Final Report

Redding Basin Water Resources Management Plan

Phase 2C Report

Prepared for

Redding Area Water Council

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Preface

CH2M HILL, under contract to the Shasta County Water Agency, prepared this report. This report was financed through grants received from California Department of Water Resources (DWR Grant Agreement Nos. 4600001787 and 4600002479).

The Redding Basin Regional Water Resources Management Plan is being conducted in three phases through a cooperative agreement of the Redding Area Water Council (RAWC). Founded in June 1993, and formalized by adoption of a Memorandum of Understanding by the governing boards of directors or city councils of the participants in 1998, RAWC is an organization of local water suppliers. In October 1996, RAWC members funded Phase 1 of the regional planning effort (the development of a regional planning framework), which was completed in September 1997. RAWC members, supplemented by a grant from the McConnell Foundation, also funded Phase 2A, the definition of current and future water needs, which was completed in September 1998. A DWR grant and a grant from the McConnell Foundation financed Phase 2B, the definition of core solution elements, which was completed in September 2001. This report covers Phase 2C, the development and evaluation of regional water resources management alternatives, which was funded by the DWR grants referenced above.

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Acronyms and Abbreviations

ac-ft	acre-foot or acre-feet
ACID	Anderson-Cottonwood Irrigation District
BVWD	Bella Vista Water District
CSA	County Service Area
CSD	Community Services District
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
DWR	California Department of Water Resources
GIS	geographic information system
M&I	municipal and industrial
mgd	million gallons per day
O&M	operations and maintenance
PAC	Policy Advisory Committee
RAWC	Redding Area Water Council
SCWA	Shasta County Water Agency
TAC	Technical Advisory Committee
TAF	thousand acre-feet
Townsend Flat	Townsend Flat Water Ditch Company
USBR	U.S. Bureau of Reclamation
WTP	water treatment plant

SECTION 1
Introduction

Study Area and Study Participants

The study area for this report is the Redding Basin, which is bounded on the north by Shasta Lake, on the south by the southerly boundary of the Anderson-Cottonwood Irrigation District (ACID), on the west by Whiskeytown Lake, and on the east by the Palo Cedro area. This area includes the Cities of Redding, Anderson, and Shasta Lake, the Town of Cottonwood, and surrounding unincorporated areas. The basin has a population of about 150,000 people, encompasses approximately 275,000 acres, and includes the service areas of the water purveyors shown on Figure 1-1.

Current Conditions

Redding Basin water purveyors supply water for a variety of municipal and industrial (M&I), agricultural, and recreational water uses. Various physical, legal, economic, and institutional factors affect the availability and reliability of surface-water and groundwater supplies. These factors affect different purveyors in different ways and to different degrees. Some purveyors have access to multiple supply sources through different surface-water diversions or multiple surface-water or groundwater pumping facilities. The current water sources of the Redding Basin water purveyors are shown on Figure 1-2.

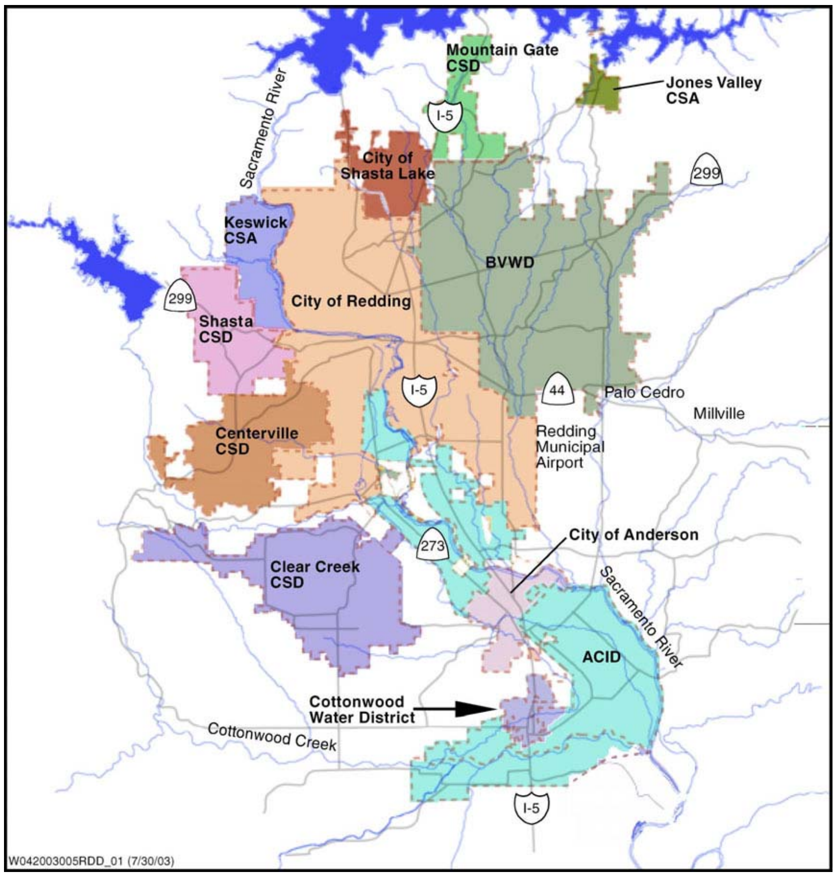

FIGURE 1-1
REDDING BASIN WATER PURVEYORS

Local water purveyors who contract with the U.S. Bureau of Reclamation (USBR) for all or part of their water supply were subject to cutbacks of up to 75 percent of their contract allocations during the drought of the late 1980s and early 1990s. Cutbacks in supply have continued in the ensuing years, even during periods of average precipitation and runoff. Reductions in supply are becoming more common as additional demands are placed on the state's water supply systems. Potential reductions may be even more severe and more frequent as additional demands are placed on the state's water supply systems. Shortages in supply create severe hardships among the local water users.

PURVEYORS	WATER SUPPLY SOURCES			
	Settlement Contract (Pre-1914 Water Right)	Post-1914 Water Right	CVP Water Supply Contract	Groundwater
City of Anderson				●
Anderson-Cottonwood Irrigation District	◒		○	
Bella Vista Water District		○ [a]	◒ [b]	○
Centerville Community Services District[c]			●	
Clear Creek Community Services District			● [b,d]	
Cottonwood Water District				●
Jones Valley County Service Area		◒	◒	
Keswick County Service Area			●	
Mountain Gate Community Services District			◒	◒
City of Redding	◒		◒	◒
City of Shasta Lake			●	
Shasta Community Services District			●	
The McConnell Foundation			● [e]	
Large Industrial				● [f]

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Notes:
[a] Privately held water rights.
[b] CVP contract includes provisions for M&I and agricultural uses.
[c] Centerville has purchased a portion of the Townsend Flat WaterDitch Company's water supplies, which were pre-1914 water rights but are now covered by a CVP water supply contract.
[d] Clear Creek CSD has two wells, but they may only be used for emergencies.
[e] Privately held CVP exchange contract water may be used within existing CVP service areas in Shasta County.
[f] ACID supplies a small portion of industrial demands.

Legend:
● Sole Source
◒ Primary Source
○ Minor Source

FIGURE 1-2
REDDING BASIN WATER PURVEYORS' SOURCES OF SUPPLY

Only three of the Redding Basin purveyors currently supply both surface water and groundwater to their customers. Overall, the Redding Basin is heavily dependent on Central Valley Project (CVP) Water Supply Contracts with the USBR. Nine purveyors rely in whole or in part on CVP contracts for their water supply. Cutbacks in surface-water supply can have negative impacts on purveyors that do not have access to alternative sources.

Current water supplies are inadequate to meet the needs of some purveyors during critical dry-year conditions. Some purveyors' water supplies are adequate to meet current needs, but additional supplies will be needed in the future. Cumulative shortages of 26,500 acre-feet (ac-ft) were experienced as a result of CVP supply cutbacks during 1995 (an average runoff year). Basinwide shortages of about 70,000 ac-ft are anticipated for the cumulative water needs projected for 2030 with critical dry-year cutbacks projected under the terms of the Central Valley Project Improvement Act (CVPIA). Without additional water supplies, the affected purveyors will be subject to more frequent and more severe supply shortages in the future.

Overview of the Planning Process

Phase 1

Phase 1 of the planning process was initiated in September 1996, and was completed in October 1997. Phase 1 documented the current land uses within Shasta County and the Redding Basin, current water supplies, and current and projected land uses and associated water needs through the year 2030. The Phase 1 Report, *Current and Future Water Needs,* documented the results of Phase 1.

Land uses for 1995 were identified from the aerial photographs and geographic information system (GIS) database from the Department of Water Resources (DWR) Northern District office in Red Bluff. Mapping provided by the DWR was reviewed with the water purveyors, and minor adjustments were made to reflect actual land uses for the period of analysis. Projections of future population and land uses were developed from State Department of Finance projected growth rates and the applicable general plans of the local agencies, respectively.

The Phase 1 report documented 55,300 acres of land using water in the basin for the year 1995 (the base year for the report). Land uses were distributed as follows:

- 42.1 percent for agricultural uses
- 41.2 percent for urban uses
- 9.1 percent for recreational and environmental uses
- 7.6 percent for commercial and industrial uses

In 1995, 280,460 ac-ft of water was diverted (surface water and groundwater) to meet these needs. These diversions included those of the basin's water purveyors, major industrial users, private water users in unincorporated areas, and water delivered through the ACID system to irrigators in Tehama County. Approximately two-thirds of the basin's water needs are met by 12 water purveyors.

The estimated population of the Redding Basin in 1995 was 130,225, and this population was projected to grow to 261,275 by 2030. The projected water need for the year 2030 was 342,350 ac-ft, an increase of about 62,000 ac-ft over the total diversions in 1995. The predominant changes in land use projected for the future involve a continuing conversion of non-water-using lands and some agricultural lands to urban, commercial, and industrial uses. Growth in commercial and industrial water use was assumed to increase at about the same rate as basinwide population growth (3 percent per year).

In Phase 1, it was concluded that current water supplies are inadequate to meet the existing water needs of some purveyors during critical dry-year conditions. Some that have adequate supplies now will need new supplies to fully meet the future needs of a growing population. The Phase 1 report indicated that by the year 2030 more than 81,000 ac-ft of supplemental supplies would be needed to meet the total water needs (including industrial groundwater pumping) in the basin during a critical dry year. It is likely that CVP contractors may face more frequent cutbacks than was anticipated then; therefore, the impact of supply shortfalls may be even greater than was originally projected.

The Phase 1 report provided recommendations for potential interim actions to help address the current and projected supply shortfalls. It was also recommended that development and evaluation of alternative concepts for basinwide water management solutions be completed.

Phase 2

Phase 2A

Phase 2 of the planning process was initiated in October 1998. Initial elements of Phase 2 (Phase 2A) included forming committees to guide the study efforts, identifying water supply problems and opportunities for each purveyor, setting preliminary goals, listing environmental and institutional concerns, establishing an approach for developing an integrated groundwater/surface-water model of the Redding Basin, developing a Memorandum of Understanding among the participants, developing a Groundwater Management Plan, and developing a work plan for future activities. A public information component was also developed to inform and obtain input from the affected agencies and the public.

In November 1998, the Redding Area Water Council (RAWC) adopted the Redding Basin Groundwater Management Plan developed in Phase 2A. The agencies that signed the Memorandum of Understanding provided input during the development and review of the plan. The purposes of the plan were as follows:

- Avoid or minimize conditions that adversely affect groundwater availability and quality within the basin.
- Develop a monitoring and data collection program to help protect local beneficial use of the groundwater resources of the Redding Basin.
- Implement the elements of the Groundwater Management Plan by achieving basinwide consensus, whenever possible.

The Groundwater Management Plan was developed because of the vital role that groundwater will play in meeting the basin's water supply needs for the future. The plan is effective within the jurisdictional boundaries of the participating public entities. It includes sections addressing data development, groundwater monitoring, public entity coordination and monitoring, public information and education, export limitations, water quality, wellhead protection, land use, conjunctive use operations, groundwater management facilities, and groundwater overdraft and well interference. The plan is intended to provide a starting point for regional cooperation in managing local groundwater resources. The Groundwater Management Plan will be updated as specific actions are defined under the regional plan.

Phase 2B

Phase 2B was initiated in March 1999. The scope of work for this phase included establishing goals for the Water Resources Management Plan and identifying and screening potential actions to increase the reliability of water supplies within the Redding Basin. It also included the development of an integrated water resources model for the basin. Numerous public outreach activities were also conducted during this phase of the work. Presentations were made to the city council or governing board of each purveyor, three public presentations were made (Shasta Lake, Redding, and Anderson), and presentations were made to several community groups.

The development of the integrated water resources model was a major element of the work in Phase 2B. The model is a useful tool to help evaluate the seasonal and long-term impacts of future water management plans within the basin. Examples of the types of impacts that can be evaluated using the model are changes in groundwater levels and streamflows, and availability of water during droughts.

The model was developed to readily facilitate future updates, as additional information is collected as part of the monitoring program included in the Groundwater Management Plan. The model includes separate land use, water conveyance, surface hydrology, and subsurface hydrology modules.

Land use data for 1969, 1976, 1982, and 1995 were input to a GIS database. The GIS database also includes the boundaries of purveyor service areas, sources of water supply, wastewater service areas, consumptive use factors for each land use, specific geographic units by which to assess groundwater conditions, and surface-water drainage areas. The GIS database is linked to an Access database that is used to compute the monthly water demand for each geographic area of the basin, determine the water supply source that would be used to meet that demand, determine the fate of the delivered water, estimate the groundwater recharge for each model node, compute the water demand for each purveyor, and compute the return flow for each water delivery.

The surface hydrology module is used to account for flow in surface streams and canals on a monthly basis. The surface-water drainage network was divided into different reaches of the major creeks, canals and drains, and the Sacramento River. The water budget for each reach is computed by summing various groundwater inflows and outflows so that reasonable estimates of the linkage between surface water and groundwater can be developed.

The subsurface hydrology module consists of a four-layer groundwater flow model that incorporates information on hydraulic conductivity, aquifer thickness, streambed permeability, and aquifer storativity. This module computes groundwater levels throughout the basin using water budget information developed for the other modules.

Hydrologic information was also developed for years from 1969 through 1995. This provided a representative range of land use and hydrologic conditions by which to calibrate the model to known conditions. The model was successfully calibrated against known historical data.

Phase 2C

Phase 2C included the development and evaluation of preliminary regional water resources management alternatives. Employing various combinations of the actions identified in Phase 2B developed these alternatives. Initial work included the establishment of a Policy Advisory Committee (PAC), which provided input for the development of policy guidelines that were used to develop and evaluate initial conceptual alternatives. The Technical Advisory Committee (TAC), which was developed in Phase 1, also provided input to the study effort; and both the PAC and TAC reviewed draft work products. TAC and PAC reviewed planning assumptions identified in Phase 2B, and adjustments were made as appropriate. These assumptions and policy guidelines provided a framework for developing three conceptual alternatives, which were then presented to the TAC and PAC for discussion.

The three conceptual alternatives embody varying degrees of reliance on surface water and groundwater, plus other potential management actions. At one end of the spectrum, the use of surface-water supplies available through CVP water supply contracts and Sacramento River Settlement Contracts would be maximized. At the other end of the spectrum, a significant shift to greater reliance on groundwater would occur. Between these two boundary conditions, an alternative was developed to provide balanced use of both surface water and groundwater. This set of conceptual alternatives provided a starting place for further analysis and refinement of these basic strategies. Model runs were then performed to evaluate the physical impacts of these alternatives on groundwater levels and flows in surface streams. The model runs provided an initial assessment of the impacts of each alternative on the basinwide water budget. Refinements were then made to the alternative involving balanced use of surface water and groundwater and additional model runs were performed. All of these results were presented to the TAC and PAC.

Phase 3

Phase 3 will include preparation of environmental documentation leading to selection of a preferred basinwide alternative and initial tasks to support implementation of the long-term plan. The implementation plan will include a recommendation concerning the institutional framework and a methodology to allocate costs and benefits to the participants.

SECTION 2

Planning Assumptions

Planning assumptions developed during Phase 2B guided development of a preliminary list of actions for regional water resources management. Since completion of Phase 2B, proposals developed for CVP contract renewals have been refined, and other events continue to occur that could affect the validity or reliability of Phase 2B assumptions.

The following three categories of planning assumptions were addressed in Phase 2B:

- Available water supplies, transfers, and wheeling
- Water supply needs
- Water supply reliability targets

The alternatives must be flexible to account for change in these planning assumptions and other uncertainties such as population growth rates, changes in water use, CVP contract terms, costs, regulatory requirements, and other potential requirements for transfers. These uncertainties will affect each of the assumptions that are used to develop specific actions and alternatives for the Basinwide Water Resources Management Plan. The adopted plan will need to be updated as changes in the planning assumptions occur.

Planning Assumptions from Phase 2B

Planning assumptions that were developed and adopted during Phase 2B follow.

Available Water Supply, Transfers, and Wheeling

- CVP water supply contract dry-year allocation reduction (percent cutback) and frequency were projected per the CVPIA Programmatic Environmental Impact Report.

- CVP water supply contracts will be renewed at the same ***quantity*** as current contracts, for each purveyor. It was assumed that the contracts would be written to allow transfers of contract supplies between in-basin contractors without restriction, assuming contractors would be subject only to the terms and conditions set by the parties involved in the transfer. Price and other terms are uncertain.

- All pre-1914 water rights supplies will be maintained at existing Settlement Contract quantities. Sacramento River Settlement Contracts supply quantities will be reduced by a maximum of 25 percent during critically dry years. Renewal terms on Sacramento River Settlement Contracts will allow transfers within the Redding Basin, without restriction as to place of use or type of use. Time of use will be in accordance with Settlement Contract terms.

- Basin groundwater supplies, within the identified high-yield areas of the basin, will not be significantly diminished and will at least remain steady at current pumping levels. New groundwater development of up to 40,000 ac-ft per year is assumed possible, with higher yield subject to analysis of local impacts through modeling and subsequent monitoring. Groundwater levels may fluctuate seasonally under these pumping rates, but the yield will remain steady.

- All existing facilities (public and private) will be available for wheeling of water, restricted only by physical capacity limits and the terms agreed upon by the parties to the wheeling agreement.
- Use of reclaimed wastewater will not impact existing or future water contract quantities, provided that the wastewater is diverted for use prior to discharge back into the Sacramento River.

Water Supply Needs

- Supply needs considered for each purveyor are ***average annual needs***, with no adjustment (increase or decrease) for critical dry-year conditions. Future water needs are estimated using the methodology presented in the Phase 1 Report, including current water conservation measures.

Water Supply Reliability Targets

- Future supply and management alternatives will provide at least 90 percent of the average annual M&I demand and 75 percent of the average annual agricultural demands for each purveyor, under a 1- in 10-year supply cutback (critical dry year) condition.
- During critical dry years, the remaining 10 percent of M&I needs will be addressed through additional demand reduction actions such as voluntary conservation and tiered pricing. The remaining 25 percent reduction in agricultural needs will be achieved through crop changes, fallowing, or other demand reduction methods. The specific actions to achieve these demand reductions will be selected and implemented by each purveyor, in accordance with their individual supply and demand factors and management policies.

  These level-of-service reliability targets serve as initial planning targets. If the targets cannot be met without unreasonable costs or impacts, then specific management choices will be made by each purveyor to implement additional conservation measures, select a lower acceptable level of reliability, and/or plan for the related supply shortage impacts accordingly.

Addressing Uncertainties Over the Planning Period

Anticipating and responding to future needs is a significant challenge for public utilities, and California water utilities in particular. Statewide water shortages, reallocation of available water supplies for environmental restoration programs, renegotiation of CVP water supply contracts, changes in land and water uses, technology advancements in water use efficiency, increasing costs for water supplies and for treatment and distribution of those supplies, and various public policy changes will all affect the validity of today's plans for the future. Historically, water utilities have focused heavily on technical issues and costs in planning to meet future customer water demands. Increasing the water supply often involved adding a pump or well to provide more water to consumers, and decisions were made largely through traditional engineering cost-benefit analyses. This process was appropriate when resources were readily available, planning issues were more straightforward, and planning involved a relatively short planning horizon. However, these types of planning processes provided little flexibility to respond to changes in planning assumptions; evolving resource management policies by local, state, and federal agencies; and other socioeconomic conditions.

Recognizing that uncertainties are inherent in long-range planning for a reliable water supply in California, water supply plans must have the flexibility to accommodate changes in future conditions. Examples of the types of changes in the planning assumptions that will need to be accommodated by the alternatives follow:

- If population growth occurs more slowly or more rapidly than assumed in the long-term water needs projections, then provisions will need to be made to accommodate these changes. This is particularly important in the smaller districts, where development of a large subdivision or development of a large industrial water user could have a significant impact on water needs of that district. In other instances, if population growth occurs more slowly than assumed, securing supplemental water supplies and development of infrastructure necessary to deliver those supplies could be deferred to avoid unnecessary capital improvements and other costs.
- Changes in land and water use patterns could impact the water needs projections, similar to population growth.
- The terms of the CVP contracts and development of additional water sources by state and federal agencies could change the amount of water available to Redding Basin purveyors, or it could increase the reliability of current supplies in dry years by addition of long-term carryover storage.
- The cost of various water supplies could change dramatically in the future. These changes could be a function of the cost charged to the water purveyor by the wholesale supplier, the cost of treating and distributing the water, and other factors. As these economic variables change, one source of water may become prohibitively costly relative to other choices that may be available. Insofar as possible, the plan needs to provide the flexibility for the water purveyors to change the ratios of the various water supply sources or engage other options to provide economical and affordable supplies to customers.

To address these possible scenarios, the plan will need to be flexible, and updates will need to occur as changes in critical planning assumptions evolve. The plan updating process will help ensure that each purveyor's capital improvement plan and water supply actions are based on current conditions and planning parameters.

SECTION 3

Development and Evaluation of Conceptual Alternatives

As shown on Figure 3-1, an iterative process was used to develop, evaluate, and compare alternative concepts for improving water supply reliability in the Redding Basin. The process began with the development of three concept-level alternatives to achieve overall water supply reliability goals. For this study, the three alternatives embody varying degrees of reliance on surface water and groundwater, plus other potential management actions. At one end of the spectrum, the use of the surface-water supplies available through CVP water supply contracts and Sacramento River Settlement Contracts would be maximized. At the other end of the spectrum, a significant shift to greater reliance on groundwater would occur. Between these two boundary conditions, an alternative was developed to provide balanced use of both resources. This process provided a starting point for further analysis and refinement of these basic concepts.

