LAO

Liquid Assets:

Improving Management of the State's Groundwater Resources

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EXECUTIVE SUMMARY

California's water system is facing a series of challenges affecting water availability, reliability, and delivery. Groundwater management is one of the state's most critical liquid assets—a key component of both local and statewide efforts to better manage water supply and water quality in the state. This report builds upon our previous 2008 publication, *California's Water: An LAO Primer*, in which we provided an overview of California's water system and related legislative policy considerations, including issues related to groundwater. Our focus and primary goal of this report is to outline ways that groundwater management could be improved from a statewide perspective in a way that builds on recent legislative efforts to address this subject area and, to the extent possible, maintains local control over day-to-day management of groundwater systems.

In our view, reevaluating how groundwater is managed is necessary if it is to achieve its full potential as a reliable source of water. In this report, we (1) provide more background on the state's current approach to groundwater management; (2) address current issues with groundwater management, including the impact of water quality on water supply; (3) address the disconnect between the law and science of groundwater; and (4) review other states' approaches to groundwater management.

We also present the Legislature with a series of actions that would be phased in over a period of time to address current and emerging groundwater management issues. In particular, we recommend that the Legislature:

- Phase in a more comprehensive groundwater monitoring system to allow the state to focus funding and technical assistance efforts in the areas of greatest need.
- Establish Active Management Areas (a defined geographic area where specific rules are established to govern the withdrawal and use of groundwater), in circumstances where groundwater overdraft potential or the extent of pollution problems are the highest.
- Bring science and law together to modernize groundwater law to accurately reflect the physical interconnection of surface water and groundwater.
- Consider phasing in statewide groundwater permitting over a multiyear period, based on data from expanded monitoring requirements, while maintaining local control over implementation of permitting to the extent possible.

BACKGROUND

Water System Facing Challenges—Groundwater Part of the Solution

California's Water System Facing Challenges. California's water delivery system is facing a series of challenges due in part to a combination of increasingly variable weather conditions, legal requirements, and system operation and conveyance constraints. These challenges affect water availability, reliability, and delivery. Recent public and private efforts have sought ways to address these challenges. These measures include proposals for groundwater storage, surface storage, infrastructure changes, system operation improvements, and water recycling, among others.

Building on Prior LAO Groundwater Recommendations. This report builds on our 2008 publication, *California's Water: An LAO Primer*, in which we provided an overview of California's water governance, supply, demand, costs, and financing. In that primer, we introduced several issues for legislative consideration, including a recommendation to reevaluate how groundwater is regulated and managed in the state. In our view, such reevaluation is necessary if groundwater is to fully serve its potential as a reliable source of water supply. In this report, we further develop this policy approach and offer specific recommendations for legislative action. Our recommendations were informed by our review of groundwater management success stories in local areas of the state and in other western states.

Local Control Essential—With Accountability. In many areas of the state, local agencies are the first to notice and deal with groundwater problems—from water quality issues to supply challenges. As we will discuss, a number of local areas of the state provide models for groundwater management and monitoring. This report will lay out issues affecting both local and statewide water supply and suggest methods to strengthen local groundwater management. Our approach is consistent with the Legislature's expressed desire to retain some level of local control over groundwater management, while allowing the state to intervene when problems go beyond the capabilities of local authorities, or when the impact of problems in the groundwater basin is regional in nature. We recommend that the retention of local control be combined with improved accountability for local management actions.

In reviewing groundwater management issues, we interviewed a broad range of interested parties, including the staff of state, local, and federal agencies that have a role in the regulation and/or management of water; private water developers and consultants; members of the public; and researchers with expertise in the subject, including the Water Education Foundation. We also reviewed relevant state law, local regulations, case studies, and federal agency activities.

What Is Groundwater and Why Is it Important?

Groundwater is the portion of water from precipitation that does not run into surface streams but rather infiltrates (either naturally or deliberately) under the surface of the ground. In a sense, all groundwater starts as some form of surface water, meaning that the two types of water are integrally connected. Much like a sponge, the ground, depending on soil type, soaks up the groundwater into basins available for use. This can happen over a period ranging from several years to over a millennium in some cases. Areas

where groundwater is present or saturated are called aquifers, which generally have boundaries defined as basins. As water is drawn out of these basins, via wells or seepage into surface streams, groundwater availability can be reduced.

