving them susceptible to desiccation and increased predation by other species. Moreover, due to the results of a FWS interim analysis on fish from Santa Rosa Reservoir exhibiting high mercury levels, the FWS did not concur with BOR's "unlikely to affect" conclusion for the tern and the eagle, without issuing a jeopardy decision (Biological Opinion, p. 2).

1.10.3 Physical and Operational Changes Made

Pursuant to the ESA section 7 process, the FWS opinion mandated "reasonable and prudent alternatives" for the shiner, and included optional "conservation recommendations" for the eagle and the tern. Section 7 requires the FWS to issue reasonable and prudent alternatives (actions to avoid further harm to the species) following a jeopardy determination (Rohlf, p. 112). Conservation recommendations are issued according to FWS regulations pursuant to the section 7 mandate for agencies to carry out programs "for the conservation of endangered and threatened species;" they are discretionary (Fowler-Propst, 7/23/93; U.S.C. § 1536(a)(1)).

The reasonable and prudent alternatives in the Biological Opinion included (1) developing an MOU between the BOR, CID, NMGF, and FWS, to establish the terms for a five year study designed to evaluate the hydrological and biological needs of the shiner; (2) requiring the BOR to fund the study; (3) having the BOR conduct hydrological studies to develop a simulation and optimization flow model; and (4) ramping (gradually releasing/decreasing) irrigation releases (Biological Opinion, p. 10). The conservation recommendations included studies of tern habitat, a BOR-sponsored analysis of heavy metals in fish and sediments in Santa Rosa and Sumner Reservoirs, an assessment of the impacts of contaminants on eagles and terns, and additional fish studies (Biological Opinion, p. 11).

In January of 1992 the five year shiner study commenced with the signing of an MOU by the four participating agencies (BOR, CID, NMGF, and FWS). The final MOU was the product of a cooperative effort among several parties. The BOR and the FWS wrote the initial draft and circulated it to other agencies for review. CID also participated in this process, contributing to the editing of the document and signing the final version (Davis,
10/12/94). Essentially, the document reflects the reasonable and prudent alternatives outlined in the Biological Opinion, with the BOR taking the lead role for hydrological studies and the FWS taking the lead for fisheries related studies (MOU, pp. 2-3).

Since the signing of the MOU, research recommended by the Biological Opinion has been initiated by all agencies. Additionally, CID has been shaping their irrigation releases to meet requirements of the MOU and to accommodate biological and hydrological data collection efforts. One effect has been to gradually increase or decrease water releases over a longer period of time (ramping) (BOR, 9/30/94; Wilber, 6/10/93). Researchers are collecting field data and meeting regularly to coordinate research needs.

The BOR in cooperation with the FSID, CID, and the State of New Mexico is discussing water conservation measures directly with FSID. Potential water savings would be identified by determining the portion of FSID’s 100 cfs water allotment not diverted. For example, if FSID diverted only 80 cfs, then 20 cfs would be "saved". The water "saved" could be stored in Sumner Reservoir through an agreement with the CID and BOR who have first priority storage rights. The water would be held in a special pool with a maximum amount allowed. Reclamation would assume responsibility for the accounting of the separate pool including evaporation losses. If the water management agreement is implemented, 50 percent of the stored water would be available to FSID during dry periods. The remaining 50 percent would be available for use by the BOR (BOR, 9/30/94).

2.10.4 Issues Raised by the Changes

While much progress has been made towards completing the study goals, problems have surfaced where research needs are in conflict with status quo operations. Unforeseen issues include interagency coordination, respective agency roles under the MOU, and water quality impacts to irrigation. MOU signatories now realize the benefits to be gained by collecting the best possible biological and hydrological data. Finally, effects of known variables other than water flow, such as predator species, need to addressed.

All participants have found the inter-agency coordination to be much more difficult than anticipated. The MOU does not contain clear directives on each agency’s role and
responsibilities. Signatories chose to leave the MOU non-specific because they preferred the flexibility afforded by more general standards. The lack of specificity has, however, had some drawbacks (Hamman 6/16/93; Wilber, 6/10/93). For example, as the process under the MOU evolved, it soon became evident that the document had not established sufficient communication lines and modes of operation.

An incident arose in the early spring of 1993 where study needs were in direct conflict with irrigation needs. CID and its constituents were concerned about existing water quality measurements in Brantley Reservoir and whether or not the water quality was adequate for cotton and young alfalfa for the first irrigation. This was in direct conflict with the researchers study needs for mimicking the timing and shape of a "natural" hydrograph. After evaluating their situation, CID decided that water must be moved to Brantley Reservoir to satisfy irrigation water quality needs. Thus an impasse occurred between Reclamation, CID, FWS and NMGF regarding these operations. BOR reiterated to CID that the research need and request was unchanged. However, BOR did not deny CID their right to deliver water to meet irrigation needs. The FWS and NMGF told BOR that any operation should be documented, justified, and sent to the MOU signatories in writing. The focus then shifted to the coordination of the irrigation release ramp down and subsequent runoff operations. The experience underscored the need for clear and complete communications between agencies so that future similar problems could be addressed and a means of dealing with the problems developed (BOR, 10/14/94).

Following this breakdown in communication, the FWS requested the BOR "to require" CID to adhere to the ESA section 7 study requirements. Uncertain of its authority to mandate CID’s compliance, the BOR did not take any action (Hamman, 6/16/93). A Regional Solicitors Opinion was requested on matters concerning Reclamation’s responsibilities under the Endangered Species Act to manage reservoir operations in the Pecos River. One issue examined what the BOR’s options were in a worse case event CID did not cooperate with research needs under the reasonable and prudent alternatives, and therefore potentially jeopardized the study and/or the Pecos bluntnose shiner. Reclamation could determine that CID failed its contract obligations for proper operation and maintenance of project facilities. Under such a scenario, the BOR could take over operation and maintenance of all or any part
of the project works. It is the aim of all MOU signatories that such a "drastic" alternative would not be needed and that the preferred alternative would be continued communication, coordination and cooperation (BOR, 10/14/94).

CID’s early spring release is necessitated by the insufficient volume and poor water quality in Brantley Reservoir. CID’s desire is to efficiently deliver the highest quality of water as it can. Salinity levels below Brantley Dam typically range from a low of approximately 1,300 parts per million (ppm) total dissolved solids (tds), to a high of about +5,000 ppm tds. Salinity levels have gone as high as 6,000 ppm tds (Davis, 6/29/93). Low salinity levels are critical for viable farming (Hamman, 6/16/93). Tolerance level vary with the crop. Young plants are more sensitive than mature plants but, in general, levels above 3,000 ppm tds will affect productivity (Davis, 10/12/94). Thus, water quality is important to CID, and has come to be recognized by all study members as an integral part of the study. Brantley Reservoir often has a sufficient quantity of water in March that is poor quality, i.e., high salinity. Therefore, a release is necessary from Sumner Dam to move better quality water to Brantley Reservoir so irrigation water is suitable for early crop needs.

Early spring irrigation releases are an important point of coordination between the MOU signatories. As mentioned previously, CID traditionally moves a large block of water downstream in early March to meet irrigation needs in terms of volume and quality. If the release is too low, it may increase delivery time, for example from 1 1/2 weeks to 2 1/2 weeks, and not get to the crops when needed (Davis 10/12/94). On the other hand, concern for the shiner is that high flows may occur when the fish is in a relatively dormant physiological state and occupying low velocity habitat. A research goal is to study the biologic and hydrologic response to alternative operations that change the magnitude, timing, and duration of late winter/early spring releases from Sumner Reservoir while still meeting irrigation needs (BOR, 9/30/94).

2.10.5 Present Status and Future Issues

In addition to asserting the biological needs of the fish, it is also hoped that after five years a hydrological model or series of models will have been developed that will simulate flows as they move downstream from Sumner Dam (BOR, 9/30/94).
Recent attempts have been made to update the existing MOU to include additional signatories, such as COE and other water users, and to more specifically define coordination requirements. Consensus could not be reached on either of these issues so the existing MOU was left in place and a new MOU is being developed between NMGF, FWS, BOR, and COE to integrate COE's endangered species contaminant studies into the process.

Other unresolved issues are the potential impacts on compact deliveries, and the possible effects on the endangered tern and eagle. The Interstate Stream Commission acknowledges that at some point they will have to become more involved in the flow determinations, currently though, they prefer a watchful approach, since it is too early to predict Compact impacts (Krai, 6/22/93). Similarly, concerns about the tern and eagle have been pushed back until the shiner study is near completion (Fowler-Propst, 6/10/93).

Access to the river has also become an issue. Many of the initial biological sampling sites were on private land with access attained through verbal agreements with landowners. However, as sensitivity to the Endangered Species Act has increased, researchers have been denied access to all biological sampling sites on private land in the vicinity of the upstream critical habitat (BOR, 9/30/94). The need for increased public information and education is recognized as being important to the success of the program. A series of public meetings were held in 1993 and contacts with landowners and interested parties has increased (BOR, 9/30/94).

In summary, while much progress has been made towards changing historical operations to meet study goals, there is still much work to be done to foster complete cooperation among all basin stakeholders, including agencies with different missions as well as traditional water users.
2.10.6 References

A draft of this chapter was reviewed by Karl Martin and others at the Albuquerque Area Office, Bureau of Reclamation, in October 1994. Their assistance, as well as the helpful telephone comments of Tom Davis, Manager, Carlsbad Irrigation District (Oct. 12, 1994) and Chris Rich, Solicitor, U.S. Department of the Interior (Oct. 12, 1994), are gratefully acknowledged.


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Telephone interview with Tom Davis, Manager, Carlsbad Irrigation District (June 29, 1993 and Oct. 12, 1994).


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2.11 MEEKS CABIN RESERVOIR, BLACKS FORK RIVER, STATELINE RESERVOIR, EAST FORK - SMITHS FORK RIVER, LYMAN PROJECT, WYOMING-UTAH
Sharyl Kammerzell

2.1.11 Introduction

Stateline and Meeks Cabin dams and reservoirs are the principal features of the Lyman Project, a part of the Colorado River Storage Project, authorized in 1956. Located in southwestern Wyoming, roughly 22 miles southwest of Fort Bridger, Wyoming, on the Blacks Fork River, Meeks Cabin Reservoir, completed in 1971, has a maximum storage of 32,470 acre-feet (AF). Stateline Reservoir, built in 1977, with a maximum capacity of 14,000 AF, is just across the state border in northeastern Utah, on the East Fork of the Smiths Fork River (see Figure 17; Project Data, pp. 595-96). Both dams are operated by the Bridger Valley Water Conservancy District (BVWCD), according to the Definite Plan Report, as stipulated in their repayment contract with the Bureau of Reclamation (BOR) (Bugas, 6/24/93). The Definite Plan Report is a BOR document that outlines the purpose and management criteria for the project.

The Lyman project was built primarily to increase irrigation opportunities for farmers within the BVWCD. Water in Meeks Cabin Reservoir is used solely for irrigation. Stateline Reservoir water use is more diverse, with 1,500 AF per year allocated for municipal and industrial use in the towns of Lyman and Mountain View, roughly 12,000 AF per year allocated for irrigation, and 1,000 AF per year allocated for fishery purposes. The fishery allocation originates in the project authorization which requires "facilities to mitigate losses of and improve conditions for the propagation of fish and wildlife" (Colorado River Storage Project, ch. 203, 70 Stat. 105 (1956)).

Management of the Lyman Project's fish and wildlife elements is delineated in the Lyman Project Definite Plan Report. The original management plan reserved 2,990 AF of inactive capacity in Meeks Cabin as a fishery and for enhancement of recreation opportunities, and required flows of at least 10 cubic feet per second (cfs) in the Blacks Fork below the reservoir. Minimum flows were increased from 10 cfs to 20 cfs in February, if the year's

*University of Colorado School of Law, class of 1995.
Figure 17. Lyman Project

snowmelt forecast indicated that the reservoir would fill (Micheli Letter). Increased winter flows were mandated according to projected storage space, spring run-off needs and expected fishery needs (Karas, 7/26/93; Definite Plan Report, p. 15). Similarly, the Definite Plan Report provided for a 2,000 AF reservoir pool in Stateline, and minimum winter flows of 10 cfs below the dam "to the extent possible with supplementary storage releases from 1,000 af of active capacity that [is] reserved for that purpose in Stateline Reservoir" (Micheli Letter).

2.11.2 Nature of the Environmental Problem

The operational plans intended to benefit the fishery were, in part, unsuccessful. BVWCD began to realize that implementation of the winter flow regime on both dams harmed their customers' lands and the fisheries. The higher than natural winter flows of 20 cfs, mandated by the Definite Plan Report (DPR), on the Blacks Fork River below Meeks Cabin Dam, resulted in flooding over ice and ice break up, that, in turn, caused bank erosion (Bugas, 6/24/93; Karas, 6/17/93). Additionally, research subsequent to the DPR demonstrated that early high flows displaced fish because fish in their dormant winter stage are unable to maintain their position against the current (Johnson, 7/19/93).

Below Stateline Reservoir the winter instream flow fluctuated dramatically because the required 10 cfs release swiftly depleted the reserved 1,000 AF pool. Once the 1,000 AF "active capacity" reserve pool was exhausted the dam release was equated to the natural winter inflow. In 1989, the 1,000 AF instream reserve in Stateline was depleted by February. The fish were left with the natural inflow of 5 cfs for the remainder of the winter. In 1990 "only 435 AF were allocated to supplement natural streamflows since the reservoir only stored 43 percent of its total allocation (Instream Report, p. 1). These periodic low flows on the East Fork of the Smiths Fork damaged the fishery by reducing trout habitat quality and the number of trout the stream could produce (Instream Report, p. 4).

Additionally, in order to meet the required winter flows below both reservoirs, mid-winter adjustments in the amount of water being released were necessary. This required driving on icy, snow-covered, seldom used roads in the middle of winter, and changing the reservoir gates - a difficult chore given the harsh nature of the Wyoming/Utah winters (Karas, 6/17/93).
2.11.3 Physical and Operational Changes

In response to these realities and complaints from their constituents about bank damage and flooding, the BVWCD, in April 1990, requested that the BOR change operating plans by decreasing the winter flow below Meeks Cabin and establishing a steady flow below Stateline (Bugas, 7/21/93). In May, 1990, representatives from interested agencies attended a meeting to discuss the proposed changes and their possible environmental impact. The BOR, the BVWCD, the U.S. Forest Service (FS), the Utah Division of Wildlife (UDW), the U.S. Fish and Wildlife Service (FWS), and the Wyoming Game and Fish Department (WGFD) were represented at the meeting (BOR Memo, p. 1).

The meeting attendees agreed that prior to modifying the DPR an instream flow study should be conducted to gage the effects of proposed changes on the trout fishery below Stateline Reservoir (BOR Memo). No such study was required for the proposed Meeks Cabin change since fish displacement is now a known effect of high winter flows (Johnson, 7/19). As manager of the fishery, the WGFD was selected to perform the Stateline instream flow study (Johnson, 6/24/93). Identifying the study funding proved to be the only remotely contentious decision related to the change. Eventually the BOR offered to fund most of the study (approximately $4,000) out of their "Technical Assistance to States" fund (Karas, 6/17/93).

Using the Physical Habitat Simulation Model (PHABISM) and the Habitat Quality Index (HIII) the WGFD's study revealed that at "normal" (10 cfs) water levels under the DPR, the fishery below Stateline supported "about 13.0 trout habitat units," (unit is defined as "the amount of habitat quality which will support 1 pound of trout") (Instream Report, p. 4). However, when the flow on the East Fork of the Smiths Fork was reduced to 5 cfs, due to depletion of the 1000 AF pool, the stream only supported 10.6 trout habitat units. Based upon these results the BVWCD requested modifying the operational plan to require a constant flow of 7 cfs throughout the winter, as opposed to drawing from a 1000 AF pool at a rate of 10 cfs until depleted (Micheli Letter). The instream study revealed that at a flow of 7 cfs the fishery would continue to support 13.0 trout habitat units, thereby avoiding the habitat loss.
associated with a flow of 5 cfs (Instream Report, p. 5). A constant flow would also eliminate
the need for BVWCD to change the gates mid-winter (Karas, 6/17/93).

The BVWCD's requested winter operation modification at Meeks Cabin Dam proposed
maintaining a 10 cfs flow until the ice had melted, rather than increasing the release to 20 cfs
in February, if the year's snowmelt forecast indicated a full reservoir (Micheli Letter). This
modification would prevent damage and flooding resulting from ice breakup, fish
displacement resulting from high flows, and eliminate the need to adjust Meeks Cabin Dam
gates in February (Bugas, 6/24/93; Karas, 6/17/93).

The results of the study and the requested modifications were sent to all interested
agencies, with a request that they respond. All agencies returned their concurring letters by
September, 1991 (BOR Memo, enclosure no. 3). Subsequently, the BOR, in compliance with
the National Environmental Policy Act, performed a categorical exclusion checklist which
indicated that the changes were not going the negatively affect the environment. Similarly,
BOR consultations with the U.S. Fish and Wildlife Service established that the changes were
in compliance with the Endangered Species Act and the Fish and Wildlife Coordination Act
(BOR Memo, Karas, 8/3/93). As a result, the current operating plan includes the original
recreational/fishery pools and the modified winter flow regimes below both dams.

2.11.4 Issues Raised by the Change

This project was remarkably free of contentious issues. Indeed, as a result of a
tentative agreement between state and federal agencies and the BVWCD, the changes were
implemented one year before the final agreement. Early implementation resulted from a
desire to see if the changes would work prior to making them permanent, and a need to
address the low water supply of 1991 (Johnson, 6/24/93; Bugas 7/21/93).

As previously mentioned, the only hurdle was finding funding for the instream flow
study. Since there was no perceived need (i.e., no problems) for an additional multi-agency
meeting or task force, the operational modifications were largely completed by individual
communication through telephone calls and letters.

All of the parties involved are satisfied with the modifications, even though the
changes do not equally benefit the parties (Bugas, 6/24/93; Johnson, 6/24/93; Karas, 6/17/93;
Zobell). For example, the new winter flow below Stateline Reservoir is partially subsidized by BVWCD water, since the fishery's 1,000 AF allocation is not enough to support a constant 7 cfs flow. Nevertheless, the BVWCD prefers the new management program because the negligible water loss is outweighed by the benefits to its members (e.g., no more winter flooding or bank damage) and the fishery (Bugas, 6/24/93).

2.11.5 Present Status

Currently, as explained above, all participants are satisfied with the modified winter flow regime. The only outstanding issue is the recommendation in the Instream Flow Report that summer flows be reduced below Stateline Reservoir. The report concluded that reducing the flow from 90 cfs to 64 cfs would increase the trout habitat units from 13.0 to 38.2 (Instream Report, p. 5). However, following distribution of the report there was no response to this suggestion, nor was there any follow up by the WGFD (Johnson, 6/24/93). Furthermore, given the realities of delivering water during the irrigation season, it is unlikely that all parties would be amenable to reduced summer flows (Bugas, 6/24/93). Since the WGFD considers the fishery below Stateline Dam to be of marginal quality, they are unlikely to push for reduced summer flows (Johnson, 6/24/93).

It is more likely that Stateline and Meeks Cabin will continue to be operated according to the modified management plan. Irrigators and land owners no longer have winter flooding problems, and the fishery below Stateline appears to be in good health. Although the degree of improvement is unknown since post-change fishery monitoring has not occurred (in part due to the fact that quality data did not exist for pre-change conditions), WGFD is satisfied with the overall quality of the fishery (Johnson, 6/24/93; Bugas, 6/24/93).
2.11.6 References

Letter from Joe G. Micheli, Manager, Bridger Valley Water Conservancy District to Mr. Ostler, Bureau of Reclamation (May 23, 1991) (Micheli Letter).

Memorandum from Projects Manager, Bureau of Reclamation to File, "Operation Changes for Meeks Cabin Dam and Stateline Dam" (June 5, 1992) (BOR Memo).

Telephone interviews with Lawrence Bugas, President, Bridger Valley Water Conservancy District (June 24, 1993, and July 21, 1993).

Telephone interviews with Kevin Johnson, Fisheries Biologist, Wyoming Game and Fish Department, Green River, WY (June 24, 1993, and July 19, 1993).

Telephone interviews with Christine Karas, Chief Biological Support Branch, U. S, Bureau of Reclamation, Salt Lake City, UT (June 17 and Aug. 3, 1993).

Telephone interview with Richard Zobell, Range Conservationist, Mountain View Ranger District, U. S. Forest Service (June 24, 1993).