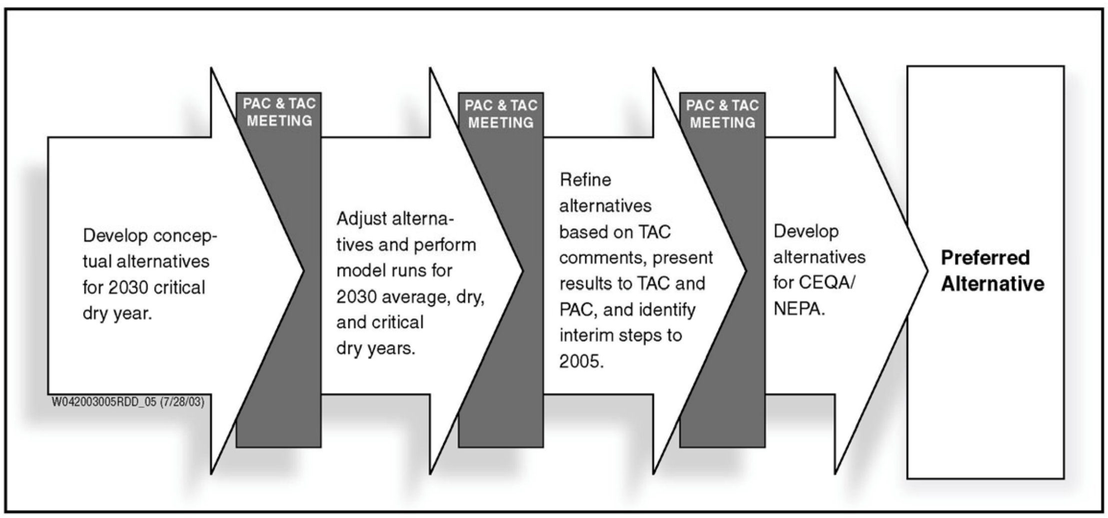


FIGURE 3-1
PLANNING PROCESS

As determined in Phase 2B of this planning effort, a solution is needed that optimizes the use of groundwater and surface water to improve water supply reliability in critical dry years. Surface water will become increasingly costly and less reliable over the planning period, and in some cases, it may be prohibitively costly to transfer it from areas where it is available to areas where it is needed. Large quantities of groundwater are available, but it may be prohibitively costly to transport it to areas where it is needed, and the impacts of pumping large amounts of groundwater will be of concern to current groundwater pumpers. These factors were considered in efforts to develop an optimum solution.

Conceptual alternatives were initially developed for critical dry-year conditions in the year 2030. After receiving comments from the PAC and TAC, these conceptual alternatives were refined and the physical impacts of those alternatives were evaluated using the integrated groundwater/surface-water model. The results of these analyses were presented to the PAC and TAC for further discussion. Interim actions, consistent with the refined alternatives for the worst-case conditions in 2030, were then identified and described for each purveyor. The intent was to provide a menu of activities that each purveyor can select from prior to renegotiations of CVP water supply contracts, and to address uncertainties in the intervening years between now and 2030. Further studies may be required to examine other potential management actions that may provide additional flexibility and reduce costs for each purveyor. Through these interim actions and periodic assessment of events that may affect the planning assumptions, the purveyors will have greater flexibility to respond to uncertainty over the planning period.

Surface-water transfers are included in all three conceptual alternatives. Currently, two principal sources for future significant surface-water transfers exist in the Redding Basin: ACID and the McConnell Foundation. ACID has a Sacramento River Settlement Contract, which includes 165,000 ac-ft of Base Water (pre-1914 water rights) and 10,000 ac-ft of Project Water. Both of these components of ACID’s water supply are subject to cutbacks of 25 percent in critically dry years. The McConnell Foundation has secured a CVP water supply contract for 5,100 ac-ft as part of the liquidation of the Townsend Flat Water Ditch Company’s (Townsend Flat) pre-1914 water rights holdings on Clear Creek. Centerville Community Services District (CSD) also secured 900 ac-ft of additional CVP supplies as a part of this transaction. These quantities of supply are not subject to cutbacks in critically dry years, and the water may be transferred to any other purveyor in the Redding Basin without limitation or imposition of administrative costs or carriage water requirements by the USBR.

It is important to consider the specific opportunities and limitations associated with these two sources of potential surface-water transfers. It is important to preserve beneficial use of ACID’s water supply as irrigated lands are converted to M&I use. The McConnell Foundation’s contract does not carry some of the same requirements for transfers that ACID may be subject to, but the supply available from the McConnell Foundation contract is fixed and is much smaller than the potential supply from ACID. Also, McConnell Foundation has indicated that it will contract with Redding Basin purveyors on an annual, as-needed basis, whereas ACID has indicated its willingness to execute long-term transfers. Because much of ACID’s service area overlies the high-yielding areas of the Redding Groundwater Basin, the opportunity exists to effect water transfers by pumping groundwater into the canal, thereby making the undiverted surface water available to other users in the basin. ACID may also have the opportunity to reduce system conveyance losses in the unlined portions of its canals and conserve water through automation of its system. The water conserved through these actions could be transferred to other purveyors in the basin.

Other purveyors may also have the ability to transfer a portion of their surface-water supplies. If they can capitalize on other sources of supply or they have a portion of their contract allocation that is currently unused, they may be able to make their CVP contract supplies available for use elsewhere in the basin. However, the need for supplemental supplies is greatest during critically dry years, when CVP contract supplies are cut back and surpluses are generally not available.

To best capitalize on the opportunities for surface-water transfers, it will be necessary to balance economic factors with the need to preserve beneficial use of ACID's water supplies. These factors were considered as the conceptual alternatives were refined.

Once the refined conceptual alternatives were more fully developed, the input of the TAC and PAC was solicited, and each alternative was adjusted and model runs were performed to assess the physical impacts. The results of the model runs were presented to the TAC and PAC, and further refinements were made and additional evaluations performed, along with additional model runs. The implications of each alternative on each purveyor's infrastructure and cost impacts of new sources of supply were evaluated at this stage of the planning process.

Conceptual Alternatives

Following are descriptions of the three concept-level alternatives that were evaluated early in the process described above. In the descriptions, the quantities of water are associated only with the historical use and future needs of the water purveyors. Historical use and future needs for large industrial groundwater pumpers and unincorporated areas of the basin are not included. These needs will be considered in the model runs to be performed to evaluate the relative impacts of the three alternatives on groundwater levels and the basin water budget.

Alternative 1 – Primary Reliance on Surface Water

- Year 2030 Target Reliable Supply (with cutbacks and reliability targets), 175,000 ac-ft
- Total Groundwater Production, 39,900 ac-ft
- Total Surface-water Production, Including Transfers, 135,100 ac-ft

This alternative relies primarily on surface water, with modest increases in groundwater pumping to accommodate growth or to help accommodate transfers of surface water. A total of 38,400 ac-ft of surface water would be transferred from the CVP water supply contracts or Sacramento River Settlement Contracts held by Redding Basin purveyors. This alternative involves relatively high institutional complexity, but capital costs for new facilities would be small relative to other alternatives. Table 3-1 shows a water balance for this alternative and Figure 3-2 shows how water would be transferred or conveyed throughout the basin.

Facilities – This alternative requires few changes to current surface-water conveyance systems. Most of the surface water that is transferred would be conveyed through existing distribution mains. The existing distribution networks would be extended to accommodate growth in currently undeveloped areas. Additional groundwater pumping would require new wells and associated distribution pipelines. New surface-water treatment facilities or

TABLE 3-1

Year 2030 Water Balance for Alternative 1 – Primary Reliance on Surface Water (Critical Dry Year)

Redding Basin Water Resources Management Plan

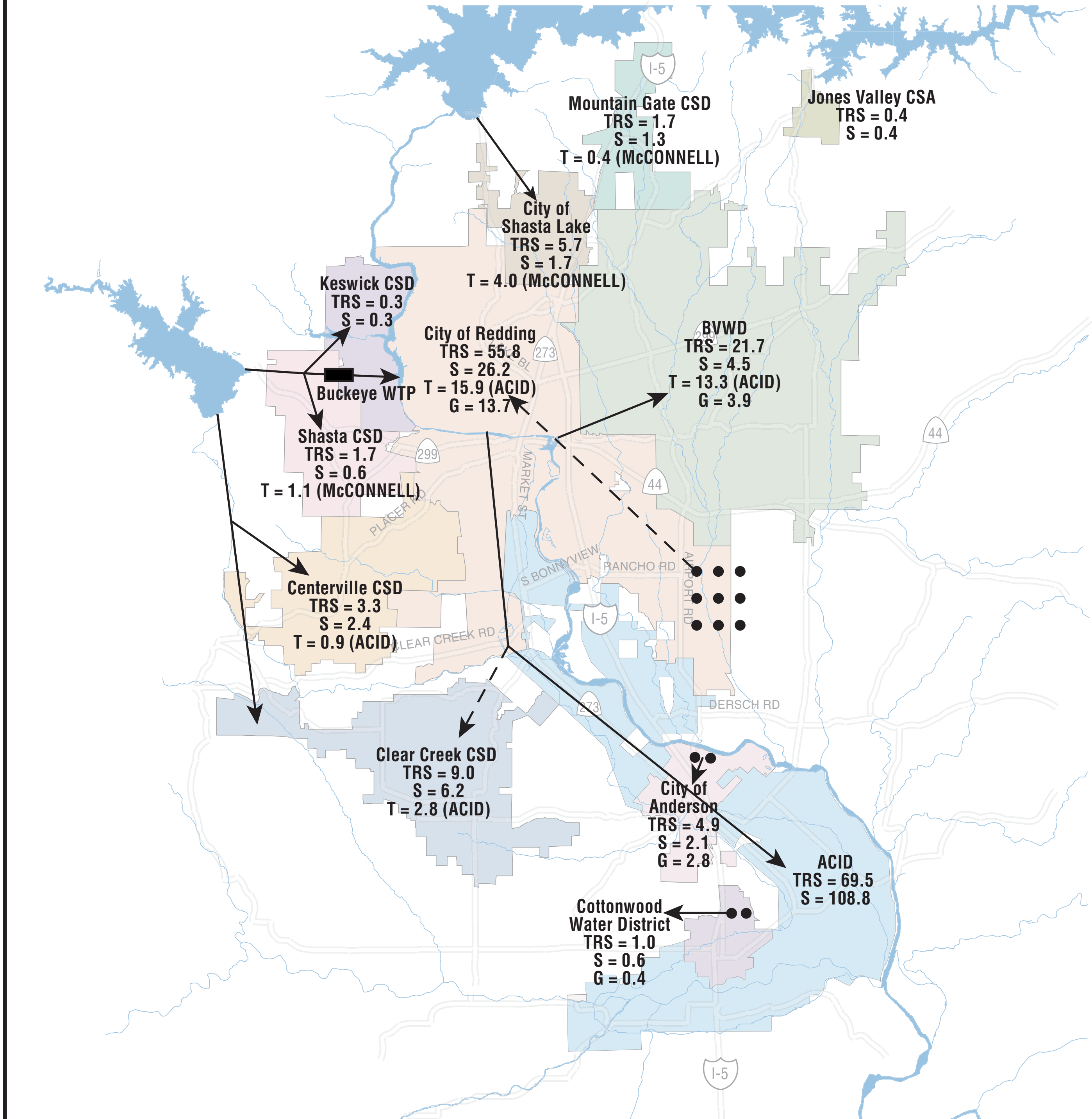
Purveyor	Target Reliable Supply (TAF)	Existing Surface-water Supply (TAF)	1995 Groundwater Pumping (TAF)	Deficit (TAF)	Surplus (TAF)	Additional Surface-water Transfers: Quantity (TAF)	Additional Surface-water Transfers: Transferred To	Additional Surface-water Transfers: Transferred From	Additional Groundwater Pumping (TAF)	Descriptions
City of Anderson	4.9	0.0	2.1	2.8		0.0			2.8	Increase existing groundwater pumping
ACID	69.5	108.8	0.0		39.3	0.0			0.0	No transfers or groundwater pumping
BVWD	21.7	4.5	3.9	13.3		13.3	BVWD	ACID	0.0	Transfer from ACID surface-water surplus
Centerville CSD	3.3	2.4	0.0	0.9		0.9	Centerville CSD	ACID	0.0	No transfers or groundwater pumping
Clear Creek CSD	9.0	6.2	0.0	2.8		2.8	Clear Creek CSD	ACID	0.0	Exchange of ACID surface water for Trinity water in Whiskeytown Lake
Cottonwood Water District	1.0	0.0	0.6	0.4		0.0			0.4	Increase existing groundwater pumping
Jones Valley CSA	0.4	0.4	0.0			0.0			0.0	No transfers or groundwater pumping
Keswick CSA	0.3	0.3	0.0			0.0			0.0	No transfers or groundwater pumping
Mountain Gate CSD	1.7	0.7	0.6	0.4		0.4	Mountain Gate CSD	McConnell Foundation	0.0	Transfer from McConnell Foundation contract water
City of Redding	55.8	19.4	6.8	29.6		15.9	Redding	ACID	13.7	Transfer from ACID with additional groundwater development
City of Shasta Lake	5.7	1.7	0.0	4.0		4.0	Shasta Lake	McConnell Foundation	0.0	Transfer from McConnell Foundation contract water
Shasta CSD	1.7	0.6	0.0	1.1		1.1	Shasta CSD	McConnell Foundation	0.0	Transfer from Centerville CSD surface-water surplus
McConnell Foundation	0.0	5.1	0.0		5.1	0.0			0.0	
Totals	**175.0**	**150.1**	**14.0**	**55.3**	**44.4**	**38.4**			**16.9**	

Notes:

TAF = thousand ac-ft

BVWD = Bella Vista Water District

CSA = County Service Area



LEGEND

- ● GROUNDWATER WELLS
- ← EXISTING CONVEYANCE
- ← – – NEW CONVEYANCE
- TRS TARGET RELIABLE SUPPLY
- S SURFACE SUPPLY
- T TRANSFER
- G GROUNDWATER SUPPLY

FIGURE 3-2
ALTERNATIVE 1
PRIMARY RELIANCE ON SURFACE WATER

2030 CRITICALLY DRY YEAR
REDDING BASIN WATER RESOURCES MANAGEMENT PLAN

W042003005RDD_97 (8/5/03)

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expansion of existing treatment facilities could be required to meet demands or changes in treatment requirements throughout the planning period.

Groundwater – This alternative requires 17,400 ac-ft of additional groundwater pumping above the purveyors’ 1995 pumping levels. Preliminary runs of the integrated groundwater/surface-water model developed in Phase 2B indicate that with adequate well spacing and other provisions, this amount of additional pumping would have minimal temporary impacts on groundwater levels. A recharge program would not be necessary, although local effects would be considered in locations near the new wells.

Institutional Complexity – This alternative involves six intrabasin surface-water transfers. The transferer may be levied costs to administer the transfer and may be required to pay the USBR for the transferred water. Costs may also be levied for foregone power if the point of diversion is transferred from downstream of a power generation facility to upstream. This alternative also includes exchanges between points of diversion on the Sacramento River and the Trinity River system. These exchanges may be more difficult to implement because of the proposed reduction of imported water from the Trinity River.

Protection of Water Rights – This alternative would protect existing water rights and contract allocations by making maximum beneficial use of surface-water supplies within the basin.

Reliability – Future changes in surface-water contract allocations and water rights could significantly reduce the reliability of water supplies under this alternative.

Costs – While less than the other alternatives, the new groundwater conveyance facilities would have significant capital and operating costs. Surface-water costs depend on the cost of water transfers and/or requirements for new conveyance facilities. Changes in the point of diversion between the Trinity and Sacramento Rivers may also increase the cost of water.

Public Acceptance – This alternative involves small amounts of additional groundwater pumping, which would lessen concerns about seasonal aquifer drawdown among private groundwater pumpers.

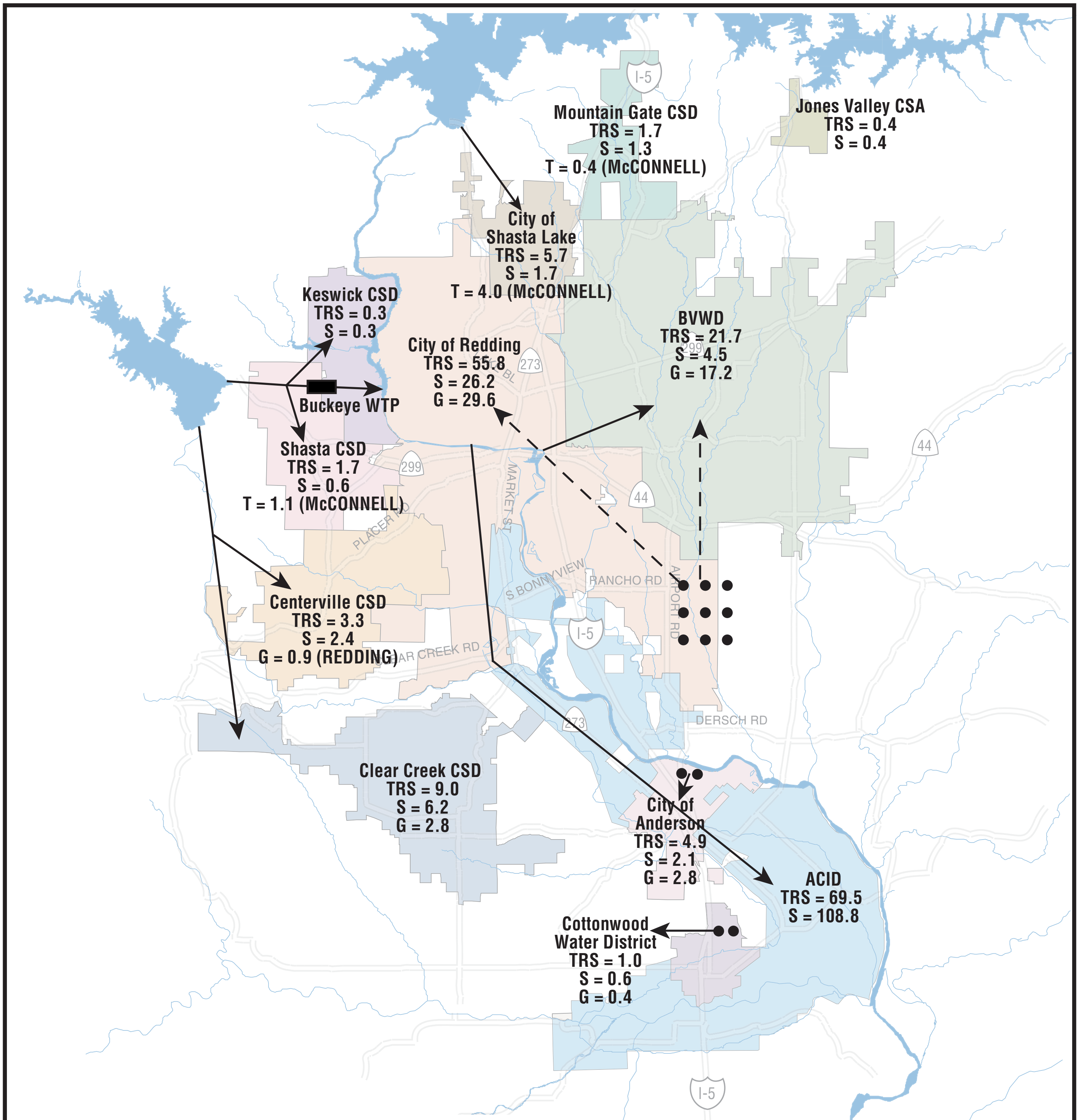
Alternative 2 – Primary Reliance on Groundwater

- Year 2030 Target Reliable Supply (with cutbacks and reliability targets), 175,000 ac-ft
- Total Groundwater Production, 63,800 ac-ft
- Total Surface-water Production, Including Transfers, 111,200 ac-ft

This alternative relies primarily on groundwater development. Surface-water transfers would be used to address future demands in areas where groundwater pumping is not feasible. A total of 5,500 ac-ft of water would be transferred from the entitlements associated with existing CVP water supply contracts or Sacramento River Settlement Contracts held by Redding Basin purveyors. This alternative involves relatively low institutional complexity, but capital costs for new wells and conveyance facilities would be relatively large. Table 3-2 shows a water balance for this alternative, and Figure 3-3 shows how water would be transferred or conveyed throughout the basin.

TABLE 3-2
Year 2030 Water Balance for Alternative 2 – Primary Reliance on Groundwater (Critical Dry Year)
Redding Basin Water Resources Management Plan

Purveyor	Target Reliable Supply (TAF)	Existing Surface-water Supply (TAF)	1995 Groundwater Pumping (TAF)	Deficit (TAF)	Surplus (TAF)	Additional Surface-water Transfers: Quantity (TAF)	Additional Surface-water Transfers: Transferred To	Additional Surface-water Transfers: Transferred From	Additional Groundwater Pumping (TAF)	Descriptions
City of Anderson	4.9	0.0	2.1	2.8		0.0			2.8	Increase existing groundwater pumping
ACID	69.5	108.8	0.0		39.3	0.0			0.0	No transfers or groundwater pumping
BVWD	21.7	4.5	3.9	13.3		0.0			13.3	Develop groundwater wells
Centerville CSD	3.3	2.4	0.0	0.9		0.0			0.9	Groundwater supplied through exchange from City of Redding
Clear Creek CSD	9.0	6.2	0.0	2.8		0.0			2.8	Develop groundwater wells
Cottonwood Water District	1.0	0.0	0.6	0.4		0.0			0.4	Increase existing groundwater pumping
Jones Valley CSA	0.4	0.4	0.0			0.0			0.0	No transfers or groundwater pumping
Keswick CSA	0.3	0.3	0.0			0.0			0.0	No transfers or groundwater pumping
Mountain Gate CSD	1.7	0.7	0.6	0.4		0.4	Mountain Gate CSD	McConnell Foundation	0.0	Transfer from McConnell Foundation Contract Supply
City of Redding	55.8	19.4	6.8	29.6		0.0			29.6	Increase existing groundwater pumping
City of Shasta Lake	5.7	1.7	0.0	4.0		4.0	Shasta Lake	McConnell Foundation	0.0	Transfer from McConnell Foundation Contract Supply
Shasta CSD	1.7	0.6	0.0	1.1		1.1	Shasta CSD	McConnell Foundation	0.0	Transfer from Centerville CSD Contract Supply
McConnell Foundation	0.0	5.1	0.0		5.1	0.0			0.0	
Totals	**175.0**	**150.1**	**14.0**	**55.3**	**44.4**	**5.5**			**49.8**	



LEGEND

- ● GROUNDWATER WELLS
- ← EXISTING CONVEYANCE
- ← – NEW CONVEYANCE
- TRS TARGET RELIABLE SUPPLY
- S SURFACE SUPPLY
- T TRANSFER
- G GROUNDWATER SUPPLY

FIGURE 3-3
ALTERNATIVE 2
PRIMARY RELIANCE ON GROUNDWATER

2030 CRITICALLY DRY YEAR
REDDING BASIN WATER RESOURCES MANAGEMENT PLAN

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Facilities – This alternative requires new wellfields and conveyance pipelines to develop additional groundwater supplies. Transferred surface water would be conveyed through existing facilities.

