

# Arkansas River Water Needs Assessment

Section 2. Introduction

By:

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# Preface

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Each section of the *Arkansas River Water Needs Assessment* contains information that may be useful for a variety of purposes. However, each section is just a part of the overall *Arkansas River Water Needs Assessment* and the information contained therein should not be taken out of context or considered in isolation. Decisions regarding riverflows and reservoir levels should consider the findings of the assessment as a whole, while also recognizing that such decisions are limited by the necessity to supply water for domestic, agricultural, and other uses in the basin consistent with existing water rights held by water users. A summary of the entire assessment can be found in Section 1 of this report.



# Acknowledgments

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**Water Workgroup:** Bill Carey (Bureau of Land Management), John Gierard (formerly Bureau of Reclamation, now Western Area Power Administration), Dan Muller (Bureau of Land Management), Roy Smith (Bureau of Land Management), Steve Swanson (Bureau of Land Management), and Steve Witte (Colorado Division of Water Resources).

**Biological Workgroup:** Clay Bridges (Bureau of Land Management, retired), Mark Elkins (Colorado Division of Wildlife), Dave Gilbert (Bureau of Land Management), Doug Krieger (Colorado Division of Wildlife), Greg Policky (Colorado Division of Wildlife), and Rich Roline (Bureau of Reclamation).

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The assessment team was guided throughout the process by a management advisory group, which was established through a formal memorandum of understanding. The members of this group are recognized for being responsive to the study

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Biology, Hydrology, and Recreation Peer Reviewers: Mark Butler (U.S. Fish and Wildlife Service), Paul Flack (Colorado Division of Parks and Outdoor Recreation), Bill Hagdorn (Bureau of Land Management), Mike Lewis (U.S. Geological Survey), Rich Niemeyer (National Park Service), Scott Schuler (U.S. Forest Service), and Jay Thompson (Bureau of Land Management).

Advisor on Reservoir Operations: Tom Gibbens (Bureau of Reclamation, retired).

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# Section 2. Introduction

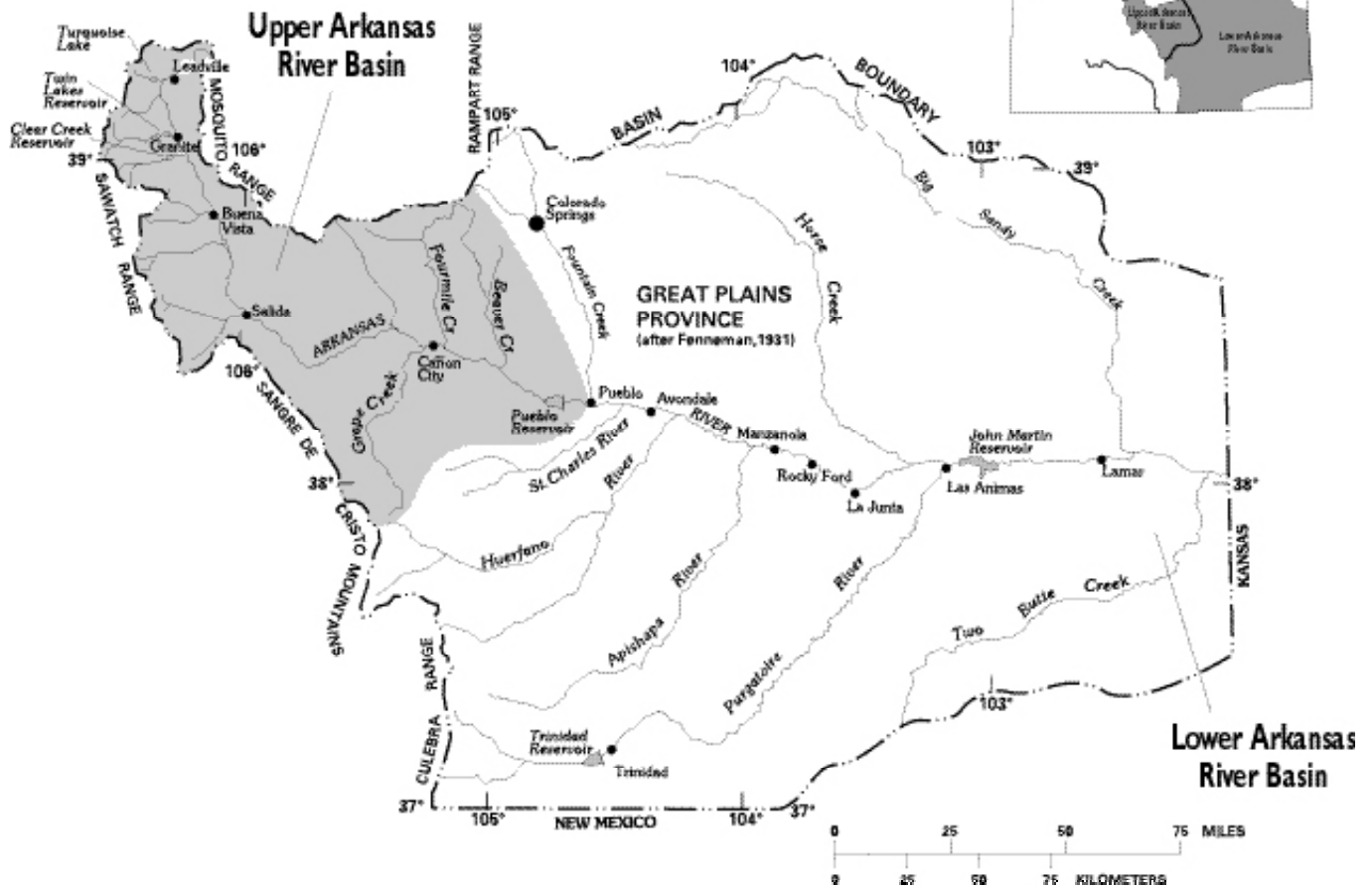
The Upper Arkansas River Basin and its related reservoirs between Leadville and Pueblo are an important hydrological, biological, and recreational resource. Competing demands for water have made it necessary for management agencies to thoroughly understand the effects decisions can have on various resources and to carefully weigh the user preferences, environmental requirements, and legal and administrative constraints associated with decisions that affect water uses, streamflow, and reservoir levels.