2.12 PAYETTE DIVISION, BOISE PROJECT, PAYETTE RIVER, IDAHO
Roberta Hoy

2.12.1 Introduction

The Bureau of Reclamation's (BOR's) Cascade Reservoir in west-central Idaho provides water for irrigation and power and is also used extensively for recreation. The fundamental operational change at Cascade, started in the mid-1980s, is using uncontracted storage space in the reservoir to establish a minimum storage volume, or conservation pool, as a result of giving precedence to recreational needs, such as fishing, while continuing to meet traditional needs, such as irrigation. This was not the first change proposed or effected for the Cascade operation, and was actually the result of a region-wide study for additional hydropower generation capabilities, not a recreation-specific study. This change has subsequently generated proposals for more changes, such as additional increases in the minimum pool or increased releases for downstream fisheries. This chapter describes: the historical conditions at Cascade Reservoir, the mechanisms used to propose operational changes, the effectiveness of changes made, and the need for operational flexibility, or continued access to the change mechanisms.

2.12.2 Physical Setting

Cascade is part of the BOR's Boise Project, which includes two divisions, the southern Arrowrock Division along the Boise River, and the northern Payette Division along the Payette River (see Figures 18 and 19). The Payette Division, which includes Cascade, is operated "as an integrated hydrologic system" (BOR Draft EA, p. 1). Therefore, information about the rest of the division, in particular the Deadwood Dam and Reservoir, needs to be considered along with information about Cascade.

The Payette Division includes three BOR dams and associated reservoirs on various reaches of the Payette River: Cascade on the North Fork; Deadwood on the Deadwood River, a tributary of the South Fork; and Black Canyon on the main stem (see Figure 20). Cascade

*University of Colorado School of Law, class of 1994.
Figure 18. Snake River Basin

Source: Palmer, pp. iv-v.
Figure 19. Boise Project

Source: BOR Project Data, p. 44.
Figure 20. Payette River Basin

Source: BOR Draft EA, p. ii.
Dam is an earthfill structure with a crest length of 785 feet and a structural height of 107 feet. Cascade Reservoir, with a storage capacity of 703,200 acre-feet (AF), is the largest reservoir in the division and in the Boise Project (Project Data, pp. 48, 51). The reservoir, which is in a broad, flat, glacial valley, has a surface area of 28,300 acres, but is surprisingly shallow, with an average depth of only 26.5 feet. In contrast, Deadwood Reservoir, which is in a gently sloping but narrow valley, has a surface area of only 3,000 acres (BOR Draft EA, p. 2) but an average depth on the order of 50 feet. Reservoir capacity is also much smaller, only 162,000 AF. Deadwood Dam is a concrete thick arch with a crest length of 749 feet and a structural height of 165 feet. Black Canyon Dam is a concrete gravity structure with a crest length of 1,039 feet and a structural height of 183 feet (Project Data, pp. 50, 51, 56). This dam is a diversion dam for power generation, rather than a storage facility, so no storage volumes are reported. However, the dam forms a long, narrow reservoir with a surface area of 1,040 acres and a maximum capacity of 44,650 AF (BOR In-House, pp. 1-3).

The Payette Division serves the Black Canyon and Emmett Irrigation Districts (Project Data, pp. 43-46). In the Black Canyon District, about 27,186 acres are served by gravity flow through a distribution system off the Black Canyon Canal and an additional 26,014 acres are served by a combination pumping/gravity system off the same canal. Another 6,881 acres are served by irrigation drains from the Arrowrock Division. The 25,000-acre Emmett Irrigation District, actually outside the project’s service area, receives water under a Warren Act contract from Black Canyon and Emmett canals (Project Data, pp. 43-45).

The average annual runoff of the Payette River, recorded at the Horseshoe Bend Gaging Station (refer to Figure 19), is about 2,500,000 AF, although the recorded range is from 823,700 AF in 1977 to 4,521,300 AF in 1974 (BOR In-House, p. 4-1). The combined storage capacities of the reservoirs in the basin control only about 30 percent of the annual runoff (BOR In-House, p. 13). BOR dams and reservoirs are the largest such facilities in the basin, although numerous smaller, private storage and diversion facilities exist on some of the reaches. The highest streamflows generally occur in May and June, followed by low streamflow from August through February, depending on the amount of snowpack and the timing of the snowmelt (BOR In-House, pp. 1-1 and 1-2).
2.12.2.1 Project Authorization

The development of the Payette Division took several years (Hess, pp. 3-6). The original Boise Project was authorized by the Secretary of the Interior on March 27, 1905, in response to petitions by local irrigators, under the provisions of the 1902 Reclamation Act (32 Stat. 388). Black Canyon Dam was authorized on June 26, 1922, under the same act, and completed in 1924 (Project Data, p. 47). The repayment plan for the Black Canyon construction was unusual in that it was based on an agreement with an existing irrigation district, the Emmitt Irrigation District, separate from the proposed Black Canyon Irrigation District. The Emmitt Irrigation District had its own canal system, which could be readily tied into the proposed Black Canyon diversion facilities. However, the design of the canal system for the proposed Black Canyon Irrigation District was not complete. Therefore, to avoid delay of the Black Canyon construction, the Emmitt Irrigation District agreed to be responsible for repayment until the canal system for the Black Canyon Irrigation District was operational (Hess, pp. 4-5).

Deadwood Dam was approved by President Coolidge on October 19, 1928 (Hess, p. 5), and completed in 1931 (Project Data, p. 47). The construction of Deadwood was justified as necessary for efficient operation of the Black Canyon Powerplant, after users of Big Payette Lake on the North Fork of the Payette River opposed use of that lake for powerplant storage (Hess, p. 5). The Payette Division as a whole was not approved until December 19, 1935, under § 4 of the act of June 25, 1910 (36 Stat. 835), which emphasized completion of reclamation projects already started. Cascade Dam was completed in 1948.

2.12.2.2 Historic Operation

The Payette Division was originally planned, in part, to provide water for a complex trans-basin exchange to the Mountain Home Plateau, southwest of Boise. As envisioned, the plan would allow development of up to 400,000 acres of land on the plateau and help alleviate irrigation drainage problems in the Boise Valley. Several variations were proposed, with reservoirs at different sites in the Payette Basin (Nace, pp. 4-7) and different trans-basin conveyance schemes (see Figure 21). However, the plans were never finalized, and in the
Figure 21. Mountain Home Project

Source: Stacy, p. 28.
1940s, the Lucky Peak Dam in the Arrowrock Division was proposed, in part, as an alternate water source for the Mountain Home area (Stacy, pp. 26-29).

Because the Mountain Home area was not developed with water from the Payette Division, the BOR continued to operate and maintain Cascade, Deadwood, and Black Canyon for irrigation; hydropower, and flood control, and the local irrigators operated their water conveyance and distribution systems. The Black Canyon Powerplant has provided some of the energy for pumping water to the local irrigators, and surplus power has been turned over to the Bonneville Power Administration (BPA) for marketing (BOR In-House, p. 1-3). Traditionally, the BOR released water from Cascade and Deadwood reservoirs for irrigation contracts, with Black Canyon Irrigation District being the largest of about 14 spaceholders at Cascade, and Emmitt Irrigation District being the largest of about 11 spaceholders at Deadwood (BOR Draft EA, p. 20). To maximize power generation at Black Canyon, BOR released water primarily from Deadwood, although water was also released from Cascade (BOR In-House, p. 1-2). For flood control, the minimum flood space maintained from November through March was 280,000 AF, with 80 percent of that in Cascade, and the amount of flood space maintained from April through July was based on runoff forecasts. The BOR also operated the reservoirs on an informal forecast basis to limit the flow of the Payette River through Horseshoe Bend to 12,000 cubic feet per second (cfs) (BOR In-House, p. 6-2).

Both Cascade and Deadwood have been increasingly used for recreation, in part because of their proximity to the Boise population center (BOR In-House, p. 3-3). However, because of differences in the surroundings and access for the two reservoirs, different types of recreation have developed. At Cascade, construction of cabins and summer homes near Cascade began shortly after the reservoir was first filled, and by the mid-1980s, there were 80 subdivisions and an additional 5,000 lots on or near the shoreline (Bald Eagle Plan, p. 2) By 1992, the existing recreation facilities included 424 recreational vehicle (RV) camp sites, 108 picnic sites, and 18 boat launches, and proposed facilities numbered half again as many as the existing facilities (BOR Draft EA, p. 85, Table 4). At Deadwood, access has historically been more difficult (essentially non-existent during the winter because of the snow pack), and the surrounding terrain has more slope. Therefore, by 1992, the only recreation facilities were 31...
campsites. However, at both Cascade and Deadwood, the demand for recreation facilities exceeds their availability (BOR Draft EA, pp. 86-88).

2.12.3 Description of the Environmental Problems

The primary environmental problems at both Cascade and Deadwood are related to fishery conditions and impacts of recreation. At Cascade, elevated concentrations of phosphorus and bacteria in the water have caused fish kills (BOR In-House, p. 3-8). At Deadwood, the variability in the water levels both within and downstream of the reservoir, caused by releases for irrigation and power, have resulted in a poorly developed fishery (BOR In-House p. 2-4). At both reservoirs, the availability of suitable habitat for endangered species, such as the bald eagle and gray wolf, has been impacted by recreation (BOR In-House, p. 6-26; Bald Eagle Plan, pp. 11-14).

2.12.3.1 Cascade

In terms of Idaho recreation fisheries, Cascade is second only to Brownlee Reservoir, which is on the Snake River downstream from its confluence with the Payette River (refer to Figure 18) (Higginson). The fish at Cascade include warm and cold water species: black crappie; brown bullhead; yellow perch; mountain whitefish; coho salmon; rainbow and brook trout; longnose, bridgelip, and largescale suckers; northern squawfish; redside shiner, and longnose and speckled dace (BOR In-House, pp. 4-2 and 6-17). Most of the trout and salmon are stocked because little or no suitable spawning habitat for these fish exists in Cascade, and suitable spawning habitat on tributaries to the reservoir is at least partially blocked by irrigation diversion dams or during the regularly occurring low flow conditions (BOR In-House, p. 4-3). In addition, management of the coho population is complicated by the species’ natural tendency to migrate downstream when water is released or spilled from the dam (BOR In-House, p. 6-17). Kokanee salmon were introduced in the 1970s but could not be sustained for several reasons (BOR Draft EA, p. 40; none of the reasons are listed). Spawning habitat for the other species is good (BOR In-House, p. 4-3). For example, the squawfish thrived to the extent that the species has been a nuisance since the reservoir was
originally filled, and at one time its population was chemically controlled (BOR In-House, p. 6-17).

Elevated phosphorus and bacteria in Cascade create favorable conditions for algal blooms which deplete oxygen concentrations in the reservoir and subsequently result in fish kills. The principal sources of the phosphorus and bacteria are livestock grazing, inadequately treated wastewater (BOR In-House, p. 3-8), and erosion of shoreline soils by waves (Williams). Fluctuations in the reservoir level exacerbate the problem; low levels further concentrate the phosphorus and bacteria loads.

The North Fork of the Payette River below Cascade provides suitable fish habitat. In the 75 miles between Cascade and Black Canyon Reservoirs, the high gradient and relatively cold water contribute to a good to excellent habitat for trout and salmon (BOR In-House, p. 6-20). In a 1978 stream evaluation performed by the U.S. Fish & Wildlife Service (USFWS) for the State of Idaho, this reach was rated as a "substantial fishery resource." Information about the streams above Cascade (the River, Lake and Gold Forks) is limited (BOR In-House, pp. 6-20 and 6-21).

2.12.3.2 Deadwood

Deadwood Reservoir contains several fish species: cutthroat, rainbow, rainbow-cutthroat hybrid, and bull trout; kokanee and Atlantic salmon; mountain whitefish; rednose shiner; and longnose dace. Of the fish species, only the kokanee and Atlantic salmon are non-native, and the Atlantic were introduced to help control the kokanee population. Little or no spawning habitat is present in the reservoir itself. Also, growth of most fish in the reservoir is limited by the naturally low biological productivity of the watershed soils and large fish populations flushed into the reservoir from excellent spawning areas upstream. Drawdowns of the reservoir exacerbate the slow growth rate by reducing available food sources (BOR In-House, pp. 3-11 to 3-13, and 6-18; Golus Comments).

Because of the excellent spawning and rearing conditions in the Deadwood River upstream of the reservoir, that portion of the river was given the "highest value fishery resource" rating in the 1978 USFWS stream evaluation. However, as of the mid-1980s, the assessment had not been updated to take into account possible adverse logging effects. The
portion of the river below the reservoir also has suitable fish habitat (including habitat for brook trout) and was given a "high priority fishery resource" rating in 1978. Even so, the habitat was adversely affected by the lack of winter releases from Deadwood Reservoir. The outlet valves originally installed at Deadwood could not be operated at flow releases of less than 300 cubic feet per second without causing cavitation. Therefore, the valves were closed at the end of the irrigation season (BOR In-House, pp. 6-13, 6-18, 6-20, and 3-13).

Finding solutions to Cascade and Deadwood environmental problems might not have achieved the priority that it did with the BOR were it not for other agency concerns along the Payette River. Minimum pools at Cascade and Deadwood might have been established eventually for recreational uses even without the fishery concerns. However, a dilemma in another federal agency, the BPA, apparently acted as a 'trigger' for the BOR change. Although the BOR had more than enough water at Cascade and Deadwood to meet contract demands, no firm commitment of the uncontracted water had been made, in part because no assessment of the relative benefits of various options had been made. BPA's 'hydropower feasibility study' in the early 1980s provided the incentive for that assessment.

2.12.4 Changes Made in the Project and the Results of those Changes

In the early 1980s, Congress authorized feasibility studies for additional hydropower production at several existing BOR projects (P.L. 96-375). This legislation was apparently formulated in response to several factors, including: predictions of insufficient power supply by the BPA, which later proved inaccurate (BOR In-House, p. 3-1); the legacy of the energy crisis; and efforts to encourage hydropower production at smaller facilities by FERPA (Golus). Because existing federal dams in the Boise Project held potential for power generation, the Boise Project Power & Modification Study was included in the legislation.

Congressional authorization was necessary for these feasibility studies per the Federal Water Project Recreation Act of 1965 (FWPRA) (16 U.S.C. § 460l-19). Under FWPRA, any

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1 When water from the reservoir enters the outlet valves, its velocity increases, causing a corresponding reduction in pressure. If the pressure is too low, the water will begin to vaporize, and part of the flow will consist of bubbles. When the water leaves the outlet valves, the velocity decreases and the pressure rises. The bubbles then collapse rapidly and violently, pitting the surrounding surfaces. (Adapted from Driscoll, p. 594.)
hydropower feasibility study must include an assessment of the potential "for outdoor recreation and for fish and wildlife enhancement" (FWPRA at § 12(a)). In the Boise Project, this assessment was performed by the BOR in cooperation with the U.S. Department of the Interior (DOI), USFWS, and Idaho Department of Fish and Game (IDFG). As discussed in greater detail in the next sections, the assessment for Cascade and Deadwood demonstrated that, although on-site power generation was determined to be a viable option at Cascade (and Idaho Power Company did construct a 12-megawatt facility there), the potential for, and public desire for increased recreation uses and improved fish and wildlife conditions was greater (Golus Comments). Therefore, as required by the FWPRA, subsequent BOR operational changes were directed toward recreation, fish and wildlife rather than power.

The fundamental operational change was relatively simple: in 1984, the BOR made an administrative decision to maintain minimum conservation pools of 300,000 and 50,000 AF at Cascade and Deadwood, respectively. Additional changes suggested during the feasibility study have also been accomplished, either by the BOR or separate agencies with more involvement in the particular problem.

2.12.4.1 Minimum Pools

The selection of 300,000 AF as a suitable minimum pool for the oxygen depletion problem at Cascade was based on a recommendation from the IDFG (BOR In-House, p. 3-9). IDFG modelled dissolved oxygen distribution in the reservoir, and the results indicated that the recommended minimum pool would reduce the risk of fish kills to less than ten percent. The minimum pool volume did not exceed the volume of the uncontracted storage space. Therefore, a 5,000 AF 'reserve' was set aside for future, new irrigation and the remaining uncontracted space of 66,309 AF was still available for assignment based on a beneficial use/environmental factors analysis. At Deadwood, 106,571 AF were uncontracted and 55,429 AF were under long-term contract. After increasing the minimum pool to 50,000 AF, the remaining uncontracted space of 56,571 AF was available for assignment based on the beneficial use/environmental factors analysis (BOR In-House, pp. 2-7 to 2-9).

After the establishment of the minimum pools, the allocations of storage space in both Cascade and Deadwood were almost equally divided between irrigation/municipal/industrial
use and environmental/recreational use. The minimum pools did not adversely affect the downstream conditions or other users, in large part because only about one-third of the basin runoff is controlled by the BOR facilities. The combined increase in storage at Cascade and Deadwood represents less than ten percent of the average annual runoff. In addition, as discussed in the next section, procedures were established for protecting existing users, such as establishment of the 5,000 AF ‘reserve’ for future, new irrigation at Cascade. Although establishment of the pools left less flexibility in the system for power generation, the predicted loss in the annual generation potential at Black Canyon was less than one percent (BOR In-House, pp. 2-12 and 2-13, Table 2-6).

2.12.4.2 Additional Changes

Some additional changes have required modification of existing structures, such as replacing the outlet valves at Deadwood, or construction of new facilities, such as fish barriers or campground facilities. Other changes have affected policy or procedures.

At Deadwood, new outflow valves and a fish barrier were proposed during the feasibility study to improve fishery conditions. The original hollow jet (or needle) valves could not be used to maintain minimum flows necessary for fish downstream of the dam during the winter because of icing and cavitation problems. In 1990, the BOR installed new jet flow gates, so minimum flows could be released, although subsequent icing problems may require installation of a bypass pipe (Draft EA, p. 4-5). The permanent fish barrier was needed upstream of the reservoir to help control the kokanee population. A temporary barrier was installed in 1982 by the United States Forest Service (USFS) and IDFG and was expected to last about 10 years (BOR In-House, p. 3-13).

To reduce the impact of human activities, campgrounds and related recreational facilities were constructed or improved at Cascade and Deadwood. Following a recommendation in the feasibility study, the BOR also adopted a policy of not renewing grazing leases on BOR land at Cascade (Bald Eagle Plan, p. 15; Golus Comments), because at

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2 A hollow jet valve consists essentially of two cones, one of which fits inside the other. As the valve is opened, the inner cone is pulled away from the outer cone, allowing water to flow out of the top of the outer cone.
least a portion of the excessive phosphorus and bacteria concentrations were attributed to livestock grazing (BOR In-House, p. 3-8).

2.12.5 Analysis of the Changes Made

The key to analysis of the changes is understanding: the statutory requirements for hydropower feasibility studies; the importance of public participation; and the authority of the BOR with respect to water rights and allocating costs for projects.

2.12.5.1 Feasibility Study Requirements

The first section of the FWPRA, under which the feasibility study was authorized, states the consideration that must be part of the investigation:

It is the policy of the Congress and the intent of this part (a) in investigation and planning any Federal navigation, flood control, reclamation, hydroelectric, or multiple-purpose water resource project, full consideration shall be given to the opportunities, if any, which the project affords for outdoor recreation and for fish and wildlife enhancement and that, wherever any such project can reasonably serve either or both of these purposes consistent with the provisions of this part, it shall be constructed, operated, and maintained accordingly. (16 U.S.C. § 460l-12(a)).

A good illustration of the BOR's shift in emphasis from hydroelectric to recreational concerns, as a result of the feasibility study considerations, comes from comparison of the wording of the "elements" of the study before the congressional authorization and after the investigatory process. Before authorization, DOI provided Congress with supplementary "statements of information" about the projects included in the legislation (Senate Report 96-890). The statement for the Payette Project included both the Arrowrock and Payette Divisions:

The initial phases of the proposed Power and Modification Study would evaluate the potential for (1) adding a hydroelectric powerplant at the existing Arrowrock Dam, as well as the potential for increasing the generating capacity at the existing Boise River Diversion Dam downstream; (2) enlarging the powerplant at the existing Black Canyon Dam; (3) adding a powerplant at the
existing Cascade Dam; and (4) meeting instream and other water needs related to the above sites (Senate Report 96-890, p. 47).

In addition to these specific criteria, the cover letter stated that "[t]he effects of the potential projects on water, quality, recreation, fish and wildlife, historic, scenic, archaeologic, and aesthetic values will be considered fully in the feasibility studies authorized" (Senate Report 96-890, p. 33).