Groundwater – This alternative would involve 50,300 ac-ft of additional groundwater pumping above the purveyors' 1995 groundwater pumping levels. Preliminary runs of the integrated groundwater/surface-water model developed in Phase 2B indicates that this amount of groundwater pumping would have manageable impacts on basin water levels. Each groundwater development would need to be evaluated to determine the extent of local impacts. This alternative also involves the staged development of the groundwater supplies along Cottonwood Creek.

Institutional Complexity – This alternative involves less institutional complexity than alternatives requiring more extensive surface-water transfers. Three surface-water transfers are required for this alternative, but the amount of water being transferred is small compared to the total water deficit. Costs may be levied for foregone power if the point of diversion is transferred from downstream of a power generation facility to upstream.

Protection of Water Rights – This alternative does not focus on solidifying beneficial use of existing surface-water supplies (CVP and Settlement Contracts).

Reliability – The groundwater alternative provides a highly reliable supplemental supply source. However, there are uncertainties involving the reliability of supply through surface-water transfers.

Costs – The new groundwater conveyance facilities would have significant capital and operating costs. The cost of water transfers and/or new conveyance facilities would drive surface-water costs.

Public Acceptance – This alternative would raise public concerns about impacts on existing private groundwater wells along Cottonwood Creek and within the aquifers near the Redding Airport.

Alternative 3 – Balanced Reliance on Groundwater and Surface Water

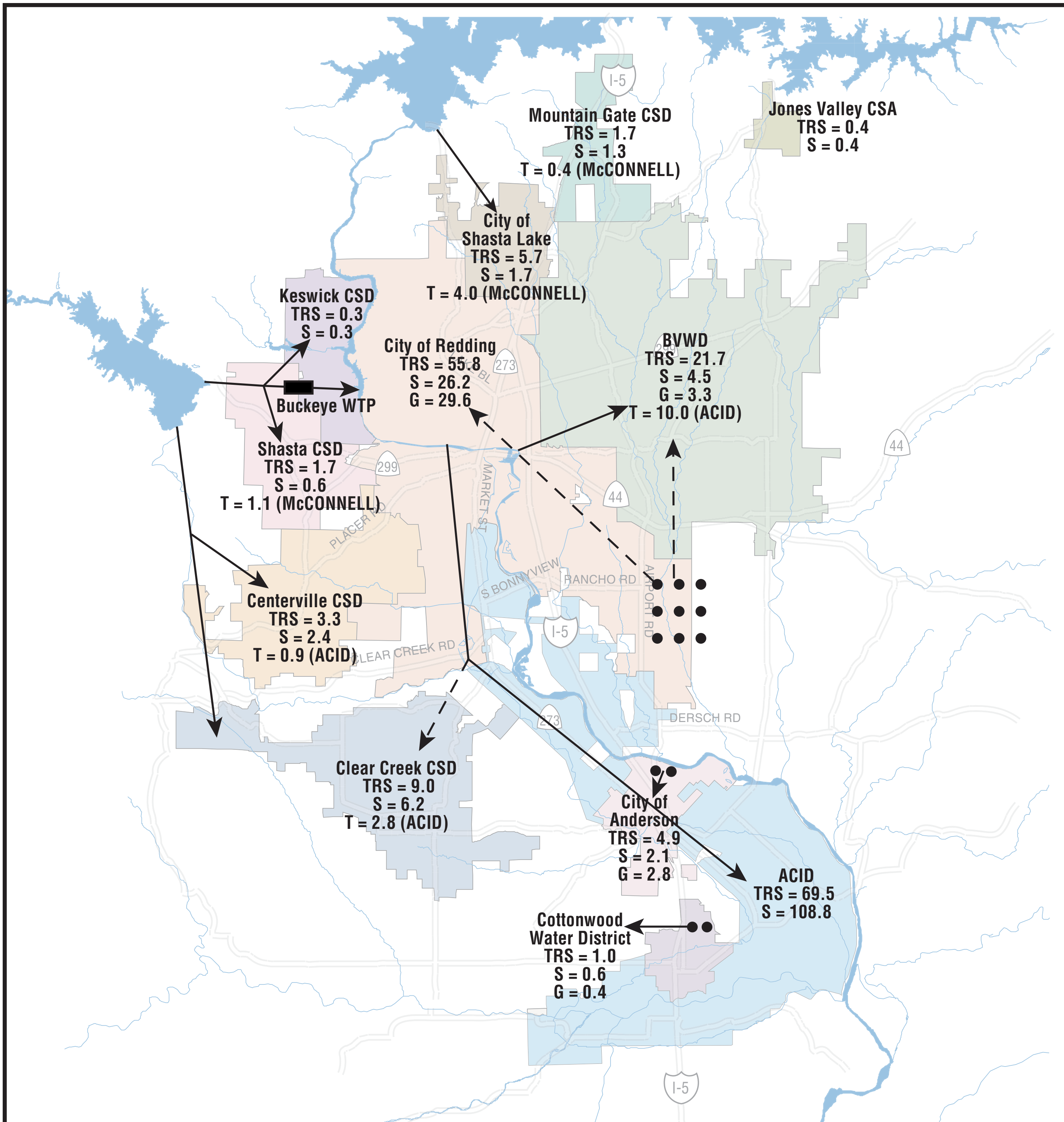
- Year 2030 Target Reliable Supply (with cutbacks and reliability targets), 175,000 ac-ft
- Total Groundwater Production, 50,100 ac-ft
- Total Surface-water Production, Including Transfers, 124,900 ac-ft

This alternative relies primarily on groundwater development, but also involves significant surface-water transfers. A total of 19,200 ac-ft of surface water would be transferred from the CVP water supply contracts or Sacramento River Settlement Contracts held by Redding Basin purveyors. This alternative involves moderate institutional complexity and moderate capital costs for new conveyance facilities. Table 3-3 shows water balance for this alternative, and Figure 3-4 shows how water would be transferred or conveyed throughout the basin.

TABLE 3-3
Year 2030 Water Balance for Alternative 3 – Balanced Reliance on Surface Water and Groundwater
Redding Basin Water Resources Management Plan

Purveyor	Target Reliable Supply (TAF)	Existing Surface-water Supply (TAF)	1995 Groundwater Pumping (TAF)	Deficit (TAF)	Surplus (TAF)	Additional Surface-water Transfers			Additional Groundwater Pumping (TAF)	Descriptions
						Quantity (TAF)	Transferred To	Transferred From		
City of Anderson	4.9	0.0	2.1	2.8		0.0			2.8	Increase existing groundwater pumping
ACID	69.5	108.8	0.0		39.3	0.0			0.0	No transfers or groundwater pumping
BVWD	21.7	4.5	3.9	13.3		10.0	BVWD	ACID[a]	3.3	Permanent transfer from ACID surface-water surplus, possible 1 to 1 exchange of water with USBR for transfer rights
Centerville CSD	3.3	2.4	0.0	0.9		0.9	Centerville CSD	ACID[a]	0.0	
Clear Creek CSD	9.0	6.2	0.0	2.8		2.8	Clear Creek CSD	ACID[a]	0.0	Permanent transfer from ACID surface-water surplus, and conveyance system, possible 1 to 1 exchange of water with USBR for transfer rights
Cottonwood Water District	1.0	0.0	0.6	0.4		0.0			0.4	Increase existing groundwater pumping
Jones Valley CSA	0.4	0.4	0.0			0.0			0.0	No transfers or groundwater pumping
Keswick CSA	0.3	0.3	0.0			0.0			0.0	No transfers or groundwater pumping
Mountain Gate CSD	1.7	0.7	0.6	0.4		0.4	Mountain Gate CSD	McConnell Foundation[a]	0.0	Permanent transfer from McConnell Foundation surface-water surplus
City of Redding	55.8	19.4	6.8	29.6		0.0			29.6	Develop groundwater wells and conveyance systems
City of Shasta Lake	5.7	1.7	0.0	4.0		4.0	Shasta Lake	McConnell Foundation[a]	0.0	Permanent transfer from McConnell Foundation
Shasta CSD	1.7	0.6	0.0	1.1		1.1	Shasta CSD	McConnell Foundation	0.0	Permanent transfer from Centerville CSD surface-water surplus
McConnell Foundation	0.0	5.1	0.0		5.1	0.0			0.0	
Totals	**175.0**	**150.1**	**14.0**	**55.3**	**44.4**	**19.2**			**36.1**	

[a]Indicates a long-term transfer of surface water.



LEGEND

- ● GROUNDWATER WELLS
- ← EXISTING CONVEYANCE
- ← – – NEW CONVEYANCE
- TRS TARGET RELIABLE SUPPLY
- S SURFACE SUPPLY
- T TRANSFER
- G GROUNDWATER SUPPLY

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FIGURE 3-4
ALTERNATIVE 3
BALANCED RELIANCE ON SURFACE WATER AND GROUNDWATER

2030 CRITICALLY DRY YEAR
REDDING BASIN WATER RESOURCES MANAGEMENT PLAN

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Facilities – This alternative requires new wellfields and conveyance pipelines to develop additional groundwater supplies. The majority of surface-water transfers would be conveyed through existing facilities, but some additional facilities are required.

Groundwater – This alternative would involve 36,600 ac-ft of additional groundwater pumping above the purveyors' 1995 groundwater pumping levels. Preliminary runs of the integrated groundwater/surface-water model developed in Phase 2B indicate that this amount of groundwater pumping would have minimal impacts on groundwater levels.

Institutional Complexity – This alternative involves moderate institutional complexity. Five surface-water transfers are required for this alternative, but there are no exchanges between Sacramento and Trinity River water sources. Costs may be levied for foregone power if the point of diversion is transferred from downstream of a power generation facility to upstream.

Protection of Water Rights – This alternative involves moderate focus on solidifying beneficial use of existing surface-water supplies (CVP Contracts and Settlement Contracts).

Reliability – The balanced reliance on the surface-water and groundwater alternative provides flexibility in achieving reliable supplemental supply sources. However, the reliability of surface water for transfers is uncertain.

Cost – The new groundwater facilities would include significant capital costs. Surface-water costs depend on the type of water being transferred and the need for new conveyance facilities.

Public Acceptance – This alternative involves moderate increases in groundwater pumping, which could create concerns about seasonal drawdown among private groundwater users.

Preliminary Evaluation and Comparison of Conceptual Alternatives

Initial comparison of the three conceptual alternatives indicates that all three would meet the fundamental goal of providing the target water supply for all purveyors within the basin in a critical dry-year condition in 2030. Meeting the target quantity and reliability criteria is the first and most basic test of an alternative. At this stage of the development and evaluation of alternatives, the remaining criteria (institutional and legal acceptance, potential environmental impacts, capital costs, operations and maintenance (O&M) costs, and public acceptance) were not addressed in detail. These criteria were, however, considered in refining the alternatives and providing more detailed information by which to begin the evaluation process later in this phase of work. These subsequent evaluations provided a basis for optimizing the alternatives to best meet the needs of each purveyor.

These alternatives were presented to the PAC and TAC for comments and recommendations. The PAC and TAC agreed that a balanced reliance on groundwater and surface water was the optimum concept to meet future water supply needs of the Redding Basin. These comments were incorporated in the refinement of Alternative 3.

Evaluation of Conceptual Alternatives Using the Redding Basin Groundwater Model

The Redding Basin groundwater model was used to forecast future groundwater conditions under each of the three conceptual alternatives in a critical dry-year condition in the year 2030. The intent was to evaluate the impact of the alternatives on groundwater levels in the aquifers compared to historical groundwater levels. Other types of analyses are possible using the model, but impacts to known groundwater levels was the focus of the modeling runs for developing and evaluating the conceptual alternatives.

The land and water use module was used to compute water demand and other water budget information (including recharge and pumping rates) at each model node. At this stage of the evaluation process, simplifying assumptions were employed to provide a benchmark comparison of the conceptual alternatives based on steady-state conditions.

Within each model run, future water needs were forecasted for each purveyor and model node. Areas of various land uses were summed by year for each purveyor and for each model node. Unit water demands, wastewater flows, groundwater recharge, and other variables were computed for each category of land use. The land use and water use factors were then combined to calculate a water budget within each purveyor's service area and for each model node.

At this level of alternative evaluation, several other simplifying assumptions were made in performing the model runs. Water use factors for urban areas were adjusted slightly so that the water demands computed through the land and water use model would agree with the water needs projections developed during Phase 2B. Because of the difficulty in forecasting where and when increases in urban area demands would occur, it was assumed that increases in urban demands would occur in currently urbanized areas. The effects of these assumptions were negligible considering the intent of the model runs was to consider the relative impacts of the alternatives.

The model runs identified the following impacts of increased groundwater pumping:

- Removal of groundwater from storage in the aquifer
- Decreased discharge of groundwater to surface streams
- Decreased evapotranspiration in areas with high groundwater levels
- Increased seepage from streams and canals

Model Results for Alternative 1 – Primary Reliance on Surface Water

Figure 3-5 shows the results of groundwater model simulations of the change in groundwater levels due to Alternative 1 compared to groundwater conditions that would occur for water demand and supply conditions for 1995. The evaluation is based on computing the average annual groundwater levels that would occur under the 1- in 10-year assumptions of water demand and supply for Alternative 1. The analysis shows a maximum drawdown of groundwater levels of 5 feet with the implementation of Alternative 1. Table 3-4 shows the difference in the water budget for Alternative 1 compared to the known and estimated water budget elements in 1995.

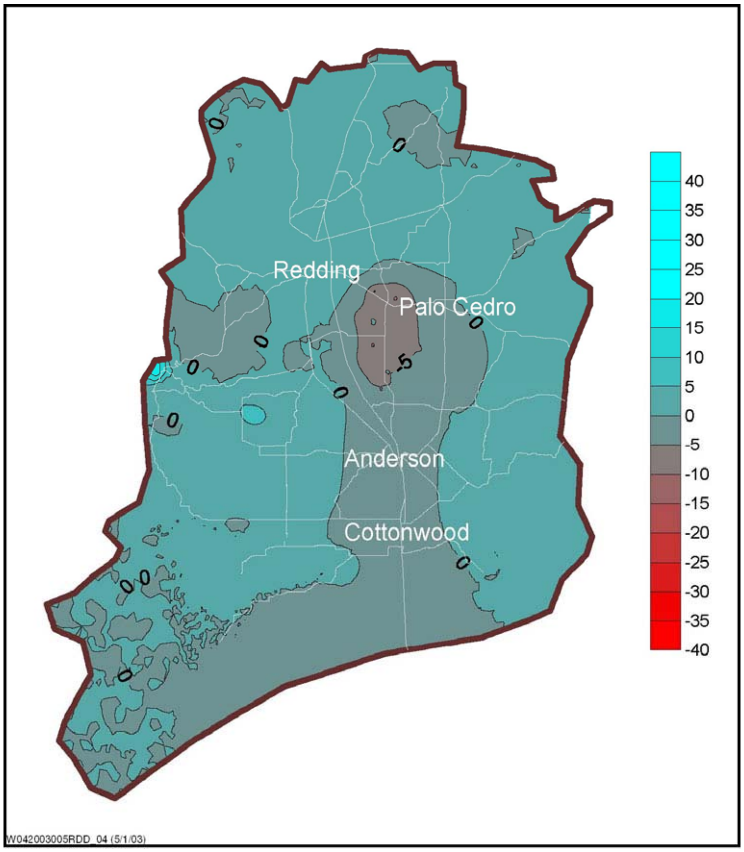

FIGURE 3-5
ALTERNATIVE 1 – CHANGE IN GROUNDWATER LEVELS (FEET) IN A 2030 CRITICAL DRY-YEAR CONDITION COMPARED TO 1995 CONDITIONS

RECHARGE	AC-FT/YEAR	DIFFERENCE FROM 1995 BASE CASE (AC-FT/YEAR)
PRECIPITATION	730,900	0
ACID CANAL SEEPAGE	44,000	0
SEEPAGE FROM STREAMS	46,232	2,419
DEEP PERCOLATION OF APPLIED WATER AND SEPTIC TANK FLOW	33,652	7,910
TOTAL RECHARGE	**854,784**	**10,329**
DISCHARGE	**AC-FT/YEAR**	**DIFFERENCE FROM 1995 BASE CASE (AC-FT/YEAR)**
PUMPING	67,403	13,567
SEEPAGE TO MINOR STREAMS	326,130	3,913
SEEPAGE TO MAJOR STREAMS	346,956	-7,453
EVAPOTRANSPIRATION IN HIGH GROUNDWATER AREAS	114,509	331
TOTAL DISCHARGE	**854,998**	**10,358**

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TABLE 3-4
ALTERNATIVE 1 WATER BUDGET

Model Results for Alternative 2 – Primary Reliance on Groundwater

Figure 3-6 shows the computer simulation of the groundwater-level impacts of Alternative 2 compared to groundwater conditions that would occur for water demand and supply conditions for 1995. The analysis shows a maximum drawdown of the groundwater levels of 25 feet with the implementation Alternative 2. The increase in seasonal drawdown reflects the greater reliance on groundwater pumping than for Alternative 1. Table 3-5 shows the difference in the water budget for Alternative 2 compared to the known and estimated water budget elements in 1995.

Model Results for Alternative 3 – Balanced Reliance on Surface Water and Groundwater

Figure 3-7 shows the computer simulation of the groundwater-level impacts of Alternative 3 compared to groundwater conditions that would occur for water demand and supply conditions for 1995. The analysis shows a maximum drawdown of the groundwater levels of 15 feet with the implementation of Alternative 3. This level of seasonal drawdown is more than Alternative 1 but less than Alternative 2, reflecting the balanced use of groundwater and surface water. Table 3-6 shows the difference in the water budget for Alternative 3 compared to known and estimated water budget elements in 1995.

Conclusions from Initial Model Runs

The primary conclusion drawn from the initial model runs for the three conceptual alternatives was that the impacts of the three alternatives were relatively minor and should not be the primary driver in selecting a specific general course of action over another. Under heavier groundwater pumping scenarios, impacts were greater, but not significantly so; and groundwater levels recover quickly and on a seasonal basis, even under the heaviest groundwater pumping scenarios. Reductions in groundwater discharge to surface streams were also small under all three alternatives.

