Issue Paper

A Perspective on the Drought in California

Executive Summary

Despite heavy rains in March 1991, California continues to face a serious near-term water problem resulting from five years of drought. In fact, the amount of water in storage on October 1, 1991 was about equal to the amount in storage one year ago — a year in which strict conservation measures were imposed in some areas and there were significant reductions in water supplies for many agricultural users. In this paper, we provide background information on California's water system, the impact of the drought, water needs in the future, and legislative options for coping with water supply limitations.

In a "normal" water year, approximately three-quarters of the developed water in California comes from surface water supplies. Groundwater accounts for most of the remaining supplies. Agriculture uses about 80 percent of the developed water. In the 1991 water year (October 1990 through September 1991) — the fifth year of the drought — overall usage was about 16 percent below a normal year. Overall usage would have been significantly lower were it not for increases in groundwater pumping to compensate for losses in surface water supplies.

In part due to the increases in groundwater pumping, the effect of the drought on agriculture, while negative, has been limited thus far. If the drought continues, the impacts will grow more severe. The drought also has had negative effects on the environment, particularly on fish, sensitive ecological areas, and endangered species.

Our review of the water outlook indicates that the state faces both a near-term and a long-term water supply problem. We identify a variety of water supply, conservation and market options the Legislature might consider in debating water policy. In our view, the Legislature should consider implementing a coordinated mix of these options due to the interrelationships between them. For example:

- *Construction of supply alternatives should be linked to water market reform to assure efficient use of existing and newly developed water.*
- *Market reforms should consider the interests of "third parties" — those who are not directly involved in the transaction but who feel its impact, such as other water users and the environment.*
- *Either market reforms or construction of new supply facilities should be accompanied by effective management of groundwater resources.*

INTRODUCTION

The state has experienced five consecutive years of drought. The amount of water currently stored in 155 of the state's major reservoirs is approximately 61 percent of the average amount stored. This is the same amount of water that was in storage one year ago despite heavy rains in March 1991 (the wettest March on record). Consequently, the state continues to face drought conditions similar to conditions one year ago — a year in which strict conservation measures were imposed in some areas and significant reductions in water supplies were experienced by many agricultural users.

This issue paper provides a broad overview of the state's water system and the impacts of the drought. In it, we review: (1) California's water system as it would look in a "normal" water year, (2) the water supply during the current drought, (3) impacts of the drought on California's economy, (4) governmental responses to the drought, and (5) implications for the future and potential legislative options for coping with a limited water supply.

CALIFORNIA'S WATER SYSTEM

Where Does California's Water Come From?

The water Californians use comes from a variety of sources. Chart 1 displays the major sources of developed water during water year 1985 — October 1, 1984 through September 30, 1985 — the most recent year of normal rainfall. (That year was followed by an unusually "wet" year, after which the drought commenced.) During water year 1985, these sources supplied about 34.2 million acre-feet of water. An acre-foot is the amount of water covering one acre of land to a depth of one foot. An acre-foot of water is about the amount of water needed to supply a family of five for one year.

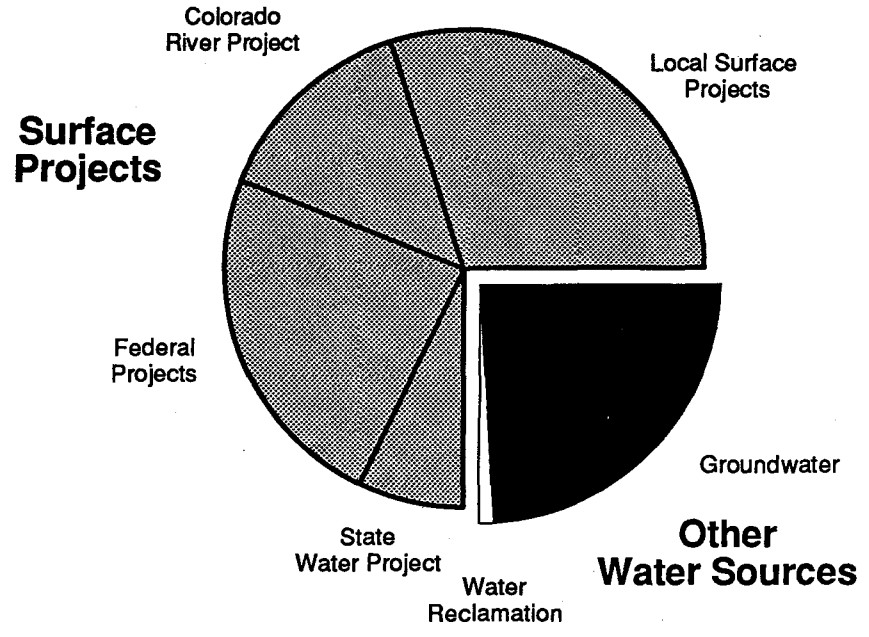
By far the most important source of California's water in a normal year (approximately 75 percent in 1985) is surface water projects — diversions of water from rivers and streams. These projects are operated by local governments (30 percent of total developed water in 1985), the federal government (24 percent), or the state (7 percent). Major local projects include Hetch Hetchy Reservoir (San Francisco) and Pardee Reservoir (East Bay Municipal Utility District). Local agencies also operate the Colorado River Aqueduct, which brings water from the federally operated Colorado River Project (14 percent). The most important federal and state projects in California are the Central Valley Project (CVP) and the State Water Project (SWP), respectively. These projects bring water from Northern California through the San Francisco Bay/Sacramento-San Joaquin Delta Estuary to the San Joaquin Valley and Southern California.

The second most important source of California's water in a normal year is groundwater (24 percent in 1985) — water pumped from underground basins. Water reclamation — the reclaiming and reusing of water — is a minor water source, accounting for less than 1 percent of California's water.

