

Introduction



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Photo captions.

1. *Micro sprinklers in an almond orchard in the west San Joaquin Valley.
Inset: closer view of the sprinkler.*
2. *Aerial view of Delta cross channel.*
3. *Clouds over green foothills.*
4. *Water treatment plant at Elsinore Valley Municipal Water District.*
5. *Warning sign that nonpotable water is being used for landscape irrigation.*
6. *Low impact development for urban runoff.*
7. *Restored meadow near Clarks Creek in Plumas National Forest.*
8. *Man windsurfing in the Sacramento-San Joaquin Delta.*
9. *Yolo Bypass with Sacramento in the background*

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Chapter 1. Introduction

A key objective of the California Water Plan Update 2009 is to present a comprehensive and diverse set of resource management strategies that can help meet the water-related resource management needs of each region and statewide. In Volume 1, Chapter 2 describes the importance of regional planning and presents general considerations for preparing sustainable integrated regional water management plans and integrated flood management plans suitable for each region's unique character. Chapter 5 of Volume 1 emphasizes the need for decision-makers, water and resource managers, and land use planners to consider uncertainty, risk, and sustainability in planning for California's water future. In this volume, we describe numerous resource management strategies that can be combined in various ways to meet the water management objectives and goals of regions.

The strategy narratives are developed by subject matter experts from the Water Plan Steering Committee member State agencies with considerable input from other experts and stakeholders.

The strategies are based on the best available information, but it is impractical to verify this information on a statewide basis because the level of implementation and performance of individual strategies will depend on regional investments and how they are combined and used in each region.

Additional analyses recommended for Update 2013 and beyond (described in Chapter 6 of Volume 1) will provide policymakers and resource managers more quantitative information on the performance of various strategies, interactions between strategies, tradeoffs, and potential groupings of strategies. Update 2009 considers several different future scenarios that can be used by planners to test the performance of alternative strategy mixes. Chapter 5 in Volume 1 presents this approach using multiple future scenarios and examples of what was learned during preparation of this Water Plan update. Chapter 6 in Volume 1 describes the analytical approach used to quantify the scenarios and describes needed improvements to quantify regional water management response packages and the performance of these response packages.

Resource Management Strategies

A resource management strategy is a project, program, or policy that helps local agencies and governments manage their water and related resources. For example, urban water use efficiency is a strategy to reduce urban water use. A pricing policy or incentive for customers to reduce water use also is a strategy. New water storage to improve water supply, reliability, and quality is another strategy. (See Box 1-1 Resource Management Strategies and Management Objectives for alphabetical listings)

Box 1-1 Resource Management Strategies and Management Objectives

Resource Management Strategy	Chapter No.	Management Objective
Agricultural Lands Stewardship	20	Practice Resource Stewardship
Agricultural Water Use Efficiency	2	Reduce Water Demand
Conjunctive Management and Groundwater Storage	8	Increase Water Supply
Conveyance—Delta	4	Improve Operational Efficiency and Transfers of Water
Conveyance—Regional/local	5	Improve Operational Efficiency and Transfers of Water
Desalination	9	Increase Water Supply
Drinking Water Treatment and Distribution	14	Improve Water Quality
Economic Incentives (Loans, Grants, Water Pricing)	21	Practice Resource Stewardship
Ecosystem Restoration	22	Practice Resource Stewardship
Flood Risk Management	28	Improve Flood Management
Forest Management	23	Practice Resource Stewardship
Groundwater Remediation/Aquifer Remediation	15	Improve Water Quality
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Land Use Planning and Management	24	Practice Resource Stewardship
Matching Water Quality to Use	16	Improve Water Quality
Other Strategies	29	Objectives vary by strategy
Pollution Prevention	17	Improve Water Quality
Precipitation Enhancement	10	Increase Water Supply
Recharge Area Protection	25	Practice Resource Stewardship
Recycled Municipal Water	11	Increase Water Supply
Salt and Salinity Management	18	Improve Water Quality
Surface Storage—CALFED	12	Increase Water Supply
Surface Storage—Regional/Local	13	Increase Water Supply
System Reoperation	6	Improve Operational Efficiency and Transfers of Water
Urban Runoff Management	19	Improve Water Quality
Urban Water Use Efficiency	3	Reduce Water Demand
Water Transfers	7	Improve Operational Efficiency and Transfers of Water
Water-dependent Recreation	26	Practice Resource Stewardship
Watershed Management	27	Practice Resource Stewardship