As the process continued after authorization, the study was split into two separate studies, one for each division. When the draft reports were prepared for the divisions, the "elements" of the studies were much more detailed, as would be expected, but the shift to recreation, fish, and wildlife was also apparent. The major elements of the plan for the Payette Division included: (1) constructing a 10-megawatt powerplant addition to the existing Black Canyon Powerplant; (2) providing a 300,000 AF minimum pool in Cascade Reservoir; (3) providing a 50,000 AF minimum pool in Deadwood Reservoir; (4) replacing an outlet valve at Deadwood Dam to facilitate minimum streamflow releases; (5) constructing a fish barrier on the upper Deadwood River to improve the reservoir fishery; and (6) constructing campgrounds at Deadwood and Black Canyon Reservoirs to meet a need for outdoor recreation facilities. The shift in emphasis was, at least in part, the result of FWPRA requirements. Under FWPRA, if the feasibility study indicated that a project could "reasonably serve either or both" the hydroelectric and the recreation, fish and wildlife purposes, then the managing agency is directed to proceed with the project (16 U.S.C. § 460l-12).

2.12.5.2 Public Participation

The feasibility study was performed in accordance with the U.S. Water Council’s "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" (BOR In-House, p. 5-1) which stresses the necessity for public participation (Water Council, p. 3, § 1.4.3). "Because of the overwhelming public preference for maintenance of the minimum pools and absence of objectionable economic, social or environmental consequences," the BOR initiated the minimum pools as an "early
action" in 1984, during the hydropower feasibility study (BOR In-House, p. 2-15). The decision has remained administrative only; congressional approval was sought, but the local representative believed that Reclamation administrative action was adequate (Golus). As discussed in the next section, the BOR continues to rely on the public desire for continuation of the minimum pools.

2.12.5.3 Water Rights

The BOR's establishment of a minimum pool, even with overwhelming public support, could contradict state law requirements, if the minimum pools were considered a change in use (Tarlock, § 5.17[6][b]). However, Idaho has, at least impliedly, approved of the change, probably due to the fact that consideration was given by the BOR to existing rights and potential impacts on them were minimal. An even stronger indication of Idaho's approval of the measure is that Idaho wants to purchase (or contract) the minimum pool volumes.

The minimum pools are to be maintained in conjunction with existing rights. Idaho Power Company has a flow right of 200 cfs (or the minimum inflow, whichever is less) from Cascade. Also, the "existing contract holders and other water user interests" are protected by three stipulations in the administrative decision: (1) the minimum pools could be violated if Payette River system flood control operation requires the space to capture floodflows; (2) in water short years when irrigators would not receive their full supply, the irrigators would have the opportunity to negotiate with the BOR and IDFG for uncontracted and minimum pool storage; and (3) in critically low runoff years, the IDFG would have the opportunity to negotiate with BOR for uncontracted and minimum pool storage to help provide for streamflow needs (BOR In-House, pp. 2-10, 2-12, and 2-15).

In 1991, the Idaho legislature expressed its approval of the maintenance of the minimum pool by passing Senate Bill 1084, which authorized negotiations for the purchase of 380,000 AF of storage space in Cascade and Deadwood (Factsheet, p. 4). In 1992, the legislature appropriated $3 million, which covers most of the purchase price. However, BOR has not signed the purchase contract because of conflicting demands that at least part of the available water in Cascade and Deadwood be released to improve conditions for anadromous fish downstream of the Payette River Basin (Higginson).
2.12.5.4 Cost Allocation

The FWPRRA sets out specific cost-sharing requirements (16 U.S.C. § 460f-13). However, all the proposed changes, except a campground at Black Canyon, were "recommended as non-reimbursable because they [were] appropriate for Federal management, and accrue benefits to public lands or waters." Even though cost-sharing was not required, IDFG contributed to the replacement of the outlet valves and construction of the temporary fish barrier (BOR In-House, pp. 9, D-1, and 3-13).

2.12.6 Status of the Payette Project and the Payette River

The establishment of minimum pools at Cascade and Deadwood has served the purpose of improving recreation opportunities and fish and wildlife conditions in the area. Also, the plan has proven feasible; only once has the minimum pool not been achieved. Due to the 1992 drought conditions, the pool at Deadwood was drawn down (Crase). Unfortunately, the BOR faces continued, conflicting demands for changes in Cascade/Deadwood operations, and procedures within and among the various agencies and interests do not seem to include a definitive process for evaluating the effectiveness of changes already made or for accommodating new concerns. Also, although the actual reservoir operation is under the direction of the BOR, that agency does not have control over many of the physical and procedural aspects of federal activities in the Payette River Basin as a whole. For example, the USFS is responsible for about 2,000 acres of the shore and interior land around Cascade and all the lands surrounding Deadwood (BOR Draft EA, p. 6), and FERC controls non-federal power concerns throughout the basin (BOR In-House, p. 1-5). The tensions among the various agencies and interests extends beyond the Payette River Basin. More recently, regional needs for the water stored in Cascade and Deadwood are thought by some to outweigh local needs. The same conflict is also viewed as a conflict between fish and wildlife habitat and hydropower (High Country News). Some of the major concerns which face the BOR are outlined below.
2.12.6.1 Fish and Wildlife

Most of the obvious operational solutions to the newer demands are essentially polar opposites, for example retaining water for the minimum pool to improve the fish and wildlife conditions at Cascade versus releasing water for anadromous fish downstream of the Payette River Basin. The best example involves the dependence of endangered and threatened species on the Cascade/Deadwood water. The controversy seems to center on the differing requirements of bald eagles and salmon (High Country News).

Bald eagles nested at Cascade before the minimum pools were established, and the recent reservoir stability has apparently contributed to the increase in the nesting bald eagle population over the past 15 years. Although this increase does not require the BOR to reevaluate its water usage, it does require control of access to the eagle habitat, which may disrupt some recreational users (Bald Eagle Plan, pp. 15-16).

In contrast, anadromous fish populations in the Snake and Columbia River Systems rely on runoff from upstream reaches throughout the northwestern states, such as the Payette River Basin in Idaho. Under the provisions of the Northwest Power Planning Act of 1980, the Northwest Power Planning Council (NPPC) prepared the Columbia Basin Fish and Wildlife Program (16 U.S.C. §§ 839-839h). As part of the 1991 Phase II amendments to this program, NPPC proposed that BOR supply at least 90,000 AF of water from uncontracted storage space to help supply sufficient water for spring migrants and the BOR supply an additional 168,500 AF "from other sources for improvement of downstream flow, velocity and temperature regimes" (BOR Draft EA, p. 10).

Idaho has used water from its state water bank to help meet the NPPC proposals. However, reliance on the water bank is problematic for two reasons. First, the availability of water from the bank has varied dramatically and, second, potential contributors are uneasy because a contributor one year has a lower priority for receiving water the next year (Golus). Because drought conditions have reduced the amount of water available from either the water bank or other sources in the Snake River, the 90,000 AF of water remaining in uncontracted storage after establishment of the minimum pools at Cascade and Deadwood has provided almost all of the water for the NPPC strategy (Crase). In 1991, the BOR temporarily reserved
the uncontracted space in excess of the minimum pools at Cascade and Deadwood (71,828 AF and 25,344 AF, respectively) for anadromous fish (see Figure 22) (BOR Draft EA, p. 10).

As the pressure increases for water contributions from Idaho, maintenance of the minimum pools in the Cascade/Deadwood system may be at increasing risk. However, the USFWS reportedly considers the current minimum pools as absolute minimums and would prefer even larger conservation pools, particularly as the oxygen depletion problem at Cascade has not been completely alleviated (Williams). Concern that regional or hydropower interests may overwhelm that preference has increased, in part because all the BOR changes have been either administrative or ‘temporary’, not ‘permanent’ such as by legislation or contract. However, BOR has stated its continuing commitment to reservoir operations with the minimum pools (BOR Draft EA, p. 4), and the administrative decision does not have a time limit (Golus).

2.12.6.2 Recreation

Even though Cascade has been heavily used for recreation for some time, direct conflict between human activities and fish and wildlife has been limited. However, recreation pressures continue to increase. For example, a proposal for the large Valbois resort at Cascade was submitted to the USFS, although the plan is apparently on hold at least for the present because of additional USFS questions about the project (Williams). Increasing concern about the impacts of recreation on bald eagle habitat led to cooperative development of the Cascade Reservoir Bald Eagle Management Plan by the USFS, USFWS, and BOR.

The National Park Service was consulted during the feasibility study because portions of both the North and South Forks of the Payette River are listed on the 1980 Nationwide Rivers Inventory for potential designation to the Wild and Scenic Rivers System (BOR In-House, p. 6-51). The federally listed stream reaches include: the entire length of the North Fork of the Payette River from McCall, Idaho to the confluence with the main stem, a reach of 58 miles exclusive of the Cascade Reservoir; the entire length of the Deadwood River from its source to confluence with South Fork, a reach of about 40 miles; and the South fork of the Payette River from the Sawtooth Wilderness to the confluence with main stem, a reach of about 54 miles (BOR Draft EA, pp. 88-89). Idaho has also taken an active role in protecting
### Figure 22. Cascade-Deadwood Reservoir Space Allocation

<table>
<thead>
<tr>
<th>CASCADE 703,200 A.F.</th>
<th>DEADWOOD 182,000 A.F.</th>
<th>TOTAL 885,200 A.F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>** CURRENT USE **</td>
<td>** CURRENT USE **</td>
<td>** CURRENT USE **</td>
</tr>
<tr>
<td>** UNCONTRACTED SPACE**</td>
<td>** UNCONTRACTED SPACE**</td>
<td>** UNCONTRACTED SPACE**</td>
</tr>
<tr>
<td>11,828 A.F. Temporarily Reserved for Anadromous Fish</td>
<td>25,344 A.F. Temporarily Reserved for Anadromous Fish</td>
<td>37,172 A.F. used for increased downstream flow or irrigation or M&amp;I or Power or Larger conservation pool</td>
</tr>
<tr>
<td>0 A.F. Administratively Held for Minimum Stream Flow</td>
<td>30,000 A.F. Administratively Held for Minimum Stream Flow</td>
<td></td>
</tr>
<tr>
<td>** SPECIAL SPACE **</td>
<td>** SPECIAL SPACE **</td>
<td>** SPECIAL SPACE **</td>
</tr>
<tr>
<td>50,000 A.F. Inactive space</td>
<td>100 A.F. Inactive space</td>
<td></td>
</tr>
<tr>
<td>** RESERVED SPACE **</td>
<td>** RESERVED SPACE **</td>
<td>** RESERVED SPACE **</td>
</tr>
<tr>
<td>19,201 A.F. RESERED SPACE – IRRIGATION &amp; MUNICIPAL &amp; INDUSTRIAL CONTRACTS</td>
<td>0 A.F. RESERVED SPACE FOR IRRIGATION &amp; MUNICIPAL &amp; INDUSTRIAL CONTRACTS</td>
<td>393,028 A.F. SPACE CONTRACTED &amp; RESERVED FOR IRRIGATION &amp; MUNICIPAL &amp; INDUSTRIAL USE</td>
</tr>
<tr>
<td>** CONTRACTED SPACE **</td>
<td>** CONTRACTED SPACE **</td>
<td>** CONTRACTED SPACE **</td>
</tr>
<tr>
<td>312,171 A.F. CONTRACTED SPACE a. Irrigation space for Districts &amp; Individuals; b. Note: Black Canyon Irrigation District has contract for 240,000 A.F. of space. The first 125,000 A.F. has been assigned a Special priority &amp; this space fills first (i.e., bottom space)</td>
<td>56,558 A.F. CONTRACTED SPACE For irrigation Districts &amp; Individuals for Irrigation use</td>
<td>388,028 A.F.</td>
</tr>
</tbody>
</table>

- Represents space which equals 97,172 A.F.
- Represents space which equals 380,000 A.F.
- Represents space which equals 388,028 A.F.

select reaches of the rivers in the Payette Basin under "interim protected status" (Idaho Code § 42-1734(b)(6)). The state listed stream reaches include portions of the North, Middle and South Forks of the Payette River (BOR Draft EA, p. 90).

The continued participation of state and local interests is critical, both for their expertise and to meet the requirements of FWRPA. For example, the Idaho Division of Environmental Quality and the Idaho Soil Conservation Commission initiated the Cascade Watershed Project in 1989 to determine water quality, soil conservation, and reservoir management goals. In addition, Valley County initiated the Cascade Reservoir Facility Planning Study, primarily to assess the effectiveness of sewage waste disposal practices (BOR Draft EA, p. 8). As mentioned previously, joint funding of some projects is necessary under the requirements of FWPRA. Campgrounds were proposed at Black Canyon during the feasibility study, for example, but ultimately were dropped from consideration because no local contributor could be found.

2.12.6.3 Future Hydropower Development

During the course of the hydropower feasibility study in the early 1980s, Idaho Power Company (IPC) obtained a license from FERC and subsequently constructed a 12-megawatt (MW) facility at Cascade. Also, the feasibility study indicated that power generation at Deadwood was not economically feasible. Therefore, power generation was eliminated as a major federal concern in the Cascade/Deadwood operations, and the only federal hydropower project considered by the feasibility study was upgrading the Black Canyon Dam from 10 to 20-MW. Even so, the potential for power generation remains at other sites within the Payette Basin. Until 1986, IPC held FERC licenses to construct two more powerplants on the North Fork of the Payette River, although IPC surrendered the licenses for the proposed Ferncroft (174-MW) and Banks (99-MW) dams, apparently due to a regional power surplus (BOR In-House, pp. 1-1, 1-5, and 1-6). In the 1980s, a group of local irrigators in the Gem Irrigation District proposed diversion of water from the North Fork of the Payette, a few miles south of Cascade, to Round Valley Creek, for a 500-MW facility (UPI). However, this proposal has been adamantly opposed because of state and recreational concerns (Energy Report).
2.12.7 References

The helpful editorial comments of Ron Golus and others at the Bureau of Reclamation Pacific Northwest Regional Office are gratefully acknowledged.


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2.13 YAKIMA PROJECT, YAKIMA RIVER, WASHINGTON
Daniel Reimer*

2.13.1 Introduction

The Yakima River Basin in south-central Washington is a diverse watershed, encompassing forest, desert, riparian, and riverine habitat on the eastern slope of the Cascade Range. The Yakima River originates north of Mt. Rainier and flows over 200 miles until it joins the Columbia River near the confluence of the Snake River. Along its journey to the Columbia, the Yakima River is joined by the Naches River near the city of Selah. In the upper elevations, the Yakima flows through heavily forested mountain terrain which changes to sagebrush desert as the elevation decreases.

The original inhabitants of the Yakima Basin included anadromous fish (the Yakima was historically the second largest single producer of Columbia River spawning runs), wildlife, plant species and a large population of Native Americans. Developments over the past 150 years have altered the watershed by introducing logging, grazing, farming, the construction of towns and factories, and the regulation of waters in the river basin.

Waters of the Yakima River Basin are now regulated by the Bureau of Reclamation’s (BOR) Yakima Project. The considerable facilities of the project control water resources of the Yakima, Tieton, and Naches Rivers. The project is divided into seven divisions: Storage, Kittitas, Tieton, Sunnyside, Roza, Kennewick, and Wapato. This last division, the Wapato, is operated by the Bureau of Indian Affairs for use in the Yakama Indian Reservation, bound on the east by the Yakima River (Project Data, p. 1337).

The six storage dams and reservoirs of the Yakima Project include: Bumping Lake, Clear Creek, Tieton, Cle Elum, Kachess, and Keechelus (see Figure 23). The largest of these reservoirs is Cle Elum, which has an active capacity of 439,000 acre-feet (AF). Taken together, the reservoirs of the project have a total capacity of over one million AF (Project Data, pp. 1344-45).

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Figure 23. Yakima River Basin
Project reservoirs are located at high elevations in the Cascade Range. Water flows from these reservoirs through the mainstem river systems and 2,000 miles of diversion canals. Undiverted waters and return flows eventually join the mainstem Columbia River. Native Americans have lived in the Yakima Basin for hundreds of years. In the mid-1800s, the 14 bands which later became the Yakima Nation were predominantly hunter-gatherers, depending upon roots, berries, wild game, and fish for their sustenance. It is estimated that, prior to European settlement, 125,000 salmon were harvested each year in the Yakima Basin by Native Americans (Tuck).

These people were joined by settlers in the mid-1800s who were predominantly cattlemen attracted by the basin’s resources. Later construction of roads and rail lines made the basin more accessible to farmers, and soon a demand for irrigation facilities became evident. Private efforts at irrigation could not meet the growing demand, however, and thus arose the desire for federal assistance.

In 1905 the Secretary of the Interior granted authorization for the Tieton and Sunnyside divisions. Construction on Tieton and Sunnyside began in 1906. In 1911, the President gave his approval for these divisions, as well as for the Benton, Kittitas, and Wapato divisions. Congress granted authorization for the Kenniwick Division in 1948 under Public Law 629, 80th Congress (62 Stat. 382), and construction of the Kenniwick Division facilities began in 1958 (Project Data, p. 1341).

Construction and operation of Yakima Project facilities has dramatically altered the natural flow regime of the Yakima and Naches rivers. Flows in the Upper Yakima are still high during the spring and summer due to snowmelt, but now these high flows are extended until October to accommodate downstream irrigators. Moreover, flows during the winter are reduced below natural levels to accumulate storage in the reservoirs for the following year. A Yakima Nation biologist asserts that the consistently high flows found throughout the year scour the sides of the river and reduce riparian habitat while low flows reduce fish habitat. In addition, upstream diversions can result in lower than historic natural flows in the Lower Yakima (Tuck).

One of the primary beneficiaries of the Yakima Project is irrigated agriculture. Project water is used to irrigate a total of 464,000 acres, and has helped to transform a landscape with
historically minimal crop output into a rich agricultural area. The Yakima Basin has become one of the finest agricultural regions in the nation, ranking only slightly below areas of central California in terms of crop production (Esget, 7/21/93). Crops in production include: fruit, vegetables, forage, hops, and mint (Project Data, p. 1342).

The project also includes hydroelectric power generating plants which produce a total of 23,250 kilowatts. Half of this power is used for pumping water to the irrigation districts, and the rest is marketed by the Bonneville Power Administration (Esget, 7/12/93).

In addition, project water is a part of the natural ecosystem within the basin. Anadromous salmon as well as resident fish, including kokanee, rainbow trout, bull trout, and whitefish, inhabit the rivers and reservoirs of the Yakima Basin. Considerable wildlife resources are also present. Both of these resources, as well as the human populations which come to use and enjoy them, depend on water regulated by the Yakima Project.

2.13.2 Environmental Problem

The Yakima Basin, along with the greater Columbia Basin, has witnessed a significant decline in its anadromous salmon populations. Dams and overharvesting account for a large portion of the decline. From an estimated 500,000 in the late 1800s, the salmon run in the Yakima Basin had been reduced to a few thousand by the late 1970s. Of the six species which historically spawned in the Yakima Basin, three are no longer present (summer chinook, coho, and sockeye salmon) (High Country News).

One of the three species which remain in the basin is the spring chinook salmon. The spring chinook enter the Yakima River during May and June, spawn in September, and emerge as fry in March and April. The chinook’s spawning cycle was well adapted to the natural flow regime because, when the fish lay their eggs in September, flows had historically been reduced to the level they would remain at for the winter, thus ensuring that the eggs would remain covered during the incubation period. The alteration of the natural flow regime by the BOR has greatly impacted the spring chinook spawning.

Much of the chinook’s spawning occurs in the Upper Yakima River. A large percentage of the chinook lay their eggs in egg beds, or redds, in the Easton Reach of the Upper Yakima, which is that portion of the river from the Easton Diversion Dam to the
confluence of the Cle Plum River (refer to Figure 23). The chinook typically do not spawn below the confluence of the Cle Elum River because releases from the Cle Elum Dam during September are generally too high for the chinook’s spawning requirements (a water level of one to two feet which will remain all winter). Discharge from Cle Elum Dam during September ranges from 1,500 to 2,200 cubic feet per second (cfs) to accommodate downstream irrigators (River System Operation, pp. 1-2).

In 1980 a biologist from the Yakima Nation discovered 60 redds in the Cle Plum Reach of the Upper Yakima, which is the area between the Cle Elum River and the Teanaway River (see Figure 24). Due to the high flows in the reach created by Cle Plum Dam, the chinook had to create redds close to the river bank where the water level was suitable. The danger created by this situation was that, when the irrigation season ended (between October 10th and 15th), flows from the Cle Elum Dam would be reduced, the water level in the Cle Elum Reach would subsequently decline, and the redds would be left "high and dry."