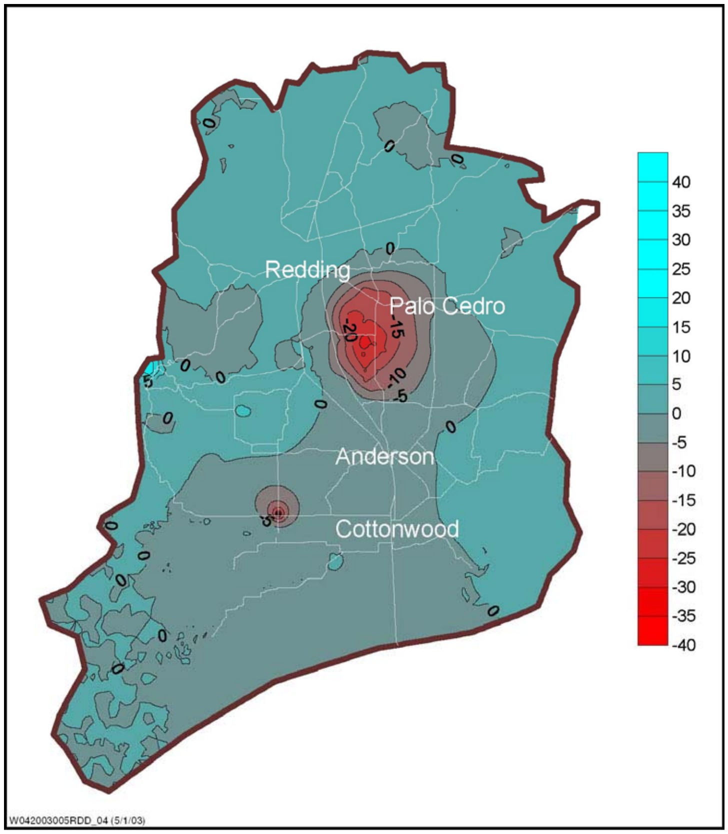

FIGURE 3-6
ALTERNATIVE 2 – CHANGE IN GROUNDWATER LEVELS (FEET) IN A 2030 CRITICAL DRY-YEAR CONDITION COMPARED TO 1995 CONDITIONS

RECHARGE	AC-FT/YEAR	DIFFERENCE FROM 1995 BASE CASE (AC-FT/YEAR)
PRECIPITATION	730,900	0
ACID CANAL SEEPAGE	44,000	0
SEEPAGE FROM STREAMS	53,525	9,712
DEEP PERCOLATION OF APPLIED WATER AND SEPTIC TANK FLOW	33,652	7,910
TOTAL RECHARGE	**862,077**	**17,622**
DISCHARGE	**AC-FT/YEAR**	**DIFFERENCE FROM 1995 BASE CASE (AC-FT/YEAR)**
PUMPING	99,703	45,867
SEEPAGE TO MINOR STREAMS	325,481	3,264
SEEPAGE TO MAJOR STREAMS	323,065	-31,344
EVAPOTRANSPIRATION IN HIGH GROUNDWATER AREAS	114,034	-143
TOTAL DISCHARGE	**862,283**	**17,644**

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TABLE 3-5
ALTERNATIVE 2 WATER BUDGET

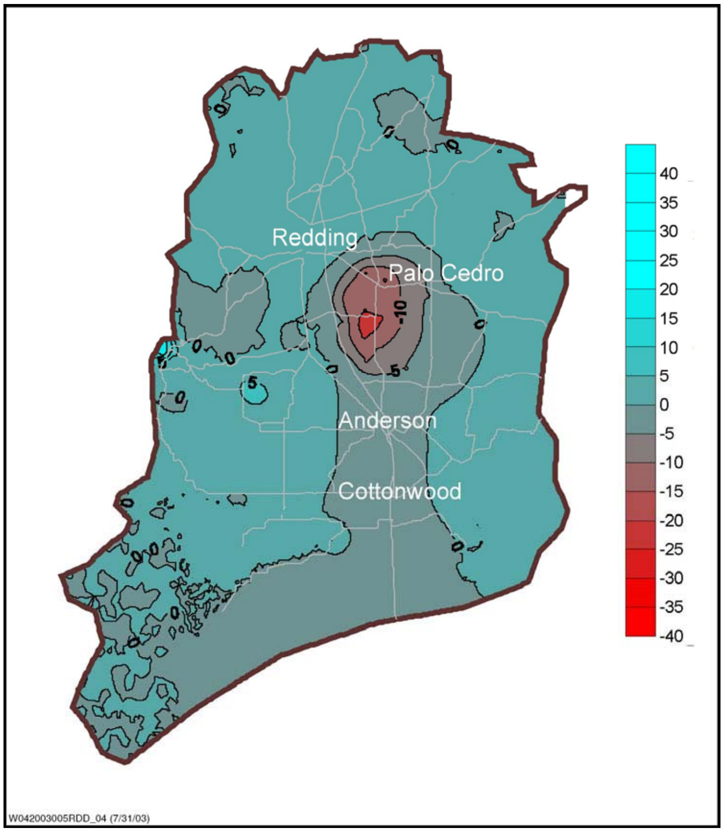

FIGURE 3-7
ALTERNATIVE 3 – CHANGE IN GROUNDWATER LEVELS (FEET) IN A 2030 CRITICAL DRY--YEAR CONDITION COMPARED TO 1995 CONDITIONS

RECHARGE	AC-FT/YEAR	DIFFERENCE FROM 1995 BASE CASE (AC-FT/YEAR)
PRECIPITATION	730,900	0
ACID CANAL SEEPAGE	44,000	0
SEEPAGE FROM STREAMS	47,852	4,039
DEEP PERCOLATION OF APPLIED WATER AND SEPTIC TANK FLOW	33,652	7,910
TOTAL RECHARGE	**856,404**	**11,949**
DISCHARGE	**AC-FT/YEAR**	**DIFFERENCE FROM 1995 BASE CASE (AC-FT/YEAR)**
PUMPING	76,947	23,111
SEEPAGE TO MINOR STREAMS	325,949	3,733
SEEPAGE TO MAJOR STREAMS	339,201	-15,208
EVAPOTRANSPIRATION IN HIGH GROUNDWATER AREAS	114,316	139
TOTAL DISCHARGE	**856,413**	**11,775**

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TABLE 3-6
ALTERNATIVE 3 WATER BUDGET

SECTION 4

Alternative Refinement and Analysis

As the study progressed, it became apparent that the process of developing a reliable water supply for all purveyors in the basin should not involve choosing between several distinctly different and rigid alternatives. For some purveyors, the number of implementable and affordable options is very limited. Others have more options, but there are many uncertainties and critical milestones over the planning period. Where significant uncertainties exist, there is significant risk in defining a very specific course of action that does not provide flexibility to respond to potential resolutions of these uncertainties. Instead, a flexible course of action needs to be identified, along with specific actions for each purveyor that are consistent with that flexible course of action. Over the next several years, specific events will occur that will shape the future options that are available to each purveyor, particularly the CVP water supply contractors. The general course of action must be flexible enough to accommodate these potential outcomes and enable choices to be made and the plan to shift without wasted cost or effort by the purveyors. For these reasons, two compatible alternatives, or alternative paths forward from the completion of CVP contract renegotiations, were identified and developed for further analysis.

The refined alternatives are permutations of Alternative 3 – Balanced Reliance on Groundwater and Surface Water. These alternatives represent two paths that could be taken by the Redding Basin purveyors following CVP water supply contract renegotiations and other planning steps. The two alternatives involve common interim actions until completion of CVP contract renegotiations. The primary difference in these alternatives is the means by which in-basin water transfers are accommodated. The elements of the two alternatives are compatible in many respects so that flexibility is provided to address uncertainties over the planning period.

A programmatic environmental document would be required to assess the impacts of this type of flexible approach. Project-specific environmental documentation would later be prepared for individual projects for which further environmental analysis is required.

The two refined alternatives are based on improving water supply reliability by transferring conserved surface water directly from one purveyor to another, or by implementing a conjunctive management program to help facilitate surface-water transfers. Alternative 3A involves direct surface-water transfers, while Alternative 3B involves conjunctive management of groundwater and surface water to facilitate the transfer of surface water.

Principles and Assumptions for Refinement of Alternative 3

Following are descriptions of the principles that were employed in developing the refined alternatives:

- 1- in 2-year and 1- in 4-year deficits would be met through long-term surface-water transfers or groundwater pumping.

- Planning assumptions developed in Phase 2B and refined in Phase 2C would be the guidelines for decisionmaking.
- The McConnell Foundation would be only a short-term supplier (providing supplemental supplies for critical dry years or short-term needs through the common pool).
- 1- in 10-year (critical dry year) water supply needs were adjusted to provide 90 percent of estimated M&I needs and 75 percent of estimated agricultural needs.
- Water demands are based on the existing water conservation measures adopted by individual purveyors. Guidelines for future conservation measures will be developed for consideration and adoption by individual purveyors.
- The future water demands for Centerville CSD and Shasta CSD were adjusted upwards from earlier projections. These adjustments were made to account for recent higher-than-projected growth within these two districts. The adjustments were necessary to reflect actual use since completion of earlier water need projections.

The alternatives were developed to meet water needs in a 1- in 4-year or more frequent deficit condition, and to shape actions for a less frequent 1- in 10-year (critical dry year) condition.

The concept of a common resource pool is embodied in the development of these alternatives. The common pool concepts would provide an overall framework so water can be transferred within the basin on a long-term or short-term (year to year) basis. Long-term agreements would be executed by purveyors who face deficits in the 1- in 4-year condition or more frequently. Critical dry-year (1- in 10-year condition) needs would be addressed on an annual basis between purveyors that have available water or access to other supplies (primarily groundwater) and those that do not. The pool could provide sufficient quantities of water to supply all the purveyors' deficits. The pool would also be available to address other purveyor needs that might arise. The advantages of a common pool are that transfers could be accommodated under "umbrella" contract terms with the resource management agencies as opposed to negotiating individual agreements and seeking regulatory approvals for transfers on a case by case basis. Recent experiences of the Redding Basin purveyors demonstrate that securing approvals of individual transfers has been difficult, in some cases nearly impossible, to achieve.

Some purveyors have voiced concerns that they learn too late in the year what their CVP contract allotments will be for a short-term transfer program to be effective during a critical dry year. However, by securing advanced approval for a basinwide transfer program, the transfers would be much easier to accommodate because the framework for such transfers would be developed and agreed to and the time required to secure approvals for specific individual transfers would be significantly reduced.

Alternative Descriptions

Alternative 3A – Direct Surface-water Transfers

Alternative 3A relies on direct transfers of surface-water between purveyors. This alternative would help to avoid costs associated with the development of infrastructure to support greater levels of groundwater use throughout the basin. Agreements to facilitate long-term surface-water transfers would be developed as part of the process of CVP contract renegotiations.

All surface-water transfers during a 1- in 4-year or more frequent condition would be long-term transfers from ACID. All critical dry-year transfers would be achieved through short-term (annual) agreements, with the McConnell Foundation, ACID, and the City of Redding as potential suppliers to the common pool. The pool would provide enough water to accommodate all users' critical dry-year water needs.

This alternative requires 31,300 ac-ft of surface-water transfers and 30,000 ac-ft of additional groundwater pumping for a critical dry-year condition. This alternative involves direct transfers of conserved surface-water, and reliance on existing conveyance facilities, where feasible. This alternative would maximize beneficial use of available surface-water within the basin. The outcome of CVP contract negotiations and the volumes of water available to the individual purveyors will have a significant impact on the feasibility of this alternative.

Alternative 3B – Transfers through Conjunctive Management

Alternative 3B incorporates conjunctive management of groundwater and surface water to accommodate transfers. The conjunctive management program would include ACID as the main supplier. ACID would have a central role in the conjunctive management program because of its location over the high yielding areas of the groundwater basin and because its canal system can be used to convey pumped groundwater to basin water users. ACID is also an important source of groundwater recharge to the groundwater basin. ACID would pump groundwater into its canals to enable a portion of its surface-water supply to be transferred to other purveyors. Transfer provisions would be developed for both 1- in 4-year (long term) and 1- in 10-year (short term) surface-water transfers. Alternative 3B provides a reliable solution to the Redding Basin purveyors by developing a conjunctive management groundwater pumping program. A total of 25,100 ac-ft of surface water would be transferred, and 52,500 ac-ft of groundwater above 1995 pumping levels would be pumped during a critical dry-year condition in the year 2030.

Why would conjunctive management be considered when the planning assumption is that surface-water supplies are more than adequate to cover the projected water needs of the basin, even in critical dry years? In weighing conjunctive management as an option to increase water supply reliability, several other important factors should be considered. First, conjunctive management provides a tool to help address declining reliability of surface-water supplies in dry years. It can help reduce potential regulatory obstacles to surface-water transfers by drawing on a supplemental source of supply and provide a "bargaining chip" for negotiations by the basin's CVP water supply contractors and for a basinwide common pool concept. It can help make optimum use of groundwater where it is plentiful and where a major north/south conveyance system is already in place. For some purveyors, the cost of transferred water may be attractive compared to direct surface-water transfers.

Descriptions of Impacts to Each Purveyor

Anderson-Cottonwood Irrigation District

Alternative 3A

Under this alternative, available surface-water supplies from ACID would be transferred to purveyors that require supplemental supplies. During a 1- in 4-year condition, ACID would supply 19,800 ac-ft for M&I and agricultural uses in the BVWD, Centerville CSD, Clear Creek CSD, Mountain Gate CSD, City of Redding, Shasta CSD, and the City of Shasta Lake. In a 1- in 10-year (critical dry year) condition, ACID would transfer an additional 6,500 ac-ft of surface water to the short-term common pool.

Alternative 3B

Under this alternative, ACID would conjunctively manage surface water and groundwater to facilitate surface-water transfers to purveyors that require supplemental supplies. As a part of its conjunctive management program, ACID would pump groundwater to make surface water available for transfer. During a 1- in 4-year condition, ACID would supply 15,800 ac-ft for long-term transfers through the common pool. ACID would transfer an additional 5,500 ac-ft of surface water through the short-term common pool in a 1- in 10-year (critical dry year) condition. ACID would pump groundwater into its canal system to accommodate these surface-water transfers. This alternative would require ACID to pump 21,300 ac-ft of groundwater in a critical dry year to make surface water available for transfer. This volume of groundwater pumping is still significantly below the currently estimated volume of seepage from ACID's canals.

City of Anderson

Alternative 3A

The City of Anderson relies entirely on groundwater. Anderson's estimated additional water needs in the year 2030 are similar for both 1- in 4-year and 1- in 10-year conditions. This alternative would expand Anderson's current groundwater pumping program to meet these future needs. Because of its location over high-yielding areas of the groundwater basin, Anderson's available supplies are not subject to the type of reductions that other Redding Basin suppliers are subject to in dry years.

Alternative 3B

Same as Alternative 3A.

Bella Vista Water District

Alternative 3A

The BVWD relies primarily on surface water for its current water supply. The geographic location of the BVWD allows the district to receive transfers of additional surface water and develop a joint groundwater-pumping program with the City of Redding. To meet water needs during the 1- in 4-year condition in 2030, BVWD would secure a direct long-term transfer of 4,000 ac-ft from ACID's surface-water supply and pump 3,800 ac-ft of additional groundwater. During the 1- in 10-year (critical dry year) condition, BVWD would need to receive an additional 3,200 ac-ft from the short-term common pool to make up for cutbacks on the 1- in 4-year transfer from ACID. BVWD would also receive an additional 3,300 ac-ft of groundwater pumped from wells in the Enterprise Wellfield during a 1- in 10-year condition. The combination of increased groundwater pumping and surface-water transfers provides a reliable solution to BVWD's future supply needs.

Alternative 3B

During the 1- in 4-year condition, BVWD would receive 7,800 ac-ft of groundwater from wells in the Enterprise Wellfield. During the 1- in 10-year condition, BVWD would need to receive an additional 5,500 ac-ft of surface water from the short-term common pool. The combination of groundwater and surface-water supplies provides a reliable solution to BVWD's future supply needs. This alternative would involve higher capital costs for new wells and conveyance systems.

Centerville Community Services District

Alternative 3A

Centerville CSD relies solely on surface water from Whiskeytown Lake. Centerville CSD's geographic location does not allow for significant levels of groundwater development for dry-year water supply reliability. During a year 2030, 1- in 4-year condition, Centerville CSD would rely on a long-term 300 ac-ft transfer from ACID. In a 1- in 10-year condition, Centerville CSD would receive an additional surface-water transfer of 500 ac-ft from the short-term common pool, which would make up for its associated 1- in 10-year cutbacks in CVP contract supplies. The change of the point of diversion from the Sacramento River to Whiskeytown Lake could complicate the surface-water transfer.

Alternative 3B

During a year 2030, 1- in 4-year condition, Centerville CSD would receive a 300-ac-ft long-term transfer from the common pool supply. In a 1- in 10-year condition, Centerville would receive an additional surface-water transfer of 400 ac-ft from the short-term common pool, which would make up for its associated 1- in 10-year cutbacks. ACID's conjunctive management program and/or the McConnell Foundation would supply the common pool.

Clear Creek Community Services District

Alternative 3A

Clear Creek CSD relies on surface water from Whiskeytown Lake. During a 2030, 1- in 4-year condition, Clear Creek CSD would not need additional water supply. In a 2030, 1- in 10-year condition, Clear Creek CSD would receive a transfer of an additional 2,800 ac-ft of surface-water from the short-term common pool. These transfers could be complicated by the change in the point of diversion from the Sacramento River to Whiskeytown Lake.

Alternative 3B

During a 2030, 1- in 4-year condition, Clear Creek CSD would not require additional water supply. In a 2030, 1- in 10-year condition, Clear Creek CSD would receive a transfer of an additional 2,800 ac-ft of surface-water from the common pool. These transfers could be complicated by the change in the point of diversion from the Sacramento River to Whiskeytown Lake.

Town of Cottonwood

Alternative 3A

The Town of Cottonwood relies primarily on groundwater. Cottonwood's year 2030 deficit of 500 ac-ft is similar for both 1- in 4-year and 1- in 10-year conditions. This alternative would expand Cottonwood's current groundwater pumping program. Because of Cottonwood's location over high-yielding portions of the groundwater basin, its supply is not subject to the types of reductions that other Redding Basin suppliers are subject to in dry years.

Alternative 3B

Same as Alternative 3A.

Jones Valley County Service Area

Alternative 3A

Jones Valley CSA shows no deficits through the years leading up to 2030, and would not require actions regarding additional water supply. In a critical dry year, Jones Valley is subject to cutbacks in supply because of the USBR's "average use" policies, but the volume of such cutbacks would be small and any supplemental needs could be accommodated through the short-term common pool.

Alternative 3B

Same as Alternative 3A.

Keswick County Service Area

Alternative 3A

Keswick CSA shows no deficits through the years leading up to 2030, and would not require actions regarding additional water supply. In a critical dry year, Keswick is subject to cutbacks in supply because of the USBR's "average use" policies, but the volume of such cutbacks would be small and any supplemental needs could be accommodated through the short-term common pool.

Alternative 3B

Same as Alternative 3A.

Mountain Gate Community Services District

Alternative 3A

Mountain Gate CSD relies primarily on Shasta Lake surface water and local groundwater, and would face critical dry-year deficits of 1,000 ac-ft in the year 2030. The projected deficit for the 1- in 4-year condition would be approximately 400 ac-ft. During a critical dry-year condition, Mountain Gate CSD is assumed to be unable to pump groundwater, and would have an additional deficit of 600 ac-ft. Mountain Gate CSD would receive a long-term transfer of 400 ac-ft from ACID. Mountain Gate CSD would also receive a short-term transfer of 700 ac-ft from the common pool to make up for the loss of groundwater in a critical dry year. The loss of power production at Shasta and Keswick Dams associated with the transfer may have to be compensated for by Mountain Gate CSD, for the ACID transfer. This transfer would secure Mountain Gate's water needs for all year types up to the year 2030.

Alternative 3B

Same as Alternative 3A.

City of Redding

Alternative 3A

The City of Redding relies primarily on surface water, supplemented by a growing amount of groundwater pumping. In a critical dry year in the year 2030, Redding shows a projected deficit of 29,100 ac-ft. Redding would require a 10,000 ac-ft surface-water transfer to serve the Buckeye and Foothill portions of its service area. This would be a long-term transfer from ACID's available surface-water supply. The remaining deficit for the 1- in 4-year condition would be met through groundwater development in the Enterprise area, which would require 19,100 ac-ft of additional groundwater pumping. During a 1- in 10-year condition, Redding would need a transfer of 3,000 ac-ft of surface water from the short-term common pool to make up for cutbacks to its surface-water supply. The combination of surface water and groundwater provides a reliable solution to Redding's future water supply.

Alternative 3B

The City of Redding would meet demands under a 1-in-4 year condition in 2030 by a combination of the 10,000 ac-ft long-term transfer from ACID and the 19,100 ac-ft of additional groundwater pumping. During a critical dry-year condition, the City of Redding would pump an additional 500 ac-ft of groundwater to meet its demands.

Shasta Community Services District

Alternative 3A

Shasta CSD relies solely on surface water from Whiskeytown Lake through the Spring Creek Conduit. Shasta CSD's geographic location does not allow for significant levels of groundwater development. During a year 2030, 1- in 4-year condition, Shasta CSD would receive a long-term transfer of 1,100 ac-ft from ACID. In a 1- in 10-year condition, Shasta CSD would need a transfer of 300 ac-ft from the short-term common pool. The change in the point of diversion from the Sacramento River to Whiskeytown Lake may complicate the surface-water transfer. The long-term transfer provides a reliable source of water for all year types.

Alternative 3B

Shasta CSD's geographic location does not allow for significant levels of groundwater development. During a year 2030, 1- in 4-year condition, Shasta CSD would receive a 1,100 ac-ft long-term transfer from the common pool. In a 1- in 10-year condition, the target reliable supply criteria offset the USBR cutbacks on CVP water, so additional transfers would not be needed.

City of Shasta Lake

Alternative 3A

The City of Shasta Lake relies solely on Shasta Lake surface water, and would face a deficit of 4,000 ac-ft in a 1- in 4-year condition in the year 2030. To meet 1- in 4-year water supply deficits, Shasta Lake would receive a long-term transfer of 4,000 ac-ft from ACID. During a 1- in 10-year condition, Shasta Lake would require an additional surface-water transfer of 1,000 ac-ft from the short-term common pool, to compensate for the pre-1914 cutbacks on the water transferred in a 1- in 4-year condition. The loss of power generation associated with the transfer may have to be compensated for by the City of Shasta Lake. This transfer would secure Shasta Lake's water needs for all year types up to the year 2030.

Alternative 3B

This alternative is similar to Alternative 3A. However, the City of Shasta Lake would not require the 1-in-10 year short-term transfer, due to the higher reliability of its 4,000 ac-ft long-term transfer.

McConnell Foundation

Alternative 3A

The McConnell Foundation has 5,100 ac-ft of surface water available for transfer on a short-term basis. The McConnell Foundation would supply water to the common pool for short-term transfers. McConnell Foundation maintains the most reliable and readily available supply of surface water in the basin.

Alternative 3B

Same as Alternative 3A.

Model Results for Alternatives 3A and 3B – Balanced Reliance on Groundwater and Surface Water

As described previously, a more rigorous analysis was performed for Alternatives 3A and 3B, incorporating the climatic variations that occurred from 1970 to 1995 with projected groundwater pumping and surface-water diversions for year 2030 critical dry-year conditions. This more rigorous analysis was performed to assess the effects of climatic variations on groundwater levels during the 25-year period. The model was run in a transient mode, tracking water levels and the basin water budget for the period of 25 years with the year 2030 diversions. Specific monitoring points were established at locations throughout the basin, and groundwater levels were plotted at each location over the 25-year period.

Figure 4-1 shows the computer simulation of the groundwater level impacts of Alternative 3A compared to groundwater conditions that would occur for water demand and supply conditions for 1995. The analysis shows a maximum drawdown of the groundwater levels of 15 feet with the implementation of Alternative 3A. Table 4-1 shows the water budget for Alternative 3A and the differences in water budget elements from 1995 conditions.