Think of these strategies as tools in a tool kit. Just as the mix of tools in the kit will depend on the job, the combination of strategies will vary from region to region depending on climate, projected growth, existing water system, environmental and social conditions, and regional goals. At the local level, it is important that the proposed strategies complement the operation of the existing water system. Some strategies may have little value in some regions. For example, because of geology, the opportunity for groundwater development in the Sierra Nevada is not nearly as significant as in the

Sacramento Valley. Other strategies may have little value at certain times. For example, precipitation enhancement may not be effective during droughts.

Planning a Diversified Portfolio

The new and continuing challenges of California's diverse and extreme conditions require local agencies and governments continue to use new and different methods of managing water. Integrated water management relies on a diversified portfolio of water strategies to achieve multiple and sustainable uses and benefits while weighing the risks of an uncertain future. Growing population, development patterns, global crop markets, changing regulations, and evolving public attitudes and values are a few conditions that have influenced recent decisions about water. Future decisions will need to factor in strategies for adapting to and mitigating climate change impacts.

Resource management strategies are the tools that local agencies and governments should consider when they prepare their Integrated Regional Water Management plans (See also Chapter 2, Volume 1). The basic intent is to prepare plans that are diversified; satisfy regional and state needs; meet multiple economic, environmental, and societal objectives; include public input; address environmental justice; mitigate impacts; protect public trust assets; and are affordable. Additional actions for planning and implementation can be found in Chapter 7 of Volume 1.

Organization of Resource Management Strategy Chapters

Although the chapters were written by different experts, the narrative for each strategy is organized similarly. Each includes:

- A short definition of the strategy.
- A section on the current use of the strategy in California including an overview of what is happening today and background on the strategy. In addition, the strategy narratives recognize the relationship of water, energy, and other resources; climate change considerations; and, as appropriate, articulate related resource policies, programs and legislation.
- Benefits section includes a discussion on how strategy implementation will benefit water supply, drought preparedness, flood management, water quality, energy, environmental/resource stewardship and other water management objectives regionally and statewide by 2030. Since the application of these strategies can vary widely among regions, the strategy descriptions are from a broader, statewide perspective. More detailed information on some of the strategies is also presented in the Reference Guide (Volume 4).
- Cost section includes estimates of implementation costs statewide by 2030, and unit cost information, when available. In most cases, costs are highly dependent on where they are incurred and can only be estimated broadly in these brief narratives.

- Major issues section discusses the tradeoffs, challenges and considerations associated with implementing each strategy. For instance, with ocean water desalination there are issues with water intake and brine disposal.
- Recommendations on how the strategy could be implemented over the next 30 to 40 years to minimize its impacts, as well as how to promote additional implementation. Many of the recommendations are for State government to provide technical support to help regional groups make better decisions on the use of the strategies. The narratives generally do not include specific recommendations for funding of individual strategies since local and regional efforts will need to complete additional analysis before deciding to proceed with strategies. (Cross-cutting recommendations that would apply to all strategies are presented in Chapter 2 of Volume 1 rather than in the individual strategy narratives. Common recommendations include the need for monetary investment and consideration of public trust, environmental justice, and environmental impacts.)
- References to other closely related strategies in Volume 2, brief descriptions of linkages.
- References and web sites
- Key acronyms

Although the resource management strategies are presented individually, they can complement each other, or trade-offs between strategies may have to be considered. For instance, water from a recycling project could contribute to ecosystem restoration and groundwater recharge, while water use efficiency might reduce the opportunity for recycling and reuse.