Chart 1

Major Sources of Water for California

Water Year 1985



Factors Affecting Water Delivery

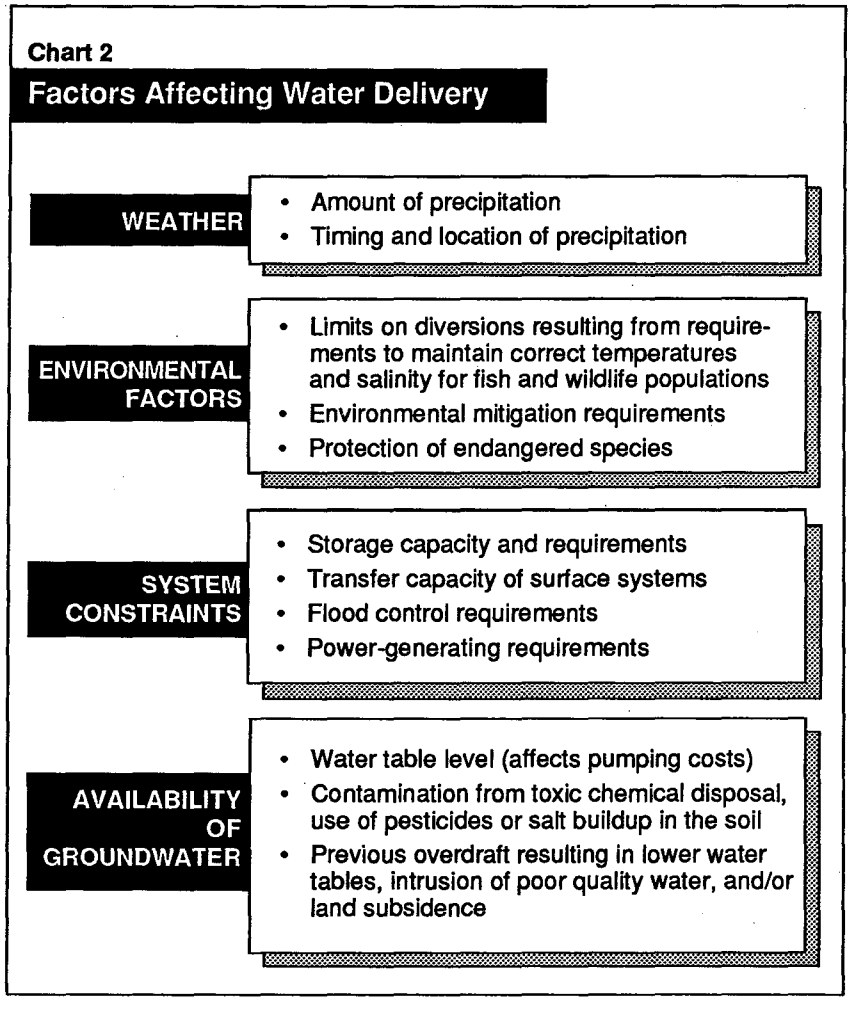
There are many factors that affect the amount of water that is available for delivery to Californians. These factors are summarized in Chart 2 (next page). The most important ones are the amount, location, and timing of the precipitation the state receives. In addition to these, many of the state's surface water systems are subject to environmental and system operation requirements that limit the amount of water the systems can actually make available to users.

First, diversions of water from rivers and streams are limited due to environmental concerns. For example, the SWP and the CVP must limit their operations to meet temperature and salinity standards that have been imposed in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary to protect fisheries. Meeting these standards requires limiting diversions of fresh water.

Second, there are a variety of system operating constraints. For example, (1) the pumps and aqueducts of the surface systems have limited capacity to transport water; (2) the storage capacity of the systems' reservoirs is limited; and (3) some reservoirs have to release water at certain times of the year for flood control and/or power generation purposes.

Finally, groundwater pumping may be affected by contamination and/or previous overdraft of groundwater supplies. "Overdraft" is the excess of the amount of water pumped over its replenishment from natural sources. Overdrafting may affect groundwater supplies

in the long term by lowering the water table, allowing intrusion of saltwater or poor quality water, or causing land subsidence, which reduces the capacity of underground basins to hold water. The Department of Water Resources (DWR) estimates that in recent normal rainfall years, such as 1985, roughly 75 percent of the amount of groundwater pumped was replenished by rainfall or seepage from different water uses (we discuss the long-term effect of overdrafting later in this issue paper).



THE CURRENT DROUGHT IN PERSPECTIVE

Water Supply and Use in a Normal Year

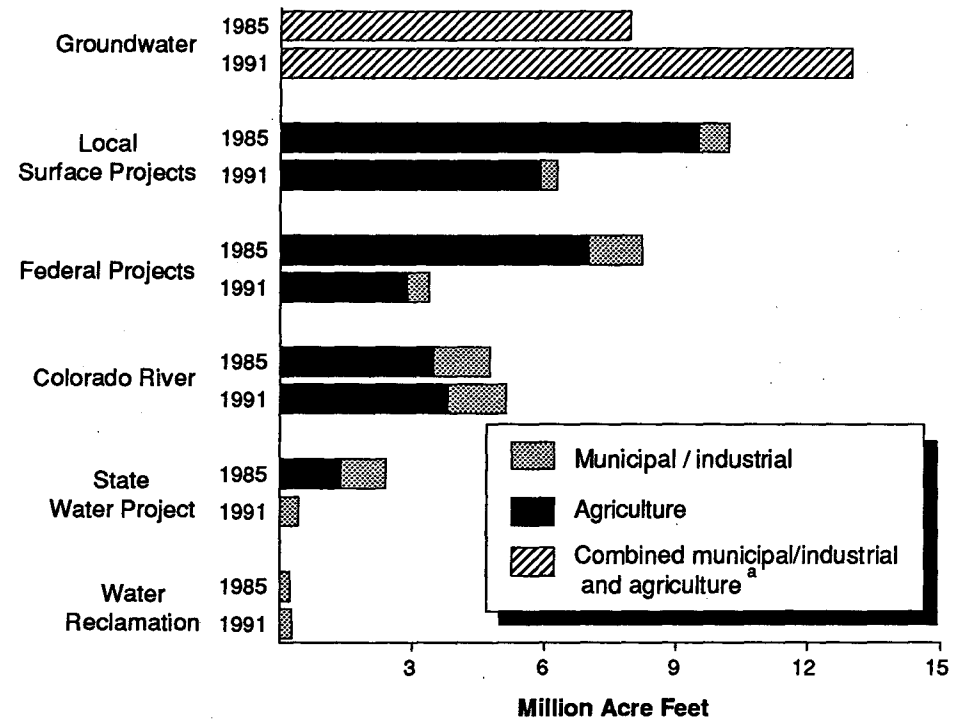
As indicated earlier, the total water used in water year 1985, the most recent year of normal rainfall, was approximately 34.2 million acre-feet (MAF). The major water source for California is surface water projects, which normally account for about three-quarters of all water used.

