7

Options for Meeting Future Water Needs in Coastal Regions of California

This chapter covers the coastal hydrologic regions of the State: the North Coast, San Francisco Bay, Central Coast, and South Coast (Figure 7-1). These four regions make up 29 percent of the State's land area and were home to 78 percent of the State's population in 1995.

FIGURE 7-1
Coastal Hydrologic Regions

The Pulgas Water Temple, owned by the City and County of San Francisco.

FIGURE 7-2

North Coast Hydrologic Region

North Coast Hydrologic Region

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Description of the Area

The North Coast Region comprises the Pacific Ocean coastline from Tomales Bay to the Oregon border, extending inland to the crest of coastal watersheds. The region includes all or large portions of Modoc, Siskiyou, Del Norte, Trinity, Humboldt, Mendocino, Lake, and Sonoma Counties. Small areas of Shasta, Tehama, Glenn, Colusa, and Marin Counties are also within the North Coast Region (Figure 7-2).

Most of the region is comprised of rugged mountains; the dominant topographic features are the Klamath Mountains and the Coast Range. Mountain elevations range from 5,000 feet along the coast to more than 8,000 feet in the Klamath River watershed. Valley areas include the high plateau of the Klamath River Basin in Modoc County, the Eureka/Arcata area, Hoopa Valley in Humboldt County, Anderson Valley, the Ukiah area, Alexander Valley, and the Santa Rosa Plain.

Precipitation in the region varies depending on location and elevation. In the Modoc Plateau of the Klamath River Basin, annual precipitation averages 10 inches, while higher elevation lands of the Smith River Basin in Del Norte County average more than 100 inches of rain per year. The southern portion of the region is drier; Santa Rosa averages about 29 inches of rain annually.

Most land area in the North Coast Region is forest or range land. Irrigated agriculture is concentrated in narrow river valleys such as the Russian River Valley in Sonoma County, and on the high plateau of the Klamath River Basin. The primary crops are pasture, grain, alfalfa, wine grapes, truck crops, and nursery stock. Principal cities in the region include Crescent City, Yreka, Eureka, Fort Bragg, Ukiah, Santa Rosa, and Rohnert Park. Table 7-1 shows the 1995 population and irrigated crop acreage in the region and 2020 forecasts.

Water Demands and Supplies

Because of the water dedicated to the North Coast's wild and scenic rivers, environmental water use comprises the majority of the total water demand in the North Coast Region. Water shortages are expected to occur only under drought conditions, as shown in Table 7-2. These water shortages will be mostly in the USBR's Klamath Project's service area and in some small coastal communities.

Three existing projects provide much of the North Coast's developed surface water supply—USBR's Klamath Project, Humboldt Bay Municipal Water District's Ruth Lake, and USACE's Russian River Project. The primary water storage facilities of USBR's Klamath Project are Upper Klamath Lake, Clear Lake, and Gerber Reservoir. This project was authorized by the Secretary of the Interior in 1905, and is one of the West's earliest reclamation projects. The project's primary purpose is to store and divert water for agricultural use. The project service area includes more than 230,000 acres of irrigable lands in Oregon and

TABLE 7-1
Population and Crop Acreage

	Population (thousands)	*Irrigated Crop Acreage (thousands of acres)*
1995	606	323
2020	835	335

TABLE 7-2

North Coast Region Water Budget (taf)[a]

	1995		*2020*	
	Average	*Drought*	*Average*	*Drought*
Water Use				
Urban	169	177	201	212
Agricultural	894	973	927	1,011
Environmental	19,544	9,518	19,545	9,518
Total	**20,607**	**10,668**	**20,672**	**10,740**
Supplies				
Surface Water	20,331	10,183	20,371	10,212
Groundwater	263	294	288	321
Recycled and Desalted	13	14	13	14
Total	**20,607**	**10,491**	**20,672**	**10,546**
Shortage	**0**	**177**	**0**	**194**

[a] Water use/supply totals and shortages may not sum due to rounding.

California. The project also serves four national wildlife areas—the Lower Klamath, Tule Lake, Clear Lake, and Upper Klamath Refuges.

The 48 taf Ruth Lake is Humboldt Bay Municipal Water District's water storage facility on the Mad River. Downstream Ranney collector wells capture water released from Ruth Lake for distribution in the Eureka-Arcata-McKinleyville area. Humboldt Bay MWD is a water wholesaler with seven municipal, two industrial, and about 200 miscellaneous water customers.

The Trinity River Division of the CVP develops supply for export to the Central Valley and does not deliver water in the North Coast Region. USBR constructed Trinity River facilities in the early 1960s to augment CVP water supplies in the Central Valley. The principal features of the Trinity Division are Trinity Dam and the 2.4 maf Trinity Lake on the upper Trinity River, Lewiston Dam, the 10.7-mile Clear Creek Tunnel that begins at Lewiston Dam and ends at Whiskeytown Lake in the Sacramento River Basin, Spring Creek Tunnel, and Spring Creek Powerplant.

Exports from the Trinity River to the Sacramento River Basin began in 1963. From 1980 through 1995, Trinity River exports averaged 825 taf annually. In 1981, the Secretary of the Interior increased instream flow requirements in the Trinity River from 120 taf to 287 taf in drought years, and 340 taf in wet years. In 1991, the Secretary of the Interior amended the 1981 decision, directing that at least 340 taf be released into the Trinity River for water years 1992 to 1996, pending completion of a USFWS instream flow study. In 1992, CVPIA mandated that the secretarial decision remain in place until the instream flow study was com-

USBR's Anderson-Rose Dam is located on the Lost River in Oregon, just north of the stateline. This Klamath Project facility diverts water to serve irrigation needs on the bed of the former Tule Lake in California and Oregon.

Courtesy of USBR

Trinity Dam and Trinity Lake. Releases from the reservoir are reregulated at Lewiston Dam, 7 miles downstream on the Trinity River. At Lewiston, water is either released back to the Trinity River or diverted through the Clear Creek Tunnel into the Sacramento River Basin.

Courtesy of USBR

pleted, at which time the study's recommendations would be implemented. Currently, a draft Trinity River flow evaluation report recommends that 815 taf, 701 taf, 636 taf, 453 taf, and 369 taf be released in the Trinity River during extremely wet, wet, normal, dry, and critically dry years, respectively. The water year types are based on Trinity Lake inflow.

Lake Mendocino on the East Fork Russian River near Ukiah and Lake Sonoma on Dry Creek near Geyserville are the water storage facilities of USACE's Russian River Project. Sonoma County WA receives most of the water from this project and delivers about 29 taf/yr to Santa Rosa, Rohnert Park, Cotati, and Forestville in the North Coast Region, and another 25 taf/yr to Novato, Petaluma, the Valley of the Moon, and Sonoma in the San Francisco Bay Region. The Russian River Project also regulates flow in the Russian River for agricultural, municipal, and instream uses within Mendocino and Sonoma Counties, and municipal uses in Marin County. Water is diverted from the Eel River into Lake Mendocino through PG&E's Potter Valley Project.

Local Water Resources Management Issues

Klamath River Fishery Issues

The primary water management issue in the Klamath River Basin is the restoration of fish populations that include listed species such as the Lost River and shortnose suckers, coho salmon, and steelhead trout. The Lost River sucker is native to Upper Klamath Lake and its tributaries, and the shortnose sucker is found in the Lost River, Clear Lake, Tule Lake, and Upper Klamath Lake. Both species spawn during the spring. Higher water levels in Upper Klamath Lake have been identified as an aid to recovery of these fisheries. Coho and steelhead were recently listed, and water supply implications will not be known until management plans are completed and recovery goals are established.

To address the need for greater certainty in project operations, USBR began preparing a long-term Klamath Project operations plan in 1995. Difficult and complex issues have delayed completion of the long-term plan. USBR has issued an annual operations plan each year since 1995 as it continues the development of the long-term plan. The Klamath River Compact Commission is facilitating discussions on water management alternatives to address ESA and water supply needs. This three-member commission was established by an interstate compact ratified by Congress in 1957 to facilitate integrated management of interstate water resources and to promote intergovernmental cooperation on water allocation issues. Members include a representative from the Department, the Director of the Oregon Water Resources Department, and a presidentially-appointed federal representative.

Trinity River Fish and Wildlife Management Program

Following completion of the Trinity River Division, fish populations in the Trinity River Basin declined dramatically. The Resources Agency estab-

lished a statewide task force in 1967 to develop a program to improve the fishery. One of the most significant problems identified was sedimentation from Grass Valley Creek. In 1980, PL 96-335 authorized construction of Buckhorn Mountain Debris Dam on Grass Valley Creek, as well as sediment dredging in the Trinity River below Grass Valley Creek. In 1984, PL 98-541 authorized the Trinity River fish and wildlife management program, providing $57 million (excluding Buckhorn Mountain Debris Dam and sediment dredging costs) to implement actions to restore fish and wildlife populations in the Trinity River Basin to pre-project levels. Congress authorized an additional $15 million in 1993 for purchase of 17,000 acres of the Grass Valley Creek watershed and its restoration. PL 104-143 in 1996 extended the program three years to October 1, 1998, to allow expenditure of funds previously authorized, but not yet appropriated. Reauthorization of the program is currently under consideration. A draft EIS/EIR is being prepared to address proposed streamflow changes and mainstem Trinity River restoration actions.

Water Supplies of Small Coastal Communities

The town of Klamath in Del Norte County obtains its water supply from two wells adjacent to the Klamath River. During the recent drought, seawater intrusion forced the Klamath Community Services District to use an upstream private well in the Hoopa Creek drainage area. All of Klamath's water supply in 1995 was obtained from the private well, and no water was pumped from Klamath CSD's wells. In 1996, Klamath CSD pumped adequate supplies from its two wells, but seawater intrusion during dry years remains a problem. Although the Hoopa Creek drainage area has adequate groundwater supplies, Klamath CSD does not have funding to construct an additional well.

The town of Smith River, 13 miles north of Crescent City, takes its water supply from wells along Rowdy Creek. Water demands in the town of Smith River are expected to exceed the capacity of the town's delivery system if projected growth occurs. (Growth from Brookings, a popular Oregon retirement and resort community about 7 miles north of the stateline, is affecting Smith River.) There are no plans to upgrade Smith River's water system.

Growth in the Crescent City area is creating the need to expand the city's water distribution system, which consists of a Ranney collector well on the Smith River and a 50,000 gallon storage tank. The Ranney collector can produce about 7.8 taf/yr, but the capacity of the existing transmission and storage system is only about 4.5 taf/yr. Crescent City is planning to add new mains, a new pump station, one additional booster pump, and a 4 mg storage tank. The upgraded system will produce 5.9 taf/yr. The estimated cost is $6.7 million. A second phase will make additional distribution system improvements. These new conveyance facilities should meet the city's demands through 2007.

The Weaverville Community Services District in Trinity County serves about 1,370 metered connections. In average water years, demands within the district are met with existing supplies from East and West Weaver Creeks. During drought years, water rationing and building moratoria were needed to reduce demands. In response to drought year demands, a new diversion of up to 3 cfs from the Trinity River was constructed. The Weaverville area is expected to have adequate water supplies to meet demands over the next 30 years.

Trinity County Water Works District #1 is investigating a wastewater treatment and reuse project for the Hayfork area. The project would treat wastewater from individual septic systems, and would eliminate septic tank seepage into local streams. The district's feasibility study identified a gravity collection system with an oxidation pond and two marsh areas as the best alternative for wastewater treatment. The project would treat 160 af annually, and could reuse the treated water to irrigate agricultural lands or landscaping. The estimated cost for this project is $8.9 million.

The City of Rio Dell obtains its water from a well on property owned by the Eel River Sawmill. Pentachlorophenol has been detected in groundwater on the sawmill's property, although not in the city's well water. Rio Dell is planning to find an alternate water supply. The most likely alternative will be treated surface water from the Eel River.

The City of Fort Bragg experiences water shortages during drought years. The water sources for the city are direct diversions from surface water sources. During average rainfall years, water rights from these sources are enough to meet the city's demands to the year 2020. Supplies are inadequate to meet the city's needs during drought years and to maintain instream flows required by DFG. DHS issued an order in 1991 prohibiting new demands on the water system until adequate water supplies were developed. The city has been investigating alternate sources of supply and has implemented water conservation measures and im-

proved existing system capacity. As a result of these corrective measures DHS lifted its order in 1993 and allowed the city to begin issuing building permits, subject to restrictions including no net increase in consumption and implementation of a conservation and retrofit program.

Groundwater use is constrained by limitations in aquifer storage capacity in some coastal communities. Wells on low terraces near the ocean are potentially vulnerable to seawater intrusion. The town of Mendocino is completely dependent on individual wells. A local survey conducted in 1986 showed that about 10 percent of the wells go dry every year and 40 percent go dry during drought years. In 1986, water was trucked in during summer and fall to help reduce shortages. The Mendocino Community Services District investigated new water supply sources, including wells in the Big River aquifer and desalting. To date, no acceptable water source has been identified. In 1990, town residents approved developing a public water system if an adequate water source could be found. The district is currently collecting hydrogeological data on the groundwater basin.

Russian River Environmental Restoration Actions

Water quality issues and barriers to fish migration are of concern in the Russian River Basin. No future water supply shortages are forecasted for the basin, although actions taken to protect recently listed salmonids may affect existing or future diversions. A Russian River Action Plan, prepared by Sonoma County WA in 1997, provides a regional assessment of needs in the watershed and identifies fishery habitat restoration projects in need of funding. The SWRCB is promoting a coordinated Russian River fishery restoration plan.

In 1997, NMFS listed coho salmon and steelhead trout as threatened along part of the Central California coast that includes the Russian River Basin. SCWA, USACE, and NMFS signed an agreement to establish a framework for consultation under Section 7 of the ESA. Under the agreement, USACE and SCWA will jointly review information on their respective Russian river activities to determine impacts to critical habitat.

The Eel-Russian River Commission, composed of county supervisors from Humboldt, Mendocino, Sonoma, and Lake Counties, provides a regional forum for agencies and groups to stay informed about projects and issues affecting the Eel and Russian Rivers. The Commission, formed in 1978 under a joint powers agreement among the counties, was to aid in implementing an Eel-Russian River watershed conservation and development plan. A regional issue currently being addressed by the Commission is the review of a

Currently, the main water issues in the Russian River Basin are related to watershed management and environmental restoration programs.

draft 10-year fishery study by PG&E for its Potter Valley Project, required as a condition of a 1983 FERC license.

A proposed SCWA project would allow fish passage through a flood control structure on Matanzas Creek in downtown Santa Rosa. The original structure, constructed in the early 1960s, does not permit fish passage. SCWA also proposes to install a fish ladder at Healdsburg Dam on the Russian River, a small flashboard dam used in the summer to create a recreational pool.

City of Santa Rosa Long-Term Wastewater Project

In early 1998 the City of Santa Rosa selected an alternative that would recharge depleted geothermal fields in the Geysers area with treated wastewater as part of its long-term wastewater recycling program. Under this alternative, the Santa Rosa Subregional Sewerage System will pump about 11 mgd of treated wastewater to the Geysers for injection into the steamfields. This amount is a little less than half the flow the treatment system is expected to produce at buildout. The project is intended to eliminate weather-related problems of the city's current disposal system and minimize treated wastewater discharges into the Russian River. The project consists of pipeline transmission and distribution systems and is scheduled to be completed by 2001.

SCWA Water Supply and Transmission Project

Sonoma County WA is preparing an EIR to develop additional water supply as well as to expand its existing water transmission system. The project will be implemented under an agreement among SCWA and its water contractors. Components of the project include water conservation, increased use of the Russian River Project, and expansion and revised operation of the water transmission system. Water conservation is planned to provide additional savings of 6.6 taf. The Russian River component will allow for increasing diversions from 75 to 101 taf from the Russian River. This increased use of the Russian River Project water will require construction of additional diversion and conveyance facilities, including new diversion locations. The project will continue to meet existing instream flow requirements associated with the SWRCB's Decision 1610 and will require new water rights applications to SWRCB. The transmission system component has two elements—facilities to divert and treat Russian River Project water, and transmission system improvements allowing for delivery of up to 167 taf/yr. The final EIR is scheduled for late 1998.

Potter Valley Project

PG&E's Potter Valley Project diverts water from the Eel River to the East Fork of the Russian River for power generation and downstream agricultural and municipal water use. The project consists of Scott Dam and Lake Pillsbury, Van Arsdale Diversion Dam and tunnel, and the Potter Valley Powerplant. The project diverts about 159 taf of water and generates about 60 million kWh of energy annually. Releases are limited by required minimum flows on the Eel River and by requirements to maintain reservoir levels in Lake Pillsbury during the summer recreation season. Under the FERC relicensing process, PG&E has been meeting with State and federal agencies to develop instream flow recommendations for the Eel River. Diversions from the Eel River are being evaluated in light of ongoing efforts to restore Eel River fisheries. PG&E is also trying to secure additional operating revenue from the project and, if unsuccessful, may sell or abandon the project. Local agencies have expressed interest in acquiring the project if it were to be sold.

Water Management Options for the North Coast Region

Table 7-3 shows a list of options for the region, and the results of an initial screening of the options. The retained options were evaluated (Table 7A-1 in Appendix 7A) based on a set of fixed criteria discussed in Chapter 6.

Water Conservation

Urban. Urban water demand forecasts for 2020 assume that BMPs are in place; consequently, only those urban conservation efforts which exceed BMPs are considered as options. All urban conservation options were retained. Reducing outdoor water use to 0.8 ET_o in new development would attain about 1 taf /yr of depletion reductions, while extending this measure to include existing development would reduce depletions by about 6 taf/yr. Reducing residential indoor water use to 60 and 55 gpcd would reduce depletions by 3 and 6 taf/yr, respectively. Reducing commercial, institutional, and industrial water use an additional 3 and 5 percent would attain 1 and 2 taf/yr of depletion reductions, respectively. Reducing distribution system losses to 7 and 5 percent would reduce depletions by 6 and 9 taf/yr.

TABLE 7-3

North Coast Region List of Water Management Options

Option	*Retain or Defer*	*Reason for Deferral*
Conservation		
Urban		
Outdoor Water Use to 0.8 ET_o	Retain	
Indoor Water Use	Retain	
Interior CII Water Use	Retain	
Distribution System Losses	Retain	
Agricultural		
Seasonal Application Efficiency Improvements	Defer	No significant depletion reductions attainable.
Flexible Water Delivery	Defer	No significant depletion reductions attainable.
Canal Lining and Piping	Defer	No significant depletion reductions attainable.
Tailwater Recovery	Defer	No significant depletion reductions attainable.
Modify Existing Reservoirs/Operations		
Ewing Reservoir Enlargement	Defer	No demand for additional supply.
New Reservoirs/Conveyance Facilities		
Boundary Reservoir - Lost River, Oregon	Defer	Low yields, high cost.
Beatty Reservoir - Sprague River, Oregon	Defer	High cost, archaeological resources, and sucker habitat.
Chiloquin Narrows Reservoir - Sprague River, Oregon	Defer	High cost, archaeological resources, and sucker habitat.
Montague Reservoir - Shasta River	Defer	Low yields, high cost.
Grenada Ranch Reservoir - Little Shasta River	Defer	Low yields, poor dam site and reservoir geology, high cost.
Table Rock Reservoir - Little Shasta River	Defer	No surplus water, no local interest.
Highland Reservoir - Moffett Creek	Defer	Low yields, high cost.
Callahan Reservoir - Scott River	Defer	Low yields, high cost, no local interest.
Grouse Creek Reservoir - E.F. Scott River	Defer	Reservoir seepage, high cost, no local interest.
Etna Reservoir - French Creek	Defer	Low yields, high cost, no local interest.
Mugginsville Reservoir - Mill Creek	Defer	Low yields, excessive cost.
Various sites in Noyo/Navarro River Basins	Defer	No local interest in offstream storage; unfavorable environmental conditions.
Long/Round/Aspen Valley Reservoirs - Klamath River	Defer	Excessive capital cost, questionable reservoir geology.
Georgia-Pacific Wood Waste Disposal Site	Defer	Site not available.
Georgia-Pacific Replacement Site	Defer	Unfavorable geotechnical conditions.
Georgia-Pacific Site No. 3	Defer	Unfavorable geotechnical conditions.
Newman Gulch Site	Defer	Unfavorable geotechnical conditions.
Large reservoir at Boddy Property Site	Defer	Excessive capital cost.
Smaller reservoir (at Boddy property site or alternate location)	Defer	Excessive capital cost.
Waterfall Gulch Intake Improvement	Defer	Biological, instream flow concerns.
South Basin (City of Fort Bragg)	Defer	Water rights issues.

TABLE 7-3
North Coast Region List of Water Management Options (continued)

Option	*Retain or Defer*	*Reason for Deferral*
Groundwater/Conjunctive Use		
New wells	Retain	
Water Marketing		
—	—	—
Water Recycling		
City of Fort Bragg	Defer	Unfavorable costs due to lack of potential users within a reasonable distance.
Desalting		
Brackish Groundwater		
City of Fort Bragg Project	Retain	
Seawater		
City of Fort Bragg Project	Defer	Excessive cost.
Other Local Options		
—	—	—
Statewide Options		
—	—	See Chapter 6.

Agricultural. The 2020 agricultural water demand forecasts assume that EWMPs are in place. As with the urban water management options, only those agricultural conservation efforts which exceed EWMPs are considered as options. Agricultural conservation options were deferred from evaluation for this region because they provide little potential to create new water (reduce depletions).

Modifying Existing Reservoirs or Operations

Trinity County Water Works District #1 has considered raising Ewing Dam, which was designed to be raised up to 12 feet to meet future water supply needs. Raising the dam 12 feet to increase reservoir capacity from 800 af to 1.45 taf and modifying the spillway and outlet works would cost $1.5 million. Plans to enlarge the reservoir were halted when Hayfork's primary employer (a lumber mill) closed, reducing the district's customer base by about 10 percent.

New Reservoirs and Conveyance Facilities

Onstream Storage. Eleven onstream reservoirs in the Klamath River Basin were evaluated and deferred, mainly because of high costs and relatively low yields. Cursory investigations of these projects were completed by USBR, the Department, or the Oregon Water Resources Department. Recent studies completed by the City of Fort Bragg identified potential onstream reservoir sites in the Noyo River watershed; however, these sites were deferred due to environmental and economic concerns.

Offstream Storage. USBR investigated three offstream reservoirs in Oregon's Long, Aspen, and Round Valleys adjacent to Upper Klamath Lake. These offstream storage plans were deferred due to high costs.

In 1993, the City of Fort Bragg moved forward with preliminary plans and work on an environmental impact report on what was then its preferred long-term project, which included a 1.5 taf offstream reservoir. Several promising locations were investigated, but geotechnical investigations indicated that all except one of the sites was unsuitable. Further detailed investigations and cost estimates for the most favorable site indicated the site was infeasible due to excessive costs. A smaller reservoir (about 1 taf) was evaluated, but was also not feasible.