## Physical Setting

The Arkansas River is the major drainage system in southeastern Colorado (Figure 2-1). The river flows from its headwaters above 12,500 feet in the Mosquito Mountain Range northeast of Leadville through Pueblo into the Great Plains. Other headwater sources to major tributaries are located in the Sawatch Range near Leadville and Sangre de Cristo Mountains between Salida and Cañon City.

FIGURE 2-1

### Arkansas River Basin



The change in topography over the river's course is dramatic. From a high-altitude, alpine environment above timberline, it flows through steep confined canyons and broad open valleys until reaching the expansive, flatter Great Plains.

The variation in climate is similarly dramatic. High altitude snowfall and subsequent spring runoff in the Mosquito, Sawatch, and Sangre de Cristo Mountain Ranges predominate the river's flow regime. Over 200 inches of snow fall annually in these mountains, with a mean annual daily temperature of 25 °F. However, the Upper Arkansas River Valley, which comprises the central portion of the basin between 7,000-8,000 feet in elevation, provides a relatively mild climate. A mean annual daily temperature of 46 °F, with mean annual snowfall of 44 inches and annual rainfall of 10 inches, make this an ideal location for recreational opportunities along the river corridor. Conditions change once again as the river approaches the Great Plains. The mean annual daily temperature rises to 55 °F and the climate becomes substantially drier.

The river itself is a single-channel, meandering, and moderately entrenched system. It has achieved a stable channel composed of coarse imbedded material generally larger than 0.1 inch in diameter. The sinuosity is moderate, normally falling between 1.2 and 1.5. Generally the river follows a sequence of low- to moderate-gradient stretches punctuated by short, high-gradient drops with the formation of rapids. The channel is typically 60-100 feet in width, with average water depths usually less than 6 feet and pool depths up to 20 feet. The primary channel adjustment mode is lateral migration associated with meandering. However, adjustments in the geomorphological character are minimal due to the multiple structural controls (e.g., dams, highway) within the basin.