Approximately 80 percent of the water from surface water projects was used by agriculture in 1985. The remaining 20 percent was used by the municipal and industrial sectors (16 percent) and for wildlife, recreation and energy production (4 percent). Data are not available on the breakdown of groundwater use. Chart 3 shows the usage of water from each major water source by municipal/industrial and agricultural users.

Chart 3

Water Use by Source

Water Years 1985 and 1991

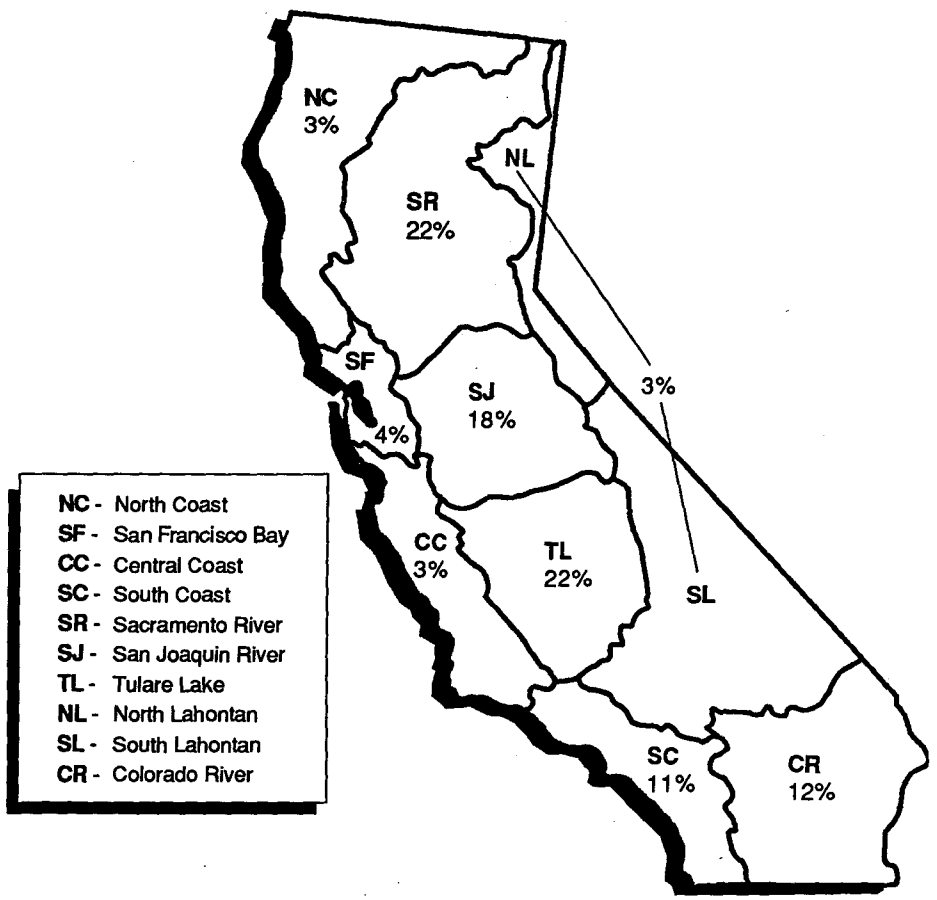


[a] Breakdown of water use by sector is not available.

Chart 4

Major Water Regions
And Percentage of Total Statewide Water Use

Water Year 1985



Regional Water Use

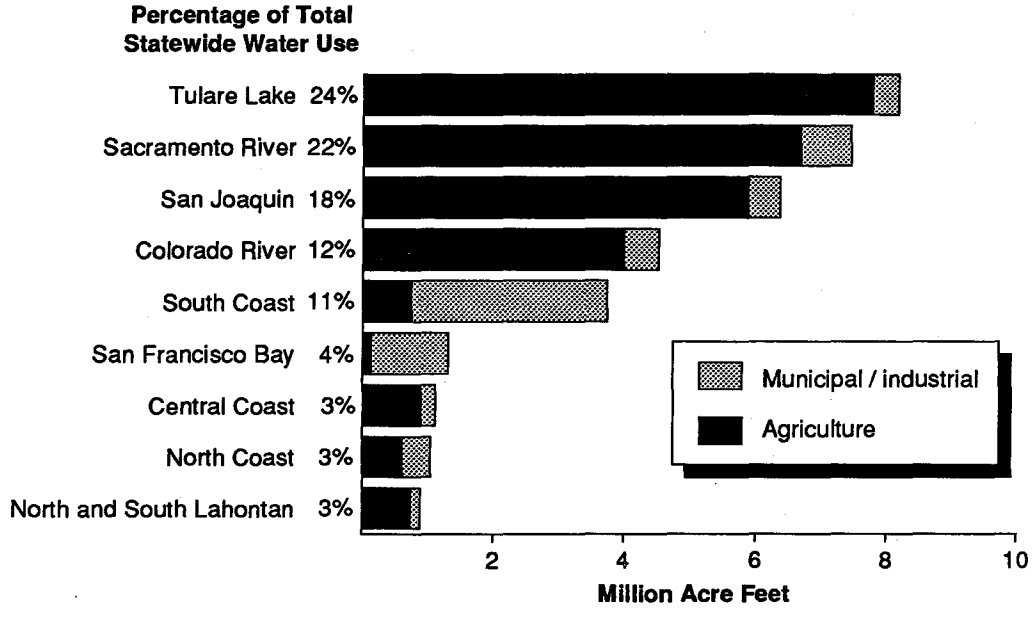
Chart 4 shows the major water regions in the state and, for each region, the percentage of total statewide water use in 1985. Chart 5 shows the usage of water in each region for municipal/ industrial and agricultural uses.

As illustrated by Chart 5, the Sacramento River, San Joaquin, and Tulare Lake regions accounted for approximately two-thirds of the state's water use in 1985. In contrast, the two regions containing the largest urban areas, the San Francisco Bay and South Coast regions, accounted for only 15 percent of these types of water use. These figures reflect the land use patterns in the regions: the first three regions are primarily agricultural while the latter two regions are primarily urban.

Chart 5

Water Use by Region

Water Year 1985



Estimated Water Supply and Use in Water Year 1991

The DWR estimates that the total water supply for water year 1991 was approximately 28.6 MAF, which is over 5 MAF less than a normal year's supply.