Groundwater Development or Conjunctive Use

Surface water sources meet most of the water needs in the coastal regions. Communities with water shortage problems continue to look for possible groundwater sources and well locations to provide adequate supplies at reasonable cost. Although groundwater quality is generally good, supplies are limited by aquifer storage capacity. For example, Fort Bragg began a test program in 1994 to identify possible well sites, but no significant groundwater supply was found. The city has drilled test wells along the Noyo River about two miles upstream of its mouth, and is studying the potential development of a small production well. It appears that the product water may be brackish.

Water Recycling

The City of Fort Bragg had considered a water recycling project which involved using tertiary treated wastewater to replace potable water used at a lumber processing plant. However, water conservation efforts by the plant reduced its water demand by more than 50 percent, rendering this option uneconomical. Other water recycling projects planned in the region would not generate a source of new supply from a statewide perspective. There are several projects planned which would produce about 15 taf of recycled water annually to serve local water management needs for agricultural, environmental, and for landscape irrigation purposes.

Desalting

Interest in desalting for Fort Bragg increased when feasibility studies showed it was economically competitive with storage alternatives. The city evaluated two reverse osmosis alternatives—one involving seawater and one involving brackish water. Both plant designs would produce about 1 taf of potable water in drought years. Major cost components for the seawater plant would include the ocean intake structure, feedwater pipeline to the plant, and plant equipment. The brackish groundwater plant would require wells, well field collection piping, and a feedwater pipeline into the plant. The city is conducting more detailed studies to identify the location of brackish water sources and brine disposal options.

Other Local Options

Fort Bragg has investigated other alternatives that have not proven to be feasible. These alternatives include improving the city's diversion from Waterfall Gulch and new surface water sources in the South Basin. Lowering the intake structure at Waterfall Gulch would capture an additional 110 af/yr, but presents biological and instream flow concerns. New surface water sources have been identified, but these sources had water rights issues.

Options Likely to be Implemented in North Coast Region

Water supplies are not available to meet all of the region's 2020 water demands in drought years. Drought year applied water shortages are forecasted to be 194 taf. No average year shortages are forecasted for 2020. Ranking of retained water management options for the North Coast Region is summarized in Table 7-4. Table 7-5 summarizes options that can likely be implemented by 2020 to relieve the shortages.

The majority of shortages in the region are agricultural and are expected to occur in the Klamath Project area. The economics of crop production have a major influence on the extent to which growers can afford drought year water supply improvements. Additional groundwater development is a possibility in some areas of the Klamath Project, but there are little data available to evaluate this option. The ability to change cropping patterns in the northern part of the region is limited by the area's climatic conditions. There are no quantifiable options available to meet agricultural shortages.

Urban water conservation options could provide 18 taf/yr in water savings. Small communities along the coast generally do not have the financial resources to construct major water supply projects, and therefore will continue to investigate new groundwater supplies.

TABLE 7-4

Options Ranking for North Coast Region

Option[a]	*Rank*	*Cost ($/af)*	*Potential Gain (taf)*	
			Average	*Drought*
Conservation				
Urban				
Outdoor Water Use to 0.8 ET_o - New Development	M	750	1	1
Outdoor Water Use to 0.8 ET_o -New and Existing Development	M	[b]	6	6
Indoor Water Use (60 gpcd)	M	400	3	3
Indoor Water Use (55 gpcd)	M	600	6	6
Interior CII Water Use (3%)	M	500	1	1
Interior CII Water Use (5%)	M	750	2	2
Distribution System Losses (7%)	M	200	6	6
Distribution System Losses (5%)	M	300	9	9
Groundwater/Conjunctive Use				
New wells - Fort Bragg and other small coastal communities	H	150	[c]	[c]
Agricultural Groundwater Development	M	[b]	[b]	[b]
Desalting				
Brackish Groundwater				
City of Fort Bragg Project	L	770	1	1

[a] All or parts of the amounts shown for highlighted options have been included in Table 7-5.
[b] Data not available to quantify.
[c] Less than 1 taf.

TABLE 7-5

Options Likely to be Implemented by 2020 (taf)
North Coast Region

	Average	*Drought*
Applied Water Shortage[a]	**0**	**194**
Options Likely to be Implemented by 2020		
Conservation	—	18
Modify Existing Reservoirs/Operations	—	—
New Reservoirs/Conveyance Facilities	—	—
Groundwater/Conjunctive Use	—	—
Water Marketing	—	—
Recycling	—	—
Desalting	—	—
Other Local Options	—	—
Statewide Options	—	—
Expected Reapplication	—	—
Total Potential Gain	**—**	**18**
Remaining Applied Water Shortage	**0**	**176**

[a] Majority of shortages in this region are agricultural. Most agricultural shortages in this region are expected to occur in the Klamath Project area.

FIGURE 7-3.

San Francisco Bay Hydrologic Region

San Francisco Bay Hydrologic Region

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Description of the Area

The San Francisco Bay Region (Figure 7-3) extends from southern San Mateo County north to Tomales Bay in Marin County, and inland to the confluence of the Sacramento and San Joaquin Rivers near Collinsville. The eastern boundary follows the crest of the Coast Range. The region includes all of San Francisco and portions of Marin, Sonoma, Napa, Solano, San Mateo, Santa Clara, Contra Costa, and Alameda Counties. The San Francisco Bay Region is divided into the North Bay and South Bay planning subareas. Geographic features include the Marin and San Francisco Peninsulas; San Francisco, Suisun, and San Pablo Bays; and the Santa Cruz Mountains, Diablo Range, Bolinas Ridge, and Vaca Mountains of the Coast Range. Streams flow into the bays or to the Pacific Ocean.

The climate within the region varies significantly from west to east. The coastal areas are typically cool and often foggy. The inland valleys and interior portions of San Francisco Bay are warmer, with a Mediterranean-like climate. The average annual precipitation in the region is 31 inches, ranging from 13 inches in Pittsburg to 48 inches at Kentfield, northeast of Mount Tamalpais in Marin County.

The region is highly urbanized and includes the San Francisco, Oakland, and San Jose metropolitan areas. Agricultural acreage is mostly in the north, with the predominant crop being grapes. In the south, more than half of the irrigated acres are in high-value specialty crops, such as artichokes or flowers. Table 7-6 summarizes the population and irrigated crop acreage for the region.

TABLE 7-6
Population and Crop Acreage

	Population (thousands)	*Irrigated Crop Acreage (thousands of acres)*
1995	5,780	65
2020	7,025	65

Water Demands and Supplies

Table 7-7 shows the water budget for the San Francisco Bay Region. Environmental water demands, primarily Bay-Delta outflow, account for most of the San Francisco Bay Region's water use. Water demands for Suisun Marsh are also included in environmental water needs. As shown in the table, water shortages are forecast only for drought years.

North Bay

Municipal and industrial water use will continue to grow as the population in the North Bay grows. The fastest growing communities have been municipalities in southwestern Solano County, such as Fairfield and Benicia. Growth in the larger communities of Sonoma and Napa Counties, such as Petaluma and Napa, has also been fairly rapid (more than 20 percent during the 1980s). Growth in Marin County has been slow, initially because of a water connection moratorium administered by Marin Municipal WD in the 1970s, and more recently because of the lack of land available for development. Marin MWD imposed a second moratorium on water service connections during the 1987-92 drought. It was lifted in 1993 with the adoption of an integrated water supply program

TABLE 7-7

San Francisco Bay Region Water Budget (taf)[a]

	1995		*2020*	
	Average	*Drought*	*Average*	*Drought*
Water Use				
Urban	1,255	1,358	1,317	1,428
Agricultural	98	108	98	108
Environmental	5,762	4,294	5,762	4,294
Total	**7,115**	**5,760**	**7,176**	**5,830**
Supplies				
Surface Water	7,011	5,285	7,067	5,417
Groundwater	68	92	72	89
Recycled and Desalted	35	35	37	37
Total	**7,115**	**5,412**	**7,176**	**5,543**
Shortage	**0**	**349**	**0**	**287**

[a] Water use/supply totals and shortages may not sum due to rounding.

and the signing of a new Russian River water supply contract.

The Suisun Marsh is the only managed wetland in the North Bay that requires deliveries of fresh water. Its annual applied water demand is expected to remain constant at 150 taf. Other environmental demands include instream flows in Walker and Lagunitas Creeks in Marin County.

Table 7-8 lists major water suppliers within the North Bay, along with their primary sources of supply. Each of these agencies serves a number of municipalities or water retailers. Groundwater and small locally developed supplies serve the remainder of the water users in the area. Table 7-9 lists local agency water supply reservoirs (with capacity greater than 10 taf) serving the North Bay.

- Sonoma County WA, which wholesales water throughout Sonoma and Marin Counties, is forecasting no water shortages through 2020, and is not looking at water supply reliability enhancement options.
- Marin MWD was once one of the most vulnerable water suppliers in the State. The district has negotiated a supplemental water supply contract with Sonoma County WA for 10 taf and now expects to have a more reliable supply as it develops infrastructure to import additional Russian River water.
- Napa County Flood Control and Water Conservation District has a contract for SWP water with a maximum entitlement of 25 taf/yr. The City and County of Napa are examining water supply en-

Vineyard acreage in the Napa and Sonoma Valleys is among the State's most expensive agricultural real estate. Grapes—wine grapes, table grapes, and raisin grapes—are one of California's top dollar value crops.

TABLE 7-8
Major North Bay Water Suppliers

Agency	*Primary Source of Supply*
Sonoma County WA	Russian River Project
Marin MWD	Local surface and Sonoma County WA contract
Napa County FC&WCD	Local surface and SWP
Solano County WA	Solano Project and SWP

hancement options to ensure future supply reliability.

- Solano County WA anticipates a water supply deficiency as municipalities in the western part of the county urbanize rapidly without developing additional water supply sources. Solano County WA's 1995 SWP supply was about 21 taf. The agency's annual SWP entitlement is 42 taf. Benicia is the most vulnerable of the agency's service areas to drought conditions because it is entirely dependent on SWP water. Fairfield also is forecasting future drought year shortages. Vallejo has its own supply from the Delta, which is now conveyed through North Bay Aqueduct facilities.

South Bay

The South Bay is highly urbanized—about 16 percent of the State's population lives in 2 percent of the State's land area. A minor portion of South Bay water use is for agriculture. Hayward Marsh is the only identified environmental water use within the South Bay. The marsh, part of the Hayward Regional Shoreline, has an annual freshwater use of approximately 10 taf of reclaimed wastewater from Union Sanitation District. Industrial water use for cooling is primarily associated with independently produced industrial supplies along the Carquinez Strait.

Table 7-10 lists the major water suppliers in the South Bay and their primary sources of supply. Those areas not served by the listed suppliers get their water from groundwater and from small locally developed surface supplies. Alameda County Water District, Zone

The SWP's North Bay Aqueduct terminates at the Napa Turnout Reservoir, a 22 af storage tank. Napa County Flood Control and Water Conservation District is the contractor for this water supply.

TABLE 7-9
Local Agency Reservoirs Serving the North Bay

Agency	*Reservoir*	*Capacity (taf)*	*Year Constructed*	*Region*
USACE/Sonoma CWA[a]	Mendocino	119	1922	North Coast
USACE/Sonoma CWA[a]	Sonoma	381	1982	North Coast
Pacific Gas & Electric	Pillsbury	73	1921	North Coast
Marin MWD	Kent	33	1953/1982[b]	San Francisco Bay
Marin MWD	Nicasio	22	1960	San Francisco Bay
Marin MWD	Soulajule	11	1979	San Francisco Bay
City of Napa	Hennessey	31	1946	San Francisco Bay
City of Vallejo	Curry	11	1926	San Francisco Bay

[a] USACE built Lake Mendocino and Lake Sonoma primarily for flood control. Sonoma County WA operates the facilities for water supply and holds water rights for the supply.
[b] A 16.5 taf reservoir was initially constructed in 1953. The dam was raised in 1982, nearly doubling the capacity.

TABLE 7-10
Major South Bay Water Suppliers

Agency	*Primary Source of Supply*
San Francisco PUC	Hetch Hetchy project and local surface
Santa Clara Valley WD	Local surface, groundwater, CVP, and SWP
Alameda County WD	Local surface, groundwater, SWP, and Hetch Hetchy project
Zone 7 WA	Local surface, groundwater, and SWP
East Bay MUD	Mokelumne River project and local surface
Contra Costa WD	CVP and local surface

7 Water Agency, and Santa Clara Valley Water District recharge and store local and imported surface water in local groundwater basins. Each of the major water agencies supplies several municipalities or water retailers. Table 7-11 lists local agency water supply reservoirs (with capacity greater than 10 taf) serving the South Bay.

- SFPUC provides water to more than 2.3 million people in San Francisco, San Mateo, Santa Clara, and Alameda Counties, and is forecasting drought year shortages through 2020. In 1990 and 1991, wholesale and retail customers received 25 percent supply reductions (based on historical use). In 1991, SFPUC adopted, but did not implement, a 45 percent rationing plan. Recently revised instream flow requirements in the Tuolumne River Basin have reduced the available Hetch Hetchy supply. The city's studies indicate that the annual yield of the Hetch Hetchy system has dropped from 336 taf to 271 taf.
- SCVWD, which supplies water to about 1.7 million people, provides water to 16 municipal and industrial retailers as well as to agricultural users in Santa Clara County. A number of these retailers also contract with SFPUC for water from Hetch Hetchy. The district possesses one of the most diverse supplies in the State, with imported state project and federal project water, locally developed surface supplies, and extensive groundwater recharge programs. Some of the retail agencies in

TABLE 7-11
Local Surface Reservoirs Serving the South Bay

Agency	*Reservoir*	*Capacity (taf)*	*Year Constructed*	*Region*
San Francisco PUC	Lloyd	273	1956	San Joaquin River
San Francisco PUC	Eleanor	27	1918	San Joaquin River
San Francisco PUC	Hetch Hetchy	341	1923	San Joaquin River
San Francisco PUC	Calaveras	97	1925	San Francisco Bay
San Francisco PUC	Crystal Springs	58	1888	San Francisco Bay
San Francisco PUC	San Andreas	19	1870	San Francisco Bay
San Francisco PUC	San Antonio	50	1964	San Francisco Bay
East Bay MUD	Camanche	417	1963	San Joaquin River
East Bay MUD	Pardee	198	1929	San Joaquin River
East Bay MUD	San Pablo	39	1920	San Francisco Bay
East Bay MUD	Briones	61	1964	San Francisco Bay
East Bay MUD	Chabot	10	1892	San Francisco Bay
East Bay MUD	Upper San Leandro	41	1977	San Francisco Bay
Contra Costa WD	Los Vaqueros[a]	100	1998	San Joaquin River
Santa Clara Valley WD	Calero	10	1935	San Francisco Bay
Santa Clara Valley WD	Coyote	23	1936	San Francisco Bay
Santa Clara Valley WD	Leroy Anderson	89	1950	San Francisco Bay
Santa Clara Valley WD	Lexington	20	1953	San Francisco Bay

[a] Reservoir provides emergency storage and water quality regulation. Does not develop local supply.

State Highway 280 parallels San Francisco's Upper and Lower Crystal Springs Reservoirs in San Mateo County. The reservoirs are located on the San Andreas fault zone.

the district are vulnerable to drought deficiencies imposed by the SWP, CVP, and Hetch Hetchy Project. These deficiencies may be intensified by diminished local runoff during drought conditions.

- ACWD serves a population of 292,000 in southwestern Alameda County, adjacent to San Francisco Bay. ACWD's Niles Cone groundwater basin supply is augmented by SWP and Hetch Hetchy supplies. The district is vulnerable to drought deficiencies imposed by SWP or SFPUC.
- Zone 7 WA delivers water in the Livermore-Almaden Valley in eastern Alameda County, serving communities such as Dublin, Livermore, and Pleasanton, as well as agricultural and industrial customers. Z7WA has an annual SWP entitlement of 46 taf.
- EBMUD provides water to 1.2 million people in the remainder of northern Alameda County, and part of western Contra Costa County. Virtually all of the water used by EBMUD comes from the 577-square-mile watershed of the Mokelumne River, which collects runoff from Alpine, Amador, and Calaveras Counties, on the west slope of the Sierra Nevada. EBMUD has water rights for up to 364 taf/yr from the Mokelumne River. In average years, district reservoirs in the East Bay capture an additional 30 taf from local watershed runoff. In drought years, evaporation and other reservoir losses may exceed local runoff.
- CCWD delivers municipal and industrial water throughout central and eastern Contra Costa County. Deliveries from CCWD go up during droughts as industrial diverters stop diverting with their own Delta water rights (because of water quality constraints) and use CCWD's CVP supplies instead. CCWD's 195 taf/yr CVP contract was recently renegotiated to include operation of Los Vaqueros Reservoir, completed in 1998. Under its new CVP contract CCWD will receive 75 percent of the contract amount, or 85 percent

Santa Clara Valley Water District operates an extensive system of groundwater recharge facilities, some of which are incorporated into a regional system of recreational walking/ biking trails.

Courtesy of CCWD

CCWD's Los Vaqueros Dam under construction. The reservoir, completed in 1998, does not provide new water supply, but provides terminal storage for CCWD's existing supply and improves service area water quality.

of historical use, during drought periods. Under severe drought conditions, the CVP supply may be reduced to 75 percent of historical use. CCWD has a smaller locally developed source at Mallard Slough, with an associated right to take up to 26.7 taf/yr. Diversions from Mallard Slough are unreliable due to poor water quality. The average annual diversion from this source over the past 20 years was only 5.6 taf.

Small independent water systems, such as those along the San Mateo coast, also suffer water supply reliability problems during droughts. These systems often rely on a single source, such as groundwater, and do not have connections to the larger systems in the Bay Area.

Local Water Resources Management Issues

Bay-Delta Estuary

The CALFED Bay-Delta Program and the 1995 SWRCB Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary are discussed in Chapters 2, 4, and 6. CALFED's ecosystem restoration program could restore wetlands and riparian habitats in the Delta. Other ERP actions in the region could include protection and enhancement of agricultural lands for wildlife, focusing on agricultural land and water management practices that would increase wildlife habitat value, and discouraging development of ecologically important agricultural lands for urban or industrial uses in the Delta, Suisun Marsh, and north San Francisco Bay.

Suisun Marsh

In 1995, USBR, DWR, DFG, and the Suisun Resource Conservation District began negotiations to update the Suisun Marsh Preservation Agreement. In 1996, the negotiators agreed in principle to 10 joint actions designed to lower soil salinity on Suisun Marsh managed wetlands (especially in the Marsh's western half) and to use water more efficiently. SWRCB will review western Suisun Marsh water quality objectives and water rights issues as part of its Bay-Delta water rights proceeding. More information on the Suisun Marsh can be found in Chapters 2, 4, and 6.

Local Water Agency Issues

North Bay. The primary water supply source for Sonoma County Water Agency, the Russian River, is in the North Coast Hydrologic Region. Issues related to SCWA and the Russian River are discussed in the North Coast Region portion of this chapter. Issues facing other major water suppliers in the North Bay are discussed below.

In 1995, SWRCB issued Decision WR 95-17, establishing instream flow requirements in Lagunitas Creek watershed. Marin MWD estimates that the decision will diminish its supply by 3 taf annually during drought years. In the past, Marin MWD examined desalting as an option to augment its water supply, studying construction of a 10 mgd reverse osmosis desalting plant near the western end of the San Rafael Bridge. The plant's annual yield would be approximately 10 taf at a cost of $1,900/af. The desalting project was included in a 1991 bond measure that was not approved by the voters. The following year, a bond measure for new facilities to bring more Russian River water to Marin County passed, and Marin MWD's need for the desalting option diminished. The new Marin MWD Russian River facilities will be on line by 2020. Since the district has all the necessary permits, this water source is not listed as a future option but is included in the district's base supply.

Napa County voters approved a local ordinance in 1998 which established a 0.5 percent sales tax to

Although lands in the Suisun Marsh are managed primarily to provide waterfowl habitat, a variety of mammals are found there as well.

fund a Napa County flood protection and watershed improvement expenditure plan. The goal of the plan was to "provide flood protection, save lives, protect property, restore the Napa River, Napa Creek, and other tributaries, maintain economic vitality, and enhance riparian environments". The Napa River and Napa Creek Project, a cooperative effort with USACE, is designed to provide 100-year flood protection for the City of Napa and environmental restoration. These objectives will be achieved by creating a flood bypass channel and wetlands; removal, redesign and replacement of floodway obstructions; elevation and relocation of homes; and construction of set-back levees and floodwalls. The design is intended to provide flood protection while allowing the river to meander through wide riparian zones. In other actions, funds would be provided for flood protection, environmental enhancement, and water supply reliability improvements for other communities and unincorporated areas of the County.

USBR and Solano County Water Agency have been involved in water rights actions on Putah Creek upstream and downstream of USBR's Solano Project facilities. In 1995, a settlement agreement was reached with water users in Lake and Napa Counties upstream of Lake Berryessa. The agreement establishes limits on future water development in the Lake Berryessa watershed and allocates water for the upstream users. A court-appointed watermaster will monitor water uses and enforce the terms of the settlement agreement.

Downstream of the Solano Project, disputes center around environmental water use and riparian water rights. The Putah Creek Council brought suit in 1990 against Solano Project water users to increase flows in the lower reaches of the creek. In 1996, the Sacramento County Superior Court ruled on instream flow requirements for Putah Creek downstream from Solano Diversion Dam, where water is diverted to Putah South Canal for delivery to agricultural lands and to communities in Solano County. The judgment cited the public trust doctrine as well as California Fish and Game code requirements and required higher (and year-round) flows from the creek into the Yolo Bypass. SCWA estimates the additional requirements are approximately 10 taf during an average year and 20 taf during a dry year. Solano County interests are appealing the judgment, which has been stayed until the appeal is heard. USBR is seeking an out-of-court settlement of the case. Under the Superior Court judgment, Solano County water users would be responsible for meeting the instream flow requirements in the downstream portion of the creek. Solano County water users have asked SWRCB to participate in the settlement process so that regulation of riparian diversions can be included in the final instream flow requirements for the creek.

SCWA's contract with USBR for Solano Project water supply will expire in 1999. The contract is renewable, but the terms and conditions of the contract will be renegotiated. SCWA will then need to renegotiate its contracts with Solano Project member entities.

SCWA has entered into a multi-year banking and

exchange agreement with Mojave Water Agency in the South Lahontan and Colorado River regions. During wet years, SCWA can bank up to 10 taf of its annual SWP entitlement in MWA's groundwater basin. During dry years, SCWA can take part of MWA's SWP entitlement in exchange (up to half the banked amount with a maximum of 10 taf/yr). SCWA pays for part of the transportation cost to convey the water to MWA.