In order to prevent this eventuality the Yakima Nation filed a court proceeding to protect the redds. The case of Kittitas Reclamation District v. Sunnyside Reclamation District was heard in the U.S. District Court for the Eastern District of Washington before Judge Justin Quackenbush, who delivered a decision on October 31, 1980 in favor of the Yakima Nation and the redds (Supplemental Instructions).

The Quackenbush decision mandated that flows be maintained at a level of 650 cfs for the remainder of the 1980-81 non-irrigation season (October 1980 to March/April 1981) to keep the salmon redds covered during the incubation and emergence (the time when chinook smolts leave the redds and "swim-up") periods. The court granted the watermaster, who had been appointed in 1977 to oversee the delivery of Yakima Project water (Order Appointing Watermaster), the flexibility of decreasing flows below 650 cfs so long as the redds were protected (Supplemental Instructions).

In addition, the Quackenbush decision called for continued study of the chinook’s spawning habitat in order to make possible changes as they became necessary. Such possible actions included: transfer of the redds, construction of berms to deflect water into side channels to cover the redds, and opening effluent ends of the side channels to keep water
Figure 24. Schematic Drawing of Upper Yakima River

Keechelus Lake 157,800 A.F.

Kachess Lake 239,000 A.F.

Kachess Lake

Keechelus Lake

Kachess Lake 239,000 A.F.

Kachess Lake

Keechelus Lake

Cle Elum Lake 436,900 A.F.

Cle Elum Lake

Cle Elum Lake

Ellensburg

Yakima

Roza Canal

Naches Selah

13-6
flowing over redds in those locations deemed necessary by fish biologists charged with overseeing the spawning habitat.

Finally, the Quackenbush decision called for an evaluation of ways to protect future spawning habitat without having to use copious quantities of stored water. To comply with the Quackenbush decision, base flows were supplemented with 62,000 AF of stored water during in the 1980-81 non-irrigation season.

In order to find the most effective means of protecting the redds while minimizing the amount of water required, the decision called for the formation of the System Operation Advisory Committee (SOAC) consisting of biologists who would provide recommendations to the Yakima Project's Superintendent. The final decision was left to the project Superintendent concerning the quantities of water to be used in protecting the chinook redds (Esget, 7/12/93).

2.13.3 Physical and Operational Changes Made

Prior to the controversy over the salmon redds, the BOR managed the Yakima Project so as to provide a balance of storage and discharge between those reservoirs on the Upper Yakima River drainage (Lake Keechelus, Kachess, and Cle Elum) and those in the Naches River drainage (Bumping, Clear, and Rimrock Lakes). Project reservoirs were designed for this type of operation so as to avoid placing undue stress on any particular reservoir and to allow for flexibility in release scheduling (Esget, 7/21/93).

In 1981 the BOR instituted a plan which would decrease flows in the Cle Elum and Easton reaches for spring chinook spawning while simultaneously meeting the demands of downstream irrigators. The plan involved changing the strategy of maintaining a balance of storage between the Upper Yakima and the Naches River. Instead, the BOR would draw heavily upon the reservoirs of the Upper Yakima during the spring and summer while retaining as much water as possible in the Naches River reservoirs. In September, the BOR would reverse its operation by reducing the flow in the Upper Yakima for spawning purposes while supplying downstream needs with the stored water from the Naches River reservoirs (River System Operation, p. 2).
In order to meet irrigation needs downstream from Cle Elum the Kittitas Main Canal would be used to bypass water around the sensitive area. Water would be diverted at the Easton Diversion Dam and returned to the Yakima River approximately nine miles downstream of the Cle Elum reach (River System Operation, p. 3).

This operation, known as "flip-flop", was designed to encourage salmon to spawn in the Cle Elum and Easton reaches rather than at higher elevations in the Cle Elum River and above the Easton Dam. Such control of the spawning habitat was important because the second phase of the operation was to supply a minimum flow over the redds from the end of the spawning period (beginning of October) through the incubation and emergence periods (late April, early May). By confining the spawning habitat to the Easton and Cle Elum reaches, the BOR could reduce the amount of water required from the Easton and Cle Elum Dams to keep the redds covered during the incubation period. In 1981, the BOR established a September target flow of 800 cfs in the Cle Elum Reach, created by a 650 cfs release from the Cle Elum Dam and a 150 cfs release from the Easton Diversion Dam.

When the flip-flop operation was instituted in 1981 an unforeseen event occurred. Biologists had expected the salmon to spawn in the Easton Reach regardless of the low flow (150 cfs) in that area because of the chinook's homing tendencies. However, greater flows in the Cle Elum River than in the Easton Reach provoked salmon instead to spawn in the Cle Elum River (Easterbrooks). In 1981, 55 spring chinook redds were discovered in the Cle Elum River and, in order to protect them, releases from the Cle Elum Dam had to be maintained at approximately 275 cfs during the incubation period. Under the original plan for 1981, base flows would have to be supplemented by about 30,000 AF of stored water. Yet the presence of redds in the Cle Elum River increased the supplement to 110,000 AF (River System Operation, p. 3).

The flip-flop operation has been implemented every year since 1981. Each year, SOAC counts the numbers of spring chinook which come to spawn in the Upper Yakima and the redds which they create (see Table 8) to establish approximate spawning and incubation requirements and measure the program's success. In addition, SOAC attempts to predict the base flows in order to estimate the amount of supplemental water which will be required to cover the redds during the incubation period. SOAC's recommendations have been generally
accepted by the project superintendent as the operating criteria for the flip-flop operation (Easterbrooks).

<table>
<thead>
<tr>
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<th>Total Run</th>
<th>Total Redd Count</th>
</tr>
</thead>
<tbody>
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<td>1334</td>
<td>466</td>
</tr>
<tr>
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</tr>
<tr>
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</tr>
</tbody>
</table>


2.13.4 Issues Raised by the Changes

Three primary issues concerning the flip-flop operation include: the timing of Judge Quackenbush's decision, the legal basis of the decision, and the water rights affected by flip-flop.

The first issue concerns the timing of the Quackenbush decision and its ramifications. Damage to the spring chinook spawning caused by Bureau operations had been known for over thirty years (Tuck). Indeed, the factors which accounted for harm to the fish, the spring chinook's spawning cycle, their spawning habitat, and the operation of the Yakima Project, had all been present since the facilities at Yakima were built.
In 1980, the Yakima Project was being run, as were many BOR projects, as a single purpose operation. Project water was primarily used to supply contract requirements of the irrigation districts, and instream flow values were not priorities. The BOR was therefore not in a position to voluntarily support an effort to support fishery values, and thus arose the need for judicial involvement to save the spring chinook.

The BOR fought the proceeding the entire way, but was eventually forced to comply with Judge Quackenbush's decision (Weaver). The involuntary cooperation mandated by the decision created some friction at the outset of the flip-flop operation (Easterbrooks). Yet the timing of the case might eventually be recognized as a positive factor because the program established by judicial decree can now benefit other efforts. Over the past few years new projects have been designed, either by judicial or legislative decree or by voluntary cooperation, to further improve the populations of the spring chinook and other resident and anadromous fish. The flip-flop operation is now well established and provides a foundation for these new programs. Moreover, SOAC is now available as an advisory group to comment on and help organize new projects.

SOAC is comprised of biologists from the Washington Department of Fisheries, the U.S. Fish and Wildlife Service, irrigation districts, and the Yakima Nation. As fishery values continue to gain recognition as a legitimate and authorized use of project water (under 62 Stat. 382), SOAC will be available to supply the necessary assistance in improving the fish population of the Yakima Basin.

A second issue concerns the legal basis of the Quackenbush decision. The Yakima Nation has been adjudged to possess an unquantified treaty-based right to fish in the Yakima River. In Kittitas Reclamation District, Judge Quackenbush protected this fishing right against dangers posed by operations of the Yakima Project. Judge Quackenbush made no attempt to quantify either this fishing right or any reserved water right which the Yakima Nation might possess for the protection of fish. Rather, Quackenbush was simply trying to alleviate an emergency situation.

The matter of a reserved water right for the protection of fish was later discussed in a general basin adjudication, Department of Ecology v. Acquavella. In a summary judgment by Judge Staufoccher (affirmed by the Washington Supreme Court in April 1993) the Yakima
Nation was found to possess a reserved water right for minimum flows to protect fish life (Acquavella).

In terms of the quantity and priority of this right the court ruled that "[t]he maximum quantity to which the Indians are entitled as reserved treaty rights is the minimum instream flow necessary to maintain anadromous fish life in the river, according to annual prevailing conditions. This diminished reserved right for water for fish has a priority date of time immemorial" (Acquavella). Although the Quackenbush decision predated the Acquavella decision, some individuals argue that the water used for the flip-flop operation could be assessed under this reserved right because the program is "necessary to maintain anadromous fish life" (Weaver).

The BOR, however, considers the water used for flip-flop to be part of storage management at Yakima (Esget, 7/22/93). Because reserved water rights are not associated with any particular reservoir, the BOR has flexibility in managing project facilities so long as appropriate amounts of water are delivered to the irrigators at the agreed upon place and time (Esget, 7/22/93).

Recognizing flip-flop as part of the Yakima Nation’s reserved right could set a precedent for other programs to support fishery values. The primary difficulty with the court’s reluctance to quantify the reserved right is that it becomes unclear which programs and what levels are necessary for the undefined value of "fish life."

A final issue concerns the ramifications of flip-flop on the water rights of other parties. Under either of the above theories, no water rights of the irrigation districts or individual irrigators are affected by the program. Irrigators were strongly opposed to flip-flop, however, because they correctly believed that their water supply would be negatively affected.

Irrigators are forced to pay more under their Operations and Maintenance (O&M) contracts while flip-flop is in place. As mentioned, project reservoirs were designed to

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1It can be argued that water used solely for the operation could be considered part of the BOR’s authorized management of project water for fishery enhancement. Flip-flop might be considered as an enhancement project because the constant flow of water supplied for incubation might not always be available under natural conditions, and operations providing benefits in excess of those afforded by natural conditions are deemed enhancement.
discharge equivalent amounts of water, thus reducing the burden on any one particular facility. Because flip-flop places a greater burden on individual reservoirs both the operation and the maintenance costs are increased. In addition, the program can result in a reduction of water to individual irrigators in dry years because flip-flop also decreases flexibility in reservoir management available prior to the program (Esget, 7/22/93). Reductions in the available water supply are equitably apportioned among all proratable irrigators, about half of the total number of irrigators, for the following month (Esget, 8/16/93).

2.13.5 Present Status

The flip-flop operation has been "fine-tuned" over the past years to protect the spring chinook redds while minimizing the augmentation of natural flows. Instead of releasing 650 cfs from Cle Elum Dam and 150 cfs from Easton Diversion Dam, the BOR now provides a more even release between the two dams, and usually the difference is no greater than 150 cfs (Bor Comments). This release is reduced in years with higher base flows, sometimes to levels as low as 150 cfs (Easterbrooks).

For purposes of incubation, the BOR uses a general operating rule that releasing 40 percent of the amount of water released for spawning provides sufficient habitat for incubation and emergence (Easterbrooks). Thus, for example, if 500 cfs is released for spawning and the creation of redds then approximately 200 cfs should be released during incubation to insure that the redds will be protected. This assumption is tested for verification each year (BOR Comments). In addition to altering releases to protect the redds, other measures such as berming are sometimes implemented to keep sufficient levels of water flowing over individual egg beds.

A second effort to support the spring chinook has also been implemented in recent years. This operation, called the "mini flip-flop" is used to allow chinook to spawn in the Keechelus Reach of the Upper Yakima, which is the area between Keechelus Dam and Easton Dam (refer to Figure 24). Like the flip-flop, the mini flip-flop creates an imbalance in reservoir operations by first drawing water from Keechelus Lake and then using water from Kachess Lake when spawning begins in the Keechelus Reach (Turner Letter). Unlike flip-flop, however, the mini flip-flop is not implemented every year but only in those years when
there is sufficient water in Keechelus and Kaches lakes to provide a minimum flow through the spawning and incubation period.

Mini flip-flop is only implemented about 80 percent of the time, and when the program is not implemented the fish ladder at Easton Dam is closed to force the spring chinook to spawn in the Easton Reach (Turner Letter). The effects of closing the fish ladder on fish that have been imprinted with a homing tendency for the Keechelus Reach is currently unknown (Tuck). The BOR contends that the chinook will spawn in the Easton Reach without difficulty (Turner Letter), but data is insufficient to know with certainty (Tuck).

On a larger scale, the Northwest Power Planning Council, created by the Northwest Power Act of 1980, has targeted the Yakima Basin for significant improvements. A three-phase project was formulated to aid the migration and overall size of fish populations. Phase one of the operation entailed the construction of fish ladders and screens on all facilities on the mainstem rivers of the Yakima Project and this phase is now complete. In addition, fish counting facilities are being constructed at several points along the river. Phase two involves construction of fish screens and other devices on smaller irrigation diversions, which should be completed by 2005. Finally, phase three involves the construction of fish hatcheries to supplement native stocks of spring chinook, fall chinook, coho, and possibly other species of native fish. Plans call for these hatcheries to go into operation in 1996 (Esget 7/12/93).

The Yakima Basin has experienced an increase in the total number of fish returning to spawn. While only 2,000 fish were counted in 1980, the total number of fish in the basin now ranges from between 8,000 to 12,000 each year. Yet in light of historic levels in excess of 500,000 fish, these gains seem somewhat modest.

Recent developments indicate that fishery values in the Yakima Basin will be further improved in the coming years. In addition to flip-flop and mini flip-flop, these developments include: the Northwest Power Planning Council’s three phase plan, the Washington Supreme Court’s decision in the Acquavella case affirming the Yakima Nation’s reserved right for minimum flows, other fish enhancement and production programs, and plans for a water leasing pilot program to support anadromous fish in dry years (Water Marketing).

The success of the flip-flop operation itself is difficult to assess for two reasons. First, the number of spring chinook returning to the Upper Yakima has varied greatly from year to
year (refer to Table 8). The cause of this fluctuation is not yet known, making the program's success difficult to establish.

Second, any effort to improve a specific anadromous fish population must be seen in the context of efforts in the larger region to support fisheries. A primary failure of flip-flop is that the program does not support spring chinook in other life stages.

For example, the flip-flop operation was not formulated in conjunction with any effort to flush the chinook smolts out of the Yakima River once they are ready to begin their journey to the sea. As mentioned, upstream diversions can lead to lower than historic natural flows in the Lower Yakima, which can result in water with a high temperature. When the chinook smolts pass through the Lower Yakima, many are killed by the heat of the water (Tuck). Protection of the spring chinook is thereby undermined because of an absence of basin-wide protection for chinook in all life stages.²

The number of deaths caused by the low flows could be alleviated by providing a flushing flow for certain periods to carry the fish out of the Yakima Basin. Flushing flows are an example of another possible application of the Yakima Nation's reserved right for the maintenance of fish life. The BOR has refused to provide flushing flows, however, as the agency contends that such flows are not absolutely necessary and that there is no precedent for their use (Weaver). Yet the application of flushing flows on the Sacramento River indicates a recognized need and precedent for such a program. On its part, the BOR claims they have accommodated SOAC several times when flushing flows were requested (BOR Comments).

On a larger scale, spring chinook are directly impacted by the operation of the Army Corp of Engineers' facilities on the Columbia River and fishing practices in the Pacific Ocean, and the welfare of the species cannot be secured without the cooperation of other bodies in control of the resource in these critical areas.

While these failings do exist, the program is successful in its ability to meet the requirements of both downstream irrigators and the spring chinook. Flip-flop has become

²The Bureau asserts that temperature models indicate higher flows would not alleviate the temperature problem because of the solar radiation of the high desert environment in which the Yakima Project is located (BOR Comments).
"standard operating procedure" for the BOR, and in conjunction with SOAC, the program appears to be a valuable tool in support of fishery values in the Yakima Basin.
2.13.6 References

A draft of this chapter was reviewed by Jim Esget, Special Projects Officer, Bureau of Reclamation. His assistance is gratefully acknowledged.


Bureau of Reclamation, Yakima Projects Office, Comments to 1993 draft Yakima Project Case Study (Jan. 1994) (BOR Comments).

Letter from Robert Turner, Director, Washington Department of Fisheries to Jerry Meninick, Chairman of the Fish and Wildlife Committee, Yakima Tribal Council of March 19, 1993 (Turner Letter).


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2.14 NEWLANDS PROJECT, TRUCKEE AND CARSON RIVERS, NEVADA
Beth Doherty

2.14.1 Introduction

In 1903 the Secretary of the Interior authorized the construction of the Newlands Project ("Project") in west-central Nevada, making it one of the Bureau of Reclamation's ("Bureau") first projects. The Newlands Project provides water from the Carson and Truckee rivers to irrigate approximately 60,000 acres of land in Lahontan Valley, near Fallon, 60 miles east of the Reno-Sparks metropolitan area (Project Data, p. 685). Both the Carson and Truckee rivers originate at the summit of the Sierra Nevada mountains, on the Nevada-California state-line, and flow for a short while to the east into Nevada, part of the Great Basin (both rivers are relatively short, approximately 100 miles in length) (Dimick, p. 2). The Truckee River begins at the outlet of Lake Tahoe at an elevation of 6,225 feet, descends east out of the Sierra Nevadas, enters Nevada and turns north, ending where it flows into Pyramid Lake. The lake is located entirely within the Pyramid Lake Indian Reservation, ancestral and present-day home of the Pyramid Lake Paiute Indians (Yardas, p. 2). Average annual inflow of the Truckee River at the California-Nevada state line is 590,000 AF per year. The Carson River begins on the eastern slope of the Sierra Nevadas and continues slightly further east than the Truckee, ending in the Carson Pasture, Carson Sink and Stillwater Marsh, greatly depleted wetlands areas. The average flow of the Carson River is 265,000 AF per year (Project Data, p. 689). In 1948, some of the land encompassing these wetlands (some 200,000 acres) was made into Stillwater Wildlife Management Area (Introduction, No. 6, p. 18).

Newlands Project facilities changed the natural flow of the rivers in several important respects (see Figure 25). Lake Tahoe Dam, constructed in 1913, controls the top six feet of Lake Tahoe, and creates a reservoir of 732,000 acre-feet (AF) that is used to control the flow of the Truckee River (Project Data, p. 685). Twenty miles east of Reno, Derby Dam regulates and partially diverts Truckee River water flows 32 miles through the Truckee Canal into Lahontan Reservoir on the Carson River. Eighteen miles west of Fallon, the reservoir is

*University of Colorado School of Law, class of 1995.
Figure 25. Truckee and Carson River Basins

an on-stream facility with a storage capacity of 314,000 AF. Two powerplants are located on
the Carson River immediately below the reservoir and water released from the reservoir is run
through the powerplants to generate energy. Approximately 5,000 project acres are served
directly from the Truckee Canal (Truckee Division); however, the majority of the project’s
acres are located and served below Lahontan Reservoir (Carson Division) (Harms).

The Carson River also flows down from the Sierras, and is eventually impounded
behind Lahontan Reservoir. All Carson River water is captured behind Lahontan, unless there
are extremely high flows which can’t be managed at the reservoir. Carson and Truckee river
water mixes in Lahontan Reservoir and, when released from the reservoir, and run through the
powerplants, is diverted by the Carson River Diversion Dam, located on the Carson River five
miles downstream of Lahontan Reservoir, into two main irrigation canals which serve the
Carson Division. More recent Bureau projects (Truckee Storage Project authorized in 1935
and the Washoe Project authorized in 1954) also dam tributaries of the Truckee before the
river enters Nevada (Project Data, pp. 685, 1219, 1293).

When construction of Derby Dam began in 1903, early settlers were already irrigating
20,000 acres of land along the rivers (Project Data, p. 687). The Newlands Project enabled
expansion of the irrigated land area to 60,000 acres. By 1986, there were 1,200 farms
supporting a population of 8,000 people in the project service area. The gross value of the
irrigated crops was over $20 million dollars (Project Data, p. 689).

The Bureau operated the Project for only a short time, turning over the operation and
maintenance of the project to the Truckee-Carson Irrigation District (the TCID) under a
contract signed December 18, 1926 (Project Data, p. 688). The TCID has operated the
project since that time.