As illustrated in Chart 3, three of the major surface water supply sources (local surface projects, federal projects, and the SWP) were significantly down from 1985 levels. However, the DWR estimates that groundwater pumping increased 63 percent, from 8 MAF in 1985 to approximately 13 MAF in 1991, to partially compensate for the shortfall in the other supply sources. This usage of groundwater is about twice the amount that would be replenished in a normal rainfall year. In addition, the state's Colorado River allocation increased slightly in 1991. The DWR and the Bureau of Reclamation estimate that approximately 81 percent of the state's water from surface water projects was used by agriculture and 19 percent by other users. There are no reliable data on estimated groundwater use by sector for 1991.

Outlook for the 1992 Water Year

No Change in Storage Levels. According to information from the DWR, carry-over storage in 155 major reservoirs on October 1, 1991 (the beginning of water year 1992) was approximately equal to the 13.6 MAF in storage on October 1, 1990. This is approximately 61 percent of the historical average amount stored. Consequently, California is in the same situation at the beginning of the 1992 water year that it was at the beginning of the previous year.

Impacts Differ Widely Between Geographic Areas. Although the statewide 1992 water outlook is poor, the prospects differ somewhat by geographic area. The impacts in some regions may be mitigated to some extent due to (1) the distribution of the March 1991 rains (the wettest March on record), (2) the redistribution of water by the state's water bank (discussed later), and (3) increased groundwater pumping.

For example, in the Central Coast, which has been the area most affected by the drought, the March rains raised reservoir storage levels from under 10 percent to 41 percent of average. This relief allowed: (1) the City of Goleta to stop plans to import water from Canada and (2) Santa Barbara to ease severe water rationing restrictions.

Also, the March rains in combination with the water provided by the drought bank allowed the Metropolitan Water District of Southern California (among others) to ease water restrictions placed on its customers due to the lack of precipitation and limits on the SWP water.

By contrast, the Colorado River desert region (parts of San Bernardino, Riverside, and Imperial Counties) has not been affected by the drought because the region has received all of its allotted water from the Colorado River project, which accounts for approximately 96 percent of the region's water use. The Sacramento region has also fared relatively well during the drought because there has been sufficient water in the several rivers and underground basins from which it gets its water.

While increased groundwater pumping has helped supplement the water shortfall throughout the state, many regions have reported dropping water tables. For example, there have been drops of (1) 25 feet in Madera County, (2) an average of 25 feet to 30 feet in the Westlands Water District in Fresno, and (3) 70 feet in Kern County.

Future Reductions in SWP Water Would Affect the Urban Sector. According to contract provisions for SWP water, following a year in which agriculture has a 100 percent reduction in supplies, urban areas must share equally in any required reductions. SWP agricultural deliveries were reduced to zero in 1991. Therefore, if 1992 is another dry year, urban water agencies receiving SWP water will experience increased reductions in their supply. Any reductions of this type will likely affect Southern California the most because that region is the largest urban user of SWP water.

IMPACTS OF THE DROUGHT ON CALIFORNIA'S ECONOMY

Many of the state's key industries, such as agriculture, semiconductors, defense-related, refining, and food processing, depend on adequate water supplies. Although reductions in water supplies have caused problems in certain areas and regions, particularly some agricultural regions, the apparent net overall impact on the state's economy has thus far been relatively minor over the five-year period of the drought. However, if the drought continues, its adverse impacts can be expected to become more significant. Below we discuss those industries that are most significantly affected by drought conditions.

Effects on Agriculture Are Mixed

As agriculture uses over 80 percent of the developed water in the state, it is the sector of the economy most directly affected by the drought.

The net impact of the drought on current farm income and profits, however, is unclear. While the drought generally has increased costs and reduced farm acreage and production, these negative factors have been mitigated by the following:

- *Continued Availability of SWP and CVP Supplies Until Recently.* The SWP and the CVP had enough water in storage to make normal deliveries to their contractors through October 1989 (the first three years of the drought). It has not been until the last two years that SWP and CVP deliveries have been significantly cut back. In 1990 the SWP cut deliveries to farmers by 50 percent and the CVP cut deliveries by up to 50 percent. In 1991 the SWP suspended deliveries to agricultural customers and the CVP reduced deliveries by 25 percent to 75 percent of the contract amounts.

- *Availability of Groundwater.* In general, groundwater is widely available throughout California. Because most farmers can obtain groundwater supplies simply by increasing pumping at existing wells or drilling new wells, the loss of (less expensive) surface water deliveries can be made up, to a substantial degree, by additional (though more expensive) groundwater pumping. Primarily as a result of increased agricultural pumping, the DWR estimates that groundwater use has increased in 1991 by approximately 5 MAF (compared to 1985 levels). As a result, the most affected areas have been those parts of the San Joaquin Valley that lack good quality groundwater or have low water tables due to overdrafting. These areas depend heavily on the SWP and the CVP for water deliveries.

- *Flexibility of Agriculture.* California farmers have shown considerable ability to change crop patterns and adopt new water conservation techniques (such as drip irrigation) to reduce their water needs without significantly reducing production levels.

- *Offsetting Price Increases.* Although it is difficult to determine the effect on prices of the drought versus other factors, it is likely that prices for crops have increased due to drought-related production cutbacks (reductions in supply typically result in price increases as consumers "bid up" the costs on remaining goods). Other factors affecting prices during this period have been high national and global demand for many of California's 250 crops and the December 1990 freeze.

As a result of these factors, total farm income has increased during the last four years, despite the drought, from $14.5 billion in 1986 to $18 billion in 1990. Adjusted for inflation, farm income has remained relatively constant. Despite this, farm profits may have been reduced because increased reliance on groundwater pumping and use of new conservation techniques raise production costs. In addition, reduced harvests can result in agricultural job losses and higher product prices leave consumers worse off.

Given the size of the state's agricultural sector ($18 billion in direct farm income and approximately $70 billion when farm-related industries are included, compared to over $700 billion for the entire state economy), it is likely that any losses to agriculture will have a relatively limited influence on the overall economic performance of the state. The drought, however, can have significant effects on specific crops or regions.

Near-Term Impacts on Manufacturing Thus Far Minor

The state's manufacturing sector contributes over $130 billion to the state's economy and employs over two million people. As stated earlier, many manufacturers are dependent on plentiful water supplies. For example, the semiconductor industry uses large quantities of water to manufacture microchips. Due to aggressive implementation of water conservation measures by this sector, manufacturing production should not be significantly affected by the

drought, at least in 1991. Despite these conservation efforts, however, if the drought continues into a sixth year (and especially if manufacturing demand increases significantly as the state moves out of the current recession), inadequate water supplies could result in increased costs or production losses, and could affect investment decisions on whether to expand existing or locate new production facilities within the state.