Solano County water agencies are monitoring use of groundwater from the Putah Fan/Tehama Formation groundwater basin because of concerns about the condition of the shared basin. The City of Vacaville, Solano Irrigation District, Maine Prairie Water District, and Reclamation District 2068 have implemented AB 3030 groundwater management plans. SCWA has initiated a groundwater monitoring and data collection program. Vacaville, SID, Dixon, and Solano County developed a 1995 agreement to cooperatively mitigate any adverse conditions related to the basin.

South Bay. San Francisco Public Utility Commission and the Bay Area Water Users Association (SFPUC Bay Area Water contractors) are cooperatively developing a water supply master plan for the PUC's retail and wholesale service areas. Phase 1 of the three-phase plan was recently completed. The preliminary list of water supply options to be considered in Phase 2 includes:

- Short- and long-term Central Valley water transfers.
- Conjunctive use / groundwater banking within the Hetch Hetchy system (Tuolumne River Basin and areas adjacent to the aqueduct).
- Transfers within the Hetch Hetchy system.
- Additional surface storage within the Hetch Hetchy system.
- Conjunctive use / groundwater banking within the Bay Area system.
- Transfers within the Bay Area system.
- Additional surface storage within the Bay Area system.
- Desalting.
- Other local projects.

Phase 2 will ultimately produce a master plan for the PUC system and is scheduled for completion in 1999. Phase 3, the implementation phase of the master plan, will include environmental review, design, and construction of plan elements. Construction is anticipated to begin as early as 2001.

Without improvements to its water supply reliability, SCVWD is forecasted to face the largest drought year shortages in the San Francisco Bay Region. The district released an integrated water resources plan in December 1996 to address water supply reliability through 2020. The primary components of the preferred strategy include water banking, water transfers, water recycling, and water conservation. Components are scheduled to be phased into operation as necessary to meet increasing demands. Implementation of specific components is designed to be flexible, with a list of contingency strategies to meet changing conditions. The plan is to be updated every three to five years.

Alameda County Water District is continuing to monitor and manage saline water intrusion in its bayside aquifers. The district depends upon the Niles Cone groundwater basin, which includes at least three distinct aquifers, for district supplies. The district recharges locally developed water and imported surface water to the basin and extracts recharged supplies. Prior to ACWD's import of surface supplies in the 1960s, the upper two aquifers were overpumped, causing saline intrusion into the basin. In 1974, ACWD began its aquifer reclamation program, which includes nine wells designed to extract and discharge saline groundwater from the basin. Because of further intrusion of saline water during the recent drought, operations have been modified to pump and dispose of greater quantities of saline water. In 1992, a reconnaissance level study was conducted to evaluate the feasibility of desalting water pumped from extraction wells, and blending it with groundwater and imported surface water. This desalting option is discussed in the following section.

ACWD is developing a groundwater model to simulate the effectiveness of its aquifer reclamation program, movement of saline water, and remediation of the basin. Because runoff from the Alameda Creek watershed is used to recharge the groundwater basin, ACWD is working with upstream agencies and the RWQCB to ensure that water quality in Alameda Creek is not compromised due to development or other activities in the watershed.

Zone 7 WA has initiated a water supply master plan program EIR to meet projected water needs. Preliminary estimates indicate a need for 40 to 50 taf of additional water supply by 2020. The water supply program will include imported surface water transfers, conservation, water recycling, and purchase of the South Bay Aqueduct's currently unused conveyance capacity.

In a separate planning effort, Z7WA has been working with local developers on a water transfer agree-

ment to provide water to 9,500 new homes in Dougherty Valley, in southern Contra Costa County. A small portion of the Dougherty Valley development is within EBMUD's existing service area. After Contra Costa County approved the development in 1992, EBMUD indicated that it could not reliably provide water service to all 11,000 new customers. Ultimately, EBMUD agreed to provide service to Dougherty Valley over a lengthy development period, with the condition that developers try to find another source of water. The developers negotiated with Berrenda Mesa Water District, a member agency of Kern County WA, to purchase 7 taf of currently unused SWP entitlement water. Dublin San Ramon Services District agreed to be the water retailer and Z7WA, a wholesaler of SWP water, will treat and deliver water from the South Bay Aqueduct. In addition to paying for the entitlement water and connection fees from Z7WA and DSRSD, developers have agreed to pay Z7WA an additional $18 million for the wholesale service. DSRSD and Z7WA anticipate that the arrangement will result in lower water costs to existing customers and improved reliability. Another condition of the agreement stated that the project could not use existing local Z7WA storage space (primarily the Livermore Valley groundwater basin). Z7WA completed an agreement with Semitropic Water Storage District for 43 taf of groundwater storage, which is also being purchased by the developers. In wet years, excess water from Berrenda Mesa WD will be delivered to SWSD and stored in the groundwater basin. In drought years, Z7WA would receive SWP water in exchange through the SBA.

After the Z7WA / Dougherty Valley arrangement was finalized, the City of Livermore and environmental interests sued Z7WA in an effort to stop similar future arrangements. (The city is one of Z7WA's primary contractors.) A major concern of the plaintiffs is that Z7WA's water supply reliability will be diminished.

EBMUD's board approved a water supply action plan in 1995 to meet the objectives of its 1993 water supply management program EIR for improving supply reliability in its service area. The action plan's recommendation was to construct a Folsom South Canal connection to EBMUD's Mokelumne Aqueduct, to allow the district to use its CVP contract for up to 150 taf/yr of American River water. The project would be designed to operate in accordance with the Alameda County Superior Court's 1990 Hodge Decision, which confirmed the district's right to divert its contract amount subject to the court's physical solution for instream flow requirements in the Lower American River.

In November 1997, EBMUD and USBR released a draft EIR/EIS with two alignment alternatives for conveying American River water and one no project alternative. One alternative incorporates a concept developed by Sacramento County, the City of Sacramento, and EBMUD to construct a joint diversion facility near the American River's confluence with the Sacramento River. American River water would be diverted near the confluence and would be pumped back to the City of Sacramento's Fairbairn Water Treatment Plant. A portion of this water would continue on to the Folsom South Canal where it would be conveyed to the Mokelumne Aqueduct via a pipeline extension from the end of the canal. Water for Sacramento County would be treated at the Fairbairn Water Treatment Plant and conveyed to local water users.

In 1997, San Joaquin County interests proposed a groundwater storage project that would allow EBMUD to store surface water in San Joaquin County aquifers and would provide significant benefits to San Joaquin County water users. A joint powers authority of San Joaquin County water agencies hopes to initiate a pilot project to help assess the feasibility of this conjunctive use proposal. EBMUD has agreed to provide water for the project and is retaining this alternative for consideration to provide more out-of-service area storage and improved supply reliability during droughts. However, a conjunctive use alternative was not included in EBMUD's draft EIR for conveyance of its CVP contract supply.

EBMUD has also been involved in negotiations related to instream flows in the Mokelumne River. EBMUD's 1981 FERC license for operation of hydropower facilities at Pardee and Camanche Reservoirs incorporated an existing instream flow agreement between the district and the DFG. During the 1987-92 drought, poor fishery conditions on the Mokelumne River and fish losses at the district's Camanche fish hatchery prompted FERC to evaluate fishery flows. FERC issued a final EIS in November 1993, which was opposed by all the involved parties. Subsequent negotiations led to preparation of a settlement agreement by EBMUD, DFG, and USFWS which was submitted to FERC for review in June 1997. EBMUD has already implemented the agreement's flows which significantly impact the district's water supply. EBMUD estimates that its 2020 shortage with the new

agreement flows would increase from 130 taf to 185 taf. The district will continue to pursue reliability enhancement options to meet the expected increased shortage.

Contra Costa Water District is facing several issues with its CVP supply, which is its primary supply source. CCWD's CVP contract is scheduled to expire in 2010, but CVPIA established financial penalties for not committing to review by 1997. The district is weighing the potential loss of supply associated with renewal against the financial penalties, and expects that the reliability of its 195 taf contractual supply will be reduced due to CVPIA implementation.

Bay Area Regional Water Recycling Program

With passage of Title 16 of PL 102-575 in 1992, USBR joined with Bay Area water and wastewater agencies to fund a study of regional water recycling potential. The Bay Area regional water recycling program (formerly Central California regional water recycling program) was established in 1993 to develop a regional partnership for maximizing Bay Area water recycling. The program is sponsored jointly by USBR, the Department, and 13 Bay Area water and wastewater agencies. During the first phase of the program, completed in April 1996, participating agencies explored potential uses for water recycled from Bay Area wastewater treatment plants. The feasibility study showed that a regional approach would be productive.

A major component of the 1996 feasibility study was assessment of potential recycled water use in the Central Valley and other locations outside the Bay Area. The study determined that marketing the recycled water for agricultural use in the Central Valley was not feasible. A regional water recycling master plan, now in preparation, will focus on recycled water markets in the Bay Area. A limited assessment of agricultural uses immediately south of Santa Clara County will be made, but no further assessment of Central Valley uses will be included. Another major component of the feasibility study was the assessment of options to improve recycled water quality with respect to salinity. Two options originally assessed will not be included in the master plan—on-site agricultural salt management and management of agricultural drainage.

Water quality, especially salinity levels, will need to be managed to ensure the feasibility of Bay Area water recycling. The master plan will consider methods to control salt at the point of origin, including controlling infiltration of saline groundwater into agencies' pipelines. Other salt control methods to be considered include regulation of water softeners, control of industrial discharges, and treatment.

Water Management Options for the San Francisco Bay Region

Table 7-12 shows a list of options for the region, and the results of an initial screening of the options. The retained options were evaluated (Table 7A-2 in Appendix 7A) based on a set of fixed criteria discussed in Chapter 6.

Conservation

Urban. Urban water demand forecasts for 2020 assume that BMPs are in place; consequently, only those urban conservation efforts which exceed the BMPs are considered as options. All urban conservation options were retained. Reducing outdoor water use to 0.8 ET_o in new development would attain about 2 taf/yr of depletion reductions, while extending this measure to include existing development would reduce depletions by about 52 taf/yr. Reducing residential indoor water use to 60 and 55 gpcd would attain depletion reductions of 38 and 77 taf/yr, respectively. Reducing commercial, institutional, and industrial water use by an additional 3 percent and 5 percent would attain 11 and 18 taf/yr of depletion reductions, respectively. About 13 taf/yr of depletion reductions would be attained by reducing distribution system losses to 5 percent.

Agricultural. As with urban demand forecasts, agricultural water demand forecasts for 2020 assume that EWMPs are in place and only those efforts which exceed the EWMPs are considered as options. Due to the relatively small amount of irrigated acreage in the region and the high SAE attained on average throughout the region, no significant depletion reductions would accrue.

Modify Existing Reservoirs/Operations

Napa County Flood Control and Water Conservation District has considered reservoir enlargement options which would provide additional offstream storage for Napa River flows. In the South Bay, SCVWD has evaluated enlarging Leroy Anderson Reservoir, which could increase SCVWD's annual supply by about 25 taf. EBMUD has had several proposals to enlarge both of its Mokelumne River reservoirs. The

TABLE 7-12

San Francisco Bay Region List of Water Management Options

Option	*Retain or Defer*	*Reason for Deferral*
Conservation		
Urban		
Outdoor Water Use to $0.8ET_o$	Retain	
Indoor Water Use	Retain	
Interior CII Water Use	Retain	
Distribution System Losses	Retain	
Agricultural		
Seasonal Application Efficiency Improvements	Defer	No significant depletion reductions attainable.
Flexible Water Delivery	Defer	No significant depletion reductions attainable.
Canal Lining and Piping	Defer	No significant depletion reductions attainable.
Tailwater Recovery	Defer	No significant depletion reductions attainable.
Modify Existing Reservoirs/Operations		
Enlarge Lake Hennessey / Napa River Diversion	Retain	
Enlarge Bell Canyon Reservoir	Retain	
Enlarge Bell Canyon Reservoir/ Napa River Diversion	Retain	
Enlarge Pardee Reservoir	Retain	
Enlarge Camanche Reservoir	Retain	
Enlarge Briones Reservoir	Defer	Geologic hazards.
Enlarge Chabot Reservoir	Defer	Substantial residential development.
Enlarge Leroy Anderson Reservoir	Retain	
Upgrade Milliken Treatment Plant	Retain	
Reoperate Rector Reservoir	Retain	
New Reservoirs/Conveyance Facilities		
Chiles Creek Reservoir Project/ Napa River Diversion	Retain	
Enlarge Lake Hennessey /Chiles Creek Project / Napa River Diversion	Retain	
Carneros Creek Reservoir / Napa River Diversion	Retain	
Upper Del Valle Reservoir	Retain	
Buckhorn Dam and Reservoir	Retain	
Upper Kaiser Reservoir	Retain	
Upper Buckhorn Reservoir	Retain	
Middle Bar Reservoir (Amador & Calaveras Counties)	Retain	
Duck Creek Offstream Reservoir	Retain	
Devils Nose Project (Amador County)	Retain	
Clay Station Reservoir (Sacramento County)	Defer	Wetlands, endangered species.
Alamo Creek Reservoir	Defer	Substantial residential development.
Bolinger Reservoir	Defer	Substantial residential development.
Cull Canyon Dam	Defer	Substantial residential development.
Canada del Cierbo Reservoir	Defer	Storage cost too high ($16,000/af).
Curry Canyon Reservoir	Defer	Substantial residential development.

TABLE 7-12

San Francisco Bay Region List of Water Management Options (continued)

Option	*Retain or Defer*	*Reason for Deferral*
Lower Kaiser Reservoir	Defer	Storage cost too high ($9,000/af).
Bailey Road Reservoir	Defer	Storage cost too high ($21,000/af).
EBMUD American River Supply	Retain	
Groundwater/Conjunctive Use		
EBMUD/San Joaquin County Conjunctive Use	Defer	Under discussion; not yet defined.
Milliken Creek Conjunctive Use	Retain	
Lake Hennessey /Conn Creek Conjunctive Use	Retain	
Recharge Dumbarton Quarry Pits	Defer	Unsuitable geologic conditions.
Sunol Valley Groundwater Recharge	Defer	Limited aquifer production.
Water Marketing		
Napa/Solano County WA Exchange	Defer	SCWA is not interested in exchange.
Solano County WA	Defer	No proposals identified at this time.
Contra Costa WD	Defer	No proposals identified at this time.
Zone 7 WA/Kern County WA	Retain	
Santa Clara Valley WD/SLDMWA	Retain	
Water Recycling		
Bel Marin Keys Golf Course - North Marin Water District	Retain	
Black Point Golf Links - North Marin Water District	Retain	
Central Marin Water Recycling Project - Marin MWD	Retain	
Golf Course Irrigation, City Park Irrigation - North San Mateo CSD	Retain	
Hercules/Franklin Canyon WRP-Phase 2 - EBMUD	Retain	
Industrial Use - Central Contra Costa Sanitary District	Retain	
Lamorinda - Central Contra Costa Sanitary District	Retain	
Nonpotable Wastewater Reuse Master Plan - Union Sanitation District	Retain	
Phase 1 Water Reclamation Program - Alameda County WD	Retain	
Phase 2 Water Reclamation Program - Alameda County WD	Retain	
San Francisco Water Recycling Master Plan	Retain	
San Ramon Valley Recycled Water Program - DSRSD/EBMUD	Retain	
San Ramon Valley Water Recycling Project - EBMUD	Retain	
South Bay Water Recycling Project - City of Santa Clara	Retain	
South Bay Water Recycling Project - San Jose	Retain	
Zone 1 - Central Contra Costa Sanitary District	Retain	

TABLE 7-12

San Francisco Bay Region List of Water Management Options (continued)

Option	*Retain or Defer*	*Reason for Deferral*
Desalting		
Brackish Groundwater		
Alameda County WD Aquifer Recovery Project	Retain	
Seawater		
Marin Municipal WD Desalting Project	Retain	
Other Local Options		
New Surface Water Diversion from Sacramento River by Cities of Benicia, Fairfield, & Vacaville	Retain	
Statewide Options		
—	—	See Chapter 6.

improvement of system yields associated with these projects has not been determined.

Reoperating Rector Reservoir in Napa County would provide an increase of approximately 1.2 taf/yr in system yield. NCFC&WCD is also considering a modification of its Milliken Water Treatment Plant, which would generate a small increase (450 af) in its annual water supply.

New Reservoirs and Conveyance Facilities

Ten new reservoirs were evaluated for Bay Area water agencies. NCFC&WCD investigated several diversion and storage projects, including Chiles Creek Reservoir Project and Carneros Creek Reservoir Project. The viability of these offstream storage projects depends upon the district's ability to make Napa River diversions. (SWRCB has declared the Napa River to

USBR's Folsom South Canal was designed to convey water from the American River below Nimbus Dam to central San Joaquin County. Only part of the canal was actually constructed, and the canal now terminates in southeastern Sacramento County.

Courtesy of USBR

be fully appropriated during parts of the year.) Some agencies, including ACWD, have examined an Upper Del Valle Reservoir Project. EBMUD has considered three new storage reservoirs in its service area and two new reservoirs in the Mokelumne Basin (Middle Bar and Devils Nose projects). These storage options have been inactive since EBMUD's focus on its supplemental water supply project.

As discussed previously, EBMUD and USBR released a draft EIR/EIS in 1997 for EBMUD's diversion of its American River CVP supply. EBMUD estimates that it would receive 112 taf and 70 taf in average and droughts years, respectively. (The draft EIR/EIS evaluates alternatives for conveyance of the water. Project yield remains the same in either of the conveyance alternatives.)

Groundwater Development or Conjunctive Use

EBMUD is continuing discussions with San Joaquin County interests for a joint groundwater storage/conjunctive use project. EBMUD's CVP contract water could be stored in San Joaquin County groundwater basins prior to being diverted into EBMUD's Mokelumne River Aqueduct in northeast San Joaquin County. This option was considered in EBMUD's 1995 Water Supply Action Plan, but not included in EBMUD's draft EIR for conveyance of its CVP contract supply. The yield is currently undefined.

Only two groundwater or conjunctive use options in Table 7-12 were retained for further evaluation. NCFC&WCD has two proposals to construct conjunctive use facilities adjacent to existing surface water facilities. The proposed Milliken Creek conjunctive use project would allow the City of Napa and the Silverado Country Club to share surface and groundwater supplies, and would provide an additional drought year yield of 1.9 taf. The proposed Lake Hennessey/Conn Creek conjunctive use project would make the City of Napa's surface water available to agricultural users in exchange for rights to pump groundwater during droughts. This option would provide an estimated 5 taf during drought years.

Water Marketing

Agencies throughout the Bay Area are proposing to negotiate for new or additional water imports into the region. Most of these proposals are preliminary. Water transfer proposals by SCWA, CCWD, and Z7WA all include transfers from as-yet-unnamed Sacramento Valley water users. The actual amount of water available through these proposals is unknown and the competition for transfers will certainly impact both price and availability. A likely option for Z7WA is the permanent transfer of 7 taf of SWP entitlement from KCWA, as provided for in SWP's Monterey Amendments.

Several agencies in the region already have banking and exchange agreements with agencies in the Tulare Lake, South Lahontan, and Colorado River regions. These agreements among SWP contractors involve exchanges of SWP entitlement. ACWD, Z7WA, and SCVWD are participating in SWSD's groundwater banking program and have long-term contracts for 50, 43, and 350 taf of storage, respectively. SWP entitlement would be delivered to SWSD for groundwater recharge in wet years and SWSD, a member agency of KCWA, would forego a portion of its entitlement in dry years in exchange. SCWA has a similar agreement with MWA in San Bernardino County for up to 10 taf.

SCVWD has also entered into a three-way transfer agreement with the San Luis Delta-Mendota Water Authority and USBR. Under this option, participating member agencies of SLDMWA may receive some of SCVWD's CVP water allocation in normal and above-normal water years, in exchange for committing to make available a share of their CVP allocation during drought years. This option would provide SCVWD with up to 14 taf in drought years and is discussed in more detail in Chapter 6.

Water Recycling

The 1995 water recycling survey identified 16 water recycling options in the San Francisco Bay Region, with a total potential 2020 yield of 101 taf. The average price of recycled water from these options would be just over $500/af, with a range from $100 to over $2,000/af. The most common use for recycled water would be for landscape irrigation. A few options were proposed for industrial or agricultural use.

One consideration in evaluating water recycling proposals is that a number of options may be proposed for the same wastewater treatment plant. These options depend upon different distribution systems and are therefore considered separately for this report. Some of the larger projects with their associated 2020 yield include the South Bay water recycling program (31 taf), the Central Contra Costa Sanitary District industrial use project (20 taf), the San Francisco water recycling management plan (12 taf), and the San

Ramon Valley recycled water project (10 taf). Most of the remaining water recycling options have 2020 yields in the range of 1 to 4 taf.

Desalting

Alameda County WD has evaluated the potential for desalting brackish water to allow increased use of groundwater. Water pumped from the district's aquifer recovery project wells would be desalted and blended with groundwater and Hetch Hetchy water to provide a quality consistent with other sources of supply. The plant would produce 9 taf/yr at a cost of about $500/af.

In the past, Marin MWD examined seawater desalting as an option to augment its water supply. The district studied constructing a 10 mgd reverse osmosis desalting plant. The plant's annual production would be approximately 10 taf at a cost of $1,900/af.

Other Local Options

Solano County WA and its member agencies have been examining several surface water management projects to improve their water supply reliability. One proposal is to apply for additional water rights from the Sacramento River. The Cities of Benicia, Fairfield, and Vacaville have filed an application with the SWRCB to divert an additional 31 taf/yr. The water would be conveyed to the cities via the North Bay Aqueduct. (Vacaville is in the Sacramento River Region and its share is 8.5 taf/yr).

Statewide Options

Statewide water supply augmentation options are discussed and quantified in Chapter 6.

Options Likely to be Implemented in San Francisco Bay Region

Water supplies are not available to meet all of the region's 2020 water demands in drought years. Applied water shortages are forecasted to be 287 taf. No average year water shortages are forecasted for 2020. Ranking of retained water management options for the San Francisco Bay Region is summarized in Table 7-13. Table 7-14 summarizes options that can likely be implemented by 2020 to relieve the shortages.

Implementation of BMPs will continue through 2020 and is reflected in the base demand levels for urban water use. Urban conservation options likely to be implemented, based on costs and feasibility, would provide an estimated 57 taf/yr in water savings in the region.

Agencies throughout the region have ambitious plans for water recycling as a future water supply option. These options could provide an additional 24 taf/yr to the region by 2020. EBMUD's American River supply would augment drought year supplies by 70 taf. Water marketing agreements being negotiated with Central Valley agencies will likely add 19 taf/yr in the near future. Statewide options including SWP improvements and drought water bank would likely augment drought supplies by 100 taf.

Many South Bay water purveyors' systems are interconnected, reflecting a common reliance on the SWP, CVP, and Hetch Hetchy facilities for their water supplies. CCWD and SCVWD are connected to the Delta via CVP facilities. In addition, piping to facilitate connections between EBMUD and CCWD and the City of Hayward is in place for emergency transfers. (These connections are of limited capacity to allow for transfers in a catastrophic event.) SCVWD, ACWD, and Z7WA are connected by the SWP's South Bay Aqueduct. SFPUC now has a permanent connection to the SWP, to allow it to take delivery of water transfers wheeled by the SWP. These interconnections facilitate water transfers and are positive factors in water resources management in the South Bay.