In the upper basin, within Lake County, there are three storage reservoirs operated by the Bureau of Reclamation (BOR) as part of the Fryingpan-Arkansas Project: Turquoise and Twin Lakes Reservoirs and Mount Elbert Forebay. The Pueblo Board of Water Works also operates Clear Creek Reservoir on Clear Creek. From the Leadville area,

the Arkansas River flows in a southerly direction through Browns Canyon and turns east as it flows from Salida towards Cañon City. The landscape is rugged as the river flows between narrow canyons and open parks. Below Cañon City, the river enters the eastern plains landscape as it continues its course toward Pueblo Reservoir.

The area included in this assessment comprises the public lands and resources associated with Turquoise, Twin Lakes, and Clear Creek Reservoirs; the main stem of the Arkansas River downstream from those reservoirs to Pueblo Reservoir; and Pueblo Reservoir, for a total of about 150 river miles.

## Purpose

The purpose of this assessment is to provide information about the legal and institutional, hydrological, and biological and recreational resource values that are of significance to the instream flows of the upper Arkansas River. The assessment relates riverflows and reservoir levels in the upper basin to these values. This assessment is the direct result of a memorandum of understanding (MOU) signed in 1992 by those Federal and State agencies responsible for managing resources in the Upper Arkansas River Basin, including the Bureau of Land Management (BLM), Bureau of Reclamation (BOR), USDA Forest Service (FS) and Colorado Department of Natural Resources (CDNR). A copy of the MOU can be found in Appendix A. These agencies have been cooperating and collaborating in the development of annual flow recommendations that help guide BOR's operations of Arkansas River reservoirs. A copy of these recommendations can be found in Appendix B.

The MOU states that the primary objective of the assessment is to provide useful information about resource needs, water use constraints, and management opportunities to planners and decisionmakers. Specific objectives outlined in the MOU are to:

1. Develop an understanding of the hydrology and geomorphology of the river and the reservoir operations that affect the river flows.

2. Develop an understanding of the relationships between streamflows, reservoir levels, and the resource values they affect. The resource values to be considered include: fish and wildlife habitat; fishing recreation; boating recreation; water quality; riparian habitat; and aesthetics.
3. Identify and evaluate the management opportunities and strategies to provide water for maintaining and improving the resource values.
4. Determine the physical, legal, and institutional factors that influence the ability to implement the management opportunities and strategies.

This report is not a decision document. However, it may be used to identify opportunities and to support future management decisions and strategies of appropriate agencies and institutions. Any future management actions supported by this report will require compliance with Federal laws (e.g., National Environmental Policy Act) and State laws.

## Existing Management and Institutional Framework

The legal and administrative framework governing the Arkansas River is extremely complex (refer to Section 3). Each of the agencies that signed the MOU has specific requirements and legal responsibilities for managing the land and water resources in the Upper Arkansas River Basin. Some of the laws, agreements, and plans that affect the management of these resources are described below.

### Colorado Water Law

Interstate compacts, Colorado water law, Federal legislation, and numerous plans and institutional arrangements govern the management of reservoir operations, water allocation, and natural resources in or adjacent to the Arkansas River. The Colorado Division of Water Resources administers allocation of water in accordance with State laws and regulations. The Constitution of the State of

Colorado recognizes the doctrine of prior appropriation as the principal means of allocating the usage of the waters of the State. As a result, the State Engineer regulates numerous agricultural, municipal, industrial, and other water rights. Obligations for water deliveries to water rights holders and to holders of water service contracts largely determine how riverflows are managed.

The Arkansas River includes both native water originating within the basin and water imported from the west slope (Colorado River Basin) into the basin by BOR's Fryingpan-Arkansas Project and several other non-Federal diversion projects. Therefore, two river compacts, the Colorado River Compact and the Arkansas River Compact, affect management of flows in the upper Arkansas River. The operation of the transbasin diversion projects and several reservoirs located in the basin directly affects Arkansas River flows.

It is unlikely that any surface water remains available for appropriation in the Arkansas River Basin at this time. Water management in the Upper Arkansas River Basin is complex and highly regulated under the authority of the State Engineer (CRS 37-92-301 and 501 et seq.). There may be opportunities, however, for maintaining and improving resource values within the existing legal, institutional, and management framework. Arrangements have been negotiated in the past to enhance certain water-dependent resource values (i.e., fisheries and float-boating activities on the Arkansas River). Negotiated agreements for reservoir releases, special-use permit stipulations, river exchanges, reservoir release substitutions, or point-of-diversion transfers are some of the options that may be available to preserve and enhance the various key resource values.