Impacts on Other Industries

Drought conditions affect a number of other industries. Specifically:

- *The Timber Industry.* The Department of Forestry and Fire Protection (CDF) estimates that dry conditions and drought-related pest infestations will destroy over six billion board feet of timber in 1991. This amount is over seven times the amount of timber killed in a normal year. Although this will likely have long-term negative effects on the timber industry, in the short run it has resulted in increased activity to "salvage" as much of the "tree kill" as possible. For example, the number of fast-track timber harvest plans approved in 1989-90 by the U.S. Forest Service (USFS) increased by more than 300 percent compared to the number in 1987-88. According to the CDF, "salvaging" represents virtually all the current logging activity on USFS land.
- *Electric Utilities.* Lack of adequate rainfall, low rivers, and depleted reservoirs have all reduced the amount of hydroelectric power available to the state's major electric utilities. As a result, utilities have substituted more expensive energy supplies (primarily natural gas) to meet electricity demand. This has resulted in increased costs to consumers in the form of higher utility rates.
- *The Building Industry.* In reaction to the drought some cities, especially in southern California, have adopted measures limiting new water hook-ups to residential and nonresidential customers. By limiting construction, such measures not only hurt local building industries, but they can also increase housing prices and hinder local economic development.
- *Leisure and Recreation Industries.* Industries that depend heavily on adequate snowfall, rainfall, or runoff levels, such as fishing, white water rafting, skiing, and boat rentals have also been hurt by the drought.

IMPACTS OF THE DROUGHT ON THE ENVIRONMENT

The drought has negatively affected the environment in a variety of ways. Below we discuss the effects on (1) fish and wildlife, (2) groundwater basins, and (3) forest lands.

Fish and Wildlife

Five years of below-normal snow and rainfall, in combination with current policies related to water diversion, have resulted in lower water levels in rivers, lakes, and wetlands. The cumulative impact has been especially severe on fish, endangered species, and sensitive ecological areas. Specifically:

- *Impacts on Fish.* As a result of five years of low stream flows and warm water temperatures, fish populations have declined dramatically. For example, the population of the fall chinook salmon run in the San Joaquin River has declined from 70,000 adult fish in 1985 to only 600 in 1990.
- *Bay-Delta Estuary.* Over 70 percent of the state's water flows through the San Francisco Bay/Sacramento-San Joaquin Delta

Estuary. In recent years, a number of fish species—including striped bass, Delta smelt, and tidewater goby—have declined to "dangerously low" levels according to the Department of Fish and Game (DFG). Although the drought is not solely responsible for these declines in fish populations in the Bay/Delta estuary (salinity standards and water diversion policies may also contribute to these problems), the lack of water has magnified many of the estuary's environmental problems.

- *Threatened or Endangered Species.* Other threatened or endangered plant and animal species are also being negatively affected by the drought (for example, many native California plant species). Given their limited numbers, these species are especially vulnerable to the lack of adequate water.
- *Migratory Waterfowl.* Declining wetland levels have reduced wintering habitat (especially in the Central Valley) essential to Pacific Flyway bird populations.

Groundwater Basins

California has large groundwater basins. As a result, water users have been able to replace — to a great extent — the lack of surface water supplies by groundwater. In some instances, overdrafting (pumping more water than is recharged) of groundwater basins has led to land subsidence (for example, in San Joaquin County) or salt water intrusion in coastal areas (for example, in Monterey County). Based on the DWR estimates, groundwater pumping in 1991 increased by approximately 5 MAF compared to the 1985 levels and resulted in overdrafting in excess of 7 MAF. However, given the lack of good information on (1) the size and geology of many of the state's groundwater basins and (2) the extent of groundwater pumping by basin, it is not known what the long-run impact of the drought will be on this resource.

Forest Lands

As indicated earlier, the drought and related pest infestations have killed many trees. The dry conditions have also resulted in extreme fire risk throughout the state's forest lands. However, thanks to a relatively mild summer there have been relatively few forest fires to date. (Approximately 12,000 acres have burned this year compared to 174,000 acres at this time in 1990-91 and 51,000 at this time in 1989-90).

GOVERNMENT RESPONSES TO THE DROUGHT

As indicated in the previous section, the private sector has taken significant steps to adjust to or mitigate the adverse impacts of the current drought. In addition to these private-sector responses, state, federal, and local governments have also responded in a variety of ways to the drought.

State Response to the Drought

Drought Legislation. In the spring of 1991 the Governor proposed a $53.4 million (General Fund) legislative package in response to the drought (the specific proposals and their current status are summarized in Chart 6). Most of the funding was targeted on increased fire suppression activities and reducing the drought's impact on fish. To date, approximately $39.2 million in funding has been made available for drought-related activities ($20.9 million through legislation and $18.3 million through the deficiency process).

In addition to the administration's proposals, the Legislature introduced a number of other water policy bills in response to the drought. We discuss the most important of these bills in a later section on the Legislature's options in addressing the state's short- and long-term water needs.

Water Bank. Accompanying the drought legislation, the administration established a water bank to purchase water (primarily from farmers) for sale and transfer to cities, districts, and individuals most severely affected by the drought. Only municipal areas that are receiving less than 75 percent of their normal water supplies and agricultural areas where the drought may cause a permanent loss of production are eligible for allocations from the water bank. Initial funding for the water bank was financed by a start-up loan of $10 million from the SWP. Ongoing funding for the water bank is to be generated by water sales.

Chart 6

Status of Drought Legislation[a]

Department of Fish and Game (DFG)

$16.4 million to maintain fishery production, increase water supplies available for fish and wildlife (through water purchases or groundwater pumping), and increase monitoring of water quality.

Status: Chapter 11, Statutes of 1991 (AB 12X, Costa), appropriated $15.3 million.

Department of Forestry and Fire Protection (CDF)

$23.7 million to increase baseline fire suppression activities to respond to the increased fire threat as a result of the drought.

Status: Chapter 43, Statutes of 1991 (AB 208, Vasconcellos), the omnibus deficiency bill, appropriated $3.3 million for the 1990-91 portion of the request. An $18.3 million deficiency request for 1991-92 was approved by the Department of Finance on August 29, 1991 to fund most of the remaining costs of this proposal.