TABLE 7-13

Options Ranking for San Francisco Bay Region

Option[a]	*Rank*	*Cost ($/af)*	*Potential Gain (taf)*	
			Average	*Drought*
Conservation				
Urban				
Outdoor Water Use to 0.8 ET_0- New Development	M	750	2	2
Outdoor Water Use to 0.8 ET_0-New and Existing Development	L	[b]	52	52
Indoor Water Use (60 gpcd)	M	400	38	38
Indoor Water Use (55 gpcd)	M	600	77	77
Interior CII Water Use (3%)	M	500	11	11
Interior CII Water Use (5%)	M	750	18	18
Distribution System Losses (5%)	M	300	13	13
Modify Existing Reservoirs/Operations				
Enlarge Lake Hennessey /Napa River Diversion	M	630	12	-
Enlarge Bell Canyon Reservoir	M	[b]	[b]	2
Enlarge Bell Canyon Reservoir/Napa River Diversion	M	[b]	[b]	4
Enlarge Pardee Reservoir	M	[b]	[b]	30
Enlarge Camanche Reservoir	M	[b]	[b]	15
Enlarge Leroy Anderson Reservoir	M	4,400	[b]	25
Upgrade Milliken Treatment Plant	M	1,770	1	1
Reoperate Rector Reservoir	M	800	-	1
New Reservoirs/Conveyance Facilities				
Chiles Creek Reservoir Project/Napa River Diversion	L	1,170	12	-
Enlarge Lake Hennessey/Chiles Creek Project/ Napa River Diversion	L	1,030	15	-
Carneros Creek Reservoir/Napa River Diversion	L	2,100	12	-
Upper Del Valle Reservoir	M	1,600	5	2
Buckhorn Dam and Reservoir	M	[b]	[b]	23
Upper Kaiser Reservoir	M	[b]	[b]	6
Upper Buckhorn Reservoir	L	[b]	[b]	3
Middle Bar Reservoir	L	[b]	[b]	15
Duck Creek Offstream Reservoir	L	[b]	[b]	15
Devils Nose Project	L	[b]	[b]	23
EBMUD American River Supply	M	850	112	70
Groundwater/Conjunctive Use				
Milliken Creek Conjunctive Use	H	150	-	2
Lake Hennessey/Conn Creek Conjunctive Use	H	280	-	5
Water Marketing				
Z7WA/KCWA (7 taf entitlement)	H	[b]	7	5
SCVWD/SLDMWA	H	[b]	-	14

TABLE 7-13

Options Ranking for San Francisco Bay Region (continued)

Option[a]	*Rank*	*Cost ($/af)*	*Potential Gain (taf)*	
			Average	*Drought*
Water Recycling				
Group 1 (Cost < $500/af)	H	500	24	24
Group 2 (Cost $500/af - $1,000/af)	M	1,000	20	20
Group 3 (Cost > $1,000/af)	M	1,500	46	46
Desalting				
Brackish Groundwater				
Alameda County Water District Aquifer Recovery Project	H	510	9	9
Seawater				
Marin Municipal Water District Desalting Project	L	1,900	10	10
Other Local Options				
New Surface Water Diversion from Sacramento River by Cities of Benicia, Fairfield, & Vacaville[c]	M	[b]	22	22
Statewide Options				
See Chapter 6.				

[a] All or parts of the amounts shown for the highlighted options have been included in Table 7-14.
[b] Data not available to quantify.
[c] The three cities have applied for 31 taf/yr of supplemental water, part of which would be used in the Sacramento River Region.

TABLE 7-14

Options Likely to be Implemented by 2020 (taf)
San Francisco Bay Region[a]

	Average	*Drought*
Applied Water Shortage	**0**	**287**
Options Likely to be Implemented by 2020		
Conservation	-	57
Modify Existing Reservoirs/Operations	-	-
New Reservoirs/Conveyance Facilities	-	70
Groundwater/Conjunctive Use	-	7
Water Marketing	-	19
Recycling	-	24
Desalting	-	9
Other Local Options	-	-
Statewide Options	-	100
Expected Reapplication	-	1
Total Potential Gain	**-**	**287**
Remaining Applied Water Shortage	**0**	**0**

[a] Implementing options to reduce drought year shortages would provide more water than is needed to meet average year needs. In average years, this water could be available for transfer to other regions, or some options could be operated at less than their full capacity.

FIGURE 7-4.

Central Coast Hydrologic Region

Central Coast Hydrologic Region

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Description of the Area

The Central Coast Region (Figure 7-4) extends from southern San Mateo County in the north to Santa Barbara County in the south. The region includes the southern tip of San Mateo County, part of Santa Clara County, most of San Benito County, all of Santa Cruz, Monterey, San Luis Obispo and Santa Barbara Counties, and the northwestern tip of Ventura County. The major topographic features include Monterey and Morro Bays; the Pajaro, Salinas, Carmel, Santa Maria, Santa Ynez and Cuyama Valleys; the Coast Range, and the coastal plain of Santa Barbara County. The region is divided into two planning subareas: Northern (including all counties except San Luis Obispo and Santa Barbara) and Southern (San Luis Obispo and Santa Barbara Counties). Summer temperatures are cool along the coastline and warmer inland. In the winter, temperatures remain cool along the coast but become cooler inland. Annual precipitation ranges from about 10 inches on valley floors at the south end of the region to as much as 50 inches on some of the highest peaks. The year-round frost-free climate of the coastal valleys makes them ideal for production of specialty crops such as strawberries and artichokes.

The principal population centers in the region are Santa Cruz, Hollister, Salinas, Monterey, Paso Robles, San Luis Obispo, Santa Maria, Goleta, and Santa Barbara. Intensive agriculture is found in the Salinas and Pajaro Valleys in the north and the Santa Maria and lower Santa Ynez Valleys in the south. Agricultural acreage has remained fairly stable during recent years, although urban development is encroaching on some valley agricultural lands. In the Pajaro and Salinas Valleys, the major crops include vegetables, specialty crops, and cut flowers. Wine grape acreage has increased in the upper Salinas Valley. The flower seed industry in Lompoc Valley is thriving and attracts many tourists each year. Parts of the upper Salinas Valley and Carrizo Plain are dry-farmed to produce grains. Table 7-15 shows the region's population and crop acreage for 1995 and 2020.

Major economic activities include tourism, agricultural-related processing, and government and

The Pajaro and Salinas Valleys are known for their production of specialty crops. Castroville is sometimes called the artichoke capital of the world.

TABLE 7-15

Population and Crop Acreage

	Population (thousands)	*Irrigated Crop Acreage (thousands of acres)*
1995	1,347	572
2020	1,946	570

service sector employment. Oil production and transportation sites onshore and offshore are important to the economies of Santa Barbara and San Luis Obispo Counties. San Luis Obispo County has major thermal powerplants at Diablo Canyon and Morro Bay. Military facilities include Hunter-Liggett Military Reservation, Vandenberg Air Force Base, and Camp San Luis Obispo.

Water Demands and Supplies

The water budget for the Central Coast Region is shown in Table 7-16. Groundwater is the primary source of water supply in the region, followed by local surface water. CVP water supply is delivered to the northern part of the region from San Luis Reservoir. SWP Coastal Branch deliveries to the southern part of the region began in 1997. Most of the water shortage in the region is due to groundwater overdraft, although the overdraft is expected to lessen with SWP water deliveries and decreased agricultural demands.

Northern PSA

This planning subarea includes Santa Cruz County, Pajaro Valley, the Monterey Peninsula, and Salinas Valley. Water agencies include Monterey County Water Resources Agency, Monterey Peninsula Water Management District, Marina Coast Water District, California-American Water Company (Carmel), Pajaro Valley Water Management Agency, City of Santa Cruz, and San Benito County Flood Control and Water Conservation District.

The Northern PSA is comprised of a number of medium-to-small independent watersheds. There is limited infrastructure for water transfers among the watersheds and from outside the region. The only water import from outside the region comes from CVP's San Felipe Unit, which imports 53 taf/yr into southern Santa Clara and San Benito Counties.

Groundwater is the primary water source for the subarea. Groundwater recharge is provided by the Pajaro, Salinas, and Carmel Rivers, and by Arroyo Seco. San Clemente and Los Padres Dams on the Carmel River (Monterey County), San Antonio Dam on the San Antonio River (Monterey County), and Nacimiento Dam on the Nacimiento River (San Luis Obispo County) are the region's main surface water storage facilities. Water impounded in these reservoirs is managed to provide groundwater recharge.

Southern PSA

The largest water agencies in the southern PSA are two countywide agencies—the San Luis Obispo County Flood Control and Water Conservation District and the Santa Barbara County Flood Control and Water Conservation District. The Central Coast Water Authority was formed in 1991 to construct, manage, and operate Santa Barbara County's 42 mile portion

TABLE 7- 16

Central Coast Region Water Budget (taf)[a]

	1995		*2020*	
	Average	*Drought*	*Average*	*Drought*
Water Use				
Urban	286	294	379	391
Agricultural	1,192	1,279	1,127	1,223
Environmental	118	37	118	37
Total	**1,595**	**1,610**	**1,624**	**1,652**
Supplies				
Surface Water	318	160	368	180
Groundwater	1,045	1,142	1,041	1,159
Recycled and Desalted	18	26	42	42
Total	**1,381**	**1,328**	**1,452**	**1,381**
Shortage	**214**	**282**	**172**	**270**

[a] Water use/supply totals and shortages may not sum due to rounding.

of the Coastal Aqueduct. Many small retail agencies and small municipalities provide their own water supplies.

The major source of water in the two counties is coastal groundwater basins. SLOCFC&WCD and SBCFC&WCD contract with the Department for SWP water. The two agencies have contractual entitlements totaling 70.5 taf/yr. Due to the 1987-92 drought, three seawater desalting plants were constructed in the region. The City of Morro Bay's plant has an annual capacity of 670 af and is used when groundwater supplies are limited during dry periods. The City of Santa Barbara's plant has an annual capacity of 7.5 taf and is on standby. (Although the Santa Barbara plant only operated briefly in 1992, it is considered in the base water budget as a drought year supply under 1995 level of development, and as an average and drought year supply in 2020.) The plant at San Simeon Beach State Park has minimal capacity (45 af) and is also on standby.

There are two USBR projects in the subarea. The Cachuma Project provides Santa Ynez River water to the Santa Barbara area; main project facilities are the 205 taf Cachuma Reservoir (Bradbury Dam) and the South Coast Conduit. The Santa Maria Project provides Cuyama River water for irrigation use in the Santa Maria area; main project facilities are Twitchell Dam and Reservoir (240 taf). Another federal reservoir, USACE's 26 taf Santa Margarita Lake (Salinas Dam) provides supply for the City of San Luis Obispo.

Local Water Resources Management Issues

Seawater Intrusion

With Central Coast's limited surface supply and few surface water storage facilities, the growing demand for water is causing an increased dependence on the region's groundwater resources. Because groundwater extractions have exceeded groundwater replenishment, seawater has advanced into some coastal freshwater aquifers, degrading water quality. Seawater intrusion is a major concern in the region.

Several decades of over-pumping groundwater have caused seawater intrusion in the aquifers that supply the Salinas Valley with nearly 100 percent of its fresh water. Seawater has intruded almost 6 miles inland into the 180-foot aquifer and two miles inland into the 400-foot deep aquifer. This intrusion has rendered the groundwater too salty for either municipal or agricultural use. Replenishment of groundwater occurs primarily from percolation of surface water from the Salinas River and its tributaries. The construction of Nacimiento and San Antonio Dams in 1957 and 1965, respectively, has increased replenishment but has

DWR's extension of the Coastal Branch to serve San Luis Obispo and Santa Barbara Counties provides an imported surface water supply that can help reduce overdraft of coastal groundwater basins.

not stopped seawater intrusion. In 1994, SWRCB began investigating the Salinas Valley. The SWRCB suggested that adjudication may be necessary if the local agencies could not halt the seawater intrusion.

In 1998, the MCWRA and the MRWPCA jointly completed a $78 million Salinas Valley reclamation project and Castroville seawater intrusion project. These projects consist of a 19.5 taf/yr tertiary treatment plant and a distribution system that will provide recycled water to 12,000 acres of Castroville area farms. During the low irrigation demand periods in winter, early spring and late fall, recycled water will supply most of the water needed for irrigation. During late spring, summer, and early fall, growers will receive a blend of recycled water and groundwater. The projects will reduce groundwater pumping in the project area, thus reducing seawater intrusion. Additionally, the projects will reduce the amount of secondary-treated wastewater discharged to the Monterey Bay National Marine Sanctuary. The sanctuary is a federally-protected aquatic ecosystem extending from Point Reyes to San Luis Obispo with abundant marine resources including kelp forests, marine mammals, and sea and shore birds.

MCWRA is preparing an EIR and preliminary design for a Salinas Valley water project to solve seawater intrusion and nitrate contamination. Major components of the project include dam modifications and reservoir reoperation, river conveyance and diversion facilities, groundwater recharge, storage for recycled water, distribution systems, and conservation. The project also will include management strategies to address nitrate contamination problems.

Seawater intrusion is also a problem facing the Pajaro Valley. Pajaro Valley Water Management Agency is preparing environmental documents to address water management issues facing the valley, following adoption of a basin management plan in 1993. The plan includes projects to develop local supplies, recharge groundwater, import new water, and adopt conservation measures to help solve groundwater overdraft and attendant seawater intrusion problems. Failing to implement the plan could result in intervention by SWRCB, potentially resulting in basin adjudication and restrictions on extractions. PVWMA is working closely with SWRCB to address groundwater overdraft problems, and SWRCB has reserved $5 million in low interest loan money from the Proposition 204 Seawater Intrusion Control Fund to help assist PVWMA in implementing its basin management plan.

Local Water Agency Issues

Santa Cruz County relies mostly on surface water diversions. Drought years pose a threat of water rationing and shortages because of the lack of adequate storage facilities. Seawater intrusion is a concern for groundwater users. For example after years of stable conditions, groundwater quality in municipal wells in the Soquel-Aptos area began to degrade in 1993-94. Soquel Creek Water District, the largest purveyor in this part of the county, relies primarily on groundwater. As measured in monitoring wells along the Monterey Bay coastline, groundwater quality degraded noticeably in less than 4 years, with chloride concentrations increasing from 20 to 40 mg/L to about 250 to 2,500 mg/L. These conditions occurred despite the district's managing its extractions to maintain coastal groundwater levels above sea level and decreasing its pumping.

Between urban growth and growth in tourism, the Monterey Peninsula is expected to experience more frequent shortages in drought years. Water supply for the area comes from the Carmel River, which has relatively little developed storage. In its Monterey Peninsula water supply project final EIR/EIS, MPWMD chose the 24 taf New Los Padres Reservoir on the Carmel River as its preferred alternative for meeting future water needs. The proposed reservoir would expand the Peninsula's water supply and help protect and restore natural resources on the Carmel River, by providing instream flows. However, voters defeated bonds for the project in a 1995 election. MPWMD staff prepared a water supply alternatives plan in 1996 which included recommendations for expanded groundwater production, additional recycled water use, desalting, and additional conservation programs.

In 1995, SWRCB determined that Cal-Am was diverting approximately 10.7 taf/yr out of the Carmel River Basin without valid water rights. SWRCB ordered that diversions from the river be reduced, and that sources outside of the basin be developed. One of these sources could be additional groundwater production from the Seaside Basin, but use of this basin as a replacement for diversions from the Carmel River is being challenged in litigation. SWRCB indicated that New Los Padres Reservoir should be reconsidered to enhance Carmel River habitat values and to provide for Cal-Am's water supply. In 1996, Cal-Am decided to proceed with the New Los Padres Reservoir, but with a reduced urban yield of 10.7 taf to support only existing water needs, without providing supplies for

The Monterey Bay National Marine Sanctuary is home to a variety of species.

future growth. The remainder of the reservoir's supply would be used for instream flow enhancement.

The City of San Luis Obispo has been pursuing a Salinas Reservoir expansion project to supplement its water supply. The existing reservoir is owned by USACE and is managed by SLOCFC&WCD. The expansion project involves installing spillway gates to expand the storage capacity from about 24 taf to 42 taf. The proposed project would increase the city's annual water supply by about 1.6 taf, but would supply only a portion of the city's expected future water demands. An initial draft EIR was issued in late 1993. A revised draft EIR was issued in May 1997.

Seawater Desalting

Current municipal seawater desalting capacity in the Central Coast Region is almost entirely based on the City of Santa Barbara's desalting plant (7.5 taf/yr). The remainder of the plants are small, less than 750 af/yr in capacity. During the 1987-92 drought, a number of seawater desalting projects were anticipated, but the return of average water years put most of these plants on hold. Only Santa Barbara, Morro Bay, and the San Simeon Beach State Park installed plants because of the drought. Proposed bonds for a 3 mgd seawater desalting plant for Monterey Peninsula Water Management District were rejected by voters in 1992. The plants in Santa Barbara and San Simeon are on standby. The plant at Morro Bay is used only during dry periods when groundwater supplies are limited.

In response to seawater intrusion in its groundwater basin, the Marina Coast Water District completed a 300,000 gpd (340 af/yr) seawater desalting plant in 1997. The plant produces about 14 percent of the district's water supply.

Water Management Options for the Central Coast Region

Table 7-17 shows a list of options for the region, and the results of an initial screening of the options.

The Cuyama River has its headwaters in northwestern Ventura County and flows onto the Cuyama Valley floor in San Luis Obispo and Santa Barbara Counties. As suggested by this photo, the river's flow is ephemeral. Valley agriculture is supported by groundwater.

TABLE 7-17

Central Coast Region List of Water Management Options

Option	*Retain or Defer*	*Reason for Deferral*
Conservation		
Urban		
Outdoor Water Use to $0.8ET_o$	Retain	
Indoor Water Use	Retain	
Interior CII Water Use	Retain	
Distribution System Losses	Retain	
Agricultural		
Seasonal Application Efficiency Improvements	Defer	No significant depletion reductions attainable.
Flexible Water Delivery	Defer	No significant depletion reductions attainable.
Canal Lining and Piping	Defer	No significant depletion reductions attainable.
Tailwater Recovery	Defer	No significant depletion reductions attainable.
Modify Existing Reservoirs/Operations		
Modify Nacimiento Spillway	Retain	
Inter-Lake Tunnel - Nacimiento/San Antonio Reservoirs	Defer	Alternative to preferred Nacimiento spillway modification.
Enlargement of Salinas Reservoir	Retain	
Enlargement of Cachuma Reservoir	Retain	
Enlargement of Lopez Reservoir	Defer	Excessive unit cost.
New Reservoirs/Conveyance Facilities		
College Lake	Retain	
Bolsa De San Cayetano Reservoir	Defer	Fishery and foundation issues; excessive cost.
Corncob Canyon Reservoir	Defer	High level of housing development in canyon.
Pescadero Reservoir	Defer	Fishery and foundation issues; excessive cost.
Gabilan Creek Dam	Defer	Questionable water supply.
Feeder Streams (Various Sites)	Retain	
Chalone Canyon Dam	Defer	Questionable water supply.
Vaqueros Canyon Dam	Defer	Questionable water supply.
New Los Padres Reservoir	Retain	
Nacimiento Pipeline	Retain	
Arroyo Seco Dam	Defer	Impacts to environment, residential and commercial development.
Barloy Dam	Defer	Questionable water supply.
Mathews Dam	Defer	Questionable water supply.
Jerret Dam	Defer	Questionable water supply.
New San Clemente Reservoir	Defer	Strong regulatory agency objections.
San Clemente Creek Reservoir	Defer	High probability of inundating spotted owl habitat.
Cachagua Reservoir	Defer	Questionable supply and located outside MPWMD boundaries.
Canada Reservoir	Defer	Questionable geological conditions at dam site.
Klondike Dam	Defer	Located near active faults; inundation of residential development.
Chupines Creek Reservoir	Defer	Questionable supply and located outside MPWMD boundaries.
Pine Creek	Defer	Potential impacts to environmentally sensitive areas.

TABLE 7-17

Central Coast Region List of Water Management Options (continued)

Option	*Retain or Defer*	*Reason for Deferral*
Buckeye Creek	Defer	Located near active faults; unsuitable dam foundation.
Lower Jack	Defer	Environmental impacts; riparian oak grassland.
Santa Rita	Defer	Environmental impacts; riparian oak grassland.
Camuesa and Salsipuedes Reservoirs	Defer	Environmental impacts; presence of endangered species.
Hot Springs, New Gilbraltar, and Round Corral Reservoirs	Defer	Insufficient yield, high unit cost of water.
Groundwater/Conjunctive Use		
College Lake Injection/Extraction Wells	Retain	
Increase Groundwater Development in Seaside Basin	Retain	
Seaside Conjunctive Use	Defer	Insufficient yield.
Salinas River Well System	Defer	Will not produce supply without implementing other new supply component.
Storage and Infiltration Basins/Recharge	Defer	Questionable water supply.
Upper/Lower Carmel Valley Well Development	Defer	Questionable water supply.
Water Marketing		
CVP (San Felipe Project Extension)	Retain	
SWP (Coastal Branch/Salinas River/Nacimiento transfer)	Defer	No current local interest.
Water Recycling		
Aquifer Storage/Recovery - Monterey County Water Resources Agency	Retain	
Castroville Seawater Intrusion Project expansion	Retain	
Santa Cruz Water Reuse Project - Pajaro Valley WMA	Retain	
SSLOCSD Reclamation Project - City of Arroyo Grande	Retain	
SVWD Recycled Water Plant - Scotts Valley Water District	Retain	
Urban Reuse Project - Monterey Regional Water Pollution Control Agency	Retain	
Watsonville Water Resue Project - Pajaro Valley WMA	Retain	
Injected Treated Water/Carmel River Mouth	Defer	Health concerns.
Desalting		
Brackish Groundwater		
City of Santa Cruz	Retain	
Seawater		
Monterey Peninsula Water Management District	Retain	

TABLE 7-17

Central Coast Region List of Water Management Options (continued)

Option	*Retain or Defer*	*Reason for Deferral*
Other Local Options		
Weather modification	Defer	Difficult to quantify.
Salinas River Diversion and Distribution Project	Retain	
Statewide Options		
—	—	See Chapter 6.

The retained options were evaluated (Table 7A-3 in Appendix 7A) based on a set of fixed criteria discussed in Chapter 6.

Water Conservation

Urban. Urban water demand forecasts for 2020 assume that BMPs are in place; consequently, only those urban conservation efforts which exceed BMPs are considered as options. Reducing outdoor water use to 0.8 ET_o in new development would attain about 4 taf/yr of depletion reductions, while extending this measure to include existing development would reduce depletions by about 13 taf/yr. Reducing residential indoor water use to 60 and 55 gpcd would reduce depletions by 8 and 17 taf/yr, respectively. Reducing CII water use by an additional 3 and 5 percent would attain 2 taf and 3 taf of depletion reductions per year, respectively. Reducing distribution system losses to 7 and 5 percent would save 3 and 8 taf/yr.