Groundwater Is a Major Contributor to State's Water Supply. Groundwater supplies about 30 percent of California's overall dedicated water supplies in average precipitation years, as shown in Figure 1. In dry years, this increases statewide to about 40 percent. This is because when surface water supplies are restricted, both local water agencies and irrigators (farmers) increase groundwater pumping to meet water supply needs. At least 43 percent of Californians obtain at least a portion of their drinking water annually from groundwater sources.

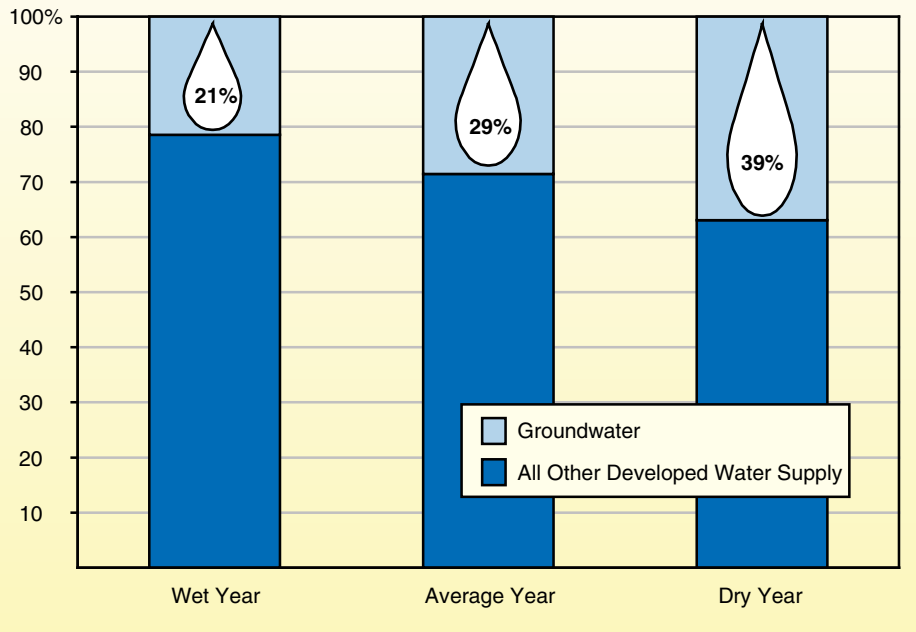
During years where surface water deliveries are not available and rainfall is scarce, groundwater may provide up to 100 percent of irrigation water for certain areas. In some areas where surface supplies are not accessible or economically feasible, groundwater provides 100 percent of a community's public water.

Future Water Supply Reliability Uncertain. The Department of Water Resources (DWR) projects that the state is likely to have an adequate water supply in the aggregate to meet its water demands in average precipitation years under current trends as shown in Figure 2. However, in dry years, projected demand by category of use will exceed the available supply in 2030 in most cases. It is for these dry cycles that the state must plan to ensure a reliable water supply.

Groundwater Is an Important Contributor to Water Reliability Solutions. There are several options available to the state to ensure that, during the driest years, disruptions from water shortages are minimized on a statewide basis. The DWR has analyzed a number of short- and long-term options to strengthen water supply reliability throughout the state, as shown in Figure 3 (see page 8). The options presented in the figure generally involve reducing water demand or increasing water supplies. They also vary in their potential to produce additional water. Basic groundwater replenishment is considered a solution that generally can be developed in the short term, potentially

Figure 1

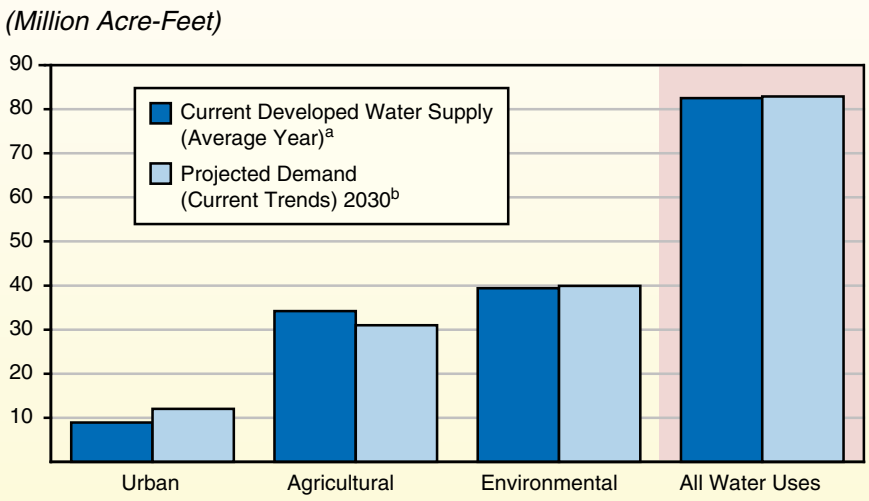
Groundwater Is Major Contributor to California's Water Supply, More So in Dry Years