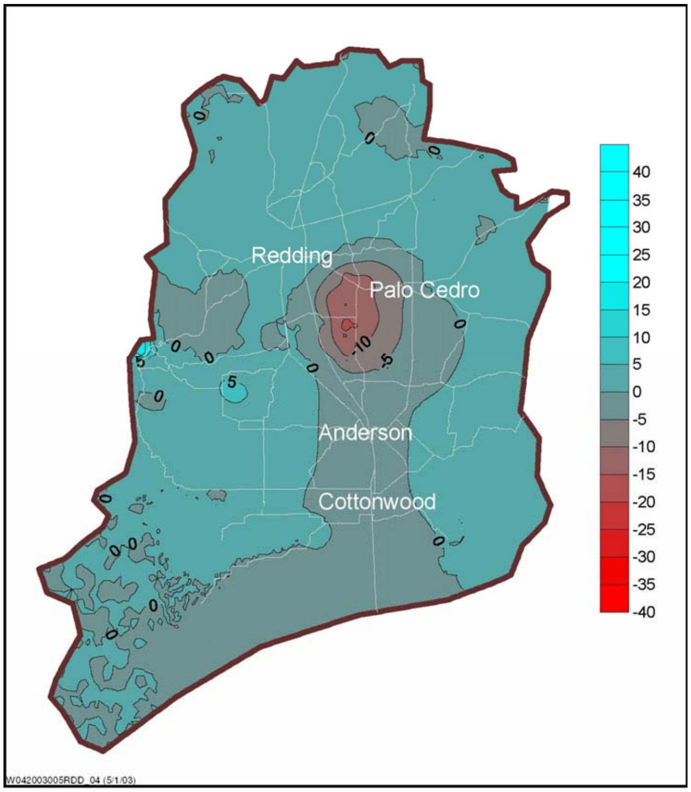

FIGURE 4-1
ALTERNATIVE 3A – CHANGE IN GROUNDWATER LEVELS (FEET) IN A 2030 CRITICAL DRY-YEAR CONDITION COMPARED TO 1995 CONDITIONS

RECHARGE	AC-FT/YEAR	DIFFERENCE FROM 1995 BASE CASE (AC-FT/YEAR)
PRECIPITATION	730,900	0
ACID CANAL SEEPAGE	44,000	0
SEEPAGE FROM STREAMS	47,297	3,484
DEEP PERCOLATION OF APPLIED WATER AND SEPTIC TANK FLOW	33,652	7,910
TOTAL RECHARGE	**855,849**	**11,394**
DISCHARGE	**AC-FT/YEAR**	**DIFFERENCE FROM 1995 BASE CASE (AC-FT/YEAR)**
PUMPING	74,172	20,336
SEEPAGE TO MINOR STREAMS	326,591	4,374
SEEPAGE TO MAJOR STREAMS	340,732	-13,677
EVAPOTRANSPIRATION IN HIGH GROUNDWATER AREAS	114,360	183
TOTAL DISCHARGE	**855,855**	**11,216**

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TABLE 4-1
ALTERNATIVE 3A WATER BUDGET

Figure 4-2 shows the computer simulation of the groundwater level impacts of Alternative 3B compared to groundwater conditions that would occur for water demand and supply conditions for 1995. Table 4-2 shows the water budget for Alternative 3B and the differences in water budget elements from 1995 conditions. The analysis shows a maximum drawdown of the groundwater levels of 15 feet with the implementation Alternative 3B. Only a small change in groundwater levels associated with the conjunctive use of groundwater in areas in and south of Anderson was projected under this alternative. This area's location in the deeper, high-yielding portion of the basin serves to dampen the seasonal drawdown in groundwater levels. By dispersing the conjunctive management canals along the ACID canal and locating them in the deeper part of the basin, the local impacts of the increased pumping would be minimal. This would help avoid significant impacts on private groundwater pumpers with shallow wells. Other water budget impacts of heavier groundwater pumping are also minor (increased seepage from streams, reduced seepage to streams, and reduced evapotranspiration in high groundwater areas).

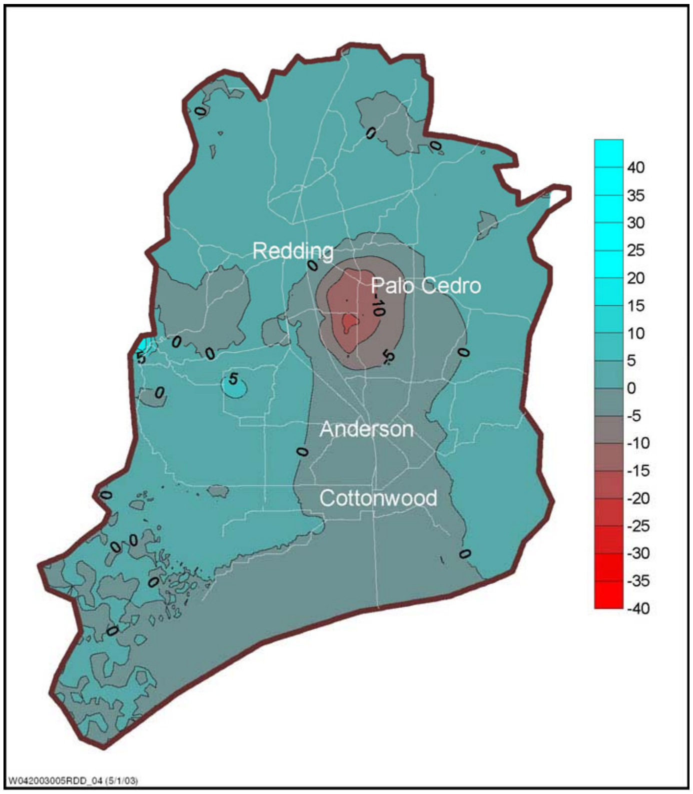

FIGURE 4-2
ALTERNATIVE 3B – CHANGE IN GROUNDWATER LEVELS (FEET) IN A 2030 CRITICAL DRY-YEAR CONDITION COMPARED TO 1995 CONDITIONS

RECHARGE	AC-FT/YEAR	DIFFERENCE FROM 1995 BASE CASE (AC-FT/YEAR)
PRECIPITATION	730,900	0
ACID CANAL SEEPAGE	44,000	0
SEEPAGE FROM STREAMS	48,758	4,945
DEEP PERCOLATION OF APPLIED WATER AND SEPTIC TANK FLOW	33,652	7,910
TOTAL RECHARGE	**857,310**	**12,855**
DISCHARGE	**AC-FT/YEAR**	**DIFFERENCE FROM 1995 BASE CASE (AC-FT/YEAR)**
PUMPING	80,704	26,868
SEEPAGE TO MINOR STREAMS	326,510	4,293
SEEPAGE TO MAJOR STREAMS	335,782	-18,627
EVAPOTRANSPIRATION IN HIGH GROUNDWATER AREAS	114,319	142
TOTAL DISCHARGE	**857,315**	**12,676**

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TABLE 4-2
ALTERNATIVE 3B WATER BUDGET

SECTION 5

Purveyor Infrastructure and Water Supply Cost Evaluations

Infrastructure Evaluations

The infrastructure evaluation focused strictly on the major raw water supply and treatment facilities within each purveyor's service area. Distribution piping and storage were not addressed. The infrastructure evaluation assessed the ability of the existing water supply infrastructure to accommodate the future water demands and identified new infrastructure required to facilitate the water transfers. Information on existing infrastructure and future requirements was developed through discussions with each purveyor's operations and/or management staff and a review of available long-term planning documents such as water master plans and capital improvement plans. Future water supply infrastructure requirements were developed based on peak-day demands.

Each purveyor must be able to meet customer needs during peak use periods. A peaking factor was developed for each purveyor by evaluating the peak daily use information from the years of 1999 through 2001 and creating a peak-day average. This peak-day average was then divided by the average annual use from the years 1999 through 2001. The resulting peaking factor was applied to the future demands to determine the ratio of peak flows versus average annual flows. The peaking factors used in the analysis define the baseline water delivery requirements for each purveyor (see Table 5-1). Peak flows were not developed for ACID, because ACID does not need supplemental water above their current base and project allocation.

TABLE 5-1
Purveyor Peaking Factors
Redding Basin Water Resources Management Plan

Purveyor	Peaking Factor
City of Anderson	2.4
BVWD	2.6
Centerville CSD	2.1
Clear Creek CSD	3.4
Cottonwood Water District	2.4
Jones Valley CSA	2.0
Keswick CSA	2.0
Mountain Gate CSD	2.4
City of Redding	2.5
Shasta CSD	2.8
City of Shasta Lake	2.3

Note:
CSA = County Service Area
CSD = Community Services District

City of Anderson

Existing System

The City of Anderson is served by nine groundwater wells, seven of which are located within the city limits. The existing wells have an average capacity of about 750 gallons per minute (gpm). The nine existing wells have a total capacity of 6,750 gpm. The City of Anderson has two storage tanks with approximate volumes of 2.3 and 1.4 million gallons. These tanks are used to meet customer needs during peak-demand periods and emergency situations. The City of Anderson treats groundwater with chlorine injection and does not require additional treatment processes at this time. The City of Anderson's distribution system consists of pipes ranging from 6 to 12 inches in diameter. The majority of the pipe material in the district is asbestos-cement. The City of Anderson's water master plan, completed in 1994, covers a 10-year planning period. The water master plan involves the construction of a new 1,000-gpm well, replacing the 6-inch-diameter asbestos-cement distribution pipelines, and general system improvements. The City of Anderson is nearing the end of the planning period for its master plan, and an update is recommended for future growth and system improvements.

Supply and Demand Summary

In 1995, the City of Anderson pumped 2,100 ac-ft of groundwater. For the year 2030, the City of Anderson would require 5,400 ac-ft of water, which would result in an average annual flow of 3,350 gpm. During peak hours, the flow could be 2.4 times the average flow, which would result in a peak flow of 8,040 gpm. Figure 5-1 presents the City of Anderson's supply and demand summary from 2005 to 2030.

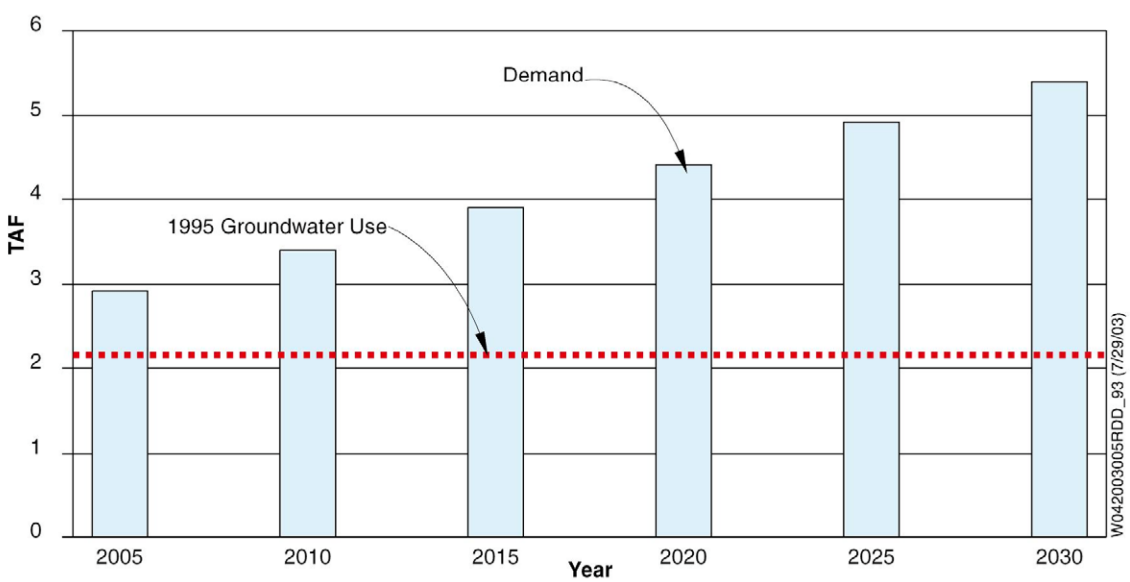

FIGURE 5-1
CITY OF ANDERSON
EXISTING SUPPLY VERSUS LONG-TERM DEMAND

Regional Alternatives Infrastructure Requirements

The City of Anderson's long-term water supply infrastructure needs would be associated with the City of Anderson's continued use of local groundwater resources to meet water supply requirements. Under both Alternatives 3A and 3B, the City of Anderson would need to either expand and rehabilitate existing wells and/or add new wells as demands increase between 2005 and 2030. With a 2030 peak-day demand of approximately 11.5 mgd and an average well capacity of 750 gpm, the City of Anderson would require approximately 11 wells. The most recent well, developed in 2003, indicates that substantially higher well flows are possible for future wells, which could help defer the construction of new wells.

Anderson-Cottonwood Irrigation District

Existing System

ACID currently diverts water from the Sacramento River at the following two locations:

- A gravity diversion at Lake Redding, which is limited to 450 cubic feet per second.
- A pump station near South Bonnyview Road. The South Bonnyview pump station has a capacity of 60 cubic feet per second.

ACID currently has 35 miles of main canal and a series of distribution laterals. Most of the canals in the ACID service area are unlined and have high seepage losses. ACID currently serves approximately 7,000 acres of agricultural land and is conducting studies to evaluate canal lining, siphons, and removing various canal constrictions that could increase system water use efficiency.

Supply and Demand Summary

Over the last several years, ACID's diversions for the Redding Basin have averaged about 93,000 ac-ft. ACID currently has an annual Sacramento River Settlement Contract for 175,000 ac-ft, of which 10,000 ac-ft is CVP water. ACID's water supply is subject to a maximum cutback of 25 percent during a critically dry year. This is less than the cutbacks that the CVP contractors are subject to in critically dry years. ACID's future demand was assumed to remain constant, and water conserved through ACID's efforts to modernize and upgrade its facilities is assumed to be available for transfer.

Regional Alternative Infrastructure Requirements

ACID's water supply and infrastructure has a sufficient capacity to meet the ACID's own requirements through 2030. However, under both Alternatives 3A and 3B, ACID is a major source of transferred water to other purveyors in the Redding Basin. Alternative 3A would not directly require any major system improvements. However, the implementation of local conservation improvements, such as lining some canal reaches and lining or piping laterals, could be necessary to help facilitate approval of the transfers. The goal would be to achieve conservation savings to accomplish the proposed surface-water transfer.

Under the Alternative 3B conjunctive management program, ACID would add significant groundwater supply infrastructure to its system. By installing approximately 11 wells, ACID would use this new groundwater supply to reduce surface-water diversions to facilitate the Sacramento River water transfers to other purveyors.

The timeline for implementing the transfer actions and infrastructure improvements under Alternatives 3A and 3B would be influenced by which purveyors participate in the transfer programs and the immediacy and severity of their supply deficits. Under Alternative 3A, the contractual foundations for the long-term transfers would be set as part of CVP contract renewal. This suggests a timeline of 2003 to 2004 for establishing the contractual framework for the transfers, and 2005 to 2006 for implementing the selected conservation improvements, which would accommodate the most immediate needs and develop agreements for other transfers, as provided for in ACID's contract renewal.

Under Alternative 3B, a pilot study, environmental review, and phased development of conjunctive management wells would occur over 15 to 20 years, working toward the full 21,000 ac-ft of annual conjunctive management transfers. A resultant intermediate target for 2010 would have to be approximately 10,000 ac-ft of seasonal groundwater pumping capacity in place, or four wells based on an average capacity of 3,000 gpm per well.

Bella Vista Water District

Existing System

BVWD diverts surface water via the Wintu Pump Station, which is located on the Sacramento River and owned by the USBR. The Wintu Pump Station has four vertical turbine pumps each having a capacity of 11,200 gpm (16.1 million gallons per day [mgd]), for a combined capacity of 44,800 gpm (64.4 mgd). The diverted water is treated by an inline filtration plant, which has a maximum capacity of 45 mgd. BVWD's main transmission pipeline is a 54-inch-diameter pre-tensioned steel cylinder pipe. BVWD currently has five groundwater wells, which have a combined capacity of 3,900 gpm, and five storage tanks, which have a combined capacity of 5.6 million gallons. The BVWD currently has nine booster pump stations, which are located within the various pressure zones. BVWD's most recent water master plan was completed in 1990. The master plan included a proposed 10-year improvements plan, which consisted of additional groundwater wells and monitoring, expansion of the water treatment plant (WTP), and a general upgrading of booster pump stations and distribution pipelines. This water master plan is not current, and an update is recommended in the near future. However, BVWD is in the process of funding the addition of six new filter cells at their treatment plant.

BVWD's existing raw water supply infrastructure is generally adequate to meet the future water supply. The water treatment plant would require expansion and upgrades to meet future supply requirements and regulatory requirements. Under both Alternatives 3A and 3B, BVWD would receive a combination of surface-water transfers and groundwater transfers through a partnership with the City of Redding. The surface-water transfer supply could be accommodated with the existing pumping and conveyance infrastructure and with the water treatment plant expansion. Approximately 3,000 to 7,800 ac-ft per year of groundwater would be transferred from the City of Redding into the BVWD system, which would require two new wells, approximately 2 miles of 24-inch-diameter pipeline, and a booster pump station. The level of pumping in any single year would vary depending on the levels of cutback to BVWD's CVP contract supply.

Supply and Demand Summary

For the year 2030, BVWD would require 26,800 ac-ft of water. BVWD currently has surface-water contracts for 24,578 ac-ft per year, which results in an annual average of about 15,250 gpm (22 mgd). BVWD has an approximate peaking factor of 2.6, which would create a peak demand of 39,650 gpm (57 mgd) in 2030. The peak surface-water flow would occur only in a 1- in 2-year supply condition because of surface-water supply cutbacks in 1- in 4-year and 1- in 10-year conditions. Under the alternatives presented, BVWD's deficit would accommodate both surface water and groundwater. Figure 5-2 presents BVWD's future water supplies and demands from 2005 to 2030.

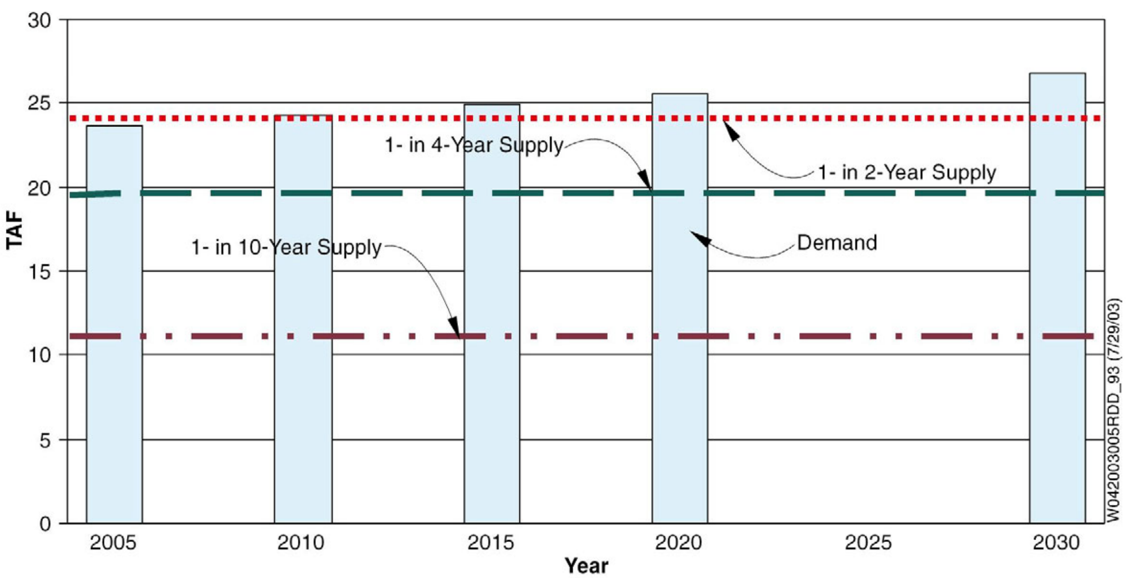

FIGURE 5-2
BELLA VISTA WATER DISTRICT
EXISTING SUPPLY VERSUS LONG-TERM DEMAND

In 2005, BVWD faces a deficit of 15,300 ac-ft per year under critical dry-year conditions. By 2015, the deficits could rise to approximately 16,500 ac-ft under a 1- in 10-year cutback condition. The potential deficits would increase through 2025 based on the projected growth in system demands. The time frame for these existing and projected deficits indicates that BVWD should begin immediately taking steps to implement the supplemental alternatives outlined under Alternatives 3A and 3B. The specifics of the transfer arrangements would likely vary from the conceptual outline presented in this report; however, the findings here support pursuing some mix of these two new sources in the immediate future.

Regional Alternative Infrastructure Requirements

The regional alternatives would require new infrastructure for the BVWD. BVWD would supplement its existing water supply by receiving additional surface water from ACID and developing regional groundwater wells with the City of Redding. The regional infrastructure, in partnership with the City of Redding, would include two new regional groundwater wells, groundwater treatment facilities, booster pump station, and approximately 10,000 linear feet of 24-inch-diameter pipe.

Centerville Community Services District

Existing System

Centerville CSD currently diverts water from Whiskeytown Lake via the Muletown Conduit. Centerville CSD shares the Whiskeytown inline treatment plant with Clear Creek CSD. Clear Creek CSD owns the facility, but allocates 25 percent (7.5 mgd) of the treated water to Centerville CSD. The distribution system ranges from 4- to 16-inch-diameter pipe, with materials consisting of asbestos-cement and polyvinyl chloride pipe. A combination of 10- and 16-inch-diameter mains located in Placer Road are the backbone of the distribution system, with laterals branching out to serve development on both sides of Placer Road. These larger asbestos-cement pipes were constructed in 1964 and 1982. Centerville CSD has five storage tanks with a combined capacity of 2.2 million gallons. Centerville CSD's water master plan was completed in 1997, and was developed for a 10-year planning period. The water master plan involves expanding the treatment facilities, adding a 6.0-mgd booster pump station at the Muletown turnout, adding 3.7 million gallons of storage volume to the system, and general expansion and replacement of transmission pipelines.

Supply and Demand Summary

Centerville CSD currently has an annual contract to divert 2,900 ac-ft of CVP water and has secured 900 ac-ft of water through the Townsend Flat. In the year 2030, Centerville CSD would require an annual diversion of 3,600 ac-ft of water from the Whiskeytown Reservoir, which would result in an average flow of 3.2 mgd. Centerville CSD has an approximate peaking factor of 2.1 and could experience flows as high as 6.7 mgd during summer months. Figure 5-3 presents the future water supplies and demands from 2005 to 2030.