California Conservation Corps (CCC)

$2.3 million to add 300 corpsmembers to assist other departments with their drought-related activities.

Status: Chapter 7, Statutes of 1991 (SB 11X, Rogers), appropriated the full amount requested.

State Water Resources Control Board (SWRCB)

$11 million (General Fund) for water reclamation projects and to expedite approval of water transfers.

Status: No action taken.

[a] All dollar amounts are from the General Fund.

To date, the water bank has purchased approximately 835,000 acre-feet of water. (This

represents about 2.5 percent of the total water delivered during a normal year.) A majority of this water comes from farmers in the Sacramento-San Joaquin Delta. The DWR estimates that as a result of these water sales, approximately 150,000 acres of farmland will be taken out of production. As of October 24, 1991 approximately 435,000 acre-feet had been allocated. Of this total, approximately 50 percent has been purchased by the Metropolitan Water District of Southern California primarily for residential, commercial, and industrial usage.

"(In 1991) the SWP suspended water deliveries to agriculture and reduced deliveries to cities by over 50 percent."

Fish and Game Proposal. In addition to the package of proposed drought legislation, in May the administration proposed $8 million from the General Fund to offset potential DFG revenue reductions attributable to the drought. The Legislature rejected this proposal.

State Water Project. The drought has forced the SWP to reduce its water deliveries. On February 4, 1991 the SWP suspended water deliveries to agriculture and reduced deliveries to cities by over 50 percent. As a result of the March rains, reservoir storage has increased substantially. However, because reservoir levels continue to be low, the SWP has not increased water deliveries.

The SWP has also responded to the drought by modifying its operations to facilitate water transfers and to assist fish and wildlife. For example, in 1988 the SWP and federal water agencies assisted in transferring 45,000 acre-feet of water purchased by the DFG for this purpose from the federal New Melones Reservoir on the Stanislaus River. This water was used to (1) increase salmon spawning habitat on the Stanislaus River in the fall of 1988, (2) flood approximately 12,000 of wetlands in the winter, and (3) increase river flows to benefit salmon in the spring of 1989.

Federal Actions

To date, the direct federal response to the drought has been limited primarily to technical assistance and coordination with state and local efforts. Although there has been some movement on a farm disaster assistance bill (including drought assistance to eligible California farmers) in the United States House of Representatives, a similar bill remains stalled in the U.S. Senate and President Bush has threatened a veto if it should pass.

Federal Water Projects. Similar to the SWP, the drought has forced federal water projects to cut water deliveries. The federal Bureau of Reclamation reduced water deliveries from the CVP on average approximately 60 percent in 1991 compared to 1985 levels.

In addition, as stated earlier, federal agencies have worked with the DWR, the DFG, and local agencies to facilitate water transfers and to modify their operations to assist fish and wildlife. For example, they have changed the timing of water releases to increase river flows during salmon runs in the fall.

"The federal Bureau of Reclamation reduced water deliveries from the CVP on average approximately 60 percent in 1991."

Federal Farm Assistance Programs. Livestock producers that have lost 40 percent of their on-farm feed production are eligible for assistance from the federal Department of Agriculture (USDA). In 1990 the state's livestock producers received approximately $9 million in this assistance. California farmers adversely affected by the drought have not been eligible for the USDA's other disaster assistance programs for a variety of reasons. For example, the federal crop insurance program does not cover losses due to reduced water deliveries. Farmers have not re-

ceived emergency disaster assistance loans because no federal disaster areas have been declared as a result of the drought.

Local Government Responses

Based on information provided by the DWR, we estimate that water supplies for municipal and industrial users in water year 1991 were approximately 32 percent less than 1985 levels. The specific responses by cities, counties, and other local water agencies to these reductions varies significantly depending on local circumstances. In general, their responses can be grouped into two categories: (1) efforts to increase available water supplies and (2) efforts to reduce water use.

Increasing Local Water Supplies. Local efforts to increase local water supplies include:

- *Groundwater Pumping.* Similar to the state's farmers, many local water agencies have increased groundwater pumping to replace lost surface water supplies. For example, the City of Fresno is adding 25 new wells in 1991 to increase local water supplies and address local water quality problems.
- *Water Transfers.* Other local agencies are purchasing water (from the water bank or other sources) for transfer to partially compensate for loss of surface water deliveries. For example, in 1989 the Santa Clara County Water District purchased 90,000 acre-feet of water from the Yuba County Water District.
- *Desalination Projects.* The drought has also highlighted the need for more secure future water supplies. As a result, a number of local agencies (for instance, Santa Barbara and San Diego Counties) are conducting feasibility studies into the construction of desalination plants to convert sea water into drinking water.

Reducing Water Use. In addition to seeking ways to increase water supplies, most local water agencies have been forced to implement programs to reduce water use. These programs include:

- *Price Incentives.* A number of local agencies have increased water prices or devised other pricing schemes to motivate end users to conserve water. Perhaps the most important of these types of plans is the one adopted by the Metropolitan Water District of Southern California (MWD), which provides water to approximately 15 million water users in southern California. The MWD set 1990-91 water delivery targets for its member agencies at approximately 70 percent of their 1989-90 usage level. A local agency that exceeds its target pays twice the normal water rate for this additional water. Conversely, an agency that uses less than its target receives a rebate equal to half of the normal water rate applied to the amount reduced. (As of October 1, the MWD has discontinued the rebate portion of this program due to its costs.)

"Water supplies for municipal and industrial users in water year 1991 were approximately 32 percent less than 1985 levels."

- *Voluntary Water Conservation.* As stated earlier, most water agencies have adopted a number of voluntary water conservation programs. Although these programs vary significantly between local agencies, they generally include public awareness campaigns, suggestions on ways to reduce water use and voluntary conservation goals.
- *Mandatory Water Conservation/Water Rationing.* Finally, due to the severe shortages, some local agencies have adopted mandatory water conservation plans. These plans also vary greatly from local agency to agency. For example, the City of Santa Barbara banned all water sprinkling and stopped issuing new water hook-ups. The City of Los Angeles has mandated 10 percent reductions in per household water consumption.

IMPLICATIONS FOR THE FUTURE: WHAT ARE THE LEGISLATURE'S OPTIONS?

As indicated earlier, the March 1991 rains, while alleviating severe water shortages in some areas, did not end the drought. Absent normal rainfall during the coming year, there will be a continued need for strict measures (such as water supply cutbacks and mandatory conservation efforts) in order to bring water supplies and demand in balance. In short, the state continues to face a serious near-term water problem.