Strategy Summary Table

The Strategy summary table provides an overview of information from the 27 resource management strategies in Volume 2; as well as several essential and cross-cutting support activities. The table can help guide selective reading of the chapters in this volume. The information in Table 1-1 is grouped by six broad management objectives and key support activities:

- Reduce Water Demand
- Improve Operational Efficiency and Transfers of Water
- Increase Water Supply
- Improve Water Quality
- Practice Resource Stewardship
- Improve Flood Management
- Key Support Activities

Table columns include:

- **Left column.** Shows the resource management strategies that are available to regions to achieve various water management objectives.
- **Center columns.** Show potential strategy benefits that can be achieved by implementing a particular strategy. The table shows icons where the resource management strategy narratives indicate that the strategies could have direct and significant benefits for water management objectives. Note that most resource management strategies can help achieve multiple benefits.
- **Right column.** Shows cumulative implementation cost information in billions of dollars to achieve the indicated benefits or perform a support activity by 2030. Note that descriptions for each cost estimate are contained in the strategy narratives; the assumptions vary per strategy. Details on implementation and financing are presented in Chapter 7 of Volume 1.

The icon placement can be viewed either horizontally for a given resource management strategy or vertically for a given water management objective. As shown (vertically) in the table, most of the resource management strategies can provide water supply benefits. Likewise, many strategies can contribute to improved water quality, environmental and other benefits.

While most of the resource management strategies have multiple potential benefits, any individual site-specific project or program within a resource management strategy may contribute only one, or a few of the benefits. For example, it is unlikely that the agricultural lands stewardship practices on a single farm will contribute to all the potential benefits (as indicated in Table 1-1). In aggregate, however, the combined agricultural lands stewardship practices on many farms can contribute to all of the water management objectives as shown in the table.

As part of the strategy narratives, the subject matter experts indicated when strategies can provide significant water supply benefits, which may include water supply increases and water demand reductions. For eight strategies, an estimated range of potential additional statewide water benefit by 2030 is quantified. Water supply benefits and estimates are shown as icons and ranges in column 2 of Table 1-1. The table shows that there is considerable capacity to benefit water supply between the eight strategies. In some cases, the values represent a local or regional benefit and may not provide statewide benefits. In addition, implementing some strategies, like water dependent recreation or ecosystem restoration, may increase total water demands. The water benefits of many strategies were not quantified because the potential for additional water supply is either incidental (small), or has not yet been estimated statewide. Supply benefits will be better quantified during subsequent water plan updates. Also, some strategies do not produce water supply benefits.

Table 1-1 Strategy summary table

	Potential Strategy Benefits ¹									
	Provide Water Supply Benefit MAF/year - Applied Water 	Improve Drought Preparedness 	Improve Water Quality 	Operational Flex & Efficient 	Reduce Flood Impacts 	Environmental Benefits 	Energy Benefits 	Recreational Opportunities 	Reduce GW Overdraft 	Accumulated Cost by 2030 (\$ Billions)

Reduce Water Demand

Strategy	MAF/year ²	Potential Strategy Benefits ¹								Accumulated Cost by 2030 \$ Billions ²
Agricultural Water Use Efficiency	0.1 - 1.0 ³									0.3 - 5.0
Urban Water Use Efficiency	1.2 - 3.1									2.5 - 6.0

Improve Operational Efficiency & Transfers

Strategy	MAF/year ²	Potential Strategy Benefits ¹								Accumulated Cost by 2030 \$ Billions ²
Conveyance—Delta	N/A									1.2 - 17.2
Conveyance—Regional/Local	N/A									N/A
System Reoperation	N/A									N/A
Water Transfers	N/A									N/A

Increase Water Supply

Strategy	MAF/year ²	Potential Strategy Benefits ¹								Accumulated Cost by 2030 \$ Billions ²
Conjunctive Management & Groundwater Storage	0.5 - 2.0									N/A
Desalination – Brackish & Seawater	0.3 - 0.4									2.0 - 3.0
Precipitation Enhancement	0.3 - 0.4									0.1 - 0.2
Recycled Municipal Water	1.8 - 2.3									6.0 - 9.0
Surface Storage—CALFED	0.1 - 1.1									0.7 - 9.2
Surface Storage—Regional/Local	N/A									N/A

Improve Water Quality

Strategy	MAF/year ²	Potential Strategy Benefits ¹								Accumulated Cost by 2030 \$ Billions ²
Drinking Water Treatment and Distribution	N/A									1.4/year
Groundwater/Aquifer Remediation	N/A									20.0
Matching Quality to Use	N/A									0.1
Pollution Prevention	N/A									21.0
Salt and Salinity Management	N/A									>10.0
Urban Runoff Management	N/A									N/A

1. Actual resource management strategy benefits, e.g., reducing groundwater overdraft, will depend on how strategies are implemented. N/A= Not Available
 2. Additional information is found in Resource Management Strategies and Volume 5 Technical Guide.
 3. Value is Net Water to account for water reuse among agricultural water users.