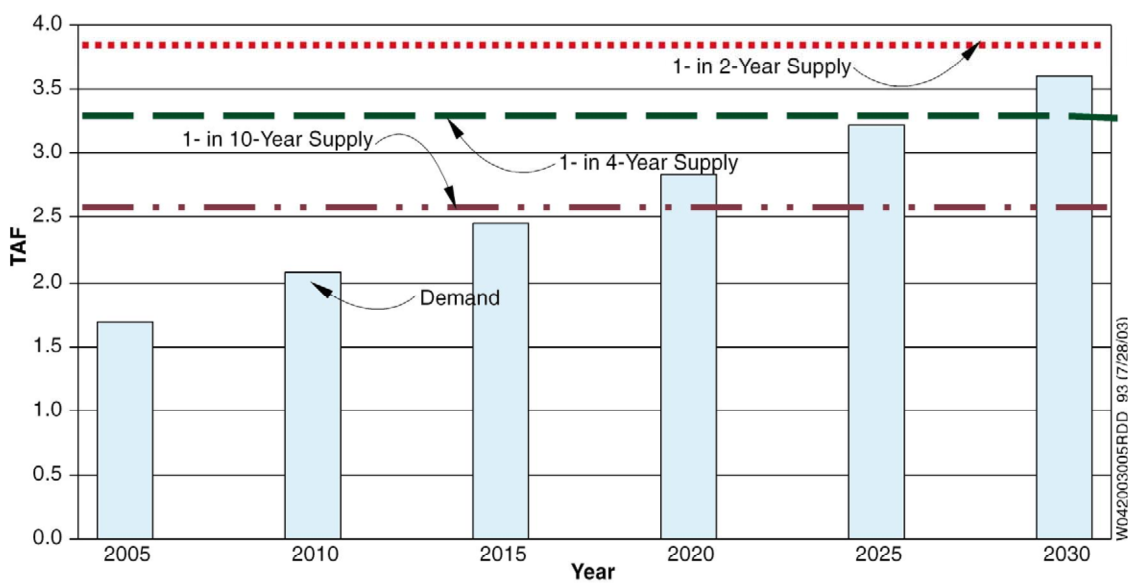

FIGURE 5-3
CENTERVILLE COMMUNITY SERVICES DISTRICT
EXISTING SUPPLY VERSUS LONG-TERM DEMAND

Under both Alternatives 3A and 3B, Centerville CSD would receive surface-water transfers to cover projected 2030 supply deficits. The transfers would range between 300 to 500 ac-ft per year under 1- in 4-year and 1- in 10-year CVP cutback conditions. Transfers would come from either ACID or McConnell Foundation's available surface-water supply. No deficits would be projected for Centerville CSD prior to 2020, when minor deficits could occur under 1- in 10-year CVP cutbacks. Between 2020 and 2030, the projected potential deficits would increase to the 600 ac-ft maximum. Because of the relatively long horizon for the occurrence of deficits, Centerville CSD's priority in the short term (through 2005) would be to support steps taken by the RAWC to ensure that maximum flexibility for transfers would be provided for through the terms of the CVP contract renewals.

Regional Alternative Infrastructure Requirements

Under these alternatives, Centerville CSD would not have regional infrastructure requirements. Centerville CSD would continue diverting water through the USBR-owned Muletown Conduit, and water treatment would continue to be provided by Centerville CSD's water treatment facility.

Clear Creek Community Services District

Existing System

Clear Creek CSD draws water from the Whiskeytown Reservoir via the Muletown Conduit, which is owned by the USBR. Clear Creek CSD owns the Whiskeytown treatment plant, which has an approximate capacity of 30 mgd. Clear Creek CSD shares 25 percent of this WTP capacity with Centerville CSD. The majority of Clear Creek CSD's distribution system was built in 1967. The district currently does not have capacity-related issues in regards to their distribution system. Clear Creek CSD is a gravity system with three storage tanks, which have a combined capacity of 5.3 million gallons. Clear Creek CSD also has three groundwater wells, each with a capacity of 2.2 mgd. These groundwater wells are located outside district boundaries and are limited to emergency use only. Clear Creek CSD has a current water master plan, which was completed in 1997. The water master plan was developed for a 10-year planning period. The water master plan improvements involve several miles of transmission pipeline varying from 6 to 12 inches in diameter, the pressure reducing station No. 5, two new groundwater wells, a 300,000-gallon storage tank, adding two pumps to the booster pump station, and miscellaneous WTP improvements. Some of these improvements have already been incorporated in the Clear Creek CSD system.

Supply and Demand Summary

For the year 2030, Clear Creek CSD would require an annual water supply of 10,600 ac-ft. Clear Creek CSD would have a supply of 15,300 ac-ft during 2030 normal-year operating conditions, but would be cut back to 6,200 ac-ft during a 2030 critically dry year. Clear Creek CSD has a fairly large peaking factor of 3.4, which is caused by the high volume of seasonal agricultural land uses and water demands within the district. With this peaking factor, Clear Creek CSD could see a peak daily flow of 32 mgd. Figure 5-4 presents Clear Creek CSD's water supply and demand from 2005 to 2030.

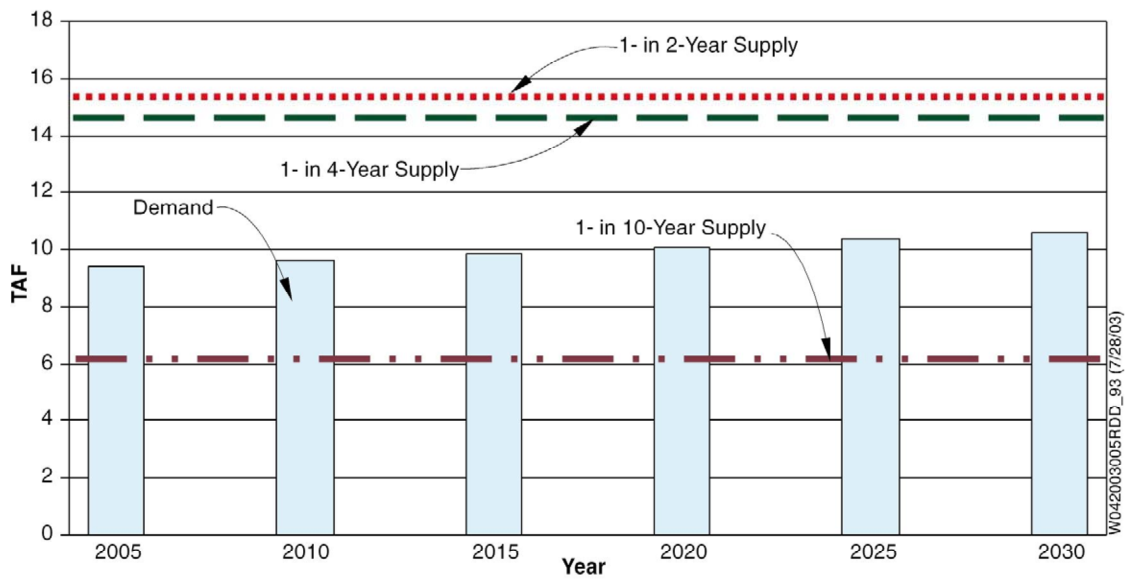

FIGURE 5-4
CLEAR CREEK COMMUNITY SERVICES DISTRICT
EXISTING SUPPLY VERSUS LONG-TERM DEMAND

Under both Alternatives 3A and 3B, Clear Creek CSD would receive surface-water transfers to cover projected 2030 supply deficits, with the supplemental supply diverted through the existing system from Whiskeytown Lake. A transfer of 2,800 ac-ft would be required under a 1- in 10-year CVP cutback condition. The transfer supply would come from McConnell Foundation or ACID's available surface-water supply.

Regional Alternative Infrastructure Requirements

Under the regional alternatives presented, Clear Creek CSD would not have regional infrastructure requirements. Therefore, Clear Creek CSD would continue diverting water from the Whiskeytown Reservoir via the Muletown Conduit.

Cottonwood Water District

Existing System

The Cottonwood Water District has a readily accessible and abundant supply of groundwater. Cottonwood Water District currently operates five groundwater wells at various locations within the district. These wells have an average pumping capacity of 1,000 gpm. Currently, the Town of Cottonwood does not require water treatment. The Cottonwood Water District has one storage tank with a capacity of 42,000 gallons, which is used for fire protection and emergencies. The Cottonwood Water District distribution system consists of 4- to 12-inch-diameter transmission mains, which were installed from the years 1956 to 1980. The majority of the pipe material consists of asbestos-cement and polyvinyl-chloride pipe. The Cottonwood Water District is periodically upgrading its system by replacing the AC pipe with PVC pipe. The Cottonwood Water District is currently in the process of developing a new water master plan, which proposes a new 1-million gallon storage tank providing storage for peak-day demands and emergency use. The new water master plan would have a 10-year planning period.

Supply and Demand Summary

In 1995, Cottonwood Water District pumped 600 ac-ft of groundwater. For 2030, Cottonwood Water District would need to produce about 1,100 ac-ft of water. This annual demand would produce an annual average flow of 680 gpm. The Cottonwood Water District could see peak flows up to 2.4 times greater than normal. The Cottonwood Water District's peak daily flow during the year 2030 would be approximately 1,636 gpm. Figure 5-5 presents the Cottonwood Water District's future water supply and demand from 2005 to 2030.

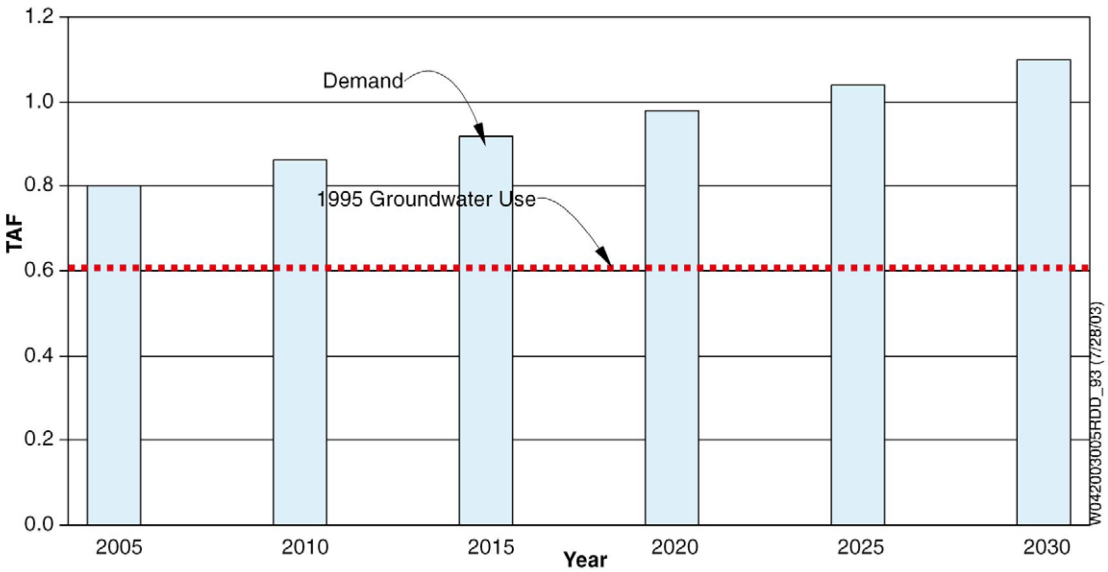

FIGURE 5-5
COTTONWOOD WATER DISTRICT
EXISTING SUPPLY VERSUS LONG-TERM DEMAND

Regional Alternative Infrastructure Requirements

Cottonwood Water District's long-term water supply infrastructure requirements are associated with the continued use of local groundwater resources to meet water supply requirements. Under both Alternatives 3A and 3B, Cottonwood Water District would need to expand and rehabilitate existing wells and/or add new wells as demands increase between 2005 and 2030. With a 2030 peak-day demand of approximately 2.3 mgd and an existing well capacity of 7.2 mgd, no expansion of the supply system would be required to meet capacity needs.

Jones Valley County Service Area

Existing System

Jones Valley CSA draws water directly from Shasta Lake by a pump station with two pumps with a combined capacity of 550 gpm. The water is then pumped to the treatment plant, which consists of a clarifier, filtration, and chlorination. The treatment plant capacity is similar to the pumping capacity of 550 gpm. Jones Valley CSA has two storage tanks capable of storing 100,000 and 225,000 gallons. The pumping is controlled by a telemetry system, which communicates the level in the two storage tanks. The water is distributed to customers through an 8-inch-diameter transmission main. The current system was upgraded in 1996; therefore, the majority of the facilities are in good condition. All facilities are owned and operated by Shasta County. Jones Valley CSA does not have a current water master plan.

Supply and Demand Summary

For the year 2030, Jones Valley CSA would need to pump 400 ac-ft of water from Shasta Lake, which would create an annual average flow of 250 gpm. Jones Valley CSA would not require additional transfers in the years leading up to 2030. Jones Valley CSA would have a peaking factor of approximately 2.0, which would create peak daily flows of approximately 500 gpm. The two storage tanks could accommodate these future peak flows. Figure 5-6 presents Jones Valley CSA's projected water supply and demand from 2005 to 2030.

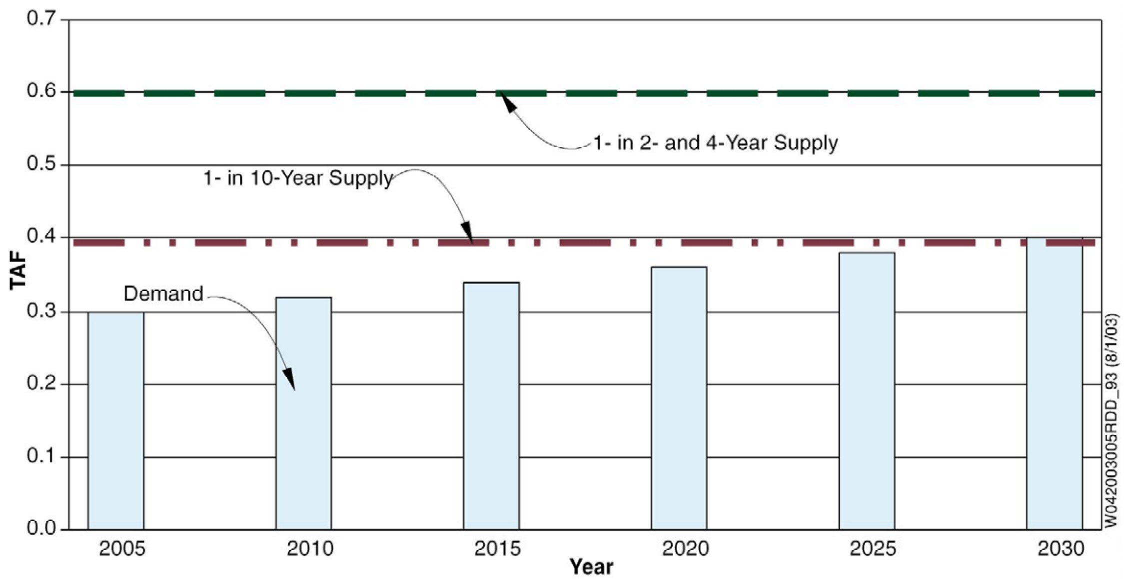

FIGURE 5-6
JONES VALLEY COUNTY SERVICE AREA
EXISTING SUPPLY VERSUS LONG-TERM DEMAND

Regional Alternative Infrastructure Requirements

The Jones Valley CSA water supply system has adequate capacity to meet the long-term projected supply requirements. The raw water pump station could require a minor expansion of about 100 gpm to meet peak-day 2030 demands. No transfers or exchanges of supply would be anticipated for Jones Valley CSA under either Alternative 3A or 3B.

Keswick County Service Area

Existing System

Keswick CSA diverts water from Whiskeytown Lake by way of the Spring Creek Conduit. The water is gravity fed to a treatment plant with a capacity of 250 gpm. The treatment plant consists of coagulation, filtration, and chlorination. Water is then delivered to two storage tanks, which maintain pressure within the system. The storage tanks have capacities of 150,000 and 50,000 gallons. The water is delivered to customers through an 8-inch-diameter main, which supplies the remaining 6- and 4-inch-diameter laterals. The system was originally constructed in 1964, but several upgrades have occurred in the years 1984 through 1987. Keswick CSA does not have a current water master plan.

Supply and Demand Summary

Keswick CSA would not require additional water transfers through the year 2030. For the year 2030, Keswick CSA would have an annual water demand of 300 ac-ft, which would result in an annual average flow of 190 gpm. Using the applied peaking factor of 2.0, the district could see peak daily flows of about 380 gpm. Figure 5-7 presents Keswick CSA's projected water supply and demand from 2005 to 2030.

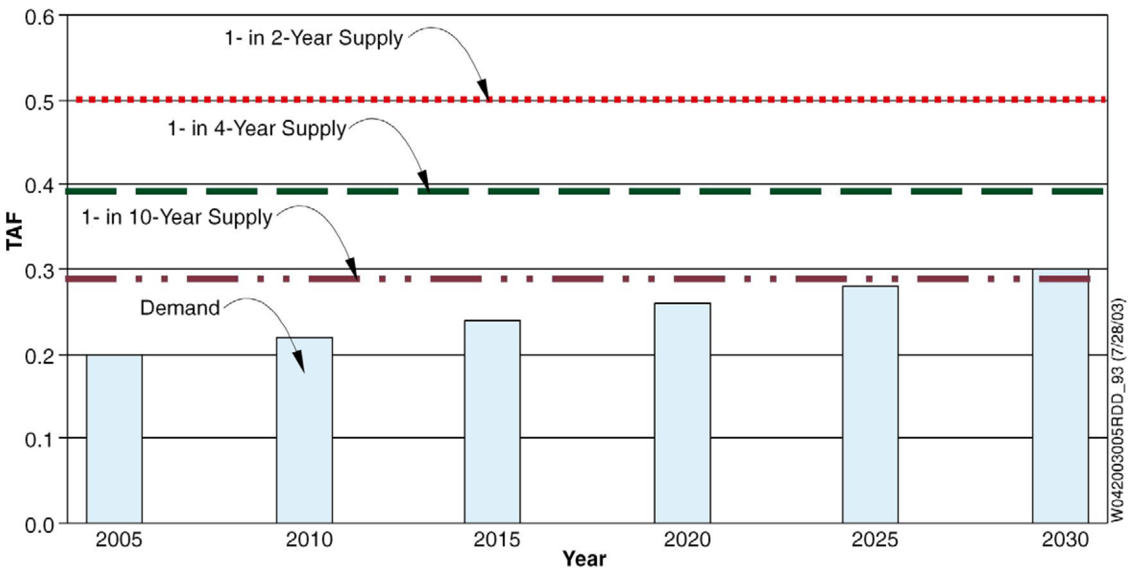

FIGURE 5-7
KESWICK COUNTY SERVICE AREA
EXISTING SUPPLY VERSUS LONG-TERM DEMAND

Regional Alternative Infrastructure Requirements

Keswick CSA's water supply system would require an expansion of the treatment plant by about 0.4 mgd before 2030. Keswick CSA would not require any other major improvements to its infrastructure by 2030. Keswick CSA would not require additional water supply through the year 2030.

Mountain Gate Community Services District

Existing System

Mountain Gate CSD uses a combination of surface water and groundwater. Mountain Gate CSA draws surface water directly from Shasta Lake. The intake pump station consists of two pumps with a combined capacity of 2,000 gpm, located on the northwest edge of Beaver Island on Shasta Lake. A second intake pump station is located at Marina 4 in Bridge Bay, which includes one pump with a capacity of 600 gpm. The surface water is treated by inline, dual-media pressure filters, which have a capacity of 2 mgd. The treatment process involves chlorine injections prior to and after filtration. The plant has an activated carbon system, which can be used for odor and taste control. Mountain Gate CSA has five storage tanks capable of storing 1.1 million gallons. The groundwater is of good quality, but the supply is not reliable during dry periods. The transmission main consists of a 12-inch-diameter ductile iron pipe, which extends from the intake pump station at Beaver Island to the booster pump station and then to the treatment plant. Mountain Gate CSA owns all of the facilities in the system. Mountain Gate CSA does not have a current water master plan. The latest water master plan was completed in 1977. Mountain Gate CSA is currently in the process of funding a new water master plan.

Supply and Demand Summary

Mountain Gate CSA shows deficits in the year 2030. For the year 2030, Mountain Gate CSA would require an annual amount of 1,900 ac-ft of water, which would result in an annual average flow of 800 gpm. The majority of this water would be accommodated by surface water, supplemented by groundwater. Mountain Gate CSA has a CVP contract for 100 ac-ft of project water and a 1,000-ac-ft contract with the SCWA. The Mountain Gate CSA's surface-water allocation would be cut back to 700 ac-ft during a 2030 critically dry year. During critically dry years, Mountain Gate CSA's groundwater supplies are assumed to be not available. Mountain Gate CSA has a current peaking factor of approximately 2.4, which would produce a peak daily flow of 1,920 gpm (2.8 mgd). Figure 5-8 presents Mountain Gate CSA's projected water supply picture from 2005 to 2030.

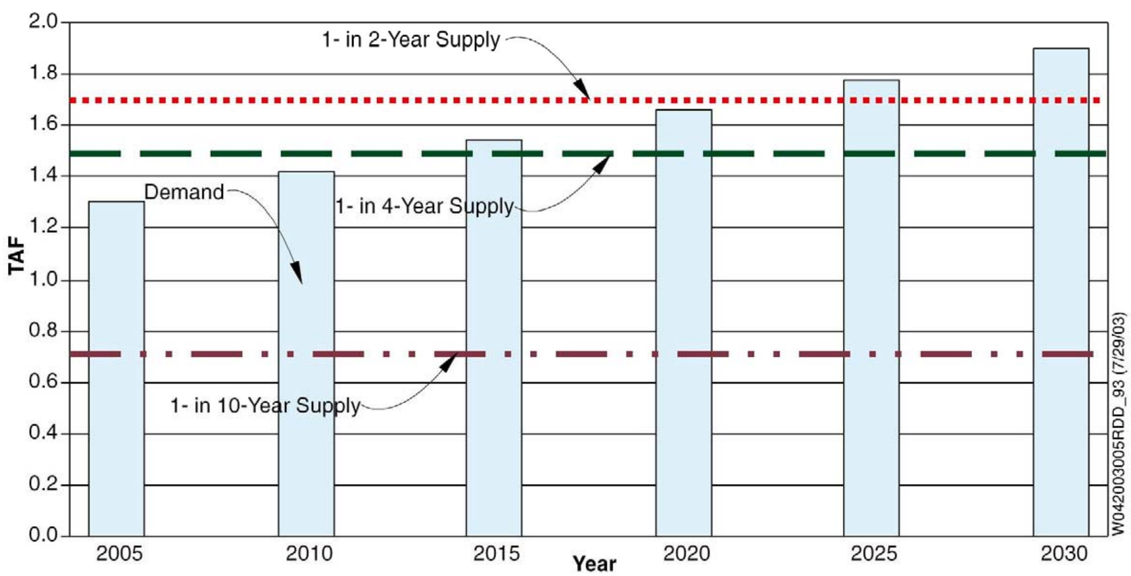

FIGURE 5-8
MOUNTAIN GATE COMMUNITY SERVICES DISTRICT
EXISTING SUPPLY VERSUS LONG-TERM DEMAND

Regional Alternative Infrastructure Requirements

Mountain Gate CSD's current water supply infrastructure is in good condition and is capable of handling the future supply requirements. Mountain Gate CSD would need to expand its water treatment plant by approximately 1 mgd prior to 2030. Mountain Gate CSD would begin to have regular deficits (1- in 4-years) after 2010, and would have occasional minor deficits between now and 2010 under a 1- in 10-year CVP cutback condition. By 2030, Mountain Gate CSD would face deficits of up to 400 ac-ft per year. In the year 2030, under critically dry-year conditions, Mountain Gate CSD's would see deficits of approximately 1,000 ac-ft, which reflects the assumption that groundwater is not available in a critically dry year.