In contrast to the abundant water supply provided by the rivers which flow down from
the Sierra Nevadas, the project’s irrigated lands are set in one of the most arid regions of the
country. The Newlands Project falls within the Great Basin, an area of over 200,000 square
miles characterized by extreme dryness. The Great Basin encompasses areas famous for their
aridity, Death Valley in the south and Black Rock Desert in the north. The land irrigated by
the Newlands Project similarly receives just over four inches of rainfall each year (Project
Data, p. 689). Westerly winds which carry much moisture from the Pacific Ocean are cooled
as they cross the Sierra Nevadas, depleting the air of any water. As the wind continues east
down the slopes of the Sierras, it becomes very warm again, capable of retaining all
remaining moisture (Knack, pp. 1-2). The resulting stark contrast between the mountains rich
in snow and rain and the desert valleys deprived of almost all moisture, provides the backdrop
for the intense competition over the one water source able to sustain life in the Newlands
Project area: the rivers, full of snowmelt, which run down from the Sierras and feed the
Great Basin.

2.14.2 Nature of Environmental Problem

Historically, there were two lakes at the terminus of the Truckee River. When the
river was running high and Pyramid Lake was full, the Truckee and Pyramid Lake would
overflow and flood a flat valley to the east, creating Winnemucca Lake. In 1882,
Winnemucca Lake was approximately 26 miles long, 4.3 miles wide and 85 feet deep
(Introduction, No. 7, p. 42). Winnemucca Lake created an average 27,500 acres of rich
marshes which supported waterfowl traveling across the Pacific Flyway (the north-south route
of migratory waterfowl). Diversions of water by upstream users and the Newlands Project
resulted in the loss of this area as a wetland in 1938 (Knack, p. 8; Introduction, No. 4).

Pyramid Lake itself supported a great number of fish. The large Lahontan cutthroat
tROUT, which grew to be over two feet long and weighed over 5 pounds, and sometimes as
much as 40 pounds lived in the lake. The trout would enter the Truckee River in December
and again in late April and swim upstream, sometimes as far as Lake Tahoe, to spawn. Great
numbers of cui-ui, a sucker-type fish unique to Pyramid Lake, also lived there. In mid-April,
it too would leave the lake and enter the Truckee to swim upstream and spawn, although it
would not travel as far as the trout. American white pelicans nest on Anaho Island in
Pyramid Lake in the summers along with other wildlife. The pelican colony had been the
largest in North America, but its population has declined since the fish population in Pyramid
Lake and the shallow-water feeding habitat of the nearby Lahontan Valley wetlands have
decreased (Knack, p. 8; Introduction, briefing papers; Sevon).

The rich, life-sustaining lake supported the Paiute tribe for many years. The Paiutes
lived on its shores and fished in its waters. Some families relied totally on dried trout and
cui-ui to survive. Until the 1920s, the majority of Paiute cash income was the sale of fish, $8,000 dollars annually (Knack, p. 274).

Pyramid Lake has no outlet, but evaporation rates are high (five feet per year) (Solbos). Even before the Newlands Project was built, sustained droughts could cause the lake level to fall, but it was always replenished by runoff from snowmelt in the Sierras and the lake level remained fairly constant (Knack, p. 271). This natural cycle of the lake, however, was changed by the installation of Derby Dam in 1903, which, for most of the Newland's Project's life has diverted more than half the Truckee River flow into the Carson River (Yardas, p. 2; Solbos). Until 1967 when the practice was discontinued, substantial amounts of water would be diverted throughout the winter months from the Truckee River and used solely for purposes of power generation. The water would then simply be spilled into the Carson River and flow to the wetlands (McConnell letter).

Within that time period, Pyramid Lake's surface level dropped 40 feet, resulting in the creation of a delta at the point where the Truckee enters the lake. By 1980, the lake level had dropped approximately 75 feet. The delta prevented the fish from reaching spawning grounds in the river and ultimately caused the near-extinction of the cui-ui and the extinction of the Pyramid Lake strain of Lahontan cutthroat trout (Pyramid Lake v. Morton, p. 255; Knack, p. 272). Derby Dam was also a contributor to the extinction of the Lahontan cutthroat trout in that it blocked passage to traditional spawning grounds. Lahontan cutthroat trout spawned in tributaries to the Truckee which were all located upstream, the closest ones near Reno. Cui-ui were not similarly affected by Derby Dam since they didn't travel as far.

As a result, from 1950 to 1980, only two successful cui-ui spawns occurred, one from 1950 and another from 1969 (Introduction, No. 6, p. 21). Only the cui-ui's long life span (45 years) allowed it to survive. In 1967 the cui-ui were listed as an endangered species. Unlike the cui-ui, Lahontan cutthroat trout disappeared from Pyramid Lake. Today, the Lake is stocked with cutthroat trout which are descendants of Pyramid Lake cutthroat trout, taken from the Lake and introduced into other streams in Nevada before the trout disappeared from the Lake. These fish, however, do not grow to the great sizes the indigenous cutthroat trout once did, and many biologists consider the genetic make-up of the Pyramid Lake cutthroat trout to be lost (Sevon).
Rivers and streams that flow into the Great Basin have no outlet to the sea, so they flow until they sink into the ground or empty into lakes, creating vast acres of wetlands. The Lahontan Valley wetlands at the terminus of the Carson River range in size from small seep pools to intensively managed major wetland areas such as Stillwater Wildlife Management Area which contains Stillwater National Wildlife Refuge. Historic acreage of just some of the major wetlands in the Lahontan Valley averaged 113,000 acres. By 1987, that number had fallen to just over 15,000 acres, representing an 85 percent loss of wetlands in western Nevada. These losses are reflective of losses to all wetlands in the Lahontan Valley. Despite these extensive losses, Lahontan Valley wetlands remained in relatively good shape for many decades due to the substantial diversions from the Truckee River. In 1986, total Lahontan Valley wetland acreage exceeded 46,000 acres, fed entirely by return flow from the irrigators' lands. Before 1967, the wetlands were even healthier because of the freshwater spills generated by power-only diversions from the Truckee.

Over 410,000 ducks, 28,000 geese, and 14,000 swans have been observed using the Lahontan Valley wetlands during wet-year migrations, reproducing up to 25,000 offspring. Up to 70 bald eagles overwinter in the area. The Lahontan Valley was dedicated as a Western Hemisphere Shorebird Reserve in 1988, one of only four such sites in the United States (Introduction, briefing papers).

As conditions worsened in Pyramid Lake, the Paiute Indian Tribe put more and more pressure on the Secretary of the Interior to protect the lake. As described in the next section, sustained efforts by the Paiutes caused the Secretary to issue regulations, known as Operating Criteria and Procedures (OCAP), which limited Truckee River diversions in order to protect the lake. Although meaningful, enforceable regulations didn’t come into place until litigation was initiated by the Tribe.

These efforts have made a difference in Pyramid Lake but had unintended side effects. Today, Pyramid Lake’s surface area is 110,000 acres. There have been seven successful spawns of cui-ui recorded since 1980. As Pyramid Lake improved, however, the Lahontan wetlands suffered. Until the mid 1970s, Carson Lake Pasture averaged over 12,900 acres of prime wetlands. In 1989, Carson Lake included only 2,500 acres of wetlands and by 1993 only 600 acres (Saake). Stillwater Wildlife Management Area has decreased from an historic
figure of 33,400 acres to a 1987 figure of 9,650 acres, and a 1993 figure of 1,200 acres. Total acreage of all Lahontan Valley wetlands is currently estimated at 2,500 acres. The primary reason cited for the recent decreases is the efficiency and maximum allowable diversion (MAD) requirements of the 1988 OCAP (Introduction, No. 4; Saake). The Bureau attributes some of the losses to the prolonged drought which has reduced overall the water in the river system.

2.14.3 Previous History of Litigation and Regulation

Almost since the inception of the Newlands Project, litigation has plagued its history and driven its operations. In 1913, the United States sued all water rights holders on the Truckee River to establish water rights on the river for the benefit of Pyramid Lake Indian Reservation and the Newlands Project (see Nevada v. U.S.). Not until 1944 did the Court, pursuant to a settlement agreement, issue a final decree in that case, known as the Orr Ditch Decree. The decree awarded the reservation a 1859 priority date to divert water to irrigate 5,875 acres on the reservation, and awarded the Newlands Project a 1902 priority date to divert up to 1,500 cubic feet per second (cfs) through Derby Dam to irrigate project lands. The decree also imposed a water duty (the amount of water an appropriator is entitled to use, including a margin for conveyance losses) of 3.5 acre-feet per acre (AF/a) for project land known as bottom land (poorly drained land consisting of fine textured soils) and 4.5 AF/a on bench land (well drained land consisting of coarse textured soils) (Wigington).

Later, in 1973, the United States attempted to seek additional water rights on the Truckee for protection of the fishery at Pyramid Lake. The U.S. Supreme Court, however, denied the water rights on the basis that all water rights on the Truckee had been determined by the Orr Ditch Decree (Nevada v. U.S.).

In 1925, the U.S. filed a quiet title action to settle water rights on the Carson. That suit was not decided until 1980 when the Court set the same water duties for the Carson River that the Orr Ditch Decree set for the Truckee River. This case is known as the Alpine Decree (U.S. v. Alpine, 1980).

In addition to court decrees, operation of the Newlands Project is governed by Project Operating Criteria and Procedures (OCAP), issued by the Secretary of the Interior. As
mentioned, the creation of the OCAP was spurred by efforts of the Paiute Indian Tribe. The Secretary of the Interior, under the Constitution and various acts of Congress, is trustee for all Native Americans and is therefore obligated to protect and preserve the rights and interests of the Pyramid Lake Paiute Tribe in the Truckee River and Pyramid Lake (43 C.F.R. §418.1(b)). Therefore, in 1967, under pressure from the Paiute Tribe to honor its trustee responsibility and the Endangered Species Act, the Secretary issued the first OCAP (a revised OCAP was issued in 1972).

In 1970, it was still necessary for the Paiute Indian tribe to bring a suit against the Secretary of the Interior, challenging the OCAP’s ability to meet Pyramid Lake needs (Pyramid Lake v. Morton). The suit alleged the Secretary was violating his trust responsibility by issuing OCAP that "illegally and unnecessarily divert[ed] water from Pyramid Lake" (Pyramid Lake v. Morton, p. 255). The District of Columbia Court ruling in the case agreed, stating "in order to fulfill his fiduciary duty the Secretary must insure . . . that all water not obligated by court decree or contract with the district goes to Pyramid Lake" (Pyramid Lake v. Morton, p. 256). Among other findings, the Court found the Secretary had not exercised his authority to require the District to prevent waste, therefore causing unnecessary diversions. The Court reduced the 1972 OCAP allocation for total diversions from both rivers from 378,000 AF to 288,000 AF by the 1974 irrigation season.

Litigation over the Truckee River continued. In 1973 the TCID intentionally violated the OCAP by diverting more water from the Truckee River at Derby Dam than was authorized and then turned around and sued the government when the Secretary of the Interior terminated its contract. The resulting ruling in favor of the government, however, was another validation of the Secretary’s authority to issue the OCAP (this case was not decided until 1984) (TCID v. Secretary). While the TCID was fired, it was immediately rehired under an interim contract which has been in place ever since. Negotiations are currently underway to develop a permanent contract. Also, the TCID is currently developing a settlement proposal to negotiate the return of nearly one million acre-feet of water the U.S. and the Tribe assert was overdiverted during the years the case was in court (Solbos).

The Secretary had a responsibility to protect the fishery, but the Secretary also was required to deliver water to irrigators with water rights established by the Orr Ditch and

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Alpine decrees. Additionally, the water duties established in those decrees shielded the individual irrigator from having to reduce on-farm water use. As a result, any water savings would have to come from the delivery system. These restraints, the Nevada District Court's 1983 ruling (Nevada v. U.S) denying the government's request for a reserved water right for Pyramid Lake, and the 1984 decision to allow termination of the TCID's contract, thus validating the OCAP, caused the Bureau to look solely to the OCAP as the means of resolving the conflicting problems of the Newlands Project (EIS p. S-1). Therefore, on April 15, 1988, the Bureau issued a revised, permanent OCAP with aggressive and unique requirements for water use in the Newlands Project (all previous issues of the OCAP had been annual or interim only).

2.14.4 Physical and Operational Changes Made or Proposed to be Made

The 1967 OCAP was a document without any real effect. As the OCAP has been litigated and approved by the courts, however, its authority has grown stronger and its regulations have become stricter. The 1988 OCAP, for the first time, established efficiency targets, providing incentives and penalties for water use that exceeds or falls below the targets. The efficiency targets were arrived at by estimating what the water conservation effects would be if the District implemented the first seven project improvements proposed in the OCAP and translating the estimates of water conserved into an efficiency percentage (LeSueur). The OCAP also established a maximum allowable diversion (MAD) from both rivers to the Project. Efficiency targets were phased in over a five year period (1988 - 1992). Targets in any given year, however, differ depending on several different factors, such as how much water the project has received and how many acres are being irrigated that year. The targets differ because the more water the system receives and the more acres that are irrigated, the more efficiently it operates. This is so because some water losses are constant no matter how much water is delivered to the project. For example, in 1992 at the end of the five-year phase-in, if irrigators had received 100 percent of their full entitlement for the acres irrigated, the efficiency target would have been 68.4 percent. If only 75 percent of the entitlement for the acres irrigated had been received, a 64 percent efficiency would have been required.
Below 75 percent delivery, no efficiency targets have been established because the less water delivered into the system, the less efficiently the system can operate (1988 OCAP, Figure 1). When too little water is available, the District simply can’t run efficiently, so no efficiency targets are even established. Since the 1988 OCAP came into effect, only 1989 was a wet enough water year to exceed the 75 percent minimum entitlement. In that year, the District’s efficiency, as measured by OCAP standards, was 58.4 percent. The current year, 1993, is the only other year the target efficiencies for the OCAP have been in effect. As of July 1993, the OCAP monitoring office expects at least a 90 percent entitlement delivery for the year, which means the District will need to meet an efficiency target of at least 66.7 percent. While the TCID efficiencies can’t accurately be measured until the end of the irrigation season, estimates from both the OCAP monitoring office and the TCID fall below the required efficiencies for 1993 (LeSueur; Hyde).

Two-thirds of all water saved by exceeding the efficiency is credited to the District for use in whatever manner it desires consistent with state law. If the District falls below the efficiency target, the overused water is considered borrowed from future years, and must be repaid through existing credits, future water savings, or restricting future water deliveries. There is a limit as to how much the District can borrow from future years (26,000 AF). Once the limit is reached the District, or as a default, the Bureau, must prepare an official repayment plan (OCAP §I(C)(2)(a), (2)(b), (3)(b)). Since it is likely the District will not meet its efficiency targets for 1993, it will be assessed a debit in the form of water storage at Lahontan Reservoir which must be paid back, and can ultimately mean a water shortage for District irrigators (LeSueur).

The MAD is an annual maximum amount of water the project can divert, from either river, for irrigation. It is calculated by multiplying the number of water-righted irrigated acres anticipated to be irrigated by the corresponding water duties established in the Alpine and Orr Ditch decrees (3.5 AF/a or 4.5 AF/a), divided by the efficiency rate required at 100 percent delivery levels (68.4 percent). If the year is going to be very dry (low runoff) the OCAP monitoring office will lower the number of acres anticipated to be irrigated, thus reducing the MAD. However, the OCAP monitoring office estimates that irrigators only cut back their
irrigated acreage if the water supply will be lower than 70 percent of a normal water supply year. The MAD for the 1993 water year is 314,300 AF (LeSueur).

While court decisions approving the OCAP caused the TCID to begin honoring the OCAP, it was the strictness in efficiency requirements and the associated penalties (debits) in the 1988 OCAP that caused the TCID to actually begin making changes in the way they operated the project. In order to meet the efficiency requirements, the 1988 OCAP offered a list of fourteen possible non-structural, inexpensive improvements the TCID could undertake to increase its efficiency. The TCID has made or will make all of the fourteen changes recommended in the OCAP, in addition to some more costly changes not on the list (Hyde).

The Newlands Project water delivery system below Lahontan Reservoir consists of the Carson Diversion Dam, on the Carson River, which diverts water into two main canals, the V-Line Canal (900 cfs capacity) and the T-Line Canal (250 cfs capacity). Three laterals, each with an approximate capacity of 250 cfs, extend out from the V-Line Canal. Those laterals are the A-Line, L-Line, and S-Line canals. The other main canal, the T-Line, has one lateral, the N-Line canal. Many sublaterals extend out from the laterals to directly serve the irrigators. Some irrigators draw water directly from the main canals (Hyde).

Four re-regulating reservoirs (Scheckler, Old River, Harmon and S-Line) are located along laterals throughout the system. Inlet canals and outlet canals, leading into and out of the re-regulating reservoirs, connect the reservoirs to the laterals. Some of these inlet and outlet canals are extremely long and lose much water from seepage. Scheckler Reservoir is located near the mid-point of the A-Line Canal and Old River Reservoir is connected to the T-Line Canal. The S-Line Reservoir is located in the upper portion of the S-Line Canal and Harmon Reservoir is found at the bottom portion of the S-Line. At least one irrigation sub-district (the TCID has ten sub-districts) is located below each re-regulating reservoir (Hyde).

Prior to the 1988 OCAP, the entire water delivery system was operated under the single principle of having enough water at all times in the system to meet demand (demand was not carefully calculated, just estimated). Both the main canals, V-Line and T-Line, as well as all the laterals would be running at all times, however not at their full capacity. For example, the upper portion of the A-Line Canal would run at 75 cfs, even though its capacity is near 250 cfs. Lahontan Reservoir and all four re-regulating reservoirs would be kept as full
as possible at all times, and any water that spilled would flow directly to the wetlands, without consequence to the TCID. Lahontan Reservoir releases would be adjusted only infrequently, about once per week, regardless of actual demand (Hyde).

Prior to 1984, there was not even a central ordering system. Orders would be given to a ditch rider, each of whom was responsible for different geographic areas which included segments of one or two canals. The ditch riders would control the flow to the sublaterals and keep the water records (Hyde).

As a result of these operations, the TCID relied heavily on the four re-regulating reservoirs. Excess flows released from Lahontan, created by misjudgment in the water demand, would easily be captured in the reservoirs (Hyde; Dimick, p. 5). However, the shallow depth and large surface areas of the re-regulating reservoirs resulted in large evaporation and seepage losses. Three of the four re-regulating reservoirs were very small (Harmon, 500 AF capacity; S-Line 1,500 AF capacity; Old River, 1,200 AF capacity), only Sheckler had a larger capacity (12,000 AF) (Hyde). In order to reduce overall seepage and evaporation losses in the system, the TCID dried out and completely stopped using Sheckler and Old River Reservoirs. Eliminating Scheckler also eliminated the need to use the long inlet and outlet channels connecting the reservoir to the delivery system. The TCID also diked off two-thirds of the S-Line Reservoir, reducing its usable capacity from 1,500 AF to 400 AF. The TCID continues to use the 500 AF available at Harmon Reservoir, but overall storage capacity in the re-regulating reservoirs was reduced from 15,200 AF to 900 AF.

While the estimated water savings from reduced evaporation and seepage has been significant, the TCID has had to radically change its operations. The room for operational mistake is much tighter, and out of necessity, project operations have become much more sophisticated. The number of measuring stations along the delivery system has significantly increased. The TCID watermaster who once spent 65 to 70 percent of his time watching water in the field now spends 95 percent of his time in the office generating more accurate estimations of how much water needs to be released from Lahontan. As a result, releases from Lahontan Reservoir are made more regularly, approximately every other day, and more accurately (Hyde).
Aside from reducing the re-regulating reservoirs, other recommendations undertaken by the TCID include requiring irrigators to provide 48 hour advance notice for water deliveries, changing the start and end of the irrigation season from a strict March 15 - November 15 schedule to one that is dictated by sufficient demand and weather, and scheduling water service so that deliveries can be made in larger volumes thus reducing losses (Dimick, p. 7; McConnell).

In addition to the 14 low or no cost changes recommended in the OCAP, the TCID has also made changes not on the list, at substantial cost to them. A total of six automated check gates were installed on the V, S, and L-lines. The automated gates maintain a constant upstream water surface level through the means of a floating sensor which transmits electronic messages to the gate telling it whether it needs to go up or down. Prior to the installation of these gates employees always had to manually adjust the gates. As a result, the water level doesn’t fluctuate when a delivery is made at points above the gate. The constant flow provides for more accurate measuring which helps conserve water and reduces labor costs for the district. The average cost of installation for each gate was $10,000. The water conserved by the installation of the automated gates is difficult to determine, although it is believed to save water (Hyde). In 1991, the TCID also installed a pumping station near the end of the S-Line Canal to re-collect drain water and re-route it back into the S-Line system for re-use by one downstream irrigation district.