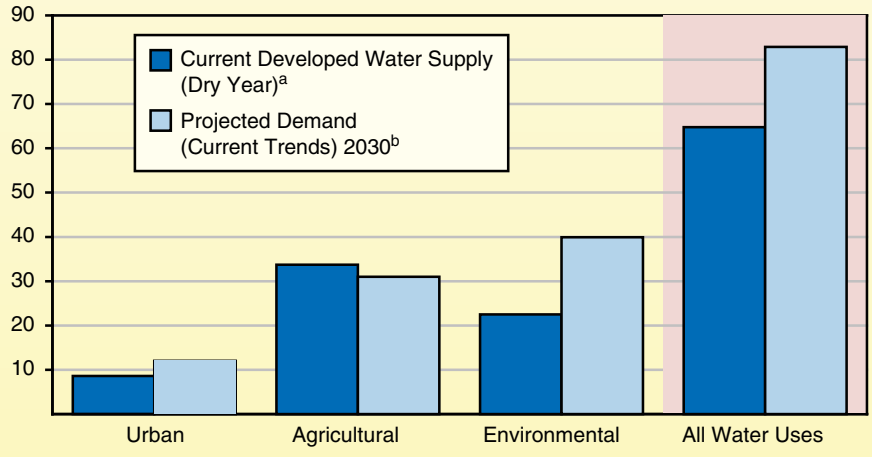
providing significant additional water supplies over time. The related options of brackish desalination (the desalting of either groundwater or reused water) as well as water recycling (re-use of water after treatment which may include reintroduction to the groundwater system) are also key water supply reliability solutions to which the management of groundwater contributes.

Figure 2

Supply and Demand Projected to Be Nearly Equal Under Average-Year Conditions in 2030...



...But Dry-Year Demand Projected to Exceed Supply



[a]Developed water supply is the amount of precipitation, surface water, or groundwater made available for use, generally through construction of storage or delivery systems.
[b]Demand projections from Department of Water Resources, 2005 California Water Plan.

Key Groundwater Laws

Key Laws Governing Groundwater Focus on Water Quality, Local Management. Groundwater is mainly managed at a local level, but several state laws govern how locals are to manage this resource. In general, groundwater law at the state level can be categorized in two ways: (1) laws that support and provide incentives for local management or (2) laws designed to protect and monitor groundwater quality. Figure 4 (see page 9) lists selected key state laws governing groundwater. This list includes recent legislation, approved as part of a package of proposals to address the state's water problems, to enhance groundwater monitoring and reporting. We discuss some of these key laws in further detail below.

"AB 3030"—Voluntary Approach to Groundwater Management. Law enacted in 1992 (commonly referred to as AB 3030), allows local governments to create groundwater management districts and gives the districts the authority to raise fee revenues to pay for management of the groundwater. Of the

10,000 public water systems in the state (at least 15 service connections), less than 1,000 are water districts that are eligible to form groundwater districts. Under the initial version of this legislation, districts submit groundwater management plans to DWR. However, beyond using these plans for general water planning, the department's role was extremely limited. Subsequent legislation required the department to report on which districts had completed AB 3030 plans. (Over 140 such plans have been submitted to DWR.)