Under both Alternatives 3A and 3B, Mountain Gate CSD would receive supplemental supply through surface-water transfers from either ACID or McConnell Foundation. Mountain Gate CSD's primary short-term focus through 2005 should be to work with the RAWC members to ensure that the CVP contract renewal terms would allow maximum flexibility for water transfers, so that the necessary supplemental supplies could be provided.

City of Redding

Existing System

The City of Redding uses both surface water and groundwater to supply customers in its service area. Three main sources of water for the City of Redding include Whiskeytown Lake, Sacramento River, and the Enterprise Aquifer. The facilities of greatest concern for the City of Redding are the Buckeye WTP and the Enterprise Wellfield. The Foothill WTP, which treats water pumped from the Sacramento River, is not a concern, because the majority of the City of Redding's growth is not expected to occur in this area. However, the condition of Pump Station No. 1 is of concern because of age and regulatory compliance (fish passage) issues. The City of Redding diverts water from the Spring Creek Conduit to the Buckeye WTP, which has a capacity of 6.5 mgd. The Enterprise Wellfield currently consists of 14 wells with a combined capacity of 12 mgd. The City of Redding's current water master plan was completed in 2001. Water master plan system improvements over the next 10 years include expanding the Enterprise Wellfield, transmission main replacements, expanding the Buckeye WTP in 2007, upgrades to Pump Station No. 1, and general system improvements.

Supply and Demand Summary

For the year 2030, the City of Redding would require an additional 10,000 ac-ft surface-water transfer. The City of Redding would also increase groundwater pumping by 19,100 ac-ft per year by the year 2030. The City of Redding would have an approximate peaking factor of 2.5. Figure 5-9 presents the City of Redding's projected water supply and demand from 2005 to 2030.

Regional Alternative Infrastructure Requirements

The City of Redding's basic water supply infrastructure would require regularly scheduled expansions to key components throughout the 2005 to 2030 planning horizon. Most of these system improvements would be driven by basic supply requirements, periodic improvements to replace existing facilities, and others required to allow the city to transfer water to other purveyors.

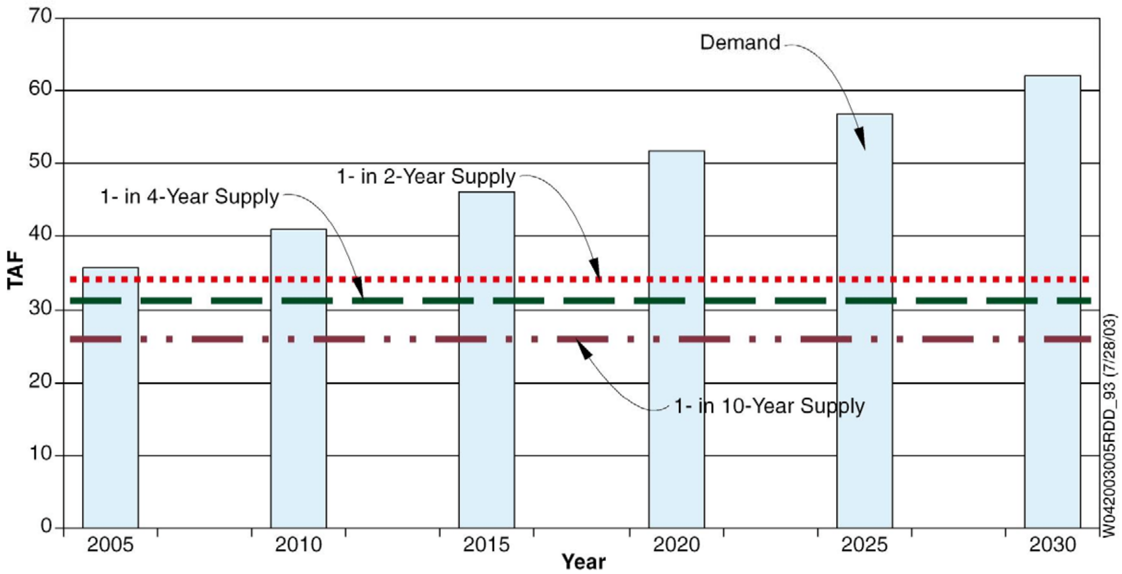

FIGURE 5-9
CITY OF REDDING
EXISTING SUPPLY VERSUS LONG-TERM DEMAND

Under Alternatives 3A and 3B, the City of Redding would need to obtain approximately 10,000 ac-ft of new surface-water supply through a long-term transfer with ACID. Short-term transfers of up to 2,500 ac-ft (for 1- in 10-year cutbacks) would also be required, from either ACID or McConnell Foundation. For both alternatives, this would require an expansion of the City of Redding's surface-water treatment capacity, beginning around 2007 with the 7-mgd expansion of the Buckeye WTP. A future expansion, beyond 2010, would require approximately 14 mgd of new capacity by either expanding Buckeye WTP again or building a separate WTP at a new location. The City of Redding would also need to expand its groundwater supply capacity, adding up to 12 new wells in the Enterprise Wellfield area over the next 20+ years, for a long-term increase of approximately 20,000 ac-ft per year of groundwater supply.

Under both alternatives, the City of Redding would be supplying groundwater to BVWD through a future intertie between the City of Redding's Enterprise Zone and the BVWD system. Two additional wells (2 miles of 24-inch-diameter pipeline and a booster pump station) would be required to provide the projected annual transfers of between 3,000 and 7,800 ac-ft per year to BVWD.

With the timing and magnitude of the projected supply deficits, the City of Redding would need to take the initial steps necessary to provide the needed infrastructure and establish a contractual basis for the future supplies. The 10,000-ac-ft transfer of surface water would need to be completed in association with the renewal of both ACID's and the City of Redding's CVP supply contracts, scheduled to be completed by 2005. Initial planning for the expansion of the Buckeye WTP would need to begin by late 2003 to allow the expansion to be complete and in service by 2007. The timing for the additional wells, pipeline, and booster pump to supply BVWD would depend on the available capacity within the City of Redding's system associated with the recent addition of new wells and the Airport Road pipeline. The City of Redding would need to study and evaluate options for how best to integrate the additional wells and conveyance systems needed to supply BVWD's short- and long-term needs.

Shasta Community Services District

Existing System

Shasta CSD diverts water from Whiskeytown Lake via the Spring Creek Conduit. Shasta CSD's water treatment plant is an inline filtration plant with a capacity of 2 mgd (1,390 gpm). The water pressure can be low during periods of high electrical demand. The district has five booster pump stations, which are owned by Shasta CSD. The booster pump stations vary in size and age. Shasta CSD has 10 storage tanks throughout its service area. The storage tanks have a combined storage volume of 735,000 gallons. Shasta CSD is in the process of developing a new water master plan that will be completed this year. Currently, Shasta CSD does not have any groundwater wells in production, but three test wells are in the planning stages.

Supply and Demand Summary

Shasta CSD would need supplemental surface-water supplies in the year 2030. In the year 2030, the Shasta CSD would have to accommodate an annual average flow of 1,900 ac-ft per year (1,178 gpm). Shasta CSD has a future CVP contract supply of 1,000 ac-ft during normal years, but a 600-ac-ft cutback would occur in a critically dry year. Shasta CSD could see peak flows up to 2.8 times larger than normal. The peak daily flow during the year 2030 would be approximately 3,300 gpm. Figure 5-10 presents the Shasta CSD's projected water supply and demand from 2005 to 2030.

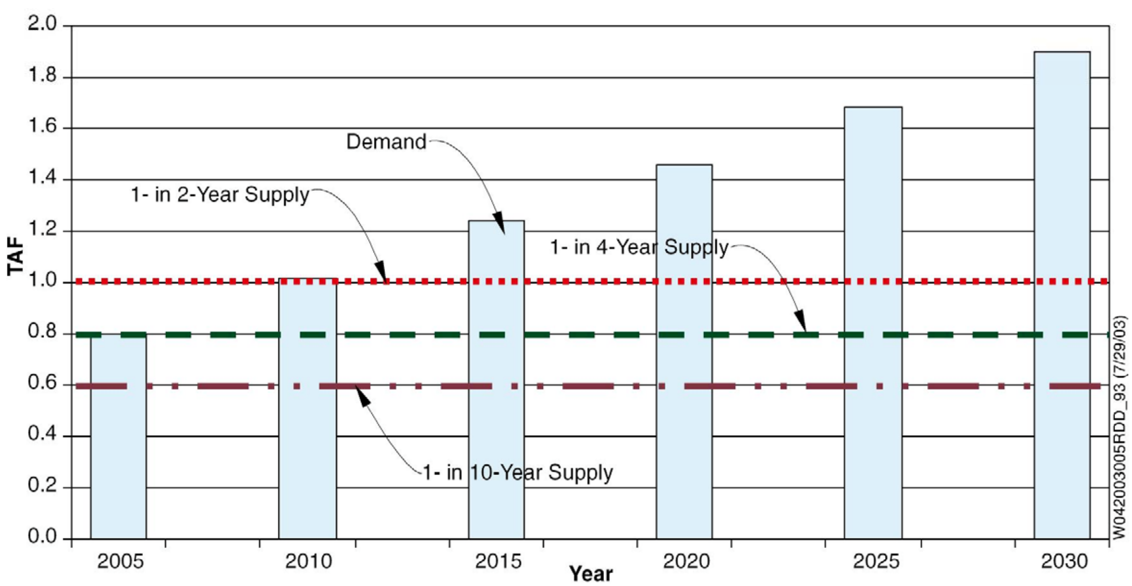

FIGURE 5-10
SHASTA COMMUNITY SERVICES DISTRICT
EXISTING SUPPLY VERSUS LONG-TERM DEMAND

Regional Alternative Infrastructure Requirements

Shasta CSD's existing raw water supply infrastructure is generally adequate to meet the future water supply requirements. The water treatment plant would need to be expanded and upgrades could be needed to meet future regulatory requirements. Under both Alternatives 3A and 3B, Shasta CSD would receive surface-water transfers to cover projected supply deficits. In 2030, the transfers would consist of approximately 1,000 ac-ft per year under 1- in 4-year CVP cutback conditions. Shasta CSD would not require additional transfers in a 1- in 10-year cutback condition due to the reduction in demand provided for by the water supply reliability targets. Transfers would come from either ACID or McConnell Foundation's available surface-water supply. Shasta CSD would see projected deficits in 2005 under critically dry-year cutback conditions (1- in 10-year cutbacks). Because of the relatively short horizon for the occurrence of deficits, Shasta CSD's priority in the short term (through 2005) should be to support steps taken by the RAWC to ensure that maximum flexibility for transfers would be provided for through the terms of the CVP contract renewals.

City of Shasta Lake

Existing System

The City of Shasta Lake diverts water from Shasta Lake through the USBR-owned pump station located within Shasta Dam. The capacity of the pump station varies depending on the water surface level of the lake. The pump station capacity ranges from 6,200 to 2,500 gpm, depending on the lake level. The diverted water is pumped to the nearby treatment facility, which has a maximum capacity of 5.9 mgd. The City of Shasta Lake's distribution system is supplied by gravity pressure beyond the treatment facility. The City of Shasta Lake currently has five storage tanks with a combined capacity of 2.9 million gallons, which provide for peak day and emergency situations. The City of Shasta Lake's distribution system piping ranges from 2 to 10 inches in diameter, and material varies from ductile iron to asbestos-cement. The majority of the distribution system was built using excess pipe from the construction of the Shasta Dam. The City of Shasta Lake currently has a 10-inch-diameter intertie with BVWD, which has been activated in recent years. The City of Shasta Lake currently has a service agreement with the City of Redding, whereby Redding serves City of Shasta Lake customers that border the City of Redding service area. The City of Shasta Lake has a current water master plan, which was completed in 1998. The master plan involves several milestones for immediate and long-term system improvements. The immediate improvements include adding additional storage, replacing the intake pumps (to be accomplished by the USBR), and expanding the existing WTP. The long-term improvements include upgrading and expanding the existing transmission mains.

Supply and Demand Summary

The City of Shasta Lake would require an annual water supply of 6,300 ac-ft (3,900 gpm) in the year 2030. The City of Shasta Lake would need an additional surface-water transfer to accommodate this increase in demand and growth. During peak-flow conditions, the City of Shasta Lake could see demands 2.3 times larger than normal, which would create a peak flow of 9,000 gpm. The City of Shasta Lake currently has a CVP M&I contract for 2,800 ac-ft during a normal year, but is attempting to reinstate 2,200 ac-ft of water that was removed from its CVP contract allocation when the city was incorporated. The city's current contract allocation would be cut back to 1,700 ac-ft in a critically dry year. Figure 5-11 presents the City of Shasta Lake's projected water supply and demand from 2005 to 2030.

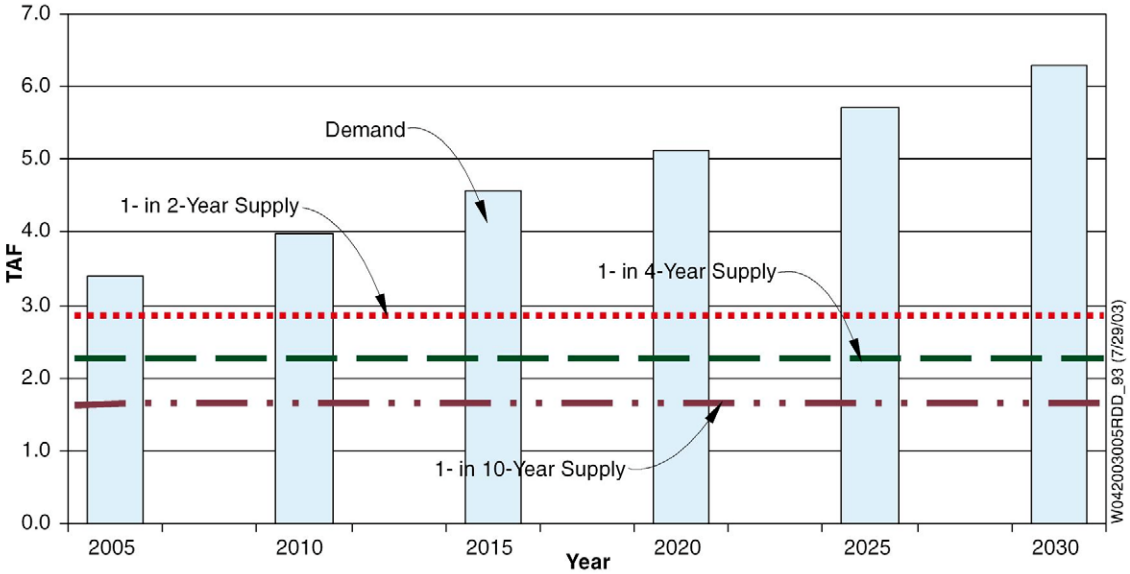

FIGURE 5-11
CITY OF SHASTA LAKE
EXISTING SUPPLY VERSUS LONG-TERM DEMAND

Under both Alternatives 3A and 3B, the City of Shasta Lake would receive surface-water transfers to cover projected 2030 supply deficits. The transfers would range from 4,000 and 1,000 ac-ft per year under 1- in 4-year and 1- in 10-year CVP cutback conditions, respectively. Transfers would come from either ACID or McConnell Foundation's available surface-water supply. The City of Shasta Lake would have projected deficits in 2005 for all CVP cutback conditions. Because of the short horizon for the occurrence of deficits, the City of Shasta Lake's priority should be to secure a surface-water transfer for 2,000 ac-ft now, and support steps taken by the RAWC to ensure maximum flexibility for transfers is provided for through the terms of the CVP contract renewals.

Regional Alternative Infrastructure Requirements

The refined alternatives proposed for the City of Shasta Lake would not require new regional facilities. The City of Shasta Lake would continue diverting water through the USBR-owned pump station at Shasta Dam.

Future Supply Cost Evaluation

In the PAC and TAC workshops, representatives of the purveyors expressed concerns regarding future water supply costs. Surface-water transfers and conjunctive management groundwater pumping may involve additional costs that must be borne by the purveyor receiving the water. Future O&M costs have not been estimated and are assumed to remain constant. All of the presented costs reflect present 2003 dollars. These gross costs reflect each purveyor's general future water supply costs and will be used as a baseline for comparing the differences in costs associated with the refined alternatives. At this level of detail, the estimated costs are representative of a feasibility-level estimate (-50 to +30 percent). Table 5-2 presents each purveyor's existing water supply and costs.

TABLE 5-2
Existing Water Supply Costs
Redding Basin Water Resources Management Plan

Purveyors	Water Supply (ac-ft)	2003 Water Cost ($/ac-ft)	In-house Cost ($/ac-ft)	Total Water Supply Cost ($/ac-ft)
City of Anderson				
Groundwater	2,100	0	290	290
ACID				
Pre-1914	165,000	0	8	8
CVP Agriculture	10,000	2	8	10
BVWD				
CVP M&I	7,578	74	140	214
CVP Agriculture	17,000	53	140	193
Groundwater	3,900	0	160	160
Centerville CSD				
CVP M&I	2,900	44	270	314
CVP (Townsend Flat)	900	67	270	337
Clear Creek CSD				
CVP M&I	10,300	60	160	220
CVP Agriculture	5,000	32	160	192
Cottonwood Water District				
Groundwater	600	0	375	375
Jones Valley CSA				
CVP M&I	600	49	521	570
Keswick CSA				
CVP M&I	500	49	424	473
Mountain Gate CSD				
CVP M&I	1,100	22	545	566
Groundwater	600	0	545	545
City of Redding				
CVP M&I	9,300	29	184	213
Pre-1914	17,800	0	184	184
Groundwater	6,800	0	52	52
Shasta CSD				
CVP M&I	1,000	27	262	289
City of Shasta Lake				
CVP M&I	2,800	15	480	495

The future unit cost of water supply for each of the alternatives was developed based on the following three components:

- Infrastructure capital costs such as the cost of a new pipeline and wellfield
- Annual average O&M costs incurred for pumping and treating the supply
- Transfer-related contract and administrative costs such as CVP water service contract costs and administrative/incentive costs for the supplier of the transferred water

Direct surface-water transfers would involve transfers of surface water from the McConnell Foundation and ACID to purveyors with future water deficits. Purveyors receiving direct surface-water transfers would be required to pay their full future CVP M&I rate for the transferred water. For the transfer of ACID water, a $5 incentive/administrative cost would be added per ac-ft of water transferred. Purveyors receiving future groundwater supplies would pay annual O&M costs for the operation of the groundwater wells (cost per ac-ft of water received) and capital costs for construction of new regional groundwater wells.

Conjunctive management to facilitate transfers would involve developing groundwater wells to make ACID surface water available for transfer. The purveyors who require surface-water transfers from ACID could be required to pay the annual O&M and capital costs for the construction and operation of the groundwater wells. In addition to these costs, the analysis assumes that purveyors would be required to pay a $5 per ac-ft incentive/ administrative cost to ACID. In some cases, purveyors could be required to pay for the loss of foregone power created by the change in the point of diversion. The purveyors receiving water from the McConnell Foundation or ACID project water would be required to pay their full future CVP M&I contract rate for water transferred.

Following is a summary of the cost components that could be applicable to specific sources of supplemental water supplies:

- **Local purveyor surface-water O&M cost.** This cost would include the individual purveyor's surface water O&M costs. The cost would typically include power costs, transmission pipeline repairs, staff salaries, treatment chemicals, equipment, and materials.
- **Local purveyor groundwater O&M cost.** This cost would include the individual purveyor's groundwater O&M costs. The cost would typically include power costs, transmission pipeline repairs, staff salaries, treatment chemicals, equipment, and materials.
- **CVP costs.** This cost would be each purveyor's CVP rate for diverted surface water. The costs would vary for each purveyor depending upon type of water use and other specific contract terms, including repayment provisions for USBR capital and O&M costs. The CVP rates would be applied to all future surface-water transfers between purveyors. Final contract terms are still being negotiated, but direct transfers of CVP surface water would be subject to the higher of two CVP rates: (1) the receiver's CVP rate; or (2) the transferer's CVP rate.
- **ACID incentive/administrative cost**. This cost would be applied to all ACID surface-water transfers.

- **City of Redding regional groundwater well costs.** This cost would involve the O&M costs to the City of Redding for groundwater pumping. The costs would include power costs, treatment chemicals, operations of wells, and maintenance of wells. The cost would also include an annual finance cost, for the capital cost of the regional wells. The capital cost of one groundwater well would be approximately $600,000, which would include treatment processes. The power costs were based on a rate of $.10 per kilowatt-hour. The finance cost was developed over a period of 30 years at an interest rate of 6 percent. This cost is specific to BVWD and would include a new pipeline and booster pump station, which would be required to deliver the water to BVWD.
- **ACID conjunctive use groundwater well costs**. This cost would involve the O&M costs for groundwater pumping. The costs would include power, operations of wells, and maintenance of wells. The cost would also include an annual finance cost, for the capital cost of the conjunctive use wells. The cost of one agricultural well would be approximately $450,000 and would not include treatment. The power costs were based on a rate of $0.10 per kilowatt-hour. The finance cost was developed over a period of 30 years at an interest rate of 6 percent.

City of Anderson Costs

The City of Anderson currently has a local purveyor O&M cost of $290 per ac-ft of groundwater pumped. The City of Anderson does not have any other associated costs for their water supply.

Alternative 3A

The City of Anderson would have one associated cost under Alternative 3A, which would be local purveyor O&M costs for groundwater pumping.

Alternative 3B

This alternative would require the same costs as Alternative 3A.

Anderson-Cottonwood Irrigation District Costs

ACID currently has a contract rate of $2 per ac-ft for CVP water diverted from the Sacramento River. The ACID has an associated O&M cost of $8 per ac-ft for water diverted. A $26 per ac-ft future contract rate for the CVP water would be expected. The costs associated with ACID's future water supply are presented in Table 5-3.