One change made by the TCID was non-discretionary. OCAP §III(E) requires that operation of Lahontan Reservoir be changed to minimize diversions from the Truckee River. The OCAP sets storage objectives from January through June for Lahontan Reservoir, based on various factors, including monthly run-off forecasts for the Carson River, and predicted water usage, to calculate and minimize the need for Truckee diversions (1988 OCAP). Prior to the OCAP, the District diverted enough water from the Truckee River to keep Lahontan Reservoir as full as possible, ensuring that even in drought years the irrigators would be able to receive full water service (Harms; Dimick, p. 5). The new, reduced, monthly storage target levels help the District to divert only that water from the Truckee which is actually needed.

The Bureau of Reclamation monitors the project under two authorities. The 1988 OCAP, again for the first time, has provisions which require the Bureau to monitor project
operations, measuring flows and making field inspections, and receiving reports regarding daily water orders and daily deliveries. Also, Public Law 101-618, a 1990 law discussed later, requires that an efficiency study on the Newlands Project be conducted to determine ways to raise the efficiency level to 75 percent within 12 years (1988 OCAP efficiency targets are 66-68 percent) (1988 OCAP; Settlement Act).

2.14.5 Issues Raised by the Changes

Much has been accomplished on the Truckee and Carson river systems. Water rights for the water users have been established through the decrees. A trust obligation on the part of the Secretary of the Interior to protect the natural resources of Pyramid Lake for the Pyramid Lake Paiute Indian Tribe has been recognized by the courts and assumed by the Secretary. The OCAP, unique in its requirement that the District meet efficiency targets in its delivery system, has been institutionalized and enforced, so far with support from the courts.

One significant accomplishment is Public Law 101-618 (better known as "the Truckee-Carson Settlement" or "the Act"). The Act, a comprehensive piece of legislation addressing the many interrelated problems on the Truckee and Carson rivers, became law on November 16, 1990. It created many "tools" to manage the Truckee and Carson rivers. Importantly, the Act clarified the rights and roles of involved parties. The Act protects existing water rights and confirms the right of the Newlands Project to divert water from the Truckee River, pursuant to applicable laws and regulations, while another provision clearly adds fish and wildlife purposes to the list of authorized project uses. In furtherance of those purposes, the Act authorized the government to purchase water rights for the benefit of Lahontan wetlands and required immediate revision and implementation of recovery plans for both the Lahontan cutthroat trout and the cui-ui. It also gave the Secretary the authority to close or modify irrigation drains adverse to water quality in the wetlands. To better manage the available water, the Act authorized storage space for a water bank, required urban conservation improvements and directed the federal and state government to undertake a feasibility study for reuse of municipal wastewater for wetland improvement (Yardas article, pp. 5-10).

Although the Act is an expansive, solution-oriented tool (only a few of its provisions are mentioned here), and although the OCAP is in place, there is still much work to be done
to resolve the problems facing the Truckee and Carson river system. Controversy and barriers still linger; the Act, as well as the OCAP, are riddled with problems.

The particulars of the OCAP are surrounded by legal disputes. A recent suit raised the question of whether the District Court administering the decrees, or the Secretary of the Interior, had the authority to classify irrigated land as bench or bottom land. The distinction is important because bottom lands receive substantially less water than bench lands. The appellate court reviewing the case ruled in 1989 that under Section 10 of the Reclamation Act the Secretary did have the authority to make that determination, but the case was remanded for court review of the Secretary’s actual land classifications. While a decision on the Secretary’s classification is still pending, another legal issue has arisen in 1993. The 1988 OCAP and the Orr Ditch and Alpine decrees appear to be in conflict. "The 1988 OCAP are believed to be consistent with the Orr Ditch and Alpine decrees." (1988 OCAP, p. 3). The TCID disagrees with that statement because the OCAP’s maximum allowable diversion (MAD) ceiling will likely be insufficient to allow all irrigators their water duties, guaranteed by the Orr Ditch and Alpine decrees, for the 1993 water year (Stone; Hyde). In a recent letter, the Bureau indicated 1993 water deliveries to irrigators will be shut off by September. As a result, the TCID wanted the legal question of which authority has priority, the OCAP or the decrees, settled by the end of the season. In the end, however, the water was only shut down eight days early because end-of-the-season demand for water was lower than expected (LeSueur).

As previously explained, the OCAP sets a MAD based on the number of water-righted irrigated acres multiplied by the water duty (3.5 AF/a or 4.5 AF/a) divided by the project efficiency at 100 percent deliveries. For this water year the MAD is 295,000 AF, based on a 68.4 percent efficiency and 100 percent entitlement. Under that mathematical formula, if the district doesn’t meet the expected efficiency (or a corresponding efficiency if water entitlements are lower than 100 percent), then there will not be enough water to deliver the required water duties. While the District wants the legal issue addressed because they may be facing water reductions, the 1988 OCAP is protected from suit until 1997 by Public Law 101-618 (Settlement Act, §209(j)(2)). Since the TCID cannot bring a suit regarding the OCAP, the more immediate legal question is whether the TCID can bring a suit under the
decrees, enforcing the water duties and therefore effectively setting aside the OCAP regulations (Stone).

Another issue which arose here is whether §209(J)(2), which protects the OCAP from suit until 1997, denies the District, or any other party, its due process rights and is therefore unconstitutional. The District raised this argument with the Nevada District Court when the OCAP was before that Court for approval. The Court indicated they would not address that issue within the framework of the OCAP approval hearing, but that the District could raise the issue in a separate suit. The District never pursued the issue (McConnell).

The legal question of whether the OCAP or the decrees have superior authority raises the broader issue of exactly what are the legal rights of the irrigators. Or, conversely, what is the extent of the U.S. government’s power and authority to make environmental improvements which affect irrigators’ water rights?

The Bureau has, so far, successfully asserted its authority to determine how the distribution system will be operated (by establishing the OCAP efficiencies, MAD and other requirements), but that assertion stops at the farmers’ headgates. The success of that assertion is measured by the 1984 ruling which allowed the Secretary to terminate the TCID contract for violating OCAP requirements (Wigington). As discussed, however, the OCAP regulations which govern water delivery above the headgate could have affected water delivery rights below the headgate for the 1993 water year (water deliveries were scheduled to be shut off in September for exceeding the OCAP maximum allowable diversion but the water demand dropped off and water delivery was shut down only eight days early). Whether or not the Bureau has the authority to affect irrigator’s water rights below the headgates, in its effort to improve project efficiency, is yet unanswered.

If the irrigators do bring a suit under the Orr Ditch and Alpine decrees to block enforcement of the OCAP’s maximum allowable diversion ceiling, it is still not likely an answer will be provided. The court will likely resolve this possible case on a different issue. The 1984 ruling in favor of terminating the TCID’s contract validated the OCAP, but it did require that the OCAP regulations be reasonable and not arbitrary (TCID v. Secretary). Since the TCID has complied with every change suggested or required by the Bureau and even

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independently initiated other substantial changes, the courts will likely find the OCAP to be arbitrary or unreasonable and decide the case on that issue alone (Wigington).

In any future cases, however, the U.S. Government’s authority to prevent waste might be supported under the concept of beneficial use. The Alpine and Orr Ditch decrees don’t guarantee a maximum water duty of 3.5 AF/a for bottom land and 4.5 AF/a for bench land because they only exist to the extent the water is put to beneficial use (Wigington). The Alpine Decree states, “by the terms of [Section 8 of the Reclamation Act of 1902], beneficial use is the ‘basis’ and ‘measure’ as well as the ‘limit’ of water rights; it sets the maximum water duty, but, under the statute, it is also the necessary rationale and source of the right.” (U.S. v. Alpine, 1993, p. 1490). Although the concept of beneficial use has not traditionally been applied to water waste, at least one court decision involving the Newlands Project approaches this idea.

Throughout the history of the Newlands Project, water has been delivered to non-water-righted parcels that were using water rights appurtenant to other project land. Over two hundred water transfers, requested by the irrigators and approved by the State Engineer, would have corrected the legal discrepancies. The Pyramid Lake Tribe brought suit to block the mass transfer based on a claim that some of the water rights to be transferred were never perfected or were abandoned or forfeited (perfection of water rights for agricultural purposes means the water must be beneficially used by actual application on the land; forfeiture is a failure to use the water beneficially for more than five years). The Ninth Circuit recently reversed and remanded back to the Nevada District Court (for the second time) its decision which upheld the water rights transfers (U.S. v. Alpine, 1993, pp. 1490, 1493, 1495).

By reversing the district court’s ruling, which affirmed the state engineer’s approval of the transfers, the circuit court was also rejecting the notion that the water duty was an absolute right (Wigington). "The engineer . . . found the transferor property rights were valid regardless of the alleged failure to perfect the water rights on the transferor property so long as water was beneficially used, albeit improperly, somewhere on Project land." (U.S. v. Alpine 1993, p. 1490). The District needs to prove beneficial use on a particular parcel, not on a project-wide basis. This ruling hints at the limited rights of the irrigators.
While the transfer case questions the extent of the water duty, under the concept of beneficial use, by questioning whether it exists at all, the water duty has not itself been challenged. The written language of the OCAP clearly defers to the decrees and the maximum water duty allowed by them (OCAP Preamble). The Bureau, as yet, has not attempted to assert an independent authority to redefine the individual irrigators water right entitlement or water duty.

However, another case known as the bench/bottom case suggests the Bureau might have an independent authority to promulgate regulations which affect the water use/water duty. The 1986 version of the OCAP provided that Bureau determinations of bench/bottom land classification would form the basis for calculating the maximum amount of water available to each parcel in the project. The Bureau’s classifications would have greatly decreased water service to some farms. The TCID brought a suit against the government, challenging this provision of the OCAP. The Ninth Circuit Court said that under Section 10 of the Reclamation Act, the Bureau has the power to make the bench/bottom land classification, subject to beneficial use. Section 10 states "[t]he Secretary of the Interior is hereby authorized to perform any and all acts and to make such rules and regulations as may be necessary and proper for the purpose of carrying the provisions of this act into full force and effect" (U.S. v. Alpine, 1989 p. 213).

If the Bureau was allowed, for efficiency purposes, to regulate the Newlands Project in a manner that affected irrigators water rights below the headgates, the issue arises of whether the regulations could be replicated elsewhere. Again, this question is not clear because the Newlands Project involves a unique factual situation. When the OCAP were first validated by the Nevada District Court in 1973 (in response to the Pyramid Tribe’s claim that the OCAP was not sufficient to protect the Tribe’s interest in Pyramid Lake), the court relied heavily on the government’s trust responsibility to the Tribe for its approval of the OCAP and ruling. However, the argument has been made that the government’s authority to regulate water use could also be based on the more general concept of beneficial use. Regardless of whether the Bureau’s authority to regulate water use is based on its trust responsibility to the Pyramid Tribe or on beneficial use, any saved water would directly benefit Pyramid Lake. Therefore, the secondary issue of determining ownership of the saved water does not have to be
addressed. This reduced complication may be a unique factor that works in favor of the government here, but in no other Bureau projects (Wigington).

The legal conflict between the OCAP and the decrees is secondary to a more tangible physical issue: why can’t the TCID meet the required efficiencies if all the recommended changes, and more, have been made. When the efficiencies were developed, only half of the OCAP’s fourteen recommended changes were incorporated into the calculations. Still, the targets are not being met.

The OCAP monitoring office speculates that the unmet efficiencies are the result of unusually high seepage levels. Extremely low water supply levels, caused by the sustained drought in 1990-92, forced the TCID to stop water deliveries by July 17 last year (1992), and completely dewater all their facilities in order to deliver the maximum amount of water available to irrigators. The delivery canals were dry for nine months in 1992 rather than the normal four months. The re-regulating reservoirs, which were often left full throughout the winter, were also completely dry for nine months. The OCAP monitoring office suggests this tactic so thoroughly dried the ground, that during the current water year (1993), seepage in the canals and other facilities is exceeding all historical levels. The USGS has recently measured the groundwater table and determined that it is six inches to one foot lower than normal (LeSueur).

The TCID agrees the cause of the excess seepage might be drought-related, but offers another possibility. Without the re-regulating reservoirs, the TCID must run water through the canals at a higher rate and for a longer period of time. For example, when the reservoirs were in use, upper A-Line Canal would run a fairly constant 75 cfs. During low demand time, the re-regulating reservoirs, which bypass the middle portions of the canal, would catch excess water. During periods of high demand, the re-regulating reservoirs would release the water back into the lower portions of the A-Line Canal for delivery to the downstream irrigators. Now, upper A-Line Canal must carry flows two to three times greater than before in order to deliver water to irrigators taking water at the lower end of the canal. Since 1993 is the first full water year without the re-regulating reservoirs, the TCID believes the new operations could also be the cause (Hyde; LeSueur). If the efficiencies could be met, the question regarding the OCAP and the decrees wouldn’t have to be raised.
Two recent Bureau of Reclamation interpretations of the OCAP, which have had the effect of decreasing water service to irrigators, have prompted the irrigators to form their own organization, the Newlands Water Protective Association. OCAP Section I(A) provides that project water may be delivered only to "eligible land" (1988 OCAP). Under that authority, the Bureau has recently made a decision that the land utilized as on-farm laterals to deliver water to the fields cannot be included in a farmer's irrigated acreage or "eligible land" (McConnell). Historically the land used as farm laterals to carry the water to the crop was included. The amount of water which can be delivered to each irrigator decreases with a decrease in eligible land, so this decision will reduce water deliveries.

Also under Section I(A), the "eligible land" provision, the Bureau has just decided that the parcels of land whose water rights are in question, pending the resolution of the previously mentioned water rights transfer case, are not "eligible land" under the OCAP and can not receive water deliveries. The Bureau ordered the TCID to stop delivering water to the lands in question (McConnell).

The OCAP has radically changed the relationship between the TCID and the irrigators. The irrigators elect the District Board and have traditionally had a good relationship with them. Now, however, the irrigators, as members of the Newlands Water Protective Association, will be filing a court action against the TCID and the government (unlike the conflict between the OCAP and the decrees, the irrigators can take these issues to court because judicial review of Bureau decisions regarding "eligible land" is expressly allowed in the OCAP (§I(A)(4)(a), p. 7)) (McConnell).

Monitoring the OCAP has been expensive. The OCAP office spends approximately one million dollars each year to monitor the project. As an example of the cost, low level aerial photos and satellite images are taken at least twice during the irrigation season to identify illegal diversions or those irrigators watering non-water righted land (Dimick, p. 8). There is extensive monitoring of project efficiencies which is also expensive. A comprehensive OCAP report is due out by the end of 1994 which will include a cost/benefit analysis of the monitoring program (Solbus).

One of the most obvious issues raised by the recent physical and operational changes to the Newlands Project is the effect the changes have had on the Lahontan wetlands. The
TCID has estimated that for every one percent increase in efficiency, there is approximately 4,500 AF less water used by the project below Lahontan reservoir. Wetlands get at least 15 percent of the water that goes to the farmer in the form of return flows. Although there is disagreement about how much the wetlands suffer, there is agreement that they do (McConnell letter). As previously discussed, there has been a significant loss to the wetlands. In 1993 the total wetlands acreage in the Lahontan Valley was estimated at only 2,500 acres. The Bureau feels that the prolonged drought which had plagued the area until 1993 exacerbated the situation considerably.

Additionally, when the "power-only" releases from Lahontan Reservoir were discontinued in 1967, the freshwater flows which were generated by the releases and spilled directly into the wetlands also ceased. Since that time the wetlands have received almost all of its water from agricultural return flow. This water contains elevated levels of arsenic, boron, selenium, lithium, molybdenum, and mercury. All of these elements, except mercury, occur naturally in the area soil; mercury was deposited into the Carson River system during the mining era of the late 1800's. The state health officer has advised children and pregnant women not to eat shoveler ducks from Carson Lake Pasture because of mercury levels. Massive wildlife death is not uncommon. In 1987, millions of fish washed aground in the Carson Sink. In 1988 20,000 birds died of avian botulism. As the return flows decrease, the problems will increase (Stillwater Report, briefing paper, No. 5).

Another loss in wetlands occurred when the TCID dried out most of its re-regulating reservoirs. Sheckler Reservoir, Old River Reservoir and two-thirds of the S-Line Reservoir were dried out and only Harmon Reservoir remained intact. The reservoirs were a valuable habitat, left full during the entire non-irrigation season, and flushed with fresh water flows during the season. When the TCID dried the reservoirs to help meet the efficiency targets, the area experienced a 300 to 400 acre loss in wetlands habitat. Although the Nevada Department of Wildlife was upset by the decision to dry-out the re-regulating reservoirs, they have not continued to pursue the issue. There is a small local movement to refill them.

Operational changes have also affected the irrigators. Now that the irrigation season is delayed until sufficient demand is present, individual irrigators who need water earlier are not served. As mentioned, water deliveries ceased in July of the 1992 water year. As a result, in
the current water year, 1993, irrigators needed to re-seed their fields early. With no water deliveries and dry land and wind, some of the irrigators have had to plant their crops two or three times. Although there is no contract provision between the District and the irrigators which specifies when water deliveries will begin, some irrigators lost money (McConnell).

2.14.6 How Issues Have Been Resolved or Proposed to be Resolved

If the OCAP and the Orr Ditch and Alpine decrees do end up in conflict with each other, the TCID will have three options. The OCAP has a provision that allows the District to submit a written request to the Bureau for additional water if the MAD will not meet delivery requirements (OCAP §3(a), p. 11). The decrees also allow for the District to petition the Federal watermaster for relief, or the District can attempt to file a suit in Federal court (Stone). Whether the Secretary of the Interior and the Bureau will increase the MAD, given the significant operational and physical improvements the District has undertaken and, or whether the District will initiate legal action remains unresolved. The legal questions regarding what land is "eligible" under the OCAP are currently not resolved and may be litigated in court in the near future.

Regarding the related issue of the TCID’s unmet efficiency targets, one possible resolution to the problem is found in the Truckee-Carson Settlement. Specifically addressing the efficiency of the Newlands Project, the law provides for cancellation of all repayment obligations owed to the Bureau by the TCID, as long as the TCID uses that money for water conservation measures (Settlement Act, §209(g)). The unpaid repayment obligation is approximately $1.6 million dollars (Solbos). The repayment obligation can only be waived, however, if the TCID enters into a settlement agreement with the Secretary of the Interior for recoupment of the water the District overdiverted from 1973 through 1984 and only if the State of Nevada contributes not less than $4 million dollars for water conservation (Settlement Act, §209(h)(1), (2)). However, the federal government will match any amount the State of Nevada contributes (Settlement Act, §209(h)(3)).

As mentioned, the Act also contains provisions that address both the Lahontan wetlands and the recovery of Pyramid Lake’s cutthroat trout and cui-ui. Significantly, it gave the U.S. Fish and Wildlife Service the authority to purchase enough water rights from willing
sellers to support up to 25,000 acres of primary wetlands in the Lahontan Valley (Settlement Act, §206). The Nature Conservancy, a private organization, is actually acting as the purchaser of the water rights and then transferring those rights to the U.S. Fish and Wildlife Service to reduce the bureaucratic process (Harms). The law established a cui-ui and Lahontan cutthroat trout recovery and enhancement program which also includes the authority to purchase water rights from willing sellers for the benefit of Pyramid Lake (Settlement Act, §207(c)(1)). It gives the Secretary the authority to use existing storage rights in upstream reservoirs (Stampede and Prosser Creek) not part of the Newlands Project, for conservation of Pyramid Lake fishery. The law establishes a $25 million fund from which the interest can be used by the Pyramid Lake Tribe for operation and management of fishery conservation and improvement facilities (Settlement Act, §207(2)).

Among other provisions, it allows the Reno/Sparks metropolitan area agencies responsible for providing municipal and industrial water to store excess water in Washoe project facilities on the Truckee. Municipal and industrial uses have also been affected by increased flows to Pyramid Lake. It also provides settlement funds to resolve outstanding litigation with both the Pyramid Lake and Fallon-Shoshone Paiute Indian tribes.

2.14.7 Present Status

Public Law 101-618 put in place the authority needed to negotiate and resolve some of the issues facing the Newlands Project. It gave the Secretary some time to work out other more detailed operational problems by protecting the OCAP from suit until 1997. While the tools to manage the Newlands Project problems have been put in place, problems remain.