Table 1-1 Strategy summary table (continued)

	Potential Strategy Benefits ¹										Accumulated Cost by 2030 (\$ Billions)
	Provide Water Supply Benefit MAF/year - Applied Water	Improve Drought Preparedness	Improve Water Quality	Operational Flex & Efficient	Reduce Flood Impacts	Environmental Benefits	Energy Benefits	Recreational Opportunities	Reduce GW Overdraft		

Practice Resource Stewardship

Strategy	MAF/year ²	Potential Strategy Benefits ¹									Accumulated Cost by 2030 \$ Billions ²
Agricultural Lands Stewardship	N/A										5.3
Economic Incentives (Loans, Grants, Water Pricing)	N/A										N/A
Ecosystem Restoration	N/A										N/A
Forest Management ⁴	0.1 - 0.5										0.3 - 0.8
Land Use Planning and Management	N/A										N/A
Recharge Area Protection	N/A										N/A
Water-dependent Recreation											N/A
Watershed Management	N/A										0.5 - 3.6

Improve Flood Management

Strategy	MAF/year ²	Potential Strategy Benefits ¹									Accumulated Cost by 2030 \$ Billions ²
Flood Risk Management	N/A										N/A

Other Resource Management Strategies

Objectives vary by strategy (see narratives in remainder of Volume 2)

Essential Support Activities to Integrate Strategies and Reduce Uncertainty

The following support activities are essential for successfully integrating packages of these resource management strategies. Compared with the costs of implementing the resource management strategies, the costs are relatively small for the essential support activities shown below (see Chapters 2 and 5 of Volume 1).

	Accumulated Cost by 2030 \$ Billions ²
Regional Water Management	0.25
Statewide Water Planning	0.17
Data & Tool Improvement	0.25
Research & Development	0.25
Science	3 - 5% of total

4. Numbers are for Meadow Restoration only.

N/A= Not Available

NOTE: The water supply benefits are not additive. Additional select unit cost information is found in Box 1-2 of Volume 2. Although presented individually, the resource management strategies are alternatives that can complement each other or compete for limited system capacity, funding, water supplies, or other components necessary for implementation. Assumptions, methods, data, and local conditions vary per strategy.

Box 1-2 Range of Strategy Unit Costs

Unit Cost Information for Selected Water Plan Update 2009 Resource Management Strategies	
Resource Management Strategy	Range of costs (dollars/acre-feet)
Agricultural Water Use Efficiency	\$85 - \$675
Brackish Groundwater Desalination	\$500 - \$900
Meadow Restoration	\$100 - \$250
Ocean Desalination	\$1,000 - \$2,500
Recycled Municipal Water	\$300 - \$1,300
Surface Storage	\$300 - \$1,100
Urban Water Use Efficiency	\$223 - \$522
Wastewater Desalination	\$500 - \$2,000

The information and data in Table 1-1, Box 1-2, and the Volume 2 strategy narratives should be treated as preliminary indicators of the scale and type of statewide potential benefits and associated costs. In most cases, assumptions and methodologies are unique to given strategies and neither benefits nor costs are additive among different strategies. The costs, benefits, and impacts of actually implementing these strategies in project specific locations could vary significantly depending upon local objectives and project-level complexities. Project-level considerations include the extent of the management strategies already incorporated into the existing system, proposed location of new strategies, operations, mitigation, system integration, and presence of cultural or environmental resources. Therefore, local and regional water management efforts should develop their own estimate of costs and potential benefits, as well as other tradeoffs associated with the application of any particular strategy or package of strategies.

Box 1-2 includes unit cost information for selected resource management strategies. Generally, the unit cost information is based on surveys of local projects.