TABLE 5-3
Anderson-Cottonwood Irrigation District Existing and Future Water Rates
Redding Basin Water Resources Management Plan

Water Rates	USBR CVP Agriculture	Local Purveyor Surface-water O&M	Conjunctive Use Wells
Existing	2.00	8.00	
Future	26.00	8.00	32.00

Note:

All data in $/ac-ft.

ACID's costs to serve its water users would be $8 per ac-ft for base supply and $34 for CVP supply. Costs for raw water transferred to other purveyors would range between $31 for transfer of CVP supply to $32 for conjunctive management supply. These costs do not include local purveyor O&M charges. The concept-level costs for the conjunctive management supply and the forecast CVP supply costs indicate that both of these sources would be cost-competitive supply options for most purveyors in the Redding Basin.

Alternative 3A

The costs associated with this alternative would include local purveyor surface-water O&M costs and USBR CVP agriculture costs for the project water.

Alternative 3B

The costs associated with this alternative would include local purveyor surface-water O&M costs, USBR costs for CVP water, and conjunctive use groundwater wells costs.

Bella Vista Water District Costs

The BVWD has O&M costs associated with the two types of water supply. The current local purveyor O&M surface-water costs would be $140 per ac-ft of water diverted. The local purveyor O&M costs for groundwater would be $160 per ac-ft of groundwater pumped. The proposed future costs for water are presented in Table 5-4.

TABLE 5-4
Bella Vista Water District Existing and Future Water Rates
Redding Basin Water Resources Management Plan

	Agriculture		Local Purveyor				
Water Rates	M&I	USBR CVP	Surface-water O&M	Groundwater O&M	ACID Incentive/ Administrative	City of Redding Regional Groundwater Wells	Conjunctive Use Wells
Existing	73.50	53.32	140.00	160.00			
Future	95.89	75.67	140.00	160.00	5.00	80.00	32.00

Note:

All data in $/ac-ft.

BVWD's future total supply costs using its CVP contract supply would be $236 per ac-ft for M&I and $216 for agricultural supply. Under Alternative 3A, supplemental supply costs would range between $132 per ac-ft for City of Redding groundwater to $241 per ac-ft for ACID surface water. Under Alternative 3B, supplemental supply costs would range between $132 per ac-ft for City of Redding groundwater to $177 per ac-ft for ACID conjunctive management supply. The concept-level cost ranges for both alternatives indicate that both Alternatives 3A and 3B would provide a supplemental supply that could have substantially lower costs than future CVP supplies.

Alternative 3A

The costs associated with this alternative would include local purveyor surface-water O&M costs, local purveyor groundwater O&M costs, USBR costs for CVP water, ACID incentive/ administrative cost, and City of Redding regional groundwater well costs.

Alternative 3B

The costs associated with this alternative would include local purveyor surface-water O&M costs, local purveyor groundwater O&M costs, USBR CVP costs for water, City of Redding regional groundwater well costs, ACID incentive/administrative costs, and ACID conjunctive use groundwater well costs.

Centerville Community Services District Costs

Centerville CSD currently has a local O&M costs of $270 per ac-ft of water diverted, and pays the USBR $43.84 per ac-ft of water diverted, for CVP M&I project water. Centerville CSD also pays $60,000 annually for repayment for the purchase of the Townsend Flat water. Table 5-5 presents the costs associated with the refined alternatives.

TABLE 5-5
Centerville Community Services District Existing and Future Water Rates
Redding Basin Water Resources Management Plan

Water Rates	CVP M&I	CVP Base (Townsend Flat)	Local Purveyor Surface-water O&M	ACID Incentive/ Administrative	Conjunctive Use Wells
Existing	43.84	66.67	270.00		
Future	43.84	66.67	270.00	5.00	32.00

Note:
All data in $/ac-ft.

Centerville CSD's future water supply costs would vary between $314 for its CVP supply and $337 for its Townsend Flat supply. Supplemental transfers from ACID and McConnell Foundation are projected to have costs of approximately $319 and $314, respectively. The projected future costs indicated that Centerville CSD could obtain the necessary supplemental supplies at costs very close to those for its existing sources.

Alternative 3A

The costs associated with this alternative would include local purveyor surface-water O&M costs, USBR costs for CVP M&I water, and ACID incentives/administrative costs.

Alternative 3B

The costs associated with this alternative would include annual local purveyor surface-water O&M costs, USBR costs for CVP M&I water, ACID incentive/administrative cost, and ACID conjunctive use groundwater well costs.

Clear Creek Community Services District Costs

Clear Creek CSD has a local purveyor surface-water O&M cost of $160 per ac-ft of water diverted. The existing and future CVP rates and additional costs for the refined alternatives are presented in Table 5-6.

TABLE 5-6
Clear Creek Community Services District Existing and Future Water Rates
Redding Basin Water Resources Management Plan

Water Rates	USBR CVP M&I	USBR CVP Agriculture	Local Purveyor Surface-water O&M	ACID Incentive/ Administrative	Conjunctive Use Wells
Existing	46.00	13.50	160.00		
Future	193.22		160.00	5.00	32.00

Note:
All data in $/ac-ft.

Clear Creek CSD's future water supply costs would vary between $199 and $353 per ac-ft for CVP agriculture and M&I supply, respectively. Transfers from McConnell Foundation would have projected costs of approximately $353 per ac-ft. Supplemental transfers from ACID would have costs of approximately $197 to $358 for conjunctive management and direct surface-water transfers, respectively. The projected future costs indicate that Clear Creek CSD could obtain the necessary supplemental supplies at costs very close to those for its existing sources.

Alternative 3A

The costs associated with this alternative would include local purveyor surface-water O&M costs, USBR costs for CVP water, and ACID incentive/administrative cost.

Alternative 3B

The costs associated with this alternative would include local purveyor surface-water O&M costs, USBR costs for CVP water, ACID incentive/administrative cost, and ACID conjunctive use groundwater wells costs.

Cottonwood Water District Costs

The Cottonwood Water District currently has a local purveyor O&M cost of approximately $375 per ac-ft for water pumped. The Cottonwood Water District does not pay any costs for the raw water.

Alternative 3A

The costs associated with this alternative would include local purveyor groundwater O&M costs.

Alternative 3B

The costs associated with this alternative would be the same as Alternative 3A.

Jones Valley County Service Area Costs

Jones Valley CSA has a local purveyor surface-water O&M cost of $521 per ac-ft of water diverted. Jones Valley CSA has a proposed CVP M&I rate of $48.66 per ac-ft of water diverted from Shasta Lake.

Alternative 3A

The costs for this alternative would have local purveyor O&M surface-water costs and USBR costs for CVP M&I water.

Alternative 3B

The costs for this alternative would be similar to Alternative 3A.

Keswick County Service Area Costs

Keswick CSA has a local purveyor surface water O&M cost of $424 per ac-ft of water diverted. Keswick CSA has a proposed future raw water cost to the USBR of $48.71 per ac-ft of CVP water delivered.

Alternative 3A

The costs for this alternative would include local purveyor O&M surface-water costs and CVP costs for water.

Alternative 3B

The costs for this alternative would be similar to Alternative 3A.

Mountain Gate Community Services District Costs

Mountain Gate CSA currently has a local purveyor O&M cost of $544.87 per ac-ft of water delivered. Mountain Gate CSA has a proposed future contract rate of $22.03 for CVP contract water. Table 5-7 presents the associated costs for the two refined alternatives.

TABLE 5-7
Mountain Gate Community Services District Existing and Future Water Rates
Redding Basin Water Resources Management Plan

Water Rates	USBR CVP M&I	Local Purveyor O&M	ACID Incentive/ Administrative	Conjunctive Use Wells
Existing	21.50	544.87		
Future	22.03	544.87	5.00	32.00

Note:
All data in $/ac-ft.

Mountain Gate CSD's future water supply costs are projected to be $567 per ac-ft. The transfer supply costs are projected to range from approximately $567 to $572 per ac-ft for McConnell Foundation and ACID supplies, respectively. The projected costs indicate that Mountain Gate CSD could obtain the required supplemental supplies at costs approximately equal to its CVP supply costs.

Alternative 3A

The costs associated with this alternative would include local purveyor O&M costs, USBR costs for CVP water, and ACID incentive/administrative cost.

Alternative 3B

The costs associated with this alternative would include local purveyor O&M costs, USBR costs for CVP water, ACID incentive/administrative cost, and ACID conjunctive use groundwater well costs.

City of Redding Costs

The City of Redding has two O&M costs associated with the two types of water supply. The current local purveyor O&M surface-water costs are $184 per ac-ft of water diverted. The local purveyor O&M costs for groundwater would be $52 per ac-ft of groundwater pumped. The City of Redding has two future proposed CVP water rates, for Sacramento River water and Whiskeytown Lake water. The Sacramento River costs would be $31.08 per ac-ft of water diverted. The Whiskeytown Lake CVP costs would be $28.05 per ac-ft of water diverted. Table 5-8 presents the future proposed costs for the two refined alternatives.

TABLE 5-8
City of Redding Existing and Future Water Rates
Redding Basin Water Resources Management Plan

	USBR CVP M&I				Local Purveyor		
Water Rates	Sacramento	Whiskeytown	Existing Groundwater	ACID Incentive/ Administrative	Surface-water O&M	Groundwater O&M	Conjunctive Use Wells
Existing	28.61	26.70	52.00				
Future	31.08	28.05		5.00	184.00	52.00	32.00

Note:
All data in $/ac-ft.

The City of Redding's future water supply costs range from $52 per ac-ft for Enterprise Wells supply to $215 per ac-ft for CVP M&I supply via the Buckeye WTP. The supplemental supply from the 10,000 ac-ft ACID transfer would have a total supply cost of approximately $220 per ac-ft, which is comparable to the City's Buckeye WTP supply costs.

Alternative 3A

The costs associated with this alternative would include local purveyor O&M for surface-water, local purveyor O&M for groundwater, USBR CVP M&I for raw water, and ACID incentive/administrative.

Alternative 3B

The costs associated with this alternative would include the costs mentioned for Alternative 3A. In addition, the City of Redding would have the ACID conjunctive use groundwater well costs.

Shasta Community Services District Costs

Shasta CSD's current local purveyor O&M surface-water costs are $261.77 per ac-ft. The existing and proposed CVP M&I rates and other associated costs are presented in Table 5-9.

TABLE 5-9
Shasta Community Services District Existing and Future Water Rates
Redding Basin Water Resources Management Plan

Water Rates	USBR CVP M&I	Local Purveyor Surface-water O&M	ACID Incentive/ Administrative	Conjunctive Use Wells
Existing	26.77	261.77		
Future	43.84	261.77	5.00	32.00

Note:
All data in $/ac-ft.

Shasta CSD's future water supply costs for its CVP supply is projected to be $306 per ac-ft. Supplemental transfers from ACID and McConnell Foundation are projected to have costs of approximately $311 and $306 per ac-ft, respectively. The projected future costs indicated that Shasta CSD could obtain the necessary supplemental supplies at costs close to those for its existing sources.

Alternative 3A

The costs associated with this alternative would include local purveyor O&M for surface water, USBR CVP M&I, and ACID incentive/administrative.

Alternative 3B

The costs associated with this alternative would be similar to those for Alternative 3A.

City of Shasta Lake Costs

The City of Shasta Lake's intake pump station (owned by the USBR) at Shasta Dam would need to be upgraded to accommodate increases in demands. The WTP would also need to be expanded in years prior to 2005 to meet peak-day demands. The City of Shasta Lake's distribution system has high system losses (leaking), which increase O&M costs.

The City of Shasta Lake currently has a proposed full contract rate of $15.00 per ac-ft for raw CVP M&I water diverted from Shasta Lake. The City of Shasta Lake has an associated local purveyor O&M surface-water cost of $480 per ac-ft of water diverted. The future contract rates would not be expected to increase for the City of Shasta Lake. Table 5-10 presents the associated costs for the two alternatives.

TABLE 5-10
City of Shasta Lake Existing and Future Water Rates
Redding Basin Water Resources Management Plan

Water Rates	USBR CVP M&I	Local Purveyor Surface-water O&M	ACID Incentive/ Administrative	Conjunctive Use Wells
Existing	15.00	480.00		
Future	15.00	480.00	5.00	32.00

Note:
All data in $/ac-ft.

The City of Shasta Lake's future water supply costs for its CVP supply is projected to be $495 per ac-ft. Transfers from McConnell Foundation are projected to have costs of approximately $495 per ac-ft. Supplemental transfers from ACID would have costs of approximately $517 to $500 for conjunctive management and direct surface-water transfers, respectively. The projected future costs indicate that the City of Shasta Lake could obtain the necessary supplemental supplies at costs close to those for its existing sources.

Alternative 3A

The costs associated with this alternative would included local purveyor surface-water O&M, USBR costs for CVP M&I water, and ACID incentive/administrative costs.

Alternative 3B

The costs associated with this alternative would include local purveyor surface-water O&M, USBR costs for CVP M&I water, ACID incentive/administrative costs, and ACID conjunctive use groundwater wells.

Summary of Cost Impacts of Refined Alternatives

A summary of the cost impacts of the refined alternatives is presented in Table 5-11. This table presents the existing purveyor and future refined alternative costs for water in dollars per ac-ft. These are not total costs for water supply; these costs would be applied the type of water received.

TABLE 5-11
Summary of Cost Impacts on Refined Alternatives
Redding Basin Water Resources Management Plan

		Water Supply	
Purveyors	**Existing Costs**	**Future Alternative 3A**	**Future Alternative 3B**
City of Anderson			
Groundwater	290	290	290
ACID			
Pre-1914	8	8	8
CVP Agriculture	10	34	34
BVWD			
CVP M&I	214	236	236
CVP Agriculture	193	216	216
Groundwater	160	160	160
ACID Direct Transfer		241	
City of Redding Regional Groundwater		132	132
ACID Conjunctive Use Transfer			177
Centerville CSD			
CVP M&I	314	314	314
CVP (Townsend Flat)	337	337	337
McConnell Foundation Transfer		314	314
ACID Direct Transfer		319	
Clear Creek CSD			
CVP M&I	206	353	353
CVP Agriculture	174	199	199

TABLE 5-11
Summary of Cost Impacts on Refined Alternatives
Redding Basin Water Resources Management Plan

		Water Supply	
Purveyors	**Existing Costs**	**Future Alternative 3A**	**Future Alternative 3B**
McConnell Foundation Transfer			353
ACID Direct Transfer		358	
ACID Conjunctive Use Transfer			197
Cottonwood Water District			
Groundwater	375	375	375
Jones Valley CSA			
CVP M&I	570	570	570
Keswick CSA			
CVP M&I	473	473	473
Mountain Gate CSD			
CVP M&I	566	567	567
Groundwater	545	545	545
McConnell Foundation Transfer		567	567
ACID Direct Transfer		572	
City of Redding			
CVP M&I	213	215	215
Pre-1914	184	184	184
Groundwater	52	52	52
ACID Direct Transfer		220	
ACID Conjunctive Use Transfer			221
Shasta CSD			
CVP M&I	289	306	306
McConnell Foundation Transfer			306
ACID Direct Transfer		311	
City of Shasta Lake			
CVP M&I	495	495	495
McConnell Foundation Transfer		495	495
ACID Direct Transfer		500	
ACID Conjunctive Use Transfer			517

Note:
All data in $/ac-ft.

The following describes the costs applied in developing these water costs.

- CVP Water – This CVP cost includes the rate for CVP water and purveyor in-house O&M surface-water costs.
- Pre-1914 Base Water – This water cost includes the purveyors in-house O&M surface-water costs. No initial raw water costs would be associated with this type of water.

- Groundwater – This water cost includes in-house O&M groundwater costs. No initial raw water costs would be associated with this type of water.
- McConnell Foundation Transfer Water – This water cost includes the purveyor CVP M&I cost for raw water and purveyor in-house O&M surface-water costs.
- ACID Direct Transfer Water – This water cost includes the purveyor CVP M&I cost for raw water, purveyor in-house O&M surface-water costs, and ACID incentive/administrative cost.
- City of Redding Regional Groundwater Wells – This water cost includes the capital and O&M costs for City of Redding regional wells and purveyor in-house O&M groundwater costs.
- ACID Conjunctive Use Transfer – This water cost includes the capital and O&M costs for the conjunctive use wells, purveyor in-house O&M surface-water cost, and ACID incentive/administrative cost.

SECTION 6

Conclusions and Recommendations

Following are conclusions and recommendations resulting from the refinement of the conceptual alternatives developed earlier in this phase of work.

Conclusions

The following conclusions were developed from information developed in earlier phases of the regional planning effort and information presented earlier in this report.

- In most cases, the existing surface-water diversions and main distribution pipelines are adequately sized to convey the increased volumes of water needed to meet the purveyors' projected water needs in 2030. However, many of the surface-water supply systems in the basin were constructed in the 1960s, and system maintenance, repairs, and replacements will be necessary to reliably meet customer needs. These ongoing system needs exist under any circumstances and are not specifically attributable to either of the two refined water supply alternatives. Water treatment facilities may require upgrades or expansions to meet regulatory requirements or to provide sufficient capacity to treat the required volumes of water but, again, these improvements are not specifically attributable to either of the two water supply alternatives.
- Infrastructure costs are not a significant differentiator between Alternatives 3A and 3B. Because groundwater has no associated direct purchase cost, the costs of the infrastructure needed to develop supplemental groundwater supplies and the ongoing O&M costs are at least partially offset. The availability of outside sources of funding through grant programs could help offset the capital costs of infrastructure improvements needed to support water conservation improvements (Alternative 3A) or the conjunctive management program (Alternative 3B).
- In evaluating water supply costs, the reliability of the supply must also be considered. Supplemental water supplies are of little value if they are not reliable, so capitalizing on the most reliable sources of supply should be a priority. The most reliable, immediately available, and most readily transferable sources of surface-water supply are the CVP water supplies of the McConnell Foundation, which is not subject to cutbacks in dry years, and ACID's project water supplies, which are subject to a maximum 25 percent cutback during critically dry years. Capitalizing on these sources of supply will help achieve the goals of the TAC and PAC to make optimum use of readily available surface water. Groundwater is highly reliable in the deeper portions of the basin, and impacts of higher levels of production on private groundwater users can be mitigated by dispersing the wells and by limiting pumping to conservative rates.
- Increased groundwater development, either through direct use or conjunctive management, represents the most reliable potential source of supplemental supply. Current levels of groundwater pumping represent only a small fraction of the annual

recharge to the basin. Groundwater development costs are well known, and through direct use or a conjunctive management program (Alternative 3B), groundwater supplies can be readily integrated into existing regional water supply systems. A conjunctive management program will also provide the purveyors more flexibility in determining whether they want to take water from the conjunctive management pool and how much they want to take.

- Water use efficiency improvements may be the most readily implementable and beneficial actions in the short term. Outside sources of funding (grants) are available for these kinds of improvements, and they are not typically subject to environmental review under the California Environmental Quality Act (CEQA). In addition to ACID's current water use efficiency projects, other purveyors with high system losses should apply for grants to complete these kinds of improvements. Reducing system losses can help extend currently available water supplies while the feasibility of other actions (other water conservation measures and conjunctive use) are explored.

Recommendations

It is of critical importance that the basin's water purveyors develop a basinwide strategy for contracting principles for renewal of CVP water supply contracts and to accommodate basinwide needs and establish a framework for implementing a regional water resources management plan. The potential elements of this strategy are as follows:

- Develop a common pool of surface-water resources that could be available to all Redding Basin contractors, with appropriate individual agreements between the purveyors. Water transfers could be accomplished under common contract principles provided for in the individual water supply contracts with the USBR. Short- and long-term transfers would be negotiated between individual purveyors. The principles of the common pool must be such so that the autonomy of the governing board of directors or city council of the individual purveyors is not compromised. Common contract terms should be developed for all Redding Basin CVP water supply contractors. This could be done by engaging an attorney who specializes in water law to draft common contract terminology.
- Adopt a common strategy to guide the actions of individual purveyors between now and the renegotiations of the long-term water supply contracts. The strategy would include means of addressing critical dry years and extended dry periods until the common pool concept receives regulatory approvals. This strategy will provide flexibility to accommodate transfers between purveyors in the basin through direct transfers of surface water or through increased groundwater pumping into the ACID canal to help reduce potential institutional impediments to surface-water transfers. The strategy should also accommodate potential outcomes of the contract renegotiations so that the purveyors have flexibility over the entire planning period.
- Consider jointly sponsored planning studies or capital improvement projects among purveyors with similar interests and needs. Regional facilities can help promote solutions that offer joint benefits by improving water supply reliability in areas along a common boundary of two or more purveyors. These types of jointly sponsored

improvements could be achieved by pooling water resources and by sharing capital costs and O&M costs. An example is the pipeline currently being implemented to serve the northeast areas of the City of Redding, which can also be used to convey pumped groundwater to adjoining areas of the BVWD.

- Develop a basinwide strategy to provide opportunities that individual purveyors might not be able to realize acting individually. Each purveyor will also need to consider strategies and actions that reflect their specific situations, independent of other basin purveyors but not inconsistent with the regional planning framework. Water reclamation and reuse or conservation are two potential areas where some purveyors may be able to realize benefits that will help them to improve water supply reliability within their service area boundaries. Therefore, within the overall basinwide strategy, a list of actions that are specific to each purveyor should be identified.
- Develop a public information program for use by the water purveyors to demonstrate the seriousness of the regional water supply problems, to show the need for a regional solution to improve water supply reliability throughout the basin, and to demonstrate that a regional solution will protect existing private water users.
- Conduct an immediate outreach program with the USBR and DWR to obtain their input and secure their acceptance of the common pool provisions of the two alternatives.
- Begin preparation of a programmatic environmental document to assess the benefits and impacts of a basinwide water resources management plan. Prior phases of the regional planning effort provide a framework for the environmental document, covering the purpose and need for a regional solution, the analysis of the no-action alternative, the target water supplies over the planning period, and the development and screening of potential actions and conceptual alternatives. Environmental documentation is needed because changes in the place of the use of CVP contract supplies and implications of additional groundwater development, both of which initiate National Environmental Policy Act and California Environmental Quality Act. The programmatic document would improve coordination and consistency among discrete actions identified in the basinwide water resources management plan that are implemented at different time in different places.
- Extend RAWC's role to provide an advisory group during completion of the programmatic environmental document and to facilitate ongoing communications and basinwide negotiation principles as new water contracts are negotiated with the USBR.
- Update the current Groundwater Management Plan to reflect new state requirements and to address any changes that result from selection of a preferred alternative for basinwide water resources management.