SBX7 6—2009 Water and Groundwater Legislation Package. A series of legislative bills enacted in the 2009 session attempted a comprehensive reform of California's water policy. While the focus of the package was on addressing problems in the Sacramento-San Joaquin River Delta system, one bill was wholly dedicated to groundwater. Chapter 1, Statutes of 2009 (SBX7 6, Steinberg), requires monitoring and public reporting of groundwater elevations in all groundwater basins in California. Local agencies are required to conduct the monitoring, which will then be reported to DWR. The department is then required to report periodically on the status of groundwater across the state, including these reported elevations, in a public report. As an incentive to enforce compliance with this monitoring requirement, the legislation bars counties from receiving state water grants and loans when certain local agencies do not conduct required monitoring. As part of the package, an $11.1 billion bond measure was passed by the Legislature which includes $1 billion specifically for groundwater supply and quality. There is potential additional funding for groundwater management in various other provisions of the bond measure. This measure has been placed on the November 2010 ballot.

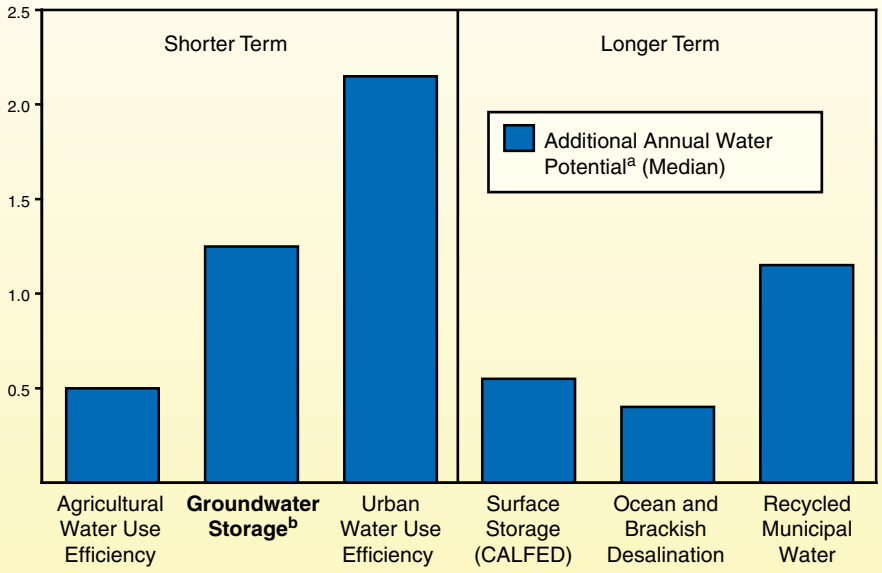
Managing Groundwater—State Law, Local Rules

State Has No Statewide Groundwater Use Permitting System. As further discussed later in this report, California is one of two western states without a comprehensive state-managed groundwater use permitting system (also sometimes referred to as a groundwater rights system). In

Figure 3

Groundwater: A Key Option for Additional Water Supply

(Million Acre-Feet Per Year)



[a]Reflects the midrange of estimates of water supply development potential of particular solutions, Department of Water Resources, California Water Plan 2005.
[b]Includes integrated management of groundwater and surface water.

California, landowners are in general entitled to the reasonable use of groundwater on property overlying the groundwater basin. In contrast, the state's surface water generally is not an entitlement—surface water rights generally are appropriated through a state-administered permitting system.

Court Adjudications and Local Regulations. Groundwater rights in some parts of the state (mainly in urban Southern California) have been adjudicated in the courts. Elsewhere, groundwater use is regulated on an ad-hoc basis by a disparate group of local agencies. These agencies include local districts with statutory authority to manage groundwater (such as water conservation districts), local water agencies that have adopted groundwater management plans pursuant to statute, and cities and counties that have adopted local groundwater ordinances.

Local Rules to Protect Local Water. Local groundwater ordinances are largely designed to protect the availability of water supplies to users within the local jurisdiction. In general, these local ordinances operate to limit groundwater transfers out of the local area, for example, by pumping groundwater and moving it through canals or rivers to another area. Also, local rules may limit the ability to transfer surface water to another area because this in turn could increase the use of groundwater to the detriment of other groundwater users. Finally, local areas are beginning to limit certain types of water uses, including for bottled water, where the sole purpose is to export the water out of the local government area.