### Fryingpan-Arkansas Project Operating Principles

BOR's Fryingpan-Arkansas Project was authorized by Congress "...for the purposes of supplying water for

irrigation, municipal, domestic, and industrial uses, generating and transmitting hydroelectric power and energy, and controlling floods, and for other useful and beneficial purposes incidental thereto, including recreation and the conservation and development of fish and wildlife” (Act of August 16, 1962, P.L. 87-590, 76 Stat. 389). Users of Project water are located in the Southeastern Colorado Water Conservancy District. Project reservoirs located in the Arkansas River Basin are Turquoise Lake and Twin Lakes Reservoirs near Leadville and Pueblo Reservoir near Pueblo. Recreation facilities and activities at the former two reservoirs are administered by the FS and at the latter reservoir by the Colorado Division of Parks and Outdoor Recreation (CDPOR).

## Arkansas River Recreation Management Plan

Under a cooperative management agreement, BLM and CDPOR have implemented this plan in the Arkansas Headwaters Recreation Area. This plan recognizes the interrelationship of recreation (e.g., boating, fishing) with the fisheries, aquatic habitats and ecosystems, riparian vegetation, and water quality of the Arkansas River. The agencies direct specific actions to maintain the quality of these resources and the opportunities they present. The plan directs recreation management on the main stem from Leadville to Pueblo Reservoir and it directs coordination with the river corridor communities, local governments, land owners, and water users.

## Pike and San Isabel National Forest Plan

This land use plan provides general direction for water resources, including management adjacent to Twin Lakes and Turquoise Reservoirs. Specific management goals are to provide healthy, self-perpetuating plant communities; meet water quality standards; provide habitats for viable populations

for wildlife and fish; and provide stable stream channels and still water-body shorelines. An earlier agreement with BOR states that efforts will be made to maintain specified minimum pool elevations for Turquoise Reservoir; however, Project needs could dictate further lowering (1976 Memorandum of Understanding). This agreement also states that the FS is responsible for administration and management of all recreation activities associated with the water surface of Turquoise Reservoir.

## Lake Pueblo State Park Management Plan

This plan governs the management of the 4,646-surface-acre reservoir and its adjacent lands by CDPOR. The reservoir is part of the Fryingpan-Arkansas Project, operated by BOR. Goals of the State Park Management Plan are to maintain safe water-based recreation activities, a variety of complementary land-based recreation facilities, the quality of the reservoir fishery, and the viability of reservoir-based concessionaires. The park is managed by agreement with BOR.

## Wildlife Management Guidelines for the Upper Arkansas River Basin

The Colorado Division of Wildlife (CDOW), under these guidelines, has set management objectives for the upper Arkansas River, the upper Fryingpan-Arkansas reservoirs, and Pueblo Reservoir. For the main stem, CDOW is to optimize the production of self-reproducing brown trout populations and encourage the development of self-reproducing rainbow trout fisheries. Within the basin, CDOW will maintain healthy populations of bighorn sheep, deer, turkey, and waterfowl, while also protecting and enhancing populations of blue herons, peregrine falcons, and bald eagles. For the upper reservoirs, the objective is to develop and sustain lake trout populations. CDOW’s objective for Pueblo Reservoir is to optimize the production of warmwater fish populations.

## Assessment Approach

This assessment was a 6-year effort involving a team of Federal and State agency professionals. Early phases of the study focused on collecting and reviewing literature and data (scoping), while latter phases dealt with analyzing legal and institutional, hydrologic, and resource values; evaluating water availability and river-reservoir resource management needs; and reporting the results of the effort (Figure 2-2). Each specific step of the assessment process is described below.

### Project Scoping

The scoping process involved a thorough review of literature, discussions with pertinent field personnel and interested parties, and a reconnaissance-level field assessment. Aerial photographs and maps were used to assist with designing specific studies. During this step, interagency cooperative agreements were arranged and specific techniques or methods were selected. This step involved careful coordination between the field personnel of the agencies involved in the MOU and other affected agencies, including offices of the U.S. Geological Survey, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and Colorado Department of Public Health and Environment. The scoping resulted in the MOU, documented summaries of literature reviews, and selected methods.