Agricultural. The 2020 agricultural water demand forecasts assume that EWMPs are in place. As with the urban water management options, only those agricultural conservation efforts which exceed EWMPs are considered as options. Agricultural conservation options were deferred for this region, because no significant depletion reductions would be achieved. Excess applied irrigation water recharges aquifers in the major agricultural areas.

Modify Existing Reservoirs or Operations

In the Northern PSA, most of these options involve Nacimiento and San Antonio Reservoirs. The options include raising and widening the spillway at Nacimiento Reservoir, constructing a tunnel or pipeline between the two reservoirs, and changing reservoir operation rules. Any combination of these reservoir modification options would likely be combined with other options (such as improved conveyance facilities or groundwater recharge projects). Some of these options are estimated to cost about $100/af—raising and widening the spillway at Nacimiento Reservoir is one such option. Sediment removal may provide a very small amount of additional supply, and MPWMD is studying the effectiveness of sediment removal from its existing reservoirs (Los Padres and San Clemente).

There are two proposals for reservoir enlargements in the Southern PSA. The Salinas Reservoir enlargement project would install a radial gate to raise the spillway height 19 feet above its existing elevation, increasing the reservoir's storage capacity by about 18 taf, and the City of San Luis Obispo's annual yield by almost 2 taf. In Santa Barbara County raising USBR's Bradbury Dam (Cachuma Reservoir) 50 feet for additional water supply plus an additional 40 feet for flood surcharge storage could result in an additional annual yield of 17 taf at a cost of about $1,200/af. The reservoir would serve coastal areas and the Santa Ynez Valley.

New Reservoirs and Conveyance Facilities

In the Pajaro Valley, constructing a 27-foot high dam at the existing College Lake drainage pump house would create a 10 taf reservoir. The reservoir could be supplied with natural runoff and a supplemental 25 cfs diversion from Corralitos Creek during the winter. Its annual yield of 3.4 taf could be supplied to the coastal or inland distribution systems through a 5-mile, 30-inch diameter pipeline. The cost of this option is estimated to be under $400/af. Other reservoir options include Corncob Canyon and Pescadero Creek, both of which could store up to 10 taf; new water supplies produced by either of these options are estimated to cost about $600/af. Bolsa De San Cayetano (estimated to cost $640/af) could store up to 4 taf. These latter three options were deferred, as shown in Table 7-17.

A dam on Arroyo Seco was removed from further consideration as a water supply project, although

MCWRA may evaluate it as a flood control project. The Monterey Peninsula could receive up to 24 taf/yr from the proposed New Los Padres Reservoir, at a cost of about $400/af. This new reservoir would inundate the existing Los Padres Dam on the Carmel River. Although bonds to fund this option were rejected in a 1995 election, Cal-Am announced its intentions to proceed with a reformulated version of the project with 11 taf of annual yield at a cost of $800/af. SWRCB's requirements that Cal-Am provide a new firm supply for existing uses and improve fishery habitat in the Carmel River make New Los Padres a likely future project.

SLOCFC&WCD has an annual 17.5 taf entitlement from Nacimiento Reservoir, only about 1.3 taf of which is now used. A pipeline would be needed to distribute the remaining 16.2 taf to 18 water purveyors. The preferred pipeline alignment would go through the communities of Paso Robles, Templeton, Atascadero, Santa Margarita, and San Luis Obispo and terminate near Avila Beach. This option is not affected by reservoir modifications under consideration by MCWRA.

There are opportunities to import purchased water wheeled through the CVP or SWP into the Northern PSA. In the Pajaro Valley, an option involves connecting a pipeline to USBR's San Felipe Unit, which serves CVP water from San Luis Reservoir to Santa Clara and San Benito Counties. PVWMA could connect to the San Felipe Unit by constructing a 22-mile pipeline from the Watsonville Turnout. This 42-inch diameter pipeline with a capacity of 75 cfs would be able to deliver a maximum of 20 taf/yr. PVWMA does not have a CVP water service contract. CVPIA banned execution of new water service contracts for an indefinite period of time. The average annual yield of a connection to the San Felipe system is estimated to be 13 taf, if a source of purchased water could be found. Northern Monterey County could also benefit from a San Felipe extension because of its close proximity to the Pajaro Valley.

Groundwater Development and Conjunctive Use

Because groundwater is the primary water source for the Central Coast Region, many options have a groundwater recharge component alone or in combination with surface water development projects. In the Pajaro Valley, options include the Pajaro recharge canal (1.5 taf annually) and the College Lake injection/extraction wells (seven wells to inject diverted surface runoff currently captured in College Lake). These wells would be used to extract groundwater during drought years when deliveries of San Felipe water are reduced. On the Monterey Peninsula, the Seaside groundwater basin has the potential to produce an additional 1 taf/yr. This option may be pursued if legal challenges are resolved, because of SWRCB's order which encourages the maximum use of supplies from Seaside to reduce diversions from the Carmel River. Another option would be to retrofit existing wells in the Seaside Basin to accomplish both injection and extraction, to increase storage and to use Carmel River and other supplies more efficiently. This option would include a series of new wells and a pipeline system from inland areas (Fort Ord) to the Monterey Peninsula. The system would be operated primarily for drought year supply. Yields and costs of this option are unknown at present.

In Santa Cruz County, options include several new wells and deep brackish groundwater wells (with reverse osmosis treatment facilities) in the northern coast area. The new wells would provide an additional water supply of about 3 taf while the brackish wells would be used for drought contingency. The groundwater resources of the north county could be increased by developing small local recharge projects, such as retention basins. However, the incremental yield of these projects would be small since the soils in the area are sandy and runoff is already minimal. There are no physical facilities available for artificial recharge in the Southern PSA, but there are some potential sites along coastal streams in San Luis Obispo County where additional runoff could be used for recharging groundwater basins.

Water Marketing

In the Salinas Valley, SWP water from the Coastal Branch could be purchased and either traded with San Luis Obispo County for that county's existing entitlement to Nacimiento reservoir water or delivered directly through a pipeline constructed at the aqueduct's crossing of the Salinas River. There are presently no local agencies seeking water marketing arrangements using this approach.

PVWMA is evaluating options for assignment of CVP water from project agricultural water contractors and opportunities for participation with SCVWD and San Benito County Flood Control and Water Conservation District (existing CVP San Felipe Division contractors) in water marketing arrangements.

Water Recycling

For the Northern PSA, water recycling options include an aquifer storage and recovery program which would use injection wells to store recycled water produced during the winter, and then would extract this water for irrigation in the Castroville area during the summer months. This program has an estimated annual yield of up to 8.3 taf.

In the Pajaro Valley, a 12 or 18 mgd recycling plant would be constructed adjacent to the existing Watsonville Wastewater Treatment Plant. The 12 mgd plant (about 13.4 taf annually) would treat water from the Watsonville area; the 18 mgd plant (about 20.1 taf annually) would treat water from both Watsonville and Santa Cruz. The 18 mgd option would require constructing a pipeline from Santa Cruz to Watsonville to transport treatment plant effluent.

On the Monterey Peninsula, the Carmel Area Wastewater District/Pebble Beach Community Services District treatment plant could be expanded to provide more recycled water (up to 100 af annually) for use on golf courses, open space, or cemeteries. In 1992, local water agencies studied potential markets for recycled water produced by the regional recycling plant near Marina. Potential uses of recycled water in Fort Ord, Seaside, and other Monterey Peninsula communities having a potential annual demand of up to 1 taf were identified, but the uses were deemed economically infeasible at that time. This study is currently being updated to reflect the conversion of Fort Ord to civilian use.

For the Southern PSA, recycled water projects have been proposed in conjunction with construction of new or expanded municipal wastewater treatment plants. In coastal areas—such as San Luis Obispo Bay, Estero, and south San Luis Obispo County—treated wastewater is discharged to the ocean, and reusing the wastewater would help reduce water supply shortages. (In the City of San Luis Obispo and in communities along the Salinas River, the wastewater recharges the groundwater basin.)

Planned recycling projects in Santa Barbara County include the Santa Barbara regional water reuse project, which would provide 1.6 taf of recycled water annually for landscape irrigation within the City of Santa Barbara, Montecito Water District, and Summerland County Water District. This project would replace potable water being used for irrigation. Other potential projects involve expanding Lompoc's secondary treatment facilities and Santa Barbara's tertiary treatment facilities for an additional annual yield of 2 taf by the year 2000.

Desalting

Several coastal cities in the region have identified desalting options for additional water supply. The City of Santa Cruz is conducting a feasibility study on a 4.5 taf/yr brackish groundwater desalting plant to supplement local water supplies. The Cambria and San Simeon community services districts had plans, recently put on hold, to jointly construct a 320 af/yr (with ultimate capacity of 1.3 taf annually) seawater desalting plant. Monterey Peninsula Water Management District's plans for a 3.4 taf/yr seawater desalting plant were defeated by voters in the 1992 election.

Other Local Options

In the Salinas Valley, a Salinas River diversion and distribution project is being planned to transfer up to 35 taf/yr to northern Salinas Valley to halt seawater intrusion. In the Northern PSA, MCWRA has a weather modification program which targets the watersheds of the Nacimiento and San Antonio Rivers and the Arroyo Seco. MCWRA estimates that increased annual flows into reservoirs ranged from about 8 taf to 68 taf between 1990 to 1994. San Luis Obispo began a 3-year cloud seeding program in January 1991 to produce more runoff in the Salinas and Lopez Watersheds. Although this program has ended, future programs may be a possibility. Future weather modification options are difficult to quantify and are not evaluated in this Bulletin. Weather modification programs are often operated on a year-to-year basis by water agencies, and usually not reliable supply sources in drought years due to a lack of storm systems to seed.

Statewide Options

Statewide water supply augmentation options are discussed and quantified in Chapter 6.

Options Likely to be Implemented in Central Coast Region

Water supplies are not available to meet all of the region's 2020 water demands in average or drought years. Applied water shortages are forecasted to be 172 taf and 270 taf in average and drought years, respectively. Ranking of retained water management options for the Central Coast Region is summarized in Table 7-18. Table 7-19 summarizes options that can likely be implemented by 2020 to relieve the shortages.

TABLE 7-18

Options Ranking for Central Coast Region

Option[a]	*Rank*	*Cost ($/af)*	*Potential Gain (taf)*	
			Average	*Drought*
Conservation				
Urban				
Outdoor Water Use to 0.8ET$_o$ - New Development	M	750	4	4
Outdoor Water Use to 0.8ET$_o$ - New and Existing Development	M	[b]	13	13
Indoor Water Use (60 gpcd)	M	400	8	8
Indoor Water Use (55 gpcd)	M	600	17	17
Interior CII Water Use (3%)	M	500	2	2
Interior CII Water Use (5%)	M	750	3	3
Distribution System Losses (7%)	M	200	3	3
Distribution System Losses (5%)	M	300	8	8
Modify Existing Reservoirs/Operations				
Modify Nacimiento Spillway	H	120	20	[b]
Enlargement of Salinas Reservoir	M	400	2	[b]
Enlargement of Cachuma Reservoir	L	1,200	17	[b]
New Reservoirs/Conveyance Facilities				
College Lake	M	350	3	-
Feeder Streams (Various Sites)	M	400	[b]	[b]
New Los Padres Reservoir	M	800	11	11
Nacimiento Pipeline	M	950	16	16
Groundwater/Conjunctive Use				
College Lake Injection/Extraction Wells	M	130	2	2
Increase Groundwater Development in Seaside Basin	L	410	1	1
Water Marketing				
CVP (San Felipe Project Extension)	M	580	13	2
Water Recycling				
Group 1 (Cost < $500/af)	H	500	29	29
Group 2 (Cost $500/af - $1,000/af)	M	1,000	8	8
Desalting				
Brackish Groundwater				
City of Santa Cruz	L	1,100	5	5
Seawater				
Monterey Peninsula WMD	L	1,700	3	3
Other Local Options				
Salinas River Diversion and Distribution Project	M	[b]	35	[b]
Statewide Options				
See Chapter 6.				

[a] All or parts of the amounts shown for highlighted options have been included in Table 7-19.
[b] Data not available to quantify.

The urban water conservation options beyond BMPs that would likely be implemented would add 32 taf/yr in depletion reductions in the region. Additional reliance on water recycling will be likely in the future to alleviate shortages. Additional water recycling in the region could produce 29 taf/yr of new water supply. Recycled water would be used for landscaping, direct agricultural application, and groundwater recharge.

In the Pajaro Valley, options that would likely be implemented by 2020 would include a pipeline to connect to the CVP's San Felipe Unit to provide an opportunity for water transfers.

Modifying existing reservoirs or constructing new reservoirs are likely options for the region. One likely option to augment water supplies in the Salinas Valley would be to modify Nacimiento's spillway. Raising the spillway 6.5 feet would increase storage capacity by 34 taf, increasing the reservoir's yield by about 20 taf. Other spillway modifications are also being evaluated to allow more water to be released throughout the year for recharge. A long-term water management plan for the Monterey Peninsula would likely include construction of the proposed New Los Padres Dam, which could augment supplies by 11 taf/yr.

In San Luis Obispo County, current planning focuses on the Nacimiento pipeline, which would convey a portion of the county's entitlement of 17.5 taf/yr from Lake Nacimiento in northern San Luis Obispo County. Communities potentially receiving supplies from this option include the City of San Luis Obispo and Cayucos (through an exchange of water from Nacimiento and Whale Rock Reservoirs). In addition, the communities of Paso Robles, Templeton, and Atascadero may also receive supplies for groundwater recharge.

If implemented, the identified options would still leave remaining shortages in drought years of 100 taf.

TABLE 7-19

Options Likely to be Implemented by 2020 (taf)
Central Coast Region

	Average	*Drought*
Applied Water Shortage	**172**	**270**
Options Likely to be Implemented by 2020		
Conservation	32	32
Modify Existing Reservoirs/Operations	22	[a]
New Reservoirs/Conveyance Facilities	27	27
Groundwater/Conjunctive Use	2	2
Water Marketing	13	2
Recycling	29	29
Desalting	–	–
Other Local Options	35	[a]
Statewide Options	5	57
Expected Reapplication	7	21
Total Potential Gain	**172**	**170**
Remaining Applied Water Shortage	**0**	**100**

[a] Data not available to quantify.

FIGURE 7-5

South Coast Hydrologic Region

South Coast Hydrologic Region

. . .

Description of the Area

The South Coast is California's most urbanized hydrologic region (Figure 7-5). Although it covers only about 7 percent of the State's total land area, it is home to roughly 54 percent of the State's population. Extending eastward from the Pacific Ocean, the region is bounded by the Santa Barbara-Ventura County line and the San Gabriel and San Bernardino Mountains on the north, and a combination of the San Jacinto Mountains and low-elevation mountain ranges in central San Diego County on the east, and the Mexican border on the south. Topographically, the region is comprised of a series of broad coastal plains, gently sloping interior valleys, and mountain ranges of moderate elevations. The largest mountain ranges in the region are the San Gabriel, San Bernardino, San Jacinto, Santa Rosa, and Laguna Mountains. Peak elevations are generally between 5,000 and 8,000 feet above sea level; however, some peaks are nearly 11,000 feet high.

The climate of the region is Mediterranean-like, with warm dry summers followed by mild winters. In the warmer interior, maximum temperatures during the summer can be over 90°F. The moderating influence of the ocean results in lower temperatures along the coast. During winter, temperatures rarely descend to freezing except in the mountains and some interior valley locations.

About 80 percent of the precipitation occurs during the four-month period from December through March. Average annual rainfall can range from 10 to 15 inches on the coastal plains and 20 to 45 inches in the mountains. Precipitation in the highest mountains commonly occurs as snow. In most years, snowfall is sufficient to support winter sports in the San Bernardino and San Gabriel Mountains.

There are several prominent rivers in the region, including the Santa Clara, Los Angeles, San Gabriel, Santa Ana, Santa Margarita, and San Luis Rey. Some segments of these rivers have been intensely modified for flood control. Natural runoff of the region's streams and rivers averages around 1.2 maf annually.

The largest cities in the region are Los Angeles, San Diego, Long Beach, Santa Ana, and Anaheim. Although highly urbanized, about one-third of the region's land is publicly owned. About 2.3 million acres is public land, of which 75 percent is national forest. Irrigated crop acreage accounts for a small percent of land use. Table 7-20 shows the region's population and crop acreage for 1995 and 2020.

Water Demands and Supplies

Since the turn of the century, extensive water development has been carried out in the South Coast Region. Steady expansion of population and of the economy led to the demands and financial resources to build large water supply projects for importing water to the region. In 1913, the Los Angeles Aqueduct began importing water from the Owens Valley to the South Coast Region. Los Angeles diversions from the

TABLE 7-20

Population and Crop Acreage

	Population (thousands)	*Irrigated Crop Acreage (thousands of acres)*
1995	17,299	313
2020	24,327	190

Although the South Coast Region has been extensively urbanized, some species of wildlife have learned to coexist with suburban development. The region's remaining riparian areas still support such common mammals as skunks and raccoons.

Mono Basin began in 1940 when the LAA was extended by about 11 miles (a second conduit was added in 1970). In 1941, MWDSC completed its Colorado River Aqueduct, which now provides about 25 percent of the region's supply. SWP began delivering water from the Delta to the South Coast Region in 1972. Table 7-21 shows the water budget for the region.

Los Angeles Aqueduct

The Los Angeles Department of Water and Power owns and operates the LAA which diverts both surface and groundwater from the Owens Valley and surface water from the Mono Basin. The combined carrying capacity of the aqueduct system is about 760 cfs, or about 550 taf/yr. An average of 400 taf/yr of water is delivered through the LAA with a record 534 taf in 1983. Court-ordered restrictions on diversions from the Mono Basin and Owens Valley have reduced the amount of water the City of Los Angeles can divert (see South Lahontan Region).

Colorado River Aqueduct

MWDSC was created in 1928 to construct and operate the Colorado River Aqueduct to deliver Colorado River water to Southern California. MWDSC wholesales water supplies from the Colorado River and the SWP to water agencies throughout Southern California.

MWDSC and its 27 member agencies (Table 7-22) serve 95 percent of the South Coast Region. Some agencies rely solely on MWDSC for their water supply, while many, like the City of Los Angeles, rely on MWDSC to supplement existing supplies. Between its fiscal years 1970 and 1994, the City of Los Angeles

TABLE 7-21

South Coast Region Water Budget (taf)[a]

	1995		*2020*	
	Average	*Drought*	*Average*	*Drought*
Water Use				
Urban	4,340	4,382	5,519	5,612
Agricultural	784	820	462	484
Environmental	100	82	104	86
Total	**5,224**	**5,283**	**6,084**	**6,181**
Supplies				
Surface Water	3,839	3,196	3,625	3,130
Groundwater	1,177	1,371	1,243	1,462
Recycled and Desalted	207	207	273	273
Total	**5,224**	**4,775**	**5,141**	**4,865**
Shortage	**0**	**508**	**944**	**1,317**

[a] Water use/supply totals and shortages may not sum due to rounding.

For much of its length, LADWP's aqueduct skirts the eastern flank of the Sierra Nevada.

purchased an average of 130 taf/yr from MWDSC, about 20 percent of the City's total water supply. In 1996, almost 90 percent (447 taf) of San Diego County Water Authority's total water supply was purchased from MWDSC.

MWDSC has received Colorado River water since 1941 under contracts with USBR. These contracts have allowed the diversion of 1.21 maf/yr, as well as 180 taf/yr of surplus water when available. (The maximum capacity of the CRA is 1.3 maf/yr.) California's basic apportionment of Colorado River water is 4.4 maf/yr plus one-half of any surplus water, when available. In the past, California was able to use hydrologic surpluses and the amount apportioned to, but not used by, Nevada and Arizona. With completion of the Central Arizona Project and Arizona's 1996 enactment of a state groundwater banking act, Arizona's use has reached it basic apportionment. California's reduction of Colorado River use from current levels to 4.4 maf / yr has significant implications for the South Coast Region. (See the issues section below and the Colorado River Region in Chapter 9). California's Colorado River use reached a high of 5.4 maf in 1974, and has varied from 4.5 maf to 5.3 maf annually over the past 10 years.

State Water Project

Local agencies contracting with the SWP for part of their supplies are shown in Table 7-23.

MWDSC is the largest SWP contractor, with an annual entitlement of more than 2 maf. In 1992, Castaic Lake Water Agency assumed the SWP contract of Devil's Den Water District in the Tulare Lake

TABLE 7-22

Metropolitan Water District of Southern California Member Agencies

Cities	*Municipal Water Districts*	*Water Authority*
Anaheim	Calleguas	San Diego County
Beverly Hills	Central Basin	
Burbank	Chino Basin	
Compton	Coastal	
Fullerton	Eastern	
Glendale	Foothill	
Long Beach	Las Virgenes	
Los Angeles	Orange County	
Pasadena	Three Valleys	
San Fernando	West Basin	
San Marino	Upper San Gabriel Valley	
Santa Ana	Western of Riverside County	
Santa Monica		
Torrance		

TABLE 7-23
State Water Project Contractors in the South Coast Region

Agency	*Contract Entitlement (taf)*	*SWP Deliveries in 1995 (taf)*
Castaic Lake WA	54.2	27.2
San Bernardino Valley MWD	102.6	0.7
San Gabriel Valley MWD	28.8	12.9
San Gorgonio Pass WA	17.3	0
MWDSC	2,011.5	436.0
Ventura County FCD	20.0[a]	0

[a] Ventura County FCD subleases 1.85 taf/yr to MWDSC.

Region, increasing Castaic's entitlement to 54.2 taf. Within the San Bernardino Valley Municipal Water District service area, groundwater is the major water source, and hence the district has used little of its SWP water. Ventura County Flood Control District also relies mostly on groundwater and has taken delivery of SWP supply only twice, during the drought in 1990 and 1991. San Gorgonio Pass Water Agency (which also serves a portion of the Colorado River Region) lacks the facilities to take delivery of SWP water, and to date has received no supply from the SWP.

The Department is working with the SGPWA and SBVMWD to extend the East Branch of the California Aqueduct to SGPWA, which serves the Banning Pass area of Riverside County (including the communities of Banning and Beaumont), and to provide system improvements to SBVMWD. The Notice of Determination for the final supplemental EIR was filed in March 1998. The project will be constructed in two phases. Phase I construction is scheduled to begin in late 1998 and to be completed by late 2000. A second phase will be constructed to serve the Mentone area if demand increases.

The Department's A.D. Edmonston Pumping Plant lifts California Aqueduct water 1,926 feet across the Tehachapi Mountains to serve Southern California. The maximum plant capacity is 4,480 cfs.