State Supports Local Groundwater Management, Including Water Quality Improvement. As discussed in more detail below, while the state does not directly regulate groundwater use, it has taken some steps to encourage local groundwater management. This is done mainly through financial incentives, including bond-funded and federally funded local assistance programs for water-related purposes that could include groundwater-related projects. For example, the State Clean Water Revolving Loan Fund, a fund seeded with federal funds and most

Figure 4

Selected Key State Laws Governing Groundwater

Law Name or Purpose	Support/Incentives for Local Management	Protect or Monitor Groundwater Quality
Porter-Cologne Water Quality Act (1969)		X
The Pesticide Contamination Prevention Act of 1985		X
Local Groundwater Management Act of 1992 (AB 3030)	X	
Local Groundwater Management Assistance Act of 2000 (AB 303)	X	
Groundwater Quality Monitoring Act of 2001		X
Amendment to Land Use Laws—2001 (SB 221)	X	
Amendment to the Urban Water Management Act—2001 (SB 610)	X	
Groundwater Management Water Code Amendment—2002 (SB 1938)	X	
Groundwater Monitoring—2009 (SBX7 6)	X	X

recently augmented by funding from the federal American Recovery and Reinvestment Act of 2009, provides low-interest loans to water agencies to improve water treatment and wastewater facilities. A similar fund for public drinking water systems is operated by the Department of Public Health (DPH). Both of these funding sources can be used for groundwater management projects.

Many state financial incentive programs relevant to groundwater are jointly operated by multiple state agencies. For example, the Integrated Regional Water Management Program, which provides financial and technical assistance to local agencies to increase water supply in part through the cleanup and removal of contaminated water in groundwater basins, is jointly administered by the State Water Resources Control Board (SWRCB) and DWR.

The state regulates water quality through pollution discharge permits (issued by SWRCB) and various industry-specific programs. However, groundwater quality is not protected under state regulation and enforcement to the same extent as surface water quality. This is in part due to the nature of groundwater, as it is more difficult to systematically monitor groundwater than surface water. However, this situation is also to the result of jurisdictional issues where the state is unable to conduct monitoring on private property without permission. The most comprehensive water quality monitoring required by the state is done by DPH through its drinking water monitoring programs.

State and Federal Agency Roles in Groundwater

Many State Agencies Involved in Groundwater. While the state has encouraged local management of groundwater, several state agencies have roles and responsibilities related to groundwater management. Figure 5 lists state agencies involved with groundwater management and their general roles. Although groundwater management is not the primary mission of any state agency, many have been assigned significant tasks in this area, including monitoring water supply, regulating water quality, developing science and monitoring, cleanup of groundwater contamination, and local financial and technical assistance. The DPH enforces drinking water standards,

Figure 5

Many State Agencies Are Involved in Groundwater

	Water Supply	Regulate to Protect Water Quality	Science and Monitoring	Cleanup	Local Financial Assistance
California Public Utilities Commission	X	X			
Department of Food and Agriculture			X		X
Department of Pesticide Regulation		X	X		
Department of Public Health		X	X		X
Department of Toxic Substances Control		X	X	X	X
Department of Water Resources	X		X		X
Integrated Waste Management Board		X			
Office of Environmental Health Hazard Assessment			X		
Pollution Control Financing Authority					X
State Water Resources Control Board		X	X	X	X

which apply to all drinking water sources, including groundwater. (For more information on DPH's role in this area, see the box on page 14.)

Federal Government—A Limited Direct Regulatory Role. The federal government does not directly administer programs to regulate the quality of groundwater as it does with surface water under the U.S. Clean Water Act. In most cases, administration of federal water quality responsibilities has been delegated to the state, such as for implementing federal safe drinking water standards. Figure 6 provides more detailed information on the three key federal agencies involved with groundwater management in California and their role in groundwater regulation.

Federal Direct Spending and Programs Nonetheless Important. Federal legislation and federal agencies have, however, played an important role in supporting California groundwater management through technical and financial assistance and through direct groundwater cleanup programs. For example, in 2009, the U.S. Geological Survey published a comprehensive report on groundwater overdraft (the withdrawal of water at a rate faster than the basin is able to recharge) in the Central San Joaquin Valley, providing key technical information for groundwater users and planners in the area. In addition, direct spending by federal agencies has included between $3 million and $5 million per year over the past five years for groundwater cleanups. This includes funding to clean up leaking underground storage tanks. In addition, the federal government has appropriated funding for federal defense site cleanups, groundwater elevation monitoring by the National Aeronautic and Space Administration, and for various technical groundwater studies conducted by the U.S. Geological Survey.

Figure 6

Key Federal Agencies and Roles

Agency	Role
U.S. Environmental Protection Agency	