### Institutional and Legal Analysis

Both existing and prospective water management were described and analyzed to evaluate both the legal and institutional availability of water; this information may be used to implement alternative management actions. Political considerations were also included in the analysis so that decisionmakers can evaluate water management opportunities that are realistic and feasible. This analysis, which is Section 3 of this report, documents water management options for both the river and reservoirs.

## Hydrologic Investigation

The hydrologic investigation included analysis of historic streamflow and reservoir operations data to determine typical and extreme levels of riverflow and reservoir storage contents. This data is relatively abundant in the basin and was analyzed to determine historical trends reflective of water management and use. Reservoir operation and riverflow models were used to simulate various management opportunities. The hydrologic investigation provided the physical resource background for analyzing the water dependency, both river and reservoir, of the resource values identified in the next step. It is Section 4 of this report.

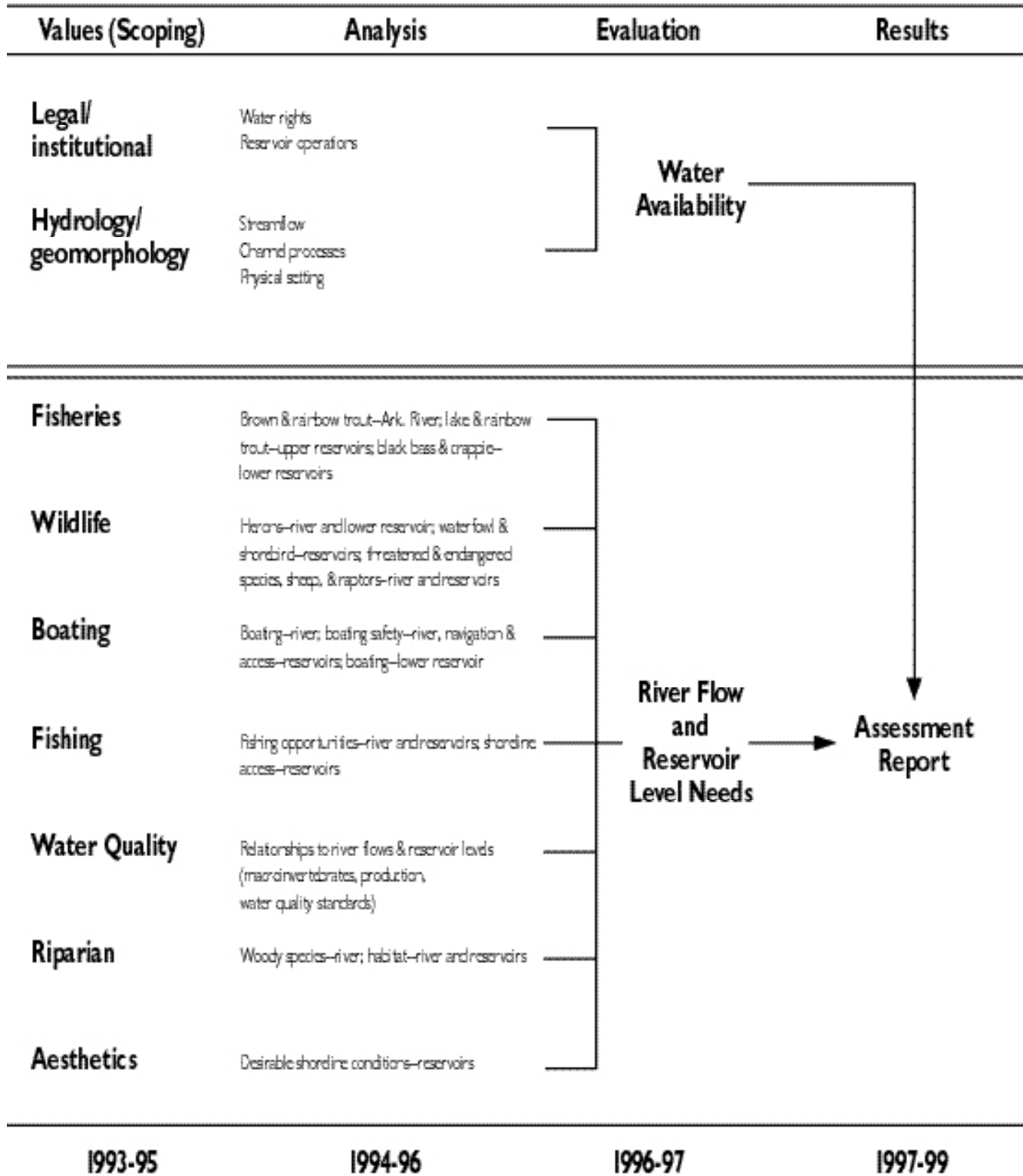
## Resource Values Assessment

Significant resource values were evaluated to determine their dependence on reservoir levels, riverflows, or other water-related conditions. This step involved close interaction among project team members with different types of expertise. Results of the hydrologic investigation, including hydraulic, geomorphic, and chemical analyses, were examined in conjunction with evaluations of resource values to develop resource-specific riverflow and reservoir level needs. This assessment documents the need for water to maintain, as well as enhance, fish and wildlife habitat and recreational pursuits, such as rafting and fishing (i.e., fly fishing, spin casting, and float fishing). For the purpose of this assessment, the term “resource values” incorporates a multitude of objective natural resource related requirements (e.g., species like brown trout require specific river conditions to survive) and subjective user preferences (e.g., activities like rafting and fishing require flows to support user experiences). During this step, data was collected to supplement available literature and other information.

Flow requirements for fish habitat and certain recreation values (e.g., boating depths) were analyzed using the Instream Flow Incremental Methodology (IFIM) developed by the U.S. Fish

FIGURE 2-2

## Arkansas River Water Needs Assessment



and Wildlife Service. Fish habitat modeling was accomplished with the Physical Habitat Simulation System (PHABSIM), the computer modeling component of IFIM. The natural resource assessment is Section 5 of this report.