Local Surface Water Supplies

Table 7-24 lists major local storage reservoirs in the region. Most of the larger reservoirs in the region have water supply as their primary purpose. However, several of the larger water supply reservoirs do not develop local supply—they are the terminal facilities of the major conveyance facilities that import water to the region.

Table 7-25 lists local water supply reservoirs in MWDSC's service area with at least 10 taf storage capacity.

About 96 percent of San Diego County's population resides within SDCWA's service area. SDCWA, a wholesale water agency, purchases imported water from MWDSC and delivers the water to its 23 member agencies (Table 7-26) in the western third of San Diego County through two aqueduct systems. SDCWA's maximum annual delivery was 647 taf in 1990. Most of San Diego's in-county water supplies are from local agencies' surface reservoirs. Twenty-four surface reservoirs are located within its service area, with a combined capacity of approximately 569 taf. Some reservoirs are connected to SDCWA's aqueduct system and can receive imported water in addition to surface runoff. In 1995, local water sources provided 118 taf, or 23 percent of the water used in SDCWA's service area. (Since 1980, local surface water supplies have ranged from 33 taf to 174 taf annually.)

TABLE 7-24

Major Reservoirs in the South Coast Region[a]

Reservoir	*Owner*	*Capacity (taf)*	*Primary Purpose*
Casitas	USBR	254	Water Supply
Lake Piru	United WCD	88	Water Supply
Pyramid	DWR	171	Water Supply
Castaic	DWR	324	Water Supply
Big Bear Lake	Big Bear MWD	73	Water Supply
Perris	DWR	132	Water Supply
Mathews	MWDSC	182	Water Supply
Vail	Rancho California WD	51	Water Supply
Henshaw	Vista ID	52	Water Supply
San Vicente	City of San Diego	90	Water Supply
El Capitan	City of San Diego	113	Water Supply
Morena	City of San Diego	50	Water Supply
Whittier Narrows	USACE	67	Flood Control
Prado[b]	USACE	188	Flood Control
Seven Oaks (under construction)	USACE	146	Flood Control
Eastside (under construction)	MWDSC	800	Water Supply

[a] Reservoirs with capacity greater than 50 taf.

[b] 26 taf of storage capacity is used for water supply purposes, for downstream groundwater recharge.

TABLE 7-25

Reservoirs Owned by Water Retailers in MWDSC's Service Area[a]

Reservoir	*Agency*	*Capacity (taf)*
Bard	Calleguas MWD	10
Vail	Rancho California	51
Hemet	Lake Hemet MWD	14
Westlake	Las Virgenes MWD	10
Los Angeles	City of Los Angeles	10
Stone Canyon	City of Los Angeles	11
Santiago	Irvine Ranch WD & Serrano ID	25
Henshaw	Vista ID	52
Barrett	City of San Diego	38
El Capitan	City of San Diego	113
Lake Hodges	City of San Diego	34
Morena	City of San Diego	50
Lower Otay	City of San Diego	50
San Vicente	City of San Diego	90
Sutherland	City of San Diego	30
Loveland	South Bay ID	25
Sweetwater	South Bay ID	28
Railroad Canyon	Temescal Water Company	12

[a] Reservoirs with capacity of at least 10 taf.

The City of San Diego's Murray Dam, shown under construction in 1917, is a multiple arch concrete dam impounding a 6 taf reservoir. The wooden stave pipeline below conveyed supplies for the Cuyamaca Water Company.

Courtesy of Water Resources Center Archives, University of California, Berkeley

Groundwater Supplies

Groundwater is a major local supply source in the remaining counties in MWDSC's service area. For example local supplies developed by individual retail agencies, primarily groundwater, presently account for about 50 percent of Orange County's water use. There are numerous groundwater basins (Figure 7-6) along the coast and inland valleys of the region. Many of these basins are actively managed by public agencies or have been adjudicated by the courts. Some groundwater basins are as large as several hundred square miles in area and have a capacity exceeding 10 maf. The South Coast's current estimated annual groundwater use is about 1.2 maf. Recharge occurs from natural infiltration along river valleys, but in many cases facilities have been constructed to recharge local, imported, or recycled supplies. For example, in average years the Los Angeles Department of Public Works intention-

TABLE 7-26

San Diego County Water Authority Member Agencies

Cities
- Del Mar
- Escondido
- National City
- Oceanside
- Poway
- San Diego

Water Districts
- Helix
- Otay
- San Dieguito
- Vallecitos

Municipal Water Districts
- Carlsbad
- Olivenhain
- Padre Dam
- Rainbow
- Ramona
- Rincon Del Diablo
- Valley Center
- Yuima

Irrigation Districts
- Santa Fe
- South Bay
- Vista

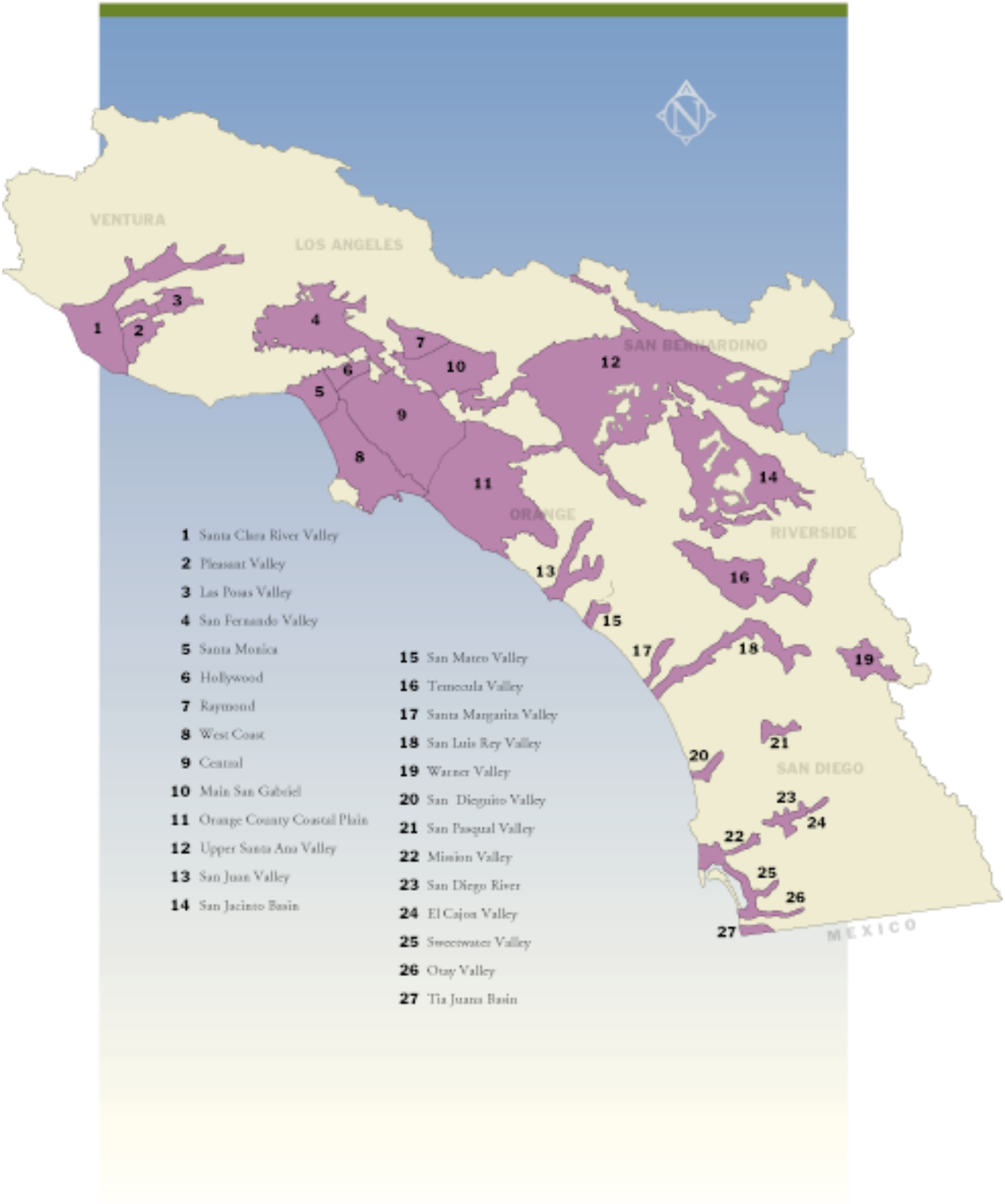
Public Utility District
- Fallbrook

Reservation
- Pendleton Military

Ex-Officio Member
- San Diego County

FIGURE 7-6

South Coast Groundwater Basins



ally recharges 230 taf of local flows, 60 taf of imported water, and 50 taf of recycled water. These surface supplies not only replenish groundwater basins, but can be banked for later use. Programs are in place to bank imported water, when available in wetter periods, to increase groundwater production during the summer season and in drought years. At a 1995 level of development, about 100 taf is banked in average years. This water is included as an average year urban water demand in Bulletin 160-98 water budgets for the South Coast.

Table 7-27 shows adjudicated groundwater basins in the South Coast Region. In the adjudicated groundwater basins, the court appoints watermasters to oversee the court judgement. The court judgement limits the amount of groundwater that can be extracted by parties to the judgement.

Local Water Resources Management Issues

Water Supply Reliability

Since local supplies are insufficient to meet water demands, the region imports more than 60 percent of its supply. A natural disaster or other emergency that would curtail or limit imports to the region would be detrimental. Water supply reliability is a critical issue for the region and water agencies are seeking to ensure a more reliable and adequate supply in case of emergencies.

Eastside Reservoir. MWDSC provides about 60 percent of the water used by the nearly 16 million people living on the coastal plain between Ventura County and the Mexican border. MWDSC is constructing Eastside Reservoir to better manage its water supplies between wet and dry years. The 800 taf reservoir, located near Hemet in southwestern Riverside County, will nearly double the region's existing surface storage capacity and will provide increased terminal storage for SWP and Colorado River supplies. When completed, Eastside Reservoir would provide the entire region with a six-month emergency supply after an earthquake or other disaster. It would also provide water supply for drought protection and peak summer demands.

Under construction in the Domenigoni and Diamond Valleys, the $2 billion project consists of two embankments to block the east and west ends of the valleys, and a saddle dam located along a low point in the hills which form the northern boundary of the reservoir. The reservoir includes a forebay and pumping plant, and the 8-mile, 12-foot diameter Eastside Pipeline. After reservoir completion in 1999, up to four years will be needed to fill the reservoir with imported water. Water from the Colorado River Aqueduct will be delivered through the San Diego Aqueduct to the reservoir forebay and pumped into the reservoir. SWP water will either be delivered from the Santa Ana Valley Pipeline and bypassed around Lake Perris, or taken from Lake Perris and conveyed through MWDSC's system into the reservoir forebay.

The Inland Feeder is a new conveyance facility to deliver SWP water made available by enlargement of the East Branch of the California Aqueduct. Upon its completion in 2004, the Inland Feeder will deliver

Plans to construct a San Diego emergency storage project reflect the area's vulnerability to natural disasters such as earthquakes. Much of the area's supplies are imported through the Colorado River Aqueduct. This photo shows an early example of local conveyance projects—a wooden trestle carrying a flume across the Sweetwater River.

Courtesy of Water Resources Center Archives, University of California, Berkeley

TABLE 7-27

Adjudicated Groundwater Basins in the South Coast Region

Court Name	*Filed in Court*	*Final Decision*	*Watermaster*	*Basin Name, County*
Upper Los Angeles River Area	1955	1979	Superior Court appointee	San Fernando Valley Basin (entire watershed), Los Angeles County
Raymond Basin	1937	1944	Raymond Basin Management Board	Northwest part of San Gabriel Valley Basin, Los Angeles County
Main San Gabriel Basin	1968	1973	9-Member Board appointed by the Los Angeles County Superior Court	San Gabriel Valley Basin, excluding Raymond Basin, Los Angeles County
Central Basin	1962	1965	DWR	Northeast part of Coastal Plain of Los Angeles County Basin, Los Angeles County
West Coast Basin	1946	1961	DWR	Southwest part of Coastal Plain of Los Angeles County Basin, Los Angeles County
Puente	1985	1985	Two consultants, one representing the Walnut Valley WD and Rowland WD; and one for the City of Industry and Industry Urban Development Agency; and a third neutral party	Southwest part of San Gabriel Valley Basin, Los Angeles County
Santa Margarita River Watershed	1951	1966	U.S. District Court appointee	The entire Santa Margarita River watershed, including Santa Margarita Coastal, Murrieta-Temecula and Anza-Cahuilla groundwater basins, San Diego and Riverside Counties
Santa Paula Basin	1991	1996	3 person Technical Advisory Committee from United Water Conservation District, City of Ventura, and Santa Paula Basin Pumpers Association	Sub-basin of Santa Clara River, Ventura County
Chino Basin	1978	1978	9-Member Board	Chino Basin, northwest part of Upper Santa Ana Valley Basin, San Bernardino and Riverside Counties
Cucamonga Basin	N/A	1958	Cucamonga County WD and San Antonio Water Company	Cucamonga Basin, north-central part of Upper Santa Ana Valley Basin, San Bernardino County
San Bernardino Basin Area	1963	1969	One representative each from Western Municipal Water District and San Bernardino Valley Municipal Water District	Northeast part of Upper Santa Ana Basin, San Bernardino and Riverside Counties

water by gravity to Eastside Reservoir via 43.7 miles of tunnels and pipeline that start at Devil Canyon and tie into the CRA and Eastside Pipeline. The Inland Feeder will provide system reliability by linking together the SWP and Colorado River systems, and will improve water quality by allowing greater blending of SWP and Colorado River waters.

San Diego Emergency Water Storage Project. SDCWA does not own or operate treatment or storage facilities. It has a contractual agreement with the City of San Diego to store up to 40 taf of water in San Vicente and Lower Otay Reservoirs. To increase local supplies that would be available during times of emergency, SDCWA has proposed an emergency storage project that could increase the county's total water storage by 90 taf. Use of the project would be limited to emergency situations, such as prolonged drought or catastrophic failure of the San Diego Aqueduct during an earthquake. Although not a water supply development project, the emergency water storage project would provide incidental local supply benefits by allowing capture of additional winter runoff.

Four project alternatives were evaluated. All involved increased surface storage and new distribution systems. Three alternatives additionally involved reservoir reoperation.

- San Vicente stand-alone. Expand San Vicente Reservoir by raising the dam 83 feet to contain 90.1 taf of emergency storage.
- Moosa Canyon construction/Lake Hodges reoperation. Construct a new dam at Moosa Canyon to hold 68 taf and reoperate Lake Hodges to provide 22 taf.
- San Vicente expansion and reoperation. Raise the dam by 65 feet, adding 68 taf of emergency storage and reoperate the reservoir to provide an additional 22 taf.
- Olivenhain construction, Lake Hodges reoperation, and San Vicente expansion. Build a new 320-foot high dam at the Olivenhain site to create 18 taf of emergency storage (24 taf total capacity, with 4 taf reserved for Olivenhain MWD). Reoperate Lake Hodges to provide an additional 20 taf and raise San Vicente Dam by 54 feet to hold an additional 52 taf.

The preferred alternative is the Olivenhain-Hodges-San Vicente project. A new reservoir would be constructed about 1 mile northwest of Lake Hodges in conjunction with Olivenhain Municipal Water District. Olivenhain Reservoir, which would also serve as operational storage for Olivenhain MWD, would be connected to Lake Hodges by a 1.5-mile pipeline. San Vicente Dam would be raised from 234 feet to 288 feet. The Olivenhain-Hodges-San Vicente project would add 90 taf of emergency storage capacity. The final EIR was certified in 1996. In 1997, USACE issued a record of decision on the final EIS and a permit for the project under Section 404 of the federal Clean Water Act. Construction of the $550 million project is scheduled to begin in 1999 and be completed by 2011. SDCWA has agreements with the City of San Diego regarding joint use of San Vicente Reservoir and Lake Hodges, and with Olivenhain MWD concerning joint use of the Olivenhain Reservoir. (Olivenhain MWD had planned to construct a 5 to 8 taf reservoir at the site for its own use if SDCWA did not go forward with a joint project.) Olivenhain MWD would construct a 20 mgd water treatment plant (to be expanded to 80 mgd ultimately) in conjunction with storage at Olivenhain reservoir.

Management of California's Colorado River Water

A major water management issue facing the South Coast Region is California's use of Colorado River water in excess of its basic annual apportionment of 4.4 maf. In the past, Arizona and Nevada were not using the full amount of their annual apportionments, and California was able to use the amount apportioned to, but not used by, Nevada and Arizona, and to use wet year surplus flows. As described in more detail in Chapter 9, the Colorado River Board's draft 4.4 Plan describes how California would reduce its use of river water over time.

The draft CRB 4.4 Plan includes actions that would be taken in two phases. The first phase, extending from the present to 2010 or 2015, would comprise those actions that are now in some stage of planning and implementation. These programs are intended to reduce California's annual use of Colorado River water to about 4.6 to 4.7 maf. The second phase would comprise actions that have not yet been formulated and quantified. Examples of phase one actions include the SDCWA/IID transfer, lining of parts of the All-American and Coachella Canals, and groundwater banking projects associated with surplus Colorado River water that could be conveyed in MWDSC's aqueduct. Examples of potential phase two actions include proposals to desalt water in Salton Sea tributaries and to convey the treated water to the South

Coast Region. (Actions such as agricultural water conservation programs or desalting proposals that would reduce the amount of fresh water inflow to the Salton Sea are subject to environmental review to ensure that they will not significantly affect the sea. A description of the Salton Sea and its environmental resources is provided in Chapter 9.)

The draft CRB 4.4 Plan would in essence reduce California's use of Colorado River water in agricultural areas in the Colorado River Region, transfer conserved Colorado River water to the South Coast Region for urban use, and define how water from wet year surpluses (and the unused apportionments of other states, when available) could be used to help keep the Colorado River Aqueduct full. When California is limited to its basic apportionment of 4.4 maf, MWDSC would only be able to exercise its fourth priority right to 550 taf, as compared to maximum aqueduct capacity of 1.3 maf.

Mono Basin

The City of Los Angeles' water diversions from Mono Basin lowered Mono Lake's water level by more than 40 feet since 1941 and also increased the lake's salinity. (See the South Lahontan Region in Chapter 9 for more detailed discussion of Mono Lake issue.) In 1994, SWRCB adopted Water Right Decision 1631 amending the city's water rights for diverting water from Mono Basin. The decision restricts diversions from the basin to increase and maintain Mono Lake's level to 6,391 feet above sea level. During the period of Mono Lake's transition to the 6,391-foot level (estimated to take about 20 years), the maximum amount of water that Los Angeles can divert from the basin is 16 taf/yr. Long-term Los Angeles diversions from the Mono Basin are projected to be about 31 taf/yr after Mono Lake has reached the 6,391-foot level, or one-third of the city's historical diversions from the Mono Basin.

Restoration of Coastal Wetlands and Estuaries

Ballona Wetlands Preserve. Although the majority of California's wetlands habitat is found in the Central Valley and San Francisco Bay area, there are significant wetlands in the South Coast, as described below. The Ballona wetlands is one of the more well-known South Coast wetlands.

The Ballona Wetlands Preserve, located in Los Angeles County near Marina Del Rey, is one of the few tidal marshes in Southern California. It is a complex of estuary, lagoon, salt marsh, freshwater marsh, and dune habitats. It provides nesting grounds for migrating waterfowl, supports a variety of plant, fish, and animal life, and is home to two endangered species—Belding's Savannah sparrow and the California least tern. The present Ballona wetlands is a small remnant of what existed in the early 1800s, when the wetlands comprised more than 2,000 acres. At the present time, it has been reduced to a little more than 180 acres.

The Ballona Wetlands Preserve was the subject of a long-running debate among private property owners and environmental groups that began in 1984 when the California Coastal Commission approved a land use plan to develop the wetlands. In the years that followed, the parties negotiated a settlement to litigation over the development. The settlement provides for:

- Restoration of 190 acres of salt marsh habitat. Plans are underway to provide the eastern portion of the salt marsh with full tidal flow and expanded habitat for sub-tidal and mudflat organisms. The western portion would be provided with muted tidal flow to protect and enhance existing salt marsh habitat for pickleweed and the Belding's Savannah sparrow.
- A 34-acre freshwater marsh.
- A 25-acre corridor of riparian habitat along Centinela Creek. This area will potentially provide appropriate vegetation for the least Bell's vireo and a wide variety of other birds which nest in riparian trees.
- Restoration of 48 acres of upland, bluff edge, and coastal strand habitat.

When completed, the Ballona Wetlands Preserve will be one of the largest wildlife sanctuaries in any major U.S. city.

Santa Monica Bay. Santa Monica Bay extends about 50 miles from Point Hume to Palos Verdes Point. A coordinated effort to improve the Santa Monica Bay ecosystem began with establishment of the Santa Monica Bay restoration project. SMBRP was included in the Clean Water Act's National Estuary Program in 1988, and was charged with assessing the bay's problems and with producing a bay restoration plan. Implementation of the plan, approved by the Governor in 1994, and by the Administrator of EPA in 1995, is currently under way.

Prado Wetlands Project. OCWD owns 2,150 acres behind Prado Dam in Riverside County where the district operates constructed freshwater wet-

An aerial view of the constructed wetlands behind Prado Dam.

Courtesy of Orange County Water District

lands to reduce the nitrogen concentration of river water. USACE's Prado Flood Control Basin is operated primarily for flood control. Under an agreement with USACE and USFWS, OCWD uses 25.75 taf of the reservoir's capacity for water supply. OCWD diverts Santa Ana River water through 465 acres of constructed wetlands for biochemical nitrogen removal. Because Santa Ana River water provides much of the recharge for Orange County's coastal plain groundwater basin, nitrogen removal is important to improving water quality.

The Prado wetlands are home to several rare and endangered bird and waterfowl species. As part of the three party agreement, OCWD set aside more than 226 acres as habitat for the endangered least Bell's vireo and southwestern willow flycatcher.

Flood Control

As noted earlier, groundwater constitutes most of the local water supply in the region. Local surface water resources are relatively limited. In the Los Angeles-Orange County coastal strip, most of the rivers and streams that drain to the Pacific Ocean have been developed primarily for flood control purposes, rather than for surface water supply. (Some of these reservoirs are operated to provide surface flows for groundwater recharge.) A few of the existing flood control reservoirs are now being evaluated for their potential to provide some, albeit small, water supply benefits, usually by reoperation of the facilities to enhance groundwater recharge and provide limited year-round storage. Several of these facilities are discussed in the water management options section. Below are a few examples of flood control-related water management issues in the region.

Los Angeles River. USACE, in cooperation with Los Angeles County, has constructed an extensive network of flood control facilities on the Los Angeles River, which passes through one of the most intensively urbanized areas in the South Coast Region. (In fact, discussions on transportation issues in the region sometimes mention converting the existing concrete channel into a freeway or high-occupancy-vehicle transit route.) USACE's flood control facilities on the Los Angeles River and its tributaries include 5 major dams, 22 debris basins, and 470 miles of channel modifications.