But while healthy rainfall can resolve the short-run problem, it will not necessarily help address the state's longer-run ability to meet its demand for water. According to 1987 projections by the DWR, the state will need approximately 35.6 MAF by the year 2010 to meet its water needs. This is about 1.4 MAF more than the state used in 1985 (again, its last "normal" water year), with most of the increase attributable to the residential and industrial sectors. This is due primarily to the expected growth in the state's population.

While any water use forecast for that far in the future is subject to considerable error, there are reasons to be concerned about the ability of the state to provide for future water needs. For instance, the DWR estimate may significantly understate future demand as it does not reflect (1) the higher state population figures contained in the 1990 census and (2) the growing demands for more water to address environmental concerns. In addition, there are constraints on some of the state's current water supplies due to continued overdrafting of groundwater basins and the eventual loss of Colorado River water due to increasing needs in Arizona.

In the sections that follow, we briefly identify and discuss the Legislature's basic options for addressing this potential longer-run imbalance in the state's water situation. These options fall into two general categories: (1) water supply and conservation alternatives and (2) water market options.

Water Supply and Conservation Alternatives

Many possible water supply options have been forwarded as means of addressing water shortfalls. Chart 7 (next page) summarizes an array of possibilities for the Legislature to consider. As indicated below, several of these options, although they are being actively studied, may be infeasible due to economic or environmental constraints.

"While healthy rainfall can resolve the short-run problem, it will not necessarily help address the state's longer-run ability to meet its demand for water."

Storage and Transfer Capacity. Increasing storage capacity is one way to increase the state's dependable water supply because it allows the state to save water in wet years to use in dry years. Constructing additional canals and pumping facilities is another way to increase the state's dependable water supply because it allows areas to receive water from outside sources and not rely exclusively on local sources. For example, Santa Barbara has not been able to receive emergency water supplies from the SWP because it has no canal in place.

A major constraint to constructing new surface storage systems and transfer facilities is that the best sites have already been developed and potential future projects may be infeasible due to high costs and environmental concerns. As an alternative to traditional surface storage, underground facilities like the Kern Water Bank are being developed and studied because they have less evaporation, lower capital costs, usually do not require an extensive distribution system, and generally have less impact on the environment.

Currently, the DWR is pursuing four major projects to increase storage and one to increase transfer capacity. Of those projects, only the Auburn Dam would require legislative funding authorization. The other projects, in various stages of development, are being sponsored by the DWR and SWP contractors and will be funded by the contractors. These are the Kern Water Bank, Los Banos Grandes, the Coastal Aqueduct (Phase II), and reservoir expansion.

Groundwater Pumping. In some areas, it is feasible to increase groundwater pumping. However, increasing groundwater pumping in other areas might lead to or exacerbate overdraft problems. Statewide there has been overdraft of groundwater basins on an average of about 2 million acre-feet per year. Overdraft in some areas has led to declining water tables, which increases pumping costs because more energy is required; land subsidence; seawater intrusion in coastal basins; and movement of poor quality water into other parts of a basin or into an adjoining basin.

There is no way to determine the extent of problems with groundwater supply because the state lacks information on groundwater levels, use, and overdraft problems. With the exception of a few adjudicated basins (basins in which the courts have determined pumping rights, mainly in Southern California), there are no controls or restrictions on the amounts of groundwater that can be pumped.

A promising strategy for improving the management of groundwater is the "conjunctive" use of groundwater and surface water — the practice of storing water in underground basins during wet (surplus) years in order to pump out for use during dry years. The DWR Kern Water Bank, currently being constructed, will have the

Chart 7

Possible Options For Maintaining And Increasing Water Supply

STORAGE AND TRANSFER CAPACITY	• Reservoir Expansion • Auburn Dam • Peripheral Canal • Canal covering/lining
GROUNDWATER PUMPING	• Collect information on groundwater use and study the effects of overdraft in major basins. • SWRCB regulation of groundwater pumping. • Additional projects for use of surface water in conjunction with groundwater
RECLAMATION	• Funding for loans or grants (bonds). • Continued study related to the use of reclaimed water. • Information campaign on the use of reclaimed water.
DESALINATION	• Funding for loans or grants (bonds). • Study of the potential environmental effects on the coast.
CONSERVATION	• Mandatory conservation goals for urban and agricultural users. • Water-efficient technologies in new construction. • Water-efficient landscaping for all public agencies as well as private businesses. • Financial assistance to needy farmers for efficient irrigation systems.

capacity to add approximately 50,000 acre-feet annually to the SWP supply.

Reclamation. The DWR estimates that the state currently reclaims 300,000 acre-feet of water each year. This water is used for a variety of purposes including crop and landscape watering, industrial cooling, groundwater recharge, and office plumbing (in high rises in the city of Irvine). The DWR estimates that water reclamation could reach 400,000 acre-feet by the year 2010. There are two major constraints to wide development of reclaimed water use: (1) high costs involved in building reclamation plants and distribution systems and (2) concerns of the public and health authorities regarding safe use of the water.

Currently, the Department of Health Services (DHS) is in the process of updating regulations that specify allowable uses of reclaimed water.

Desalination. Desalination projects have not been developed on a large scale because the large amounts of energy required for desalination make the projects very expensive. Nevertheless, this technique is being used on a limited basis to reclaim brackish groundwater, desalt sea water, and treat water for industry. Currently, the County of Santa Barbara is studying the development of a permanent sea water desalination facility. Santa Catalina Island recently constructed a desalination plant to supplement its drinking water supply. There is, however, very little information available on how widespread desalination would affect the environment. For example, there may be significant impacts on the marine environment due to (1) disposing of large quantities of salt and (2) the action of intake pipes and pumps.

Conservation. As already indicated, many communities have imposed conservation measures during the drought and have ongoing conservation, retrofit, and educational programs.

In addition, the DWR and many irrigation and resource conservation districts are working with farmers to improve water management techniques. For example, to conserve water, farmers can water in the evening, shorten furrow lengths, reduce the number of times crops are irrigated, and improve water application uniformity. In addition, many farmers have installed drip irrigation and sprinkler systems to reduce water use. A major constraint to the widespread use of these systems continues to be the high cost associated with installation.