Recreation user surveys were specifically designed and implemented for the purpose of assessing recreation water needs within the study area; one was oriented towards river recreation, and one was oriented towards reservoir recreation. In addition to these user surveys, several other secondary data sources were reviewed and evaluated. The recreation assessment is Section 6 of this report.

Using this approach, reservoir levels and river-flows were evaluated and identified to support the resource values as shown below:

#### **Fisheries**

- ~ Flow requirements to optimize the brown trout fishery and to develop the rainbow trout fishery in the Arkansas River
- ~ Upper reservoir levels and conditions to sustain and develop lake and rainbow trout populations
- ~ Pueblo Reservoir levels and conditions for black bass and crappie warmwater fish production

#### **Wildlife**

- ~ Flow and Pueblo Reservoir level requirements to maintain habitat for heron populations
- ~ Reservoir levels to maintain waterfowl and shorebird populations
- ~ Flows and reservoir levels to protect bighorn sheep, peregrine falcons, bald eagles, osprey, golden eagles, and other sensitive, threatened, or endangered species and to maintain habitat associated with these animals

#### **Boating**

- ~ Flows for various types of experiences and boats on the river
- ~ Flows for boating safety on the river

- ~ Reservoir levels for navigability and accessibility (e.g., shorelines, docks)
- ~ Pueblo Reservoir levels for various types of craft and experiences
- ~ Reservoir levels for adequate boater access

#### **Fishing**

- ~ Flows and reservoir levels for various types of fishing opportunities
- ~ Reservoir levels for access to shorelines

#### **Water Quality**

- ~ Flows and reservoir operations that may indirectly affect resource values (e.g., macroinvertebrates, primary productivity, water quality standards) by substantially changing water quality (water quality is addressed in Appendix E)

#### **Riparian Habitat**

- ~ Flow requirements to maintain significant areas of riparian woody species
- ~ Pueblo Reservoir levels that may be required to maintain cottonwood trees and other types of woody vegetation

#### **Aesthetics**

- ~ Upper reservoir levels required for desirable shoreline conditions

Additionally, the implications of various flow regimes on these resource values were analyzed using hypothetical scenarios (Appendix F).

## **Findings and Conclusions**

In the final step, the legal and institutional analysis, streamflow and reservoir hydrologic analyses, and resource value assessment were integrated to produce a summary of findings (Section 1 of this report). The findings present water amounts needed to protect or support critical resource values.