Flood control operations in coastal Southern California and their interaction with reservoir operations for water supply typically differ from those in Northern California. The Sierran reservoirs in the Central Valley that provide most of California's developed surface water supply are, as a broad generalization, operated from a water supply standpoint to manage snowmelt runoff that occurs over a period of several months, and to hold large volumes of carryover storage throughout the year. Flood control reservoirs in coastal Southern California are operated to provide short-term detention (days to weeks) of peak flows from rainfloods. Many of these reservoirs impound ephemeral streams, or streams whose runoff is so small that little water supply benefit is available.

USACE's facilities on the Los Angeles River were designed to provide temporary detention of peak flows, allowing the floodflows to be released to the Pacific Ocean without exceeding downstream channel capacities. Continually increasing water demands in the South Coast Region have prompted reevaluting operations of some of the larger facilities, to determine if their operations could be modified to provide limited additional water supply. One example is a 67 taf flood control detention basin impounded by Whittier Narrows Dam on Rio Hondo, a Los Angeles River tributary, described in the water management options section.

Santa Ana River. The Santa Ana River has been channelized for almost its entire length throughout the highly urbanized part of Orange County, from the river's mouth near Costa Mesa upstream to the vicinity of Yorba Linda. Prado Dam, located in the Corona area between the Chino Hills and the Santa Ana Mountains, impounds a large flood control detention basin. USACE has constructed several flood control features of the Santa Ana mainstem project, with the most recent facility of that project being Seven Oaks Dam. The 550-foot high Seven Oaks Dam is under construction about 35 miles upstream from Prado Dam and will have a gross storage capacity of about 146 taf.

The existing 134-foot high earthfill Prado Dam has a storage capacity of 188 taf. OCWD manages the water supply provided by the dam for groundwater recharge. Future plans entail enlarging Prado's capacity to 363 taf for flood control and water supply storage. After Prado Dam is enlarged, OCWD would propose to raise the reservoir's minimum pool level to increase water supply benefits. Enlargement would be accompanied by development of a new flood forecasting system for the reservoir. The district is currently undertaking a feasibility study with USACE to evaluate potential water supply gains from Prado's enlargement. Modifying flood control operations would provide an additional 3 to 5 taf of annual supply for groundwater recharge.

Salinity Management Actions

Imported Colorado River water is a significant source of supply for the South Coast Region. The total dissolved solids concentration in imported water has water management implications for the region, affecting the feasibility of water recycling and groundwater recharge programs. Because residential use of water increases TDS concentration, water recycled from a moderately high TDS source water can result in unacceptably high TDS concentrations. Groundwater recharge potential may be restricted because the RWQCB has established TDS requirements for recharge water in some groundwater basins, to protect existing basin water quality.

In 1996, USBR and MWDSC began a joint salinity management study to develop information to support adoption of regional salinity management policies by MWDSC and to coordinate interagency action to solve salinity problems. The study's initial phase focused on identifying problems and salinity management needs in MWDSC's service area.

Phase I identified the average TDS concentration of MWDSC's Colorado River water in 1996 as being about 700 mg/L, and average TDS of MWDSC's SWP supplies as being about 300 mg/L. The City of Los Angeles' water supply from the eastern Sierra Nevada had significantly lower TDS concentration, typically about 160 mg/L. TDS levels in local groundwater supplies in the South Coast Region vary considerably, ranging from 200 mg/L (Cucamonga Basin near Upland) to more than 1,000 mg/L (Arlington Basin near Corona). Table 7-28 shows groundwater supplies by salinity.

Local sources of salinity also contribute significantly. Municipal and industrial use of water add between 250 to 500 mg/L of TDS to wastewater. Key sources of local salts include water softeners (typically contributing from 5 to 10 percent of the salt load) and industrial processes.

The long-term salt balance of South Coast groundwater basins is an important management problem. Smaller basins like the Arlington and Mission groundwater basins were abandoned for municipal supply because of high salinity levels. These basins have only recently been restored through construction of desalting projects. Blending SWP and Colorado River supplies or using the SWP's relatively low TDS supplies for groundwater replenishment has been a goal in some areas. However, without an ocean outfall or stream discharge, some inland agencies that reuse wastewater have salt accumulation problems in their groundwater basins. Some inland agencies have access to a brine line for exporting salt and concentrated wastes to a coastal treatment plant and ocean outfall, while others have not found construction of a brine line economical.

During droughts when use of recycled water projects and marginal quality groundwater are most important, some local supplies may be constrained by water quality problems. Concerns about wastewater TDS have grown with the expansion of water recy-

TABLE 7-28

Salinity of South Coast Region Groundwater Supplies

Annual Production (maf)	*TDS (mg/L)*	*Percent*
<500	1.06	78
500 to 1,000	0.15	11
>1,000	0.15	11
Total	**1.36**	**100**

cling programs. In general, TDS more than 1,000 mg/L is a quality problem for irrigation and industrial reuse customers.

The MWDSC/USBR study's second phase will evaluate regional applications of four TDS management options: local water service control, imported water source control, desalting, and blending.

Groundwater Issues

San Gabriel and San Fernando Valleys. Groundwater contamination in the San Gabriel Valley and San Fernando Valley Basins has come from many sources dating back to the 1940s. Each basin has four areas on EPA's Superfund list.

More than 30 square miles of groundwater under the San Gabriel Valley Basin may be contaminated. Contamination from volatile organic compounds was first detected in 1979 when Aerojet Electrosystems in Azusa sampled nearby wells in Valley County Water District. Subsequently, DHS initiated a well sampling program to assess the extent of contamination. By 1984, 59 wells were found to be contaminated with high levels of VOCs. The most prevalent contaminants were trichloroethene, perchloroethylene, and carbon tetrachloride.

The San Gabriel Basin Water Quality Authority was created by the Legislature in 1993 to be the agency responsible for remediating groundwater contamination in San Gabriel Valley. The authority's mission is to plan and implement groundwater quality management programs and to protect the basin from future contamination. The SGBWQA is governed by a 5-member board, comprised of one member from each of the overlying municipal water districts, one from a city with prescriptive water pumping rights and one from a city without prescriptive water pumping rights. (The three municipal water districts are San Gabriel Valley MWD, Three Valleys MWD, and Upper San Gabriel Valley MWD.)

Currently, four areas of the basin are of concern: Whittier Narrows, Puente Basin, Baldwin Park/Azusa, and El Monte/South El Monte. The SGBWQA is involved in groundwater cleanup projects in these areas. The Whittier Narrows and Puente Basins are also being managed by EPA under its Superfund program. Another concern is that contamination in the South El Monte area might migrate from the San Gabriel Basin through Whittier Narrows and into the Central Basin.

The Arrow Well Treatment Plant in Baldwin Park was the first project implemented by SGBWQA, with a $1.3 million construction grant from SWRCB. The project, completed in 1992, extracts about 3 taf/yr of contaminated groundwater, treats the water, and distributes it to customers. The Big Dalton Well Treatment Project was the second in a series of projects focusing on contamination problems in the Baldwin Park area. The facility, designed to extract and treat approximately 4 taf/yr of contaminated groundwater, is part of a three-well barrier to stop migration of contaminated groundwater. The Monrovia Wells project currently treats approximately 4.6 taf/yr of contaminated groundwater with airstripping, giving the City of Monrovia the ability to use water from contaminated aquifers while preventing the spread of contamination to adjacent clean aquifers. In 1996, legislation was enacted extending SGBWQA's authority to remediate groundwater contamination in the San Gabriel Basin through July 1, 2002.

About 50 percent of the water supply wells in the eastern portion of the San Fernando Valley Basin were found to be contaminated with volatile organic compounds. Many of the wells have been shut down. The RWQCB is investigating area-wide sources of groundwater contamination for four Superfund sites in the San Fernando Valley Basin. Interim clean-up measures include groundwater pumping and treatment.

Actions taken to address groundwater contamination included a basin-wide Superfund investigation, completed in 1992. The study included installation of 87 monitoring wells, development of a basin-wide groundwater flow model, and evaluation of the extent of contamination. Presently, two large-scale plants are in operation—the North Hollywood Treatment Plant (2,000 gpm) which uses aeration with GAC scrubbing and the Burbank Operable Unit (9,000 gpm) which uses aeration with GAC scrubbing and liquid-phase GAC polishing units. The Pollock Wells Treatment Plant (3,000 gpm) is under construction with a start-up date in 1998, and two additional plants, the 5,000 gpm Glendale Operable Unit and the 13,500 gpm Headworks Wells Treatment Plant, are in the planning/preliminary design phase. These plants will collectively treat over 48 taf/yr of San Fernando Basin's groundwater supply. The basin provides urban water supply for Los Angeles, Burbank, Glendale, and La Crescenta.

San Bernardino Valley. As late as the 1940s, the lowest portion of San Bernardino Valley was largely marshlands with abundant springs. Downtown San Bernardino is located over a confined aquifer which

experiences high groundwater levels. Buildings have experienced seepage of water into basements or ground floors. High groundwater conditions increase soil liquefaction potential in an area that could be affected by movement along the Cucamonga, San Jacinto, or San Andreas Faults. The presence of unreinforced masonry buildings above the confined aquifer increases the risk of damage in the event of liquefaction.

The Bunker Hill Basin groundwater extraction project involves extracting groundwater from the basin to lower groundwater levels, thereby reducing seismic risks. The water could potentially be sold to help offset project costs. Groundwater extraction for this project will not exceed the perennial yield of the San Bernardino Basin (which includes both Bunker Hill and Lytle Creek Basins). The ultimate goal of the extraction project is to reduce the unacceptably high groundwater levels in the basin. A suggested minimum depth target of 30 feet below ground surface in the confined zone would minimize the risk of liquefaction and other adverse impacts associated with high groundwater. One plan being considered is for San Bernardino Valley Municipal Water District to pump between 20 taf/yr and 70 taf/yr, with larger volumes being extracted as necessary after exceptionally wet seasons.

Ventura County. Groundwater is the main water supply for agricultural and urban use in much of the coastal plain of Ventura County, including Oxnard Plain. Seawater intrusion was initially observed in the late 1940s, following the widespread development of agriculture and food processing in the Oxnard Plain. Increasing water demands in the 1940s led to overdraft of groundwater aquifers underlying the plain.

In the 1990s demand has decreased due to agricultural and urban water conservation measures. Recent estimates show an approximate balance between extractions and recharge because of increased artificial recharge and a reduction in groundwater extraction required by Fox Canyon Groundwater Management Agency. The agency adopted ordinances requiring meter installation on wells extracting more than 50 af/yr, and restricting drilling of new wells in some areas.

In 1991, United Water Conservation District completed construction of the Freeman Diversion improvement project on Santa Clara River. This project increased average annual diversions from the river from 40 taf to 60 taf. The diverted water is used for groundwater recharge and irrigation, reducing agricultural demand for groundwater.

Southern California Comprehensive Water Reclamation and Reuse Study

In 1993 USBR, seven local agencies and the Department began evaluating the feasibility of regional water recycling in Southern California. The seven participating local agencies are: Central and West Basin Municipal Water Districts, City of Los Angeles, City of San Diego, MWDSC, SDCWA, Santa Ana Water Project Authority, and South Orange County Reclamation Authority. Regional planning would take advantage of potential surpluses of recycled water which could serve needs in areas throughout Southern California. The plan of study called for a three-part, six-year comprehensive effort to identify a regional recycling system and develop potential projects.

The study has identified regional and area-wide water recycling potential for 20 and 50 year planning horizons. An economic distribution model will be used to maximize the allocation of recycled water at minimum cost throughout the region.

Water Marketing

The highly urbanized South Coast Region relies substantially on imported water. Water wholesalers serving the region expect to acquire part of their future supplies from water marketing arrangements, using the Colorado River Aqueduct and California Aqueduct to convey the acquired water.

A difficulty associated with future supply from water marketing arrangements—as opposed to from fixed facilities such as reservoirs or water recycling plants—is the greater uncertainty involved in forecasting future contractual arrangements for transfers. For example, SDCWA recently released a request for proposals for entities interested in selling water both on a short-term or long-term basis. Details of marketing arrangements developed would depend on specific terms and conditions negotiated for each arrangement. An urban agency may plan to acquire water from agricultural users in the Central Valley or the Colorado River Region, but terms and conditions of the transfers are subject to negotiation with potential sellers and the availability of conveyance. There are many ways to structure marketing arrangements—long-term agreements for base year transfers that occur every year regardless of hydrology, drought year transfers tied to specific hydrologic criteria, or transfer options that may be exercised based on negotiated criteria. Marketing may also be accomplished through short-term (one year

or less) agreements on the spot market. Of note in the South Coast Region, local agencies are now planning to use water transfers for part of their base supplies, a change from past years when marketing arrangements were viewed as primarily drought year supplies.

An example of a base year transfer is the SDCWA/IID transfer described in Chapter 9. The two agencies executed an agreement in 1998 for a long-term transfer that would build up over time to 200 taf/yr. SDCWA would need to use MWDSC's Colorado River Aqueduct to convey the transferred water to the South Coast Region. SDCWA and MWDSC have negotiated an initial wheeling agreement.

New Conveyance Facilities from Colorado River Region to South Coast Region

SDCWA has been studying the feasibility of constructing a new aqueduct from the Imperial Valley to its service area. Two alternatives have been considered—an aqueduct on the U.S. side of the international border that would be used to convey Colorado River water acquired through marketing arrangements with water users in the Colorado River Region, and a joint aqueduct on the Mexican side of the border with the City of Tijuana. SDCWA has completed the first phase of a feasibility study for the U.S. alignment; Proposition 204 authorizes funding for further feasibility-level study of conveyance alternatives. In addition to the usual engineering and environmental considerations associated with large-scale conveyance projects, the ability to implement this project would be affected by the other Colorado River Basin states' concerns about a new California diversion on the river, and by international considerations involved in financing and constructing a project with the Mexican government.

Water marketing arrangements established through the draft CRB 4.4 Plan would be a source of water for a new conveyance facility. Other sources could result from responses to SDCWA's 1998 request for proposals for short-term and long-term marketing arrangements. While new conveyance may be a possible option for the South Coast Region in the long term, the time required to implement such a large scale project and the schedule presently contemplated for implementing the draft CRB 4.4 Plan suggest that a facility would not be constructed within the Bulletin 160-98 planning horizon.

Mexican Border Environmental Quality Issues

Tijuana's excess sewage has plagued San Diego area beaches since the 1930s. During frequent failures of Tijuana's inadequate, antiquated sewage treatment system, millions of gallons of raw sewage have been carried across the border through the Tijuana River to its estuary in San Diego County. San Diego's first attempt to alleviate this problem was in 1965, when the city agreed to treat Tijuana's wastewater on an emergency basis. In 1983, the United States and Mexico signed an agreement stating that Mexico would modernize and expand Tijuana's sewage and water supply system and build a 34 mgd sewage treatment plant. Mexico received a grant for $46.4 million from the Inter-American Development Bank to help finance the expansion and was to spend an additional $11 million to build a wastewater treatment plant 5 miles south of the border. The plant became fully operational in 1988.

In 1990, the United States and Mexico, through the International Boundary and Water Commission, agreed to construct international wastewater treatment facilities in the United States to solve continuing border sanitation problem. Facilities included a 25 mgd secondary treatment plant at a site just north of the international border and a 3.5 mile ocean outfall. Construction of the first phase of the international plant, a 25 mgd advanced primary treatment plant is being completed. Construction of the secondary phase of the international plant is on hold pending the completion of a supplemental environmental impact statement on alternative methods of secondary treatment. The second phase is expected to be complete by December 2000.

EPA and IBWC have completed a supplemental EIS on interim options for discharge of effluent from the international plant prior to completion of the ocean outfall and the secondary treatment component of the plant. The preferred option is a combination of discharging the effluent to the City of San Diego's metropolitan sewerage system and constructing a detention basin to hold flows for discharge during off-peak hours.

Water Management Options for South Coast Region

Southern California's challenge in managing its water resources is driven by one of the most fundamental realities of the West—it is an arid region. The major water agencies in the South Coast Region are extensively involved in water resources management planning. A mixture of water management options will

be needed to replace California's reduced supply from the Colorado River and to offer long-term reliability to the region. Table 7-29 shows a list of options for the region, and the results of an initial screening of the options. The retained options were evaluated (Table 7A-4 in Appendix 7A) based on a set of fixed criteria discussed in Chapter 6.

Water Conservation

Urban. Urban water demand forecasts for 2020 assume that BMPs are in place; consequently, only those urban conservation efforts which exceed BMPs are considered as options. Reducing outdoor water use to 0.8 ET_o in new development would attain 67 taf/yr of depletion reductions, while extending this measure to include existing development would reduce depletions by 246 taf/yr. Reducing residential indoor water use to 60 and 55 gpcd would reduce depletions by 110 and 220 taf/yr, respectively. Reducing commercial, institutional, and industrial water use by an additional 3 percent and 5 percent would attain 30 taf/yr and 49 taf/yr of depletion reductions, respectively. Reducing system losses to 5 percent would reduce depletions by 84 taf/yr.

Agricultural. The 2020 agricultural water demand forecasts assume that EWMPs are in place. As with the urban water management options, only those agricultural conservation efforts which exceed EWMPs are considered as options. Agricultural water conservation options are limited in the region because of the relatively high SAEs that currently exist, the reliance on high cost, pressurized potable water or groundwater, and the limited agricultural acreage. Improving irrigation management to raise SAEs to 76, 78, and 80 percent in the South Coast would reduce depletions by 4, 7, and 10 taf/yr, respectively. Flexible water deliveries are deferred because most of the water applied for agriculture is delivered on-demand in the region. Canal lining and piping are deferred because of the absence of open canal systems in the region. The spill recovery and tailwater systems option is deferred because of the relatively small acreage under furrow or border irrigation in the region.

Modify Existing Reservoirs or Operations

USACE operates flood control reservoirs in the Los Angeles and San Gabriel River Basins of Los Angeles County. Water conservation benefits could be realized if storage was established in these reservoirs for temporarily impounding storm flows for later release to downstream recharge facilities. The Los Angeles County Department of Public Works and USACE are evaluating the potential for reoperating USACE flood control reservoirs. Preliminary studies have indicated that an additional 17 taf of conservation storage is possible, and USACE is currently performing a feasibility study expected to conclude in 1998.

Prado Dam. As discussed in the water management issues section, construction of Seven Oaks Dam on the Santa Ana River and pending enlargement of the existing Prado Dam create an opportunity to increase water supply storage in Prado Reservoir for recharging Orange County groundwater basins. Modifying Prado Reservoir's flood control operation would provide an additional 3 to 5 taf of annual supply for groundwater recharge.

Hansen and Lopez Dams. Hansen Dam on Tujunga Wash and Lopez Dam on Pacoima Wash are small USACE flood control detention reservoirs (essentially debris basins) located on adjoining drainages in Los Angeles County, in the San Gabriel Mountains above Pacoima. The combined storage capacity of the two reservoirs is about 25 taf. Los Angeles County has cooperated with USACE in completion of a reconnaissance study (1994) and preparation of a feasibility-level study to evaluate possible water supply benefits from reoperating the reservoirs for limited water supply storage. The feasibility study is scheduled to be completed in 1998.

Santa Fe and Whittier Narrows Dams. Santa Fe Dam (32 taf storage capacity) on the San Gabriel River and Whittier Narrows Dam (67 taf storage capacity) on Rio Hondo are USACE dams that impound flood control detention basins in Los Angeles County. The county cooperated with USACE in a 1994 reconnaissance study and feasibility-level evaluation of possible water supply benefits from reoperating the reservoirs to provide limited water supply storage. The feasibility study, scheduled to be completed in 1998, is examining allowing a permanent water conservation pool to be maintained at Santa Fe Dam and expanding the existing conservation storage pool at Whittier Narrows.