Water Market Options

One way of reallocating existing water supplies is to establish a water market. A water market would have two essential characteristics: (1) water could be transferred freely among users and (2) prices for water would be set by the market. Below we discuss these characteristics, and the advantages and disadvantages of implementing a water market.

Water Transfers. The ability to transfer water means that a water rights holder can trade, sell, or lease the right or the water. Current law allows the voluntary transfer of water and water rights and directs state water agencies to encourage them. Transfers that involve changes in purpose or place of use require the approval of the State Water Resources Control Board (SWRCB). The Legislature in recent years has passed several measures clarifying the ability of rights holders to negotiate or enter into transfer agreements without fear of losing their rights.

The ability of an individual water user to transfer water obtained through the SWP or the CVP is limited because the individual must obtain approval from two intermediaries in addition to the SWRCB. This is because (1) the water rights are held by the project operators, either the state DWR or the federal Bureau of Reclamation, not individuals and (2) water wholesalers, generally special districts, contract for the water from the SWP and the CVP. AB 2090 (Katz), considered by the Legislature this year, would have allowed consumers of SWP water to participate in the state water bank, discussed earlier, without obtaining these approvals.

Pricing. Water resources are more likely to be

used most efficiently if prices charged for water and water-related services are set by the market. For example, pricing water to reflect its value as a commodity might encourage some farmers to take marginal land out of production and use the water for more valuable crops or sell it to another user willing to pay a higher price.

At a minimum, proponents of a water market believe that government water agencies should charge prices that at least reflect the cost of providing the water. For instance, users farther from the source of supply and at an elevation requiring pumping would pay the extra costs imposed on the system. Users who require extra capacity in the system for peak periods of use would pay the incremental costs of providing increased capacity.

Some water supplies in California, particularly for agricultural use, are priced well *below* the actual cost of providing the water. Taxpayers subsidize at least 80 percent of the costs of irrigation water provided by the federal CVP. We estimate that the SWP has received subsidies of at least $1 billion (1991 dollars) due to interest-free General Fund loans.

"A market system would promote efficiency by providing incentives for conserving water and offering compensation to those willing to transfer the amount they conserve. The system (also) would provide incentives to develop other innovative arrangements..."

Some cities do not meter water deliveries and others that do meter do not base water charges on the cost of service. Therefore, the level of water use is not responsive to the cost of providing the water. The Legislature recently enacted legislation requiring meters in new construction — both residential and commercial (Ch 407/91 — SB 229, Boatwright).

Advantages of a Market System. Reallocating the current water supply through a market system may be less expensive and less destructive to the environment than increasing the water supply with dams and other large construction projects. A market system would promote efficiency by providing incentives for conserving water and offering compensation to those willing to transfer the amount they conserve. In addition, the system would provide incentives to develop other innovative arrangements, such as water banking, purchase of dry-year options (arrangements in which one party pays for the right to use another party's water in a dry year), and conjunctive use of surface and groundwater supplies.

Problems with Implementing a Market System. Federal contracts offer the greatest opportunity for reforming water use practices because of the highly subsidized rates, the greater quantity of water involved, and the expiration of contracts over the next 20 years. (State water contracts, by comparison, will not begin to expire until 2035). However, uncertainty and complexity in several areas of federal policy and law are potential barriers to transfers of federal water. For example, federal reclamation law and the legislation that established the CVP lack express language regarding water transfers.

Within the framework of existing contracts, state law and administrative practice are more straightforward and provide few barriers to water transfers involving SWP water. The DWR has statutory authority to help negotiate transfers and transport transferred water. However, contractors can impede transfers (1) with policies that prohibit transfers outside the water district and (2) by opposing transfers of SWP water by another contractor. Although the DWR has final authority over the allocation of project water, the contractors have a great deal of influence over DWR decisions.

In addition to these legal problems, there are major practical problems that would result from market reforms. For instance, transferring water raises concerns for protection of the interests of "third parties" — those who are not directly

involved in the transaction but who feel its impact. These interests include other water users who hold rights to the runoff or return flow of the water to be transferred; fish, wildlife and other "instream" users; and the economy of the area from which the water is transferred. Water supplies for fish, wildlife, and other instream uses are particularly vulnerable because (1) most water rights decisions were made before instream uses became a priority for the state and (2) current law prohibits establishment of an explicit right to keep water instream. The water board can provide water for instream uses only by (1) issuing a permit for diversion for this purpose or (2) restricting individual water right permits.

"All Western states, with the exception of Texas and California, have established state groundwater management programs."

In addition, a market system would provide greater incentives for groundwater pumping, thereby exacerbating the state's overdrafting problem. Currently, in most basins there are no restrictions on pumping groundwater. In order to protect this resource, the state would need to establish restrictions on pumping in conjunction with market reforms. All Western states, with the exception of Texas and California, have established state groundwater management programs.

Options for Legislative Action. The role state government could play in a water market system would depend on the degree to which the Legislature wants government to control water use. The role of government could be that of a passive facilitator, the implementor of a quasi-market system overseen by a centralized agency, or the protector of interests not reflected in the market, such as water quality and "third-party" interests. To facilitate water marketing and protect third-party interests, the Legislature could among other things:

- Seek changes in federal law and/or decisions by the Bureau of Reclamation that (1) state law generally governs the transfer of federal project water and (2) alter federal pricing policy to reflect the full cost of water deliveries.
- Require the DWR to act as the state's central water broker.
- Require that prices charged by governmental agencies for water and water-related services fairly reflect their cost. Alternatively, require governmental agencies to charge a "market price" for water.
- Establish restrictions on groundwater pumping in conjunction with market reforms.
- Tax use of water and use the revenue to compensate third parties during the transition to a market system for water.
- Adopt legislation to permit public or private entities to obtain water rights for maintenance of flows without physically diverting the water.
- Help preserve flows by prohibiting transfers of water unless the water is made available through reduction of consumptive use (the amount of water actually consumed).

CONCLUSION

Our review of the water outlook indicates that the state faces both a near-term and a long-term water supply problem. The five-year drought provides an impetus for legislative action on the state's water supply needs. In our view, the Legislature should consider implementing a coordinated mix of the water supply, conservation, and market options we have identified, due to the interrelationships between them. For example:

- Construction of supply alternatives should be linked to market reform to assure efficient use of existing and newly developed water.
- Market reforms should consider the interests of "third parties," including other water users and the environment.
- Either market reforms or construction of new supply facilities should be accompanied by effective management of groundwater resources.

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