None of the money authorized for improvement of the project efficiency ($1.6 million from cancellation of the repayment obligation or $4 million from the state and federal governments) has been expended. The TCID is, as mentioned, developing a proposal to settle their outstanding water debt from past overdiversions, a prerequisite to the project receiving any money. Considering that the current MAD limits the project to a maximum diversion of 300,000 AF (varying from year to year), settling an outstanding water debt, which the Bureau estimates to be approximately one million AF, is an enormous task.
The authorized purchase of water rights for the benefit of the wetlands and Pyramid Lake has been stalled because the process to develop the environmental impact statement (EIS) has been very controversial. Since the purchase of water rights by the U.S. Fish and Wildlife Service is a major federal undertaking, the National Environmental Policy Act requires that an EIS be filed. The combined water rights authorized for purchase by the act make up one-third to one-half of the projects available diversions. As a result, the viability of the project, and the community built-up around it, has been called into question. Public hearings have been very emotional and divisive (Solbos; Harms; McConnell). The act requires that rights be bought from "willing sellers". Purchasing water rights in this possibly haphazard way can leave giant holes or gaps scattered throughout the project which may affect efficiencies. Support industries such as seed and equipment suppliers may be faced with so great a reduction in their market base that they could leave the area (Solbos).

As mentioned, even with the protection against litigation provided by the new law, the OCAP may still be facing legal challenges in court. Project efficiencies are not at levels that had been hoped for and mandated by OCAP. The Lahontan wetlands are at extremely low levels. Much controversy surrounds the Newlands Project and great barriers still stand in the way of progress.
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2.15  SHASTA DAM, CENTRAL VALLEY PROJECT, SACRAMENTO RIVER, CALIFORNIA

Beth Doherty

2.15.1  Introduction

Shasta Dam, Lake and Powerplant are located on the Upper Sacramento River in northern California, approximately 175 miles north of Sacramento and just eight miles north of Redding. Shasta Dam, with a 4.5 million acre-feet (AF) storage capacity, is the primary feature of the Bureau of Reclamation’s Central Valley Project (CVP) (Project Data, pp. 217, 19).

The CVP was originally authorized in 1935 under the Emergency Relief Appropriation Act. It was reauthorized in 1937 under the Rivers and Harbors Act for multiple purposes, subject to these priorities: "first, for river regulation, improvement of navigation, and flood control; second, for irrigation and domestic uses, and, third, for power." (Act of Aug. 26, 1937). In 1954, the project was authorized for fish and wildlife purposes, however these newly authorized uses are subject to the 1937 priorities (Act of Aug. 27, 1954).

Shasta Dam is part of the Shasta/Trinity River Division of the CVP. The Shasta division also includes Keswick Dam and Powerplant, located nine river miles downstream from Shasta Dam on the Sacramento River (see Figure 26). The Trinity River division includes Trinity Dam and Powerplant and Lewiston Dam and Powerplant on the Trinity River, Whiskeytown Dam on Clear Creek and Spring Creek Powerplant on Spring Creek (Project Data, pp. 219-21). The Sacramento River is the main stream entering Lake Shasta, along with the Pit and McCloud rivers. Water from all three rivers flows into the lake and is stored behind Shasta Dam. When released from Shasta Dam and Powerplant down the Sacramento River, the water is collected behind Keswick Dam together with water imported from Trinity River through a series of dams and tunnels ending at Spring Creek Power Plant. Keswick Dam acts as an afterbay, regulating the uneven water releases from Shasta and Spring Creek powerplants. Once released from Keswick Dam, water is not captured again, although minor impoundments occur at the Anderson-Cottonwood Irrigation District and Red

*University of Colorado School of Law, class of 1995.
Figure 26. Upper Sacramento River Basin

River Miles Below Keswick

Clear Creek - 12.73
Deschutes - 21.97
Balls Ferry - 26.05
Cottonwood - 28.54
Bend Bridge - 44.57
Red Bluff - 58.98

River Mileage Source:
DWR Bulletin #111 -- 8/62
Bluff Diversion Dams, located 3 and 58 river miles below Keswick. Below Red Bluff, the Sacramento River eventually combines with the Feather and American Rivers, and flows to the Sacramento-San Joaquin Delta and out to the San Francisco Bay (Project Data pp. 217, 19).

The entire Central Valley Project is operated with water rights granted by California’s State Water Resources Control Board (State Board), a statewide regulating and adjudicating body responsible for all water rights, and water pollution and water quality control (CVP-OCAP, p. 14; Cal. Water Code §174). Members of the State Board are appointed by the Governor of California. Water rights are recognized through permits issued pursuant to applications submitted to the State Board. In issuing water rights permits, the State Board has authority to condition permits to protect other water rights, or to protect any matter deemed to be in the public interest, such as fish and wildlife (CVP-OCAP, p. 15).

Additionally, California water law authorizes nine regional water quality control boards to govern and monitor water quality within a particular region. Members of the regional boards are also independently appointed by the Governor, but regional board actions are subject to approval by the State Board (Cal. Water Code §§13200 to 13225). The California Regional Water Quality Control Board, Central Valley Region, sets water quality objectives for the Sacramento River, approved as modified by the State Board, which affect project operations discussed in this case study.

2.15.2 Nature of Environmental Problem

The Sacramento River Basin is unique in providing habitat for four distinct populations of Chinook salmon. These populations, or runs, Fall, Late Fall, Winter and Spring, are each named for the time of year during which the population migrates upstream to spawn (Co-Operative, p. 1). All four runs have experienced drastic population reductions since Shasta Dam was built, but the Winter-run has experienced the greatest decline.

As with other spawning fish populations, the cycle of the Winter-run salmon is characterized by discreet phases. Adult salmon spend two to four years in the ocean before they return to the Sacramento River to spawn (Order 89-18, p. 3). Winter-run adults migrate upstream from December to May; peak spawning occurs in May and June; and incubation of
the eggs and larvae occurs from May through September (1992 Report, app. B: biological analysis). Newly emerged salmon rear on the river’s edge until they are ready to migrate downstream. Downstream migration of the juvenile salmon begins in early August and lasts through October and beyond (1987 Report, p. 1).

During the eight to ten week incubation period, when the eggs develop into fish, river temperature is critical. U.S. Fish and Wildlife Service (USFWS) and California Department of Fish and Game (CDFG) biologists suggest the eggs and larvae require cold water less than or equal to 56 degrees Fahrenheit (56° F) (1992 Report, app. B). A high rate of mortality occurs at water temperatures above 56° F. During sustained periods of 60 to 61° F river temperatures, an 80 percent mortality rate occurs. Prolonged exposure to temperatures of 62° F and above results in a 100 percent mortality rate. (Order 89-18; 1987 Report, p. ii). In addition, an extremely common disease, *Saprolegnia*, a fungus that attacks and kills eggs, spreads among eggs at a faster rate in higher river temperatures (1992 Report, app. B). Warm river temperatures, along with the 1966 construction of Red Bluff Diversion Dam, have been cited as the most significant factors in the drastic reduction of the salmon population, especially the Winter-run (Co-Operative, p. 2).

2.15.2.1 Shasta Dam releases too warm for young salmon

Prior to the construction of Shasta Dam in 1945 and Keswick Dam in 1950, Winter-run migrated upstream to the very cold McCloud River, where they spawned and their eggs develop into fish. Specific data is sparse as to spawning populations of the Winter-run prior to construction of the dams. However, recent CDFG research indicates the numbers may have been as high as 200,000 fish (Biological Opinion, p. 25).

Shasta and Keswick dams blocked upstream migration of these salmon, preventing Winter-run from reaching their historic spawning grounds in the McCloud. However, operation of the dams altered the river temperature directly below Keswick so that the water temperature was much colder than it would have been without the dams, and was sufficient for Winter-run spawning (Co-Operative, pp. 1-2). In fact, the 1967-1969 average Winter-run population was 84,000 fish (54 Fed. Reg. 32,085). While this figure is much lower than the estimated historic run size of 200,000, it is significantly higher than current run sizes because,
in recent years, water temperature below Keswick Dam has frequently risen to levels damaging to salmon in their early life stages, significantly diminishing the population (Order 89-18, pp. 5, 6, 11).

During the normal water supply years between 1970 and 1986, daily average water temperatures below Keswick Dam exceeded 56° F 40 percent of the time from July to October (when Winter-run eggs are incubating). In critically dry years, daily average temperatures during these months exceeded 56° F 80 percent of the time and exceeded 60° F 60 percent of the time (Order 89-18, p. 5).

Water temperature problems are occurring in the Upper Sacramento because cold water stored in Shasta and other Sacramento River reservoirs is difficult to access, especially when reservoir levels are low. Water in large reservoirs can become thermally stratified. The surface layer of water, warmed by the sun, remains on top and the colder water remains on the bottom without mixing (Order 89-18, p. 6). By late summer or early fall, when the irrigation season comes to an end and much of the stored water has already been released for irrigating crops, the reservoir typically drops to a low level.

Shasta Dam has outlets at 742, 815, 842 and 942 feet above sea level. Only the outlet at 815 feet is connected to the power plant and releases are made only through it. In the early years after Shasta was constructed, a continuous flow of cool water was possible because the reservoir, having a large capacity and subject to relatively low water demands, remained full. Water to be released downstream through the outlet at 815 feet (the power outlet) could be drawn with relative ease from the cooler middle layers of the reservoir. Eventually, however, the demand for water grew; irrigation, municipal and industrial needs increased; and Sacramento River water was called upon to protect the water quality of the Sacramento-San Joaquin Delta, mandated by State Water Resource Control Board Decision D-1485 (CVP-OCAP).

In 1977, when the demands for water had grown significantly and a drought struck California, the water level in Shasta dropped so low that the colder, thermally stratified water could not be accessed. Only the sun-warmed surface level water could be drawn through the 815 foot power outlet. Releases from Shasta were so warm, river temperature became lethal
to the eggs and fry below. The problem has continued, fluctuating in intensity, since that time (Paff).

2.15.2.2 Red Bluff Diversion Dam hinders migration

Another significant factor in the Winter-run decline is Red Bluff Diversion Dam. Red Bluff impedes both upstream adult salmon migration and downstream juvenile migration. While fish ladders were installed on each abutment when the dam was built in 1966, and while a middle gate has been converted to a fish ladder every irrigation season since 1984, the dam is still difficult for adult salmon to ascend. The fish ladders become ineffective at or above a flow level of 6,000 cubic feet per second (cfs). Flood control spills which raise the flow above 6,000 cfs are common during March and April, also the time when numbers of Winter-run attempting to pass Red Bluff Dam are at their highest (CVP-OCAP, p. 64; Smith). As a result, Winter-run adults were delayed or completely blocked during their migration upstream, until the Bureau of Reclamation finally raised the gates during the critical winter months. Delay is harmful because after a salmon leaves salt water its energy reserve of muscle and flesh is limited. If the salmon have to use their limited energy to pass Red Bluff, they are expending energy which would otherwise be later used to spawn, or swim further upstream where the water is colder and more supportive of their eggs. If the salmon are unable to pass the dam, they are forced to spawn below Red Bluff, where the warm water temperature generally kills all offspring. Delay, therefore, reduces the likelihood of successful spawning or survival of the eggs (McKee; Smith).

Juvenile salmon migrating downstream are also impacted by Red Bluff Diversion Dam. Until recently the fish screens within the channel that diverts water to adjacent delivery canals (Tehama-Colusa and Corning) when the gates are down were in poor condition and, as a result, some juveniles would go through the openings in the screen and become trapped in the canals. Juveniles avoiding the canal when the gates are down must still pass under Red Bluff Dam, where the water is extremely turbulent and forceful. When the juveniles come up on the downstream side of the dam they are disoriented and separated from their schools. Forced through a relatively small opening underneath the dam, the juveniles are also concentrated into a smaller area near the bottom of the river rather than safely spread out.
across the river so that predatory squawfish can easily feed on them (McKee; Smith). Five to
21 percent of the juvenile salmon are lost to these predators during passage under the dam
(Biological Opinion, p. 55).

Between the temperature problem below Shasta Dam and the impediments at Red
Bluff Diversion Dam, the Winter-run salmon population shrunk to dangerously low numbers. From 1967 to 1985, Winter-run salmon declined from a 1967-69 mean run size of nearly 84,000 to a 1983-85 mean run size of 2,962, approximately 3.5 percent of the 1967 size. In 1989, the return class of Winter-run was only 400 fish (54 Fed. Reg. 32,085). The preliminary estimate for 1993 was 350 fish, although the 1992 count was 1180 fish (the number of adult salmon returning to the river can vary greatly from one year to the next because the return class is dependent upon how many eggs and juveniles survived from a previous years’ spawn) (McKee).

Winter-run are now listed as threatened under the federal Endangered Species Act, but in June, 1992 the National Marine Fisheries Service (NMFS) proposed reclassification as endangered (57 Fed. Reg. 27,146). The State of California listed the Winter-run salmon as endangered in 1989 (Biological Opinion, p. 24). Under federal law, the Sacramento River segment from Keswick Dam in Shasta County all the way down to the Golden Gate Bridge in San Francisco Bay has been designated as critical habitat for the Winter-run salmon (58 Fed. Reg. 33,212).

2.15.3 Physical and Operational Changes Made or Proposed to be Made

As the population declined, many parties became active in the effort to restore the Winter-run Chinook salmon. The Bureau of Reclamation began to conduct studies and experiment with temperature control devices, such as "shutters," gates and "curtains", all engineering devices that attempted to allow for withdrawal of the lower, colder reservoir water (Paff). In mid-1986 the California Department of Fish and Game (CDFG) and the U.S. Fish and Wildlife Service (USFWS) identified ten actions to benefit the Winter-run salmon and, together with the Bureau, implemented an informal "Ten Point Agreement" (Agreement) in an attempt to mitigate the problem. The Agreement included such steps as restricting fishing and raising the gates at Red Bluff Diversion Dam during Winter-run upstream
migration (1987 Report, p. 5). In 1985, the American Fisheries Society applied to the NMFS to list the Winter Run as an endangered species and, as a result, these two entities became involved in restoration efforts. As mentioned above the NMFS did not list the Winter Run as threatened until later, but they did begin to monitor the Winter-run population (54 Fed. Reg. 32,085).

Extremely dry run-off years in 1987 and 1988 caused the Bureau’s water storage forecasts for those years to approach the low levels experienced in 1977, prompting the Bureau to take further action to protect the fishery (Paff). In 1987, the Bureau increased Spring Creek Powerplant releases in July (part of Trinity River system) while reservoir temperatures in Whiskeytown were still relatively cool and then reduced releases to essentially zero in August when temperatures in Whiskeytown (and therefore releases through Spring Creek Powerplant) are much warmer. The purpose of this operational procedure was to maintain a more constant, cooler temperature release from Keswick Dam. Releasing large amounts of water in July from Spring Creek Powerplant would slightly lower the August release temperature from Shasta Dam because the reservoir level behind Shasta Dam could stay at a higher elevation during July, keeping the reservoir water cooler.

The Whiskeytown temperature curtains were completed in 1993. In 1994, large amounts of water were brought from the Trinity Basin through Whiskeytown from April through the end of August for release through Spring Creek Power Plant. The curtains successfully prevented the cooler water coming into Whiskeytown from mixing with the warmer water already in the reservoir. As a result, cooler releases from the Spring Creek Powerplant could be maintained through October (Read).

Releases from Trinity Dam, upstream of Spring Creek Powerplant in the Trinity River system, were also modified to control the temperature on the Sacramento River. However, alternating releases on the Trinity River in this manner can create enormous problems, not discussed here, with Trinity River recreation interests and with the Hoopa Valley Tribe, which has an interest in protecting the Trinity River fishery. Alternating releases also affects the Bureau’s ability to dilute effluents from Iron Mountain Mine, the nation’s largest Superfund site, which drains into Keswick Reservoir via Spring Creek (Holt).
Although this method of alternating releases lowered the temperature slightly, the temperature was still above desirable levels for the fishery. Therefore, in 1987, the Bureau made a decision to protect the fishery at the expense of power generation, and, using its last resort option, authorized the first power bypass at Shasta Dam (Paff). Water was released from the lower 742 foot outlet in order to reach the cooler water located at the lower levels of the reservoir, bypassing the powerplant connected only to the higher 815 foot outlet. Releases at Shasta continued from the lower outlet between August 24 and September 14, totaling 156,640 AF and sacrificing 54,351,000 kilowatt hours. These 1987 bypasses cost Western Area Power Administration (WAPA), the federal agency that markets CVP power, $870,000 for purchase of replacement power (1987 Report, p. 13).

Power bypasses have occurred every year since the first experiment in 1987 and have increased over time. In 1991, for example, power bypasses were used for an additional mitigation effort: releases were made from Shasta’s 842 and 942 foot level outlets, which are also not connected to the powerplant, in order to purposely release warm water during the early periods of upstream salmon migration. Researchers have observed that sharp increases in temperature cause the salmon to swim further upstream to colder water. Early warm water releases had that affect on the salmon, and, in addition, conserved the colder water for later in the summer when the eggs are incubating and colder temperatures are needed most (CVP-OCAP, p. 42). By 1992, the estimated annual bypass was 997,000 AF or 320 gigawatt hours, and spanned the months of May to October (1992 Report, Table C-2). Fortunately, the wet conditions California is experiencing this year (1993) have greatly reduced the need for power bypasses. As of August 5, 1993 no bypasses had been made for the 1993 water year (Bowling). However, cumulative costs for the power bypasses are extremely high. From August, 1987 through December, 1992, power bypasses from Shasta have totaled one billion KWH, at a 26 million dollar replacement cost to WAPA (Bradley).

Power bypasses were incorporated into a binding 1988 Co-Operative Agreement between the BOR, CDFG, NMFS, and the USFWS for restoration of the Winter-run. The Agreement was prompted by the alarming Winter-run population decline and by a desire to eliminate the need for listing the species as endangered or threatened under the Endangered Species Act.
To access colder water from the Trinity River which is partially diverted to the Sacramento River, power bypasses were also made at Trinity Powerplant. Because Trinity Powerplant’s design allows for lower level withdrawals than Shasta’s design, and because its location is at a higher altitude where water stays colder, bypasses to access this colder water only needed to be made in the driest of years, 1991 and 1992, having a much smaller affect on WAPA (Bowling).

The 1988 Co-Operative Agreement referenced above also required the BOR to raise the dam gates at Red Bluff Diversion Dam. Although the BOR made the same commitment in the earlier Ten Point Agreement, the earlier agreement was informal, and not binding on the parties. As a result, since 1987, the Red Bluff gates have been raised from at least December 1 through April 1 of each year, creating a free flowing river and allowing unimpeded upstream and downstream migration of salmon. Prior to 1987, gates were closed 360 days of the year, except for flood control releases (under the 1993 biological opinion issued in conjunction with Section 7 consultation required by the Endangered Species Act, the time period for the dam gates to be raised was extended to November 1 through May 1, and beginning September 15, 1994, from September 15 through May 14) (Biological Opinion, p. 54; Smith).

Even with the dam gates open, however, some salmon are still prevented from passing Red Bluff. Some Winter-run salmon are continuing to migrate upstream during June, July and possibly even August, when the gates are closed. In 1990, for example, 10 percent of the returning adult population spawned below Red Bluff. Considering that one salmon can produce 3,458 to 3,500 eggs, a 10 percent loss is significant (McKee).

In 1990, pursuant to the Co-Operative Agreement, fish screens at Red Bluff were replaced (Co-Operative Agreement, p. 8). Preliminary estimates indicate the new fish screens are nearly 100 percent effective in catching the juvenile salmon and returning them back to the river through a bypass tunnel. Additionally, two new pumps known as Archimedes Screw Pumps, will be installed at Red Bluff as part of a pilot project to augment diversion capacity and reduce reliance on Red Bluff Diversion Dam (Smith). Standard pumps use high velocity propellers, approximately 1800 to 2000 revolutions per minute (rpm), to push river water into the delivery channels. The new Archimedes pump is a large helical, low velocity pump,
operating at 12 to 15 rpm. It moves water through a cylinder by using a series of screws that move water upwards. Unlike standard pumps, operation of the pump appears not to be harmful to fish.

Originally, the Bureau planned to install these pumps at Red Bluff Diversion Dam on a large scale. Approximately forty pumps were estimated to be required, capable of diverting all needed water directly to the irrigation canals and completely eliminating the need to lower dam gates except for summer recreation purposes (a lake backs up behind Red Bluff Diversion Dam when the gates are down) (Faggard). The plan, however, has been modified to a smaller pilot project, involving the two Archimedes pumps described above and one new high velocity pump, also manufactured to prevent fish kills. Scheduled for completion in the summer of 1994, designs and environmental assessments are underway, and the cost of the project has been fully funded (Smith; Biological Opinion, p. 20). A final decision on the use of pumps, by-passes, or a combination of these is not expected before 1988 (Holt).

2.15.4 Issues Raised By The Changes

The Shasta/Trinity Division of the Central Valley Project serves many diverse purposes. As a result, substantial changes can raise many varied issues. The power bypasses at Shasta and Trinity affect the agencies that deliver or rely on project power. Increasing or alternating releases from Trinity and Spring Creek Powerplant affect interests on the Trinity River system. Withholding water in Shasta to reduce reservoir water temperature puts an added demand on an already overextended water supply and affects irrigators in dry years. Raising the gates at Red Bluff Dam also hinders the Bureau’s ability to serve irrigators and recreation interests.

2.15.4.1 Changes at Shasta Dam raise issues

Releasing water from lower outlets at Shasta Dam, thus bypassing the Shasta Powerplant, raises several issues for project administrators. Power generated at all CVP facilities is applied first to meet the project load (energy required to operate the project) and, second, to meet preference customer needs (CVP-OCAP, pp. 19-20). Preference customers include other federal agencies such as the U.S. Navy and the Department of Energy.
laboratories and local municipalities such as the City of Redding (Bradley). Any excess power is sold commercially, primarily to Pacific Gas & Electric (PG&E). As mentioned, the Western Area Power Administration (WAPA), formed in 1977 under the federal Department of Energy, has responsibility for marketing all CVP power and energy (CVP-OCAP, p. 19).

When the Bureau bypassed power generation at Shasta beginning in 1987, WAPA was unable to produce enough energy to meet its on-going contracts with all preference customers and PG&E with which WAPA has a contract. As a result, WAPA was forced to purchase replacement power to meet these contracts, at the previously mentioned five-year total of $26 million. After the first bypasses, a coalition of power customers, in coordination with WAPA, persuaded Congress to pass Public Law 101-514 which made the bypass replacement power costs non-reimbursable. Although the law was not passed until November 5, 1991, it was applied retroactively. Non-reimbursable costs cannot be passed on to the consumer and must, therefore, be absorbed by taxpayers. Given federal budget problems, WAPA has political concerns that Congress and the public will not tolerate bearing these costs much longer. (Bradley).

Other problems surrounded the 1967 Bureau contract with PG&E, now assumed by WAPA, for the sale, interchange and transmission of electric capacity and energy (CVP-OCAP, p. 19). The contract with PG&E is an integration contract. It allows for exchange of energy under a "banking" arrangement. Over time, the energy needs of the CVP project load and preference customer load exceed the total power produced by the CVP. The deficits are satisfied by purchases of energy and capacity from PG&E. However, on any given day, CVP energy produced may exceed project and preference customer load. The short-term excess energy is sold on the open market, primarily to PG&E (Bradley; CVP-OCAP, p. 20).

One aspect of the contract's "banking" arrangement is a minimum level of kilowatt hours per kilowatt of capacity minimally guaranteed by the contract, generated by CVP facilities and made available to PG&E. The contract specifies these minimum levels, known as "Table 1" levels, for each month of the year, with differing minimums for normal and dry years. If Table 1 minimums are not met, the contract automatically sets in motion a five-year re-determination process of the minimum levels. Since the contract with PG&E is an integrated contract with complex, intertwined provisions, one aspect of the contract affects the
rest. If the Table 1 minimum levels had to be lowered, the overall cost of the contract would have gone up. Lowering Table 1 levels would have increased the cost of purchasing power from PG&E in other aspects of the contract and decreased income paid to WAPA by PG&E for the Table 1 minimum energy levels (Thomas).

Another facet of the PG&E integration contract is the CVP commitment to provide PG&E with capacity. Capacity is the quantified ability to produce energy. PG&E relies on the capacity available from the CVP and guaranteed under contract for emergencies (an emergency does not have to be a major power outage, an emergency state can also exist when the energy reserve margin is not at a comfortable level). WAPA’s ability to provide capacity could also have been affected.

In most water supply years power bypasses made to protect the fishery will have no affect on downstream water users (Diede; Bowling). The outlet level from which water is released does not change the flow level needed by irrigators, and the Bureau is very committed to maintaining delivery service to its water contractors (Diede). However, in 1991 and 1992, when the recent drought was at its worst, the Bureau had to significantly limit water service to irrigators (CVP-OCAP, pp. 108-09). While one of the reasons water service was reduced was to protect the salmon, it was not the primary reason (the water service reduction was enforced partially to keep Shasta’s reservoir level high enough so that remaining water available for release through the 742 foot outlet could be drawn from cold, rather than warm surface level water). The water supply was so low, if reductions to water service contracts were not instituted, carryover storage for the next season would have been inadequate, water supply to meet Delta water quality standards would have been insufficient and many other water needs would have been unmet. Therefore, only a small percentage of the reduced water deliveries could be attributed to fishery protection (Paff; Bowling).

Early in the process of trying to restore the Winter-run population, the Bureau proposed installing a temperature control device (TCD), already in use elsewhere, which could selectively withdrawal water from various levels of the reservoir yet release the water through the power outlet. In an attempt to have the Bureau implement that proposal, the Regional Water Quality Control Board, Central Valley Region (Regional Board) stepped into the
process. The State Water Resources Control Board (State Board) was brought into the process when the Bureau asked the State Board to review the Regional Board’s actions.

Under its statutory authority to regulate water quality, the Regional Board wrote to the Bureau in June, 1987 regarding elevated temperature and turbidity (water clarity) levels in the Sacramento River caused by water discharges from Shasta and Keswick Dams and Spring Creek Powerplant. These elevated levels were in violation of water quality objectives set out in a July 1975 water quality control plan for the Sacramento River Basin. Failure to negotiate mutually acceptable discharge requirements resulted in the Regional Board issuing Order 88-043 (1988) which directed the Bureau to comply with specific temperature and turbidity water discharge requirements, adding also a third requirement for dissolved oxygen levels (the specific temperature requirement was to maintain an average daily temperature of 56° F between Keswick and Red Bluff Diversion Dam) (Order 88-043).

Two years later, pursuant to its review of the Regional Board’s Order, the State Board adopted an order amending the Bureau’s state water right permits for Shasta and Keswick Dams and Spring Creek Powerplant, to include the Regional Board’s temperature requirement (Order 90-5). Although the permit amendments did not include turbidity and dissolved oxygen requirements, they added a requirement that the proposed TCD be installed at Shasta Dam (estimated cost to build a TCD at Shasta at the time was $50 million).

Legal issues regarding whether the State or Regional Board had the authority to regulate releases from Shasta Dam arose. These issues were initially raised by the Bureau during the State Board’s review of the Regional Board’s Order. The Bureau argued that under California v. United States, 438 U.S. 645 (1978), state authority is limited by congressional authorizing legislation, which for the CVP establishes a clear priority in which fish and wildlife purposes are subject to other project purposes, as described earlier in this case study. The Regional Board could not require that power be bypassed (the effective result of mandated temperature objectives) in favor of the protection of salmon; in view of these project priorities, the state’s interference was unlawful (1988 Petition, pp. 15-16).

The Bureau also argued that state authority to regulate federal facilities is limited, under principles of sovereign immunity, to only those circumstances expressly allowed by Congress. While admitting that, under the federal Clean Water Act, Congress gave states
limited authority to regulate federal facilities, the Bureau nevertheless argued that the Regional Board’s order exceeded such authority (1988 Petition, pp. 5-7). Under Section 13 of the Clean Water Act, states can regulate water quality impacts of federal facilities to the extent they result in the discharge of pollutants. The Bureau countered, however, that the waste discharge requirements set by the Regional Board, governing temperature, turbidity and dissolved oxygen, were not pollutants under the Clean Water Act.

As a final issue, the Bureau argued the Regional Board Order 88-043 exceeded the Regional Board’s authority under the California state water quality act (the Porter-Cologne Water Quality Control Act) (1988 Petition). Making similar arguments as were made under the federal Clean Water Act, the BOR claimed that the discharge requirements outlined in the Regional Board Order would not fall under the state law’s definition of waste. A complaint raising these issues was filed with the State Water Resources Control Board, which reviews all regional board actions, but never filed in state or federal court.

As mentioned, however, the State Board disagreed with the Bureau and issued Order 90-5 amending Bureau permits. In response, the Bureau filed a complaint against the State Board in the Eastern District of California. The complaint did not question the State Board’s authority to issue Order 90-5 as raised in the Bureau’s complaint against the Regional Board, but rather asserted that Order 90-5 violated California’s Environmental Quality Act (CEQA) and the California Water Code (U.S. v. SWRCB, p. 3). The State Board had determined their Order amending the Bureau’s permits was exempt from the environmental analysis required under CEQA. The Bureau argued that the Order was not exempt, and additionally that, by violating CEQA’s requirements, they violated the Water Code as well (U.S. v. SWRCB, p. 10).

With both the Regional Board and State Board, the Bureau attempted to negotiate mutually acceptable guidelines for river water quality but, as agreement was not reached, both Boards issued public orders (1988 Petition; Order 90-5). While the orders might be linked to political pressure, they might also be blamed on the Bureau’s past actions (Paff). The Bureau had made significant changes before the water quality issue went to the two water boards, such as the power bypass and raising the gates at Red Bluff. Nevertheless, the Bureau had a difficult time convincing state administrators, and representatives from environmental
organizations present at Board meetings, that it was sincere in its efforts to work for fish protection. In the end, negotiations failed and the California State and Regional Water Boards stepped in and set down orders and compliance schedules (Paff).

2.15.4.2 Changes at Red Bluff Diversion Dam raised issues

Operational changes at Red Bluff Diversion Dam also raised some issues, primarily relating to conflicts with other water users. The Bureau’s voluntary commitment to open dam gates December 1 to April 1, followed by the ESA’s requirement to open the gates November 1 to May 1, affected the Bureau’s ability to deliver irrigation water. Traditionally, irrigators could request deliveries in early spring if required by their crops. When the gates are open there is a limited ability to withdraw water for irrigation use. With the requirement to leave the gates open until May 1, previous operational flexibility was lost, and irrigators had to alter their cropping patterns. In April, 1993 there were actual crop losses (Campbell). However, problems have so far not been disabling because the primary demand for water passing through Red Bluff is still irrigation, and the high demand season generally occurs during the summer months, when the gates can be closed. However, in 1995 and beyond, when the gates must be open from September 15 through May 14 as required by the ESA, significant conflicts will likely arise.

Much controversy did, however, surround the proposal to change Red Bluff Diversion Dam to a full-scale pumping facility. Lake Red Bluff backs up behind Red Bluff Diversion Dam. Installing full-scale pumping facilities would allow the dam gates to be raised at all times, completely draining the lake. Lake Red Bluff has significant recreational value to the local community. It is heavily used for water skiing and drag boat racing. Boat racing has been estimated as generating $500,000 to $1 million in local tourist revenues (Smith). Consequently, local city and county officials strongly opposed the full-scale pumping proposal.

Irrigators raised other issues concerning the Red Bluff pumping proposal. The pumps would be considerably more expensive to operate than the dam. Estimates neared $1 million in energy costs, and local irrigators were concerned that these new costs would be passed on to them. Additionally, the irrigators were generally concerned about changing to a new
irrigation system based completely on pumps, the purpose of which was to protect fish, yet the pumps hadn't been fully tested to prove that the fish would indeed benefit.

2.15.5 How Issues are Resolved or Proposed to be Resolved

The creation of an operational task force, negotiated settlements, and the federal authority which comes with the listing of a species as threatened or endangered under the Endangered Species Act all helped to resolve problems at Shasta Dam. Finding alternative interim water sources and limiting the full-scale pumping project to a smaller scale, acceptable to all involved, has helped solve the immediate problems at Red Bluff Diversion Dam, but a permanent solution is still being sought. It should be emphasized, however, that the immediacy of the need to solve the Winter-run population problem, and an actual desire on the part of all groups involved to solve the problem, permeated the entire process and dramatically contributed to the compromises and solutions (Paff).

2.15.5.1 Shasta Dam

In response to the operational conflicts at Shasta Dam caused by the salmon problems, an annual operations multi-agency task group known as the Sacramento River Temperature Task Group (Task Group) was formed in early 1988. Members of the Task Group included NMFS, USFWS, CDFG, WAPA and the California Department of Water Resources. Meeting for only a short time each year, the Task Group uses water forecasts and other data to develop an annual temperature operational plan for the upcoming year. This plan must be submitted to California's State Water Resources Control Board every year by June 1 (Biological Opinion, p. 18).

Bureau officials took significant steps to involve the Western Area Power Administration (WAPA) in the problem solving process, including membership in the Task Group. WAPA did not legally challenge the power bypasses despite the significant cost of replacement power or the contractual difficulties experienced by WAPA under the PG&E contract. While one reason WAPA refrained from a legal challenge may have been the widespread publicity and support the salmon restoration effort received, Bureau administrators believe it was also a result of involving WAPA in the Task Group (Paff). As a member of
the Task Group, WAPA officials were able to see the necessity of the bypasses and worked with the Task Group to incorporate the bypasses into the annual operational plan. WAPA's involvement also allowed them to better forecast and plan for its power supply and needs (Paff).

Regarding the PG&E contract problem for capacity, the Bureau guaranteed WAPA that even during bypasses, if a power emergency occurred, limited use of Shasta Dam capacity would be available. NMFS, the federal agency monitoring operations under the Endangered Species Act, approved this plan because during an emergency capacity is only needed for two to three hours. NMFS did not believe the release of warmer water from the power outlet for such a short period of time would have an adverse affect on the salmon. Regarding the Table 1 minimum levels, WAPA purchased additional power from suppliers in the Pacific Northwest to guarantee that PG&E contract Table 1 minimum levels would be met. Substituting purchased power for project power is specifically allowed under the contract (The purchase of replacement power is also an unresolved political problem for WAPA) (Thomas). Additionally, WAPA and PG&E were simultaneously undergoing settlement talks, created by completely separate problems, through which a lowering of project dependable capacity, and therefore Table 1 levels, was accomplished anyway.

However, WAPA continues to closely monitor the Bureau's progress toward installation and operation of the Shasta Dam Temperature Control Device (TCD) so that eventually bypasses can be discontinued (Bradley). Upon installation on the inside face of the dam, the TCD will allow Bureau operators to withdraw water from a variety of levels, yet still release the water through the power outlet.

Bureau administrators believe the Task Group helped to forge cooperation from all agencies, not just WAPA, because the short time limit under which the Task Group had to operate and develop a plan encouraged the development of solutions rather than conflict. The Task Group only begins to meet early in the year when forecast data are available, and must develop a plan by June 1 when it is due to the State Board. "The greatest motivator for solving problems was shortness of time." (Paff).

Litigation regarding CEQA requirements between the Bureau and the State Board was resolved through a negotiated settlement. That agreement is embodied in State Water
Resources Control Board Order 91-1, issued in January, 1991. Order 91-1 modifies Order 90-5 in several ways, but most importantly makes the requirements listed in 90-5 temporary, scheduled to expire in 1995-96 (Diede; Paff). With this stipulation, the BOR agreed to move forward without the environmental analysis required by CEQA and dropped the lawsuit. Ultimately, the BOR did prepare an equivalent environmental analysis required by NEPA (Planning Report).

Resolution of the legal conflicts between the BOR and the water boards was also influenced by the introduction of Endangered Species Act (ESA) issues. The process initiated under the federal ESA diminished the importance of the California State Board’s order and limited the Board’s involvement to receiving annual operations reports regarding the proposed yearly plan developed by the Task Force (Paff; Kassel). For example, a 1993 Biological Opinion issued pursuant to Section 7 consultation required under the ESA established temperature objectives for the Upper Sacramento River very similar to, yet preempting, the State Board’s objectives.

2.15.5.2 Red Bluff Diversion Dam
In order to mitigate water losses suffered by irrigators in April when Red Bluff Diversion Dam gates are open, in 1993 the Bureau arranged a one-time agreement or permit to divert water from Black Butte Reservoir, located on Stony Creek, a tributary to the Sacramento River. At a point where the Tehama-Colusa Canal crosses Stony Creek, the Corps of Engineers installed an instream dike in the creek to raise the creek level and allow it to overflow into the canal. The stream overflows into the canal’s emergency spillway, also located at the canal/creek intersection, which was altered to allow the water to flow backwards and into the canal. Water is diverted at a rate of three hundred cubic feet per second (cfs) (Faggard). Unfortunately, the permit was not issued until April 23, 1993, so the remedy, though helpful, came too late to save some crops that year. While the agreement has since been extended, the Bureau is looking into obtaining a long-term permit, but it may be impractical because it would require an environmental assessment, a source point agreement, and installing fish screens which would be very expensive at this particular location.
Temporary pumps with a 125 cfs pumping capacity were also installed to assist with flows to the irrigators.

In response to the public opposition to the proposal to convert Red Bluff Diversion Dam to a full-scale pumping facility, the plan was limited to pilot project size, or three pumps. As the pumps are tested, the scale of the project will be further examined, although the Bureau would like to be able to maintain Lake Red Bluff by closing the dam gates for at least four months during the summer if at all possible (Faggard).

Installation of these three pilot project pumps will also allow more water (270 cfs) to be diverted when the gates are open. This added benefit will help irrigators during the month of April when they have traditionally received enough water to meet crop demand. Between the additional 270 cfs generated by the three new pumps, 125 cfs generated by the temporary pumps, water diverted from Black Butte, and water that is stored in the canals, irrigators believe they will be able to "scrape by" (Campbell). If water from Black Butte is unavailable, however, other options will have to be examined.

2.15.6 Present Status of the Case

As mentioned earlier, the preliminary estimate for the return class of Winter-run in 1993 is a mere 350 fish. Also, until 1993, because of the continued drought, the annual Sacramento River Temperature Task Group was forced to establish a modified or alternate temperature goal than that established by the State Board at Red Bluff Diversion Dam. The alternate goal was 56° F at Cottonwood Creek from April through September, and 60° F during October. Cottonwood Creek is only 26 miles below Keswick Dam, and forty miles above Red Bluff, the point at which the Bureau is supposed to be able to maintain 56° F (1992 Report). Fortunately, 1993 has been a very wet year and the temperature objectives, as well as the river temperatures, have improved (McKee). The 1993 Biological Assessment also now requires that a temperature of 56° F be maintained at Bend Bridge from April through September, and a temperature of 60° F be maintained at the same location for the month of October. Bend Bridge is located 44 miles below Keswick, and approximately 20 miles above Red Bluff Diversion Dam. In very dry water years, the temperature objectives are relaxed slightly (Biological Opinion, p. 53).
The Bureau will continue the power bypasses, as well as various other mitigation efforts not described here, to restore the salmon population. However, all parties involved in the restoration effort are looking forward to the installation of the long-awaited temperature control device, currently estimated to be completed in May 1994 at a revised cost of $80 million. As mentioned, this device will eliminate the need for power bypasses, restoring Shasta's power generation capability.

Although using the temperature control device to better regulate the temperature of Shasta releases is an important step in restoring the Winter-run population, it is only a partial solution. Even the installation of the temperature control device is not, alone, enough to solve the problem; too many other factors contribute to the problem (Diede; Planning Report, Attachment I: letters of comment). The temperature of releases from Lewiston Dam and Whiskeytown Dam, located on the Trinity River also in northern California, and diverted into the Sacramento through Spring Creek Powerplant, also contribute to the problem. Additionally, as already noted, Red Bluff Diversion Dam adds significantly to the diminished number of Winter-run. Tributary accretions, air temperature and other factors can add to the temperature problem, impacting the population. The Bureau has undertaken a comprehensive investigation (Sacramento Basin Fish Habitat Study) of the temperature issues in the Upper Sacramento and Trinity rivers. The study, planned for completion in 1995, will evaluate a full range of management issues, including all potential operational and physical changes throughout the Shasta/Trinity Division.

Also, the Biological Opinion issued in February, 1993 under the ESA establishes operational requirements throughout the Sacramento River system which the Bureau must meet. Aside from both the increased time during which gates at Red Bluff Dam must be raised, and the temperature requirements at Bend Bridge discussed above, the Biological Opinion includes a minimum end-of-water-year carryover storage requirement for Shasta Reservoir of 1.9 million AF, a minimum flow of 3,250 cfs from Keswick Dam from October through March to protect against stranding of juvenile Winter-run salmon, and various requirements for managing the fish in the Sacramento-San Joaquin Delta (Biological Opinion, pp. 51-63). As requirements and improvements from these two documents are implemented,
further complications may arise. The fate of the Winter-run Chinook salmon and other water users in the CVP is still undetermined.
2.15.7 References


Biological Opinion for the Operation of the Federal Central Valley Project and the California State Water Project, Southwest Region, National Marine Fisheries Service (Feb. 12, 1993) (Biological Opinion).


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