New Reservoirs

In an average year, about 200 taf of storm runoff from the Los Angeles River flows to the ocean. A proposed freshwater reservoir project in Long Beach would include an inflatable weir across the Los Angeles River

TABLE 7-29

South Coast Region List of Water Management Options

Option	*Retain or Defer*	*Reason for Deferral*
Conservation		
Urban		
Outdoor Water Use to $0.8ET_o$	Retain	
Indoor Water Use	Retain	
Interior CII Water Use	Retain	
Distribution System Losses	Retain	
Agricultural		
Seasonal Application Efficiency Improvements	Retain	
Flexible Water Delivery	Defer	No significant depletion reductions attainable.
Canal Lining and Piping	Defer	No significant depletion reductions attainable.
Tailwater Recovery	Defer	No significant depletion reductions attainable.
Modify Existing Reservoirs/Operations		
Reoperate Prado Dam	Retain	
Reoperate Hansen and Lopez Dams	Retain	
Reoperate Santa Fe and Whittier Narrows Dams	Retain	
New Reservoirs/Conveyance Facilities		
Freshwater Reservoir in Long Beach Harbor	Retain	
New Aqueduct from Imperial Valley to San Diego	Defer	Interstate issues.
Groundwater/Conjunctive Use		
Local Groundwater Banking/Conjunctive Use	Retain	
Water Marketing		
Castaic Lake Water Agency	Retain	
Water Recycling		
Alamitos Barrier - Los Angeles County Sanitation Districts	Retain	
Alamitos Barrier Recycled Water Project - Water Replenishment District	Retain	
Carlsbad Water Reclamation Plan - Encina Basin - P2 - Carlsbad MWD	Retain	
Castaic Lake Water Agency Reclaimed Water Master Plan - LACSD	Retain	
Central City/Elysian Park Water Recycling Project - LADWP	Retain	
City of Escondido Regional Water Recycling Program	Retain	
City of Poway - Escondido Expansion	Retain	
City of Poway - S.D. Expansion	Retain	
City of West Covina - LACSD	Retain	
Dominguez Gap Barrier Recycled Water Project - Water Replenishment District	Retain	

TABLE 7-29

South Coast Region List of Water Management Options (continued)

Option	*Retain or Defer*	*Reason for Deferral*
E. Thornton Ibbetson Century Recycled Water Project - City of Downey	Retain	
East Valley Water Recycling Project Expansion - LADWP	Retain	
El Toro Water District Reclamation	Retain	
Esteban Torres Water Recycling Project - Central Basin MWD	Retain	
Green Acres-Phase 2 - Orange County WD	Retain	
Headworks Water Recycling Project - LADWP	Retain	
Irvine Ranch Water District	Retain	
Los Angeles Harbor Water Recycling Project - LADWP	Retain	
Montebello Forebay Advanced Treatment Plant - Water Replenishment District	Retain	
Non-domestic Irrigation System - Capistrano Valley Water District	Retain	
North City Reclamation Plant - Poway Resources Expansion - City of Poway	Retain	
North San Diego County Reclamation Project Phase 2 - Leucadia County WD	Retain	
OCR Project - CSDOC - Orange County Sanitation District	Retain	
Orange County Regional Reclamation Project - Orange County Water District	Retain	
Puente Hills/Rose Hills Reclaimed Water District System - LACSD	Retain	
San Elijo Joint Powers Authority - Santa Fe Irrigation District	Retain	
San Elijo Joint Powers Authority WRF	Retain	
San Gabriel Valley Groundwater Recharge Demonstration - LACSD	Retain	
San Pasqual Groundwater Management Program - City of San Diego	Retain	
Sepulveda Basin Water Recycling Project - LADWP	Retain	
South Bay Water Reclamation Project - City of San Diego	Retain	
Verdugo-Scholl-Brand Project - City of Glendale	Retain	
Water Repurification Project - City of San Diego	Retain	
West Basin Recycling Project-Phase 2 - West Basin MWD	Retain	
West Los Angeles Extension Expansion - West Basin MWD	Retain	
Westside Water Recycling Project - LADWP	Retain	
Whittier Narrows Recreation Area - Los Angeles County Sanitation Districts	Retain	

TABLE 7-29

South Coast Region List of Water Management Options (continued)

Option	*Retain or Defer*	*Reason for Deferral*
Desalting		
Brackish Groundwater		
Capistrano Beach Desalter	Retain	
Huntington Beach Colored Water	Retain	
IRWD Colored Water Treatment Project	Retain	
Laguna Beach GW Treatment Project	Retain	
Mesa Colored Water Project	Retain	
Oceanside Desalter No. 2	Retain	
OCWD Undetermined Colored Water Projects	Retain	
Corona/Temescal Basin Desalter	Retain	
Otay/Sweetwater Desalter	Retain	
Perris Basin Desalter	Retain	
Rubidoux/Western Desalter	Retain	
San Dieguito Basin Desalter	Retain	
San Juan Basin Desalter No. 2	Retain	
San Pasqual Basin Desalter	Retain	
Santee/El Monte Basin Desalter	Retain	
Sweetwater Desalter No.2	Retain	
Tijuana River Valley Desalter	Retain	
Torrance Elm Ave. Facility	Retain	
West Basin Desalter No. 2	Retain	
West Basin Desalter No. 3	Retain	
Western/Bunker Basin Treatment Project	Retain	
Winchester/Hemet Desalter	Retain	
Seawater		
Reverse Osmosis Facilities at South Bay Powerplant	Retain	
Reverse Osmosis Facilities at Encina Powerplant	Retain	
Reverse Osmosis Facilities at Alamitos Powerplant	Retain	
Multiple-effect Distillation Process	Retain	
Other Local Options		
Draft CRB 4.4 Plan	Retain	
Multipurpose Flood Control Basins	Retain	
Statewide Options		
—	—	See Chapter 6.

near its mouth, to direct some of the storm flows into intakes along existing river levees. From the intakes, the storm flow would be pumped or flow by gravity via culverts or tunnels to an offshore reservoir. The reservoir site would be in the vicinity of the existing Long Beach Breakwater in San Pedro Bay. Reservoir dikes would be constructed in the bay with a diaphragm wall constructed through the dikes to prevent leakage of fresh water through the walls of the dam. A bulb of fresh water would be maintained at the bottom of the reservoir to repel seawater. The reservoir could be sized to store 100 taf to 300 taf of storm water during the wet season. This captured storm water could subsequently be distributed for a number of uses, with the most likely use being groundwater recharge. A final feasibility report was issued in March 1998.

The option analyzed consisted of a 100 taf reservoir sited within San Pedro Bay supplying the Montebello Forebay spreading grounds with 71 to 129 taf/yr. The annual cost of the water would be about $1,700/af at 71 taf of supply, decreasing to $1,000/af at 129 taf of supply. Expansion of the project to use additional captured storm water runoff would maximize the reservoir yield at 172 taf/yr, decreasing the annual cost to $800/af.

Groundwater Development and Conjunctive Use

As a result of MWDSC's seasonal storage service pricing program, local agencies are storing imported water in groundwater basins and increasing their groundwater use during the summer and during drought years. It is estimated that an average of 100 taf/yr of groundwater supply is now produced as a result of MWDSC's discount pricing for winter season deliveries. The program provides imported water at an average discount of $125/af during the winter.

MWDSC had identified the potential for 200 taf of additional groundwater production during drought years. To accomplish this additional drought year production, about 600 taf of dedicated storage capacity within the local basins may be required. The cost of the water would be about $350/af. MWDSC is working with Calleguas Municipal Water District on a Las Posas Basin aquifer storage and recovery project. CMWD would develop up to 300 taf of storage in the lower aquifer system of the Las Posas groundwater basin. The project currently provides 70 taf of water supply in drought years, which has been included as 2020 supply in the water budget. MWDSC is pursuing an additional 130 taf/yr of groundwater production in the region.

Water Marketing

Water from the Colorado River Region. Several water marketing arrangements are being planned or implemented as part of the draft CRB 4.4 Plan. These arrangements are described in the section on implementing the draft CRB 4.4 Plan.

Water from the Central Valley. More than half of California's agricultural water use is in the Central Valley. The California Aqueduct could be used for voluntary transfers of some of this water to the South Coast. It is estimated that potential future marketing arrangements from the Central Valley to the South Coast Region could be about 200 taf/yr. Voluntary marketing arrangements would be developed through option agreements, storage programs, and purchases of water through the drought water bank or other similar spot markets.

MWDSC is currently banking water with Semitropic Water Storage District under a long-term transfer agreement to store up to 350 taf. The agreement allows MWDSC to deliver available SWP water in wetter years to SWSD for in-lieu groundwater recharge. In drought years SWSD would release its SWP allocation to MWDSC, and if necessary pump groundwater back into the California Aqueduct to meet its obligations. The drought year yield would be about 60 taf/yr.

A long-term agreement has been completed between MWDSC and Arvin-Edison Water Storage District to store up to 350 taf of water for MWDSC in Arvin-Edison's groundwater basin. Water banked in this program would be provided by both MWDSC and AEWSD. MWDSC would withdraw about 60 taf in drought years under this program.

As specified in the Monterey Amendment, agricultural contractors will make available up to 130 taf of annual SWP entitlement for permanent transfer to urban contractors, on a voluntary basis. Berrenda-Mesa Water District has already completed the transfer of 25 taf of entitlement to MWA. Similar permanent transfers could be negotiated in the South Coast Region. Castaic Lake Water Agency is preparing an EIR for the proposed transfer of 40 taf of SWP entitlement from Wheeler Ridge-Maricopa Water Storage District, a member agency of KCWA. The CLWA service area includes the Santa Clarita Valley in northwestern Los Angeles County and extends into eastern Ventura County.

Implementing the CRB's Draft 4.4 Plan

The draft CRB 4.4 Plan would reduce California's use of Colorado River to the State's basic apportionment while using marketing arrangements and other options to keep a full Colorado River Aqueduct for the South Coast. Phase one elements of the draft CRB 4.4 Plan that have been quantified and would provide water supplies for the South Coast are described below. More detail on the draft plan and its elements is provided in Chapter 9. Chapter 9 also presents an overview of how the use of Colorado River water is apportioned among the basin states and among California entities.

Bulletin 160-98 water budgets assume that the South Coast Region's 2020 base supply from the Colorado River will be limited to MWDSC's fourth priority right of 550 taf, plus any marketing arrangements that have already been implemented (i.e., 107 taf from the MWDSC/IID agreement described in Chapter 3). Actions taken as part of the draft CRB 4.4 Plan to fill the CRA's remaining capacity are treated as future options in the water budgets. As described in Chapter 9 (and shown in Table 9-25), the base water demand forecasts for Bulletin 160-98 include implementation of EWMPs. This conserved water would be another source of water for Colorado River/South Coast marketing arrangements, in addition to those actions that Bulletin 160-98 categorizes as water management options.

Water management options contained in phase one of the draft CRB 4.4 Plan include the SDCWA/IID water transfer, MWDSC intrastate groundwater banking programs, interstate groundwater banking in Arizona, drought year land fallowing programs (such as an MWDSC/PVID program), lining parts of the All American and Coachella Canals, and agricultural water conservation beyond EWMP implementation. As described in Chapter 9, potential South Coast supplies from these options are assumed to be made available for the region after shortages due to groundwater overdraft in the Colorado River Region have been balanced out.

The draft CRB 4.4 Plan further proposes criteria for reoperating Colorado River system reservoirs. The Colorado River has a high ratio of storage capacity to average annual runoff. Projections of consumptive use for the upper basin states suggest that those states will not attain full use of their Compact apportionments until 2060. USBR's surplus declarations to date have not adversely impacted the other states' use of their apportionments—reservoir flood control releases were made in 1997 and 1998. The more significant impediment to implementing revised operating guidelines would be concerns of the other basin states about impacts of an extended period of reoperation on the ability to avoid future shortages. Reservoir reoperation is not numerically evaluated in Bulletin 160-98, because implementing new operations criteria would require agreement of USBR and the remaining basin states, and there is presently no generally accepted proposal available for quantification.

Water management options in phase two of the draft CRB 4.4 Plan have not yet been quantified; implementation of some may extend beyond the Bulletin 160-98 planning horizon. Examples of phase two actions include desalting tributary inflows to the Salton Sea or weather modification programs. For example, USBR had developed a 1993 proposed pilot program to evaluate cloud seeding potential in the upper basin, but had not implemented the program because of opposition from the upper basin states. Large-scale weather modification programs are typically difficult to implement due to institutional and third-party concerns.

Water Recycling

Since the 1970s, Southern California has been a leader in developing water recycling projects. Recycled water is currently used for applications that include groundwater recharge, hydraulic barriers to seawater intrusion, landscape and agricultural irrigation, and direct use in industry. Currently some 80 local recycling projects are producing about 210 taf/yr of new water supply. It is estimated that these existing projects will provide an additional 70 taf /yr of water supply by year 2020.

Almost 40 new water recycling projects were evaluated as future water supply augmentation options for the region. Water recycling could potentially increase by 639 taf by 2020, yielding about 527 taf of new water. The price of recycled water from these options ranges from $180/af to more than $2,500/af. This large range is due to the individual characteristics of proposed projects—some entail major capital costs for construction of new treatment plants while others may involve only distribution systems from an existing plant. For example, projects designed for groundwater recharge are often located near the treatment plant—reducing the costs for distribution. As another example, projects that are designed for landscape irri-

gation or direct industrial uses will generally be higher in cost because of the extensive distribution system needed for delivery.

In an effort to broaden the potential application of recycled water to include indirect potable use, the City of San Diego has conducted research into advanced treatment and ultimate use of recycled water as a supplement to potable water supplies. This indirect potable reuse concept has been termed repurification by San Diego. The City of San Diego is currently working on a water repurification project (described in Chapter 5) that would produce about 16 taf/yr of repurified water to augment local supplies. The repurified water would be stored in the San Vicente Reservoir and blended with local runoff and imported water.

To evaluate and compare recycling options with other water management options, the water recycling options were grouped by cost into three groups. Group I included those options which cost under $500/af; Group II included those options which cost between $500 and $1,000/af; and Group III included those options which cost more than $1,000/af. The costs used to group these projects are based on the costs reported by local agencies in the Department's 1995 water recycling survey. (These costs are not likely to have all been calculated on the same basis by the local project sponsors.) The local agencies' costs were used to judge the order of magnitude of proposed projects' costs.

A proposed Orange County regional water recycling project is being developed jointly by the Orange County Water District and County Sanitation Districts of Orange County. Wastewater currently discharged into the Pacific Ocean would be recycled to supplement Orange County's potable supplies. The treated wastewater would be used to recharge an aquifer along the Santa Ana River, in lieu of using imported water provided by MWDSC. A plant to treat second-

San Diego Area Water Reclamation Programs

The San Diego County Water Authority and its member agencies are engaged in a long-term effort to reduce regional reliance on imported water supplies. Water recycling is critical to the success of that effort. Two major programs are currently underway.

The San Diego Area water reclamation program is a system of interconnected reclamation facilities designed to serve southern and central San Diego County. When completed, the program will serve an area of more than 700 square miles and add more than 60 taf/yr to the San Diego region's local water supply. Summarized below are the eight participating agencies and each agency's planned reuse. Facilities to be constructed include up to ten new or expanded water recycling plants, a water repurification facility, and hundreds of miles of recycled water delivery pipelines.

Agency	New Water Supply (taf/yr)
City of Escondido	3.2
City of Poway	2.3
City of San Diego	26.9
City of San Diego/San Diego County Water Authority	15.0
Otay Water District	2.9
Padre Dam Municipal Water District	1.9
Sweetwater Authority	7.2
Tia Juana Valley County Water District	2.2
Total	**61.6**

Padre Dam MWD has completed construction of its treatment facility, and has begun delivery of recycled water. The City of San Diego's North City water recycling plant and distribution system have also been completed and are delivering recycled water.

The North San Diego County Area water recycling project will provide more than 15 taf/yr of recycled water to northern coastal and inland San Diego County. The project is a cooperative effort of Carlsbad and Olivenhain MWDs, the Leucadia County Water District and the San Elijo JPA. When completed, the system of interconnected recycling facilities will serve an area of more than 100 square miles, from the coastal communities of Carlsbad, Encinitas and Solana Beach inland to the San Dieguito River Valley. Facilities to be constructed include three new or expanded water recycling facilities, about 65 miles of recycled water delivery pipeline and associated pump stations and storage facilities, and new groundwater recharge and extraction facilities.

ary effluent produced by an existing wastewater treatment plant would be constructed, with a transmission pipeline to convey the recycled water to existing spreading basins located in the Orange County Forebay in Anaheim. Some recycled water would also be injected into a seawater intrusion barrier in Fountain Valley. Another benefit would be that water recycling would decrease the total wastewater treatment discharge to the ocean, which would eliminate or delay the need for a new or expanded ocean outfall. Phase I is planned to produce 50 taf/yr of recycled water by 2002. Phases II and III would produce an additional 50 taf/yr by 2020, reducing Orange County's dependence on imported water.

Desalting

Groundwater. Recovery of mineralized groundwater supplies is an important resource strategy for Southern California. This resource option is usually expensive—because it involves sophisticated technologies and high energy costs. Some groundwater recovery projects serve the dual purpose of managing migration of plumes to prevent further contamination of usable aquifers.

Groundwater desalting plants currently operating include Santa Ana Watershed Project Authority's Arlington Desalter (6.7 taf), the City of Oceanside's Oceanside Desalter No.1 (2.2 taf), and West Basin MWD's West Basin Desalter No.1 (1.7 taf). Construction of Sweetwater Authority's groundwater demineralization plant (3.6 taf) in the Sweetwater River Valley began in 1998. Plans are to expand the plant to produce an additional 4 taf. Additional plants and plant expansions are being planned or constructed throughout the coastal areas of the Los Angeles Basin, with an estimated total installed capacity of 33 taf/yr by 2000. The estimated total net groundwater recovery potential in the South Coast is about 150 taf/yr.

The Santa Ana Watershed Project Authority was formed in 1972 to plan and operate facilities to protect water quality in the Santa Ana River's watershed. The authority is a joint powers agency composed of the five larger water districts that share the watershed—Chino Basin Municipal Water District, Eastern Municipal Water District, Orange County Water District, San Bernardino Valley Municipal Water District, and Western Municipal Water District. SAWPA operates a brine disposal line which facilitates disposal of waste brine from regional desalting plants and operates the Arlington Desalter.

While increases in groundwater recovery are technically feasible, they are challenged by the need for development of new brine lines (or alternative brine disposal options) for inland projects as well as requirements for replenishment in certain groundwater basins. Approximately 20 potential groundwater recovery projects were evaluated with a net yield of 95 taf/yr. Supply costs range from $300/af to $900/af. The groundwater recovery projects are grouped by cost into two groups, those projects less than $500/af and those more than $500/af.

Seawater. Seawater desalting is sometimes described as the ultimate solution to Southern California's water supply shortfall. Although there is often public support for this resource, seawater desalting is currently limited by high costs, environmental impacts of brine disposal, and siting considerations. Based on current technology, the costs for desalting seawater for potable use ranges from about $1,000 to $2,000/af depending on the type of treatment and the distribution system that would be required to deliver the water. Although high costs may currently limit this resource, seawater desalting may prove to be an important strategy in the future. MWDSC, with joint funding from the U.S. Government and Israel Science and Technology Foundation, recently embarked on a demonstration project

Brackish Water Reclamation Demonstration Facility

The Port Hueneme Water Agency was formed to develop and operate a brackish water desalting demonstration facility for its member agencies, all of whom are located in Ventura County. The BWRDF is the cornerstone of the program to improve water quality and reliability and reduce groundwater extractions and seawater intrusion in the Oxnard Plain. BWRDF will provide a full-scale demonstration of side-by-side operation of three brackish water desalting technologies (reverse osmosis, nanofiltration, and electrodialysis reversal). The feasibility of using desalting concentrate for wetlands enhancement is also being studied. Construction of the project has begun and is expected to be completed in 1998. The total capital costs are estimated to be $15.2 million.

using a multiple-effect distillation process, as described in Chapter 5.

In the past, SDCWA has evaluated the possibility of constructing two reverse osmosis desalting facilities in conjunction with the proposed repowering of the San Diego Gas and Electric South Bay Powerplant and the Encina Powerplant. The capacity of the two plants would total 20 taf/yr. The City of Long Beach and the Central Basin MWD are also collaborating on a study of a reverse osmosis plant with 5.6 taf annual capacity to be located at Southern California Edison's Alamitos Powerplant.

Other Local Options

Chino Basin Water Conservation District has prepared a scoping report on the construction and operation of multipurpose storm water detention and groundwater recharge basins. The proposed project involves San Bernardino County Flood Control District's plans for additional flood control facilities in the City of Ontario. SBCFCD plans to construct a storm water conduit to convey water to existing multipurpose flood control and groundwater recharge basins and to develop a new flood control detention basin. Converting the proposed single-purpose basin into a flood control and groundwater recharge basin could provide additional water supply benefits for the Chino Basin. Although the volume of water to be conserved and developed by these projects is relatively small (about 1 taf), the projects meet specific local needs.

Statewide Options

Statewide water supply augmentation options are discussed and quantified in Chapter 6.

Options Likely to be Implemented in South Coast Region

Water supplies are not available to meet all of the region's 2020 water demands in average or drought years. Applied water shortages are forecasted to be 944 and 1,317 taf in average and drought years, respectively. Ranking of retained water management options for the South Coast Region is summarized in Table 7-30. Table 7-31 summarizes options that can likely be implemented by 2020 to relieve the shortages. These shortages are primarily attributed to increased urban demands and reduced Colorado River supplies.

To meet the water shortages, water agencies in the South Coast Region are planning to implement additional conservation programs, water recycling, and groundwater recovery, as well as water marketing and other water supply augmentation options. Demand reduction options such as urban conservation are currently an important program for all water agencies in the South Coast. Supply augmentation options to be implemented would include the draft CRB 4.4 Plan and a combination of local and statewide options.

Implementation of BMPs and EWMPs will continue through 2020 and is reflected in the base demand levels for urban and agricultural water use. Additional conservation options likely to be implemented, based on costs and feasibility, would provide 91 taf/yr in depletion reduction.

The South Coast Region will increase its reliance on water marketing as Colorado River supplies are reduced. Options in the first phase of the draft CRB 4.4 Plan could make available up to 172 taf in average years and 410 taf in drought years for transfer to the South Coast Region. Additional banking and marketing arrangements, as well as permanent transfer of SWP entitlement, are likely options for the region, amounting to 37 taf and 27 taf in average and drought years, respectively.

Local groundwater conjunctive use programs will likely add 130 taf of production in drought years. Water recycling will continue to be a source of water supply for Southern California. New projects could provide an additional 367 taf/yr by 2020. Groundwater desalting projects could provide an additional 27 taf/yr.

TABLE 7-30

Options Ranking for South Coast Region

Option[a]	*Rank*	*Cost ($/af)*	*Potential Gain (taf)*	
			Average	*Drought*
Conservation				
Urban				
Outdoor Water Use to 0.8 ET_o - New Development	M	750	67	67
Outdoor Water Use to 0.8 ET_o -New and Existing Development	L	[b]	246	246
Indoor Water Use (60 gpcd)	M	400	110	110
Indoor Water Use (55 gpcd)	M	600	220	220
Interior CII Water Use (3%)	M	500	30	30
Interior CII Water Use (5%)	M	750	49	49
Distribution System Losses (5%)	M	300	84	84
Agricultural				
Seasonal Application Efficiency Improvements (76%)	H	100	4	4
Seasonal Application Efficiency Improvements (78%)	M	250	7	7
Seasonal Application Efficiency Improvements (80%)	M	450	10	10
Modify Existing Reservoirs/Operations				
Reoperate Prado Dam	H	60	5	5
Reoperate Hansen and Lopez Dams	M	[b]	[b]	[b]
Reoperate Santa Fe and Whittier Narrows Dams	M	[b]	[b]	[b]
New Reservoirs/Conveyance Facilities				
Freshwater Reservoir in Long Beach Harbor	L	1,000	172	—
Groundwater/Conjunctive Use				
Local Groundwater Banking/Conjunctive Use	H	350	—	130
Water Marketing				
Castaic Lake WA/Kern County WA (40 taf entitlement)	H	—	37	27
Water Recycling				
Group 1 (Cost < $500/af)	H	500	391	391
Group 2 (Cost $500/af- $1,000/af)	M	1,000	75	75
Group 3 (Cost > $1,000/af)	M	1,500	61	61
Desalting				
Brackish Groundwater				
Group 1 (Cost < $500/af)	M	500	27	27
Group 2 (Cost $500/af- $1,000/af)	M	1,000	68	68
Seawater				
Reverse Osmosis Facilities at South Bay Powerplant	L	920	5	5
Reverse Osmosis Facilities at Encina Powerplant	L	1,220	15	15
Reverse Osmosis Facilities at Alamitos Powerplant	L	1,700	6	6
Multiple-Effect Distillation Process	L	<1000	85	85
Other Local Options				
Multipurpose Flood Control Basins	H	[b]	[c]	[c]
Draft Colorado River Board 4.4 Plan	H	230	172	410
Statewide Options				
See Chapter 6.				

[a] All or parts of the amounts shown for highlighted options have been included in Table 7-31.
[b] Data not available to quantify.
[c] Less than 1 taf.

TABLE 7-31

Options Likely to be Implemented by 2020 (taf)

South Coast Region

	Average	*Drought*
Applied Water Shortage	**944**	**1,317**
Options Likely to be Implemented by 2020		
Conservation	91	91
Modify Existing Reservoirs/Operations	5	5
New Reservoirs/Conveyance Facilities	-	-
Groundwater/Conjunctive Use	-	130
Water Marketing	37	27
Recycling	367	367
Desalting	27	27
Colorado River Board's Draft 4.4 Plan	172	410
Statewide Options	150	144
Expected Reapplication	95	116
Total Potential Gain	**944**	**1,317**
Remaining Applied Water Shortage	**0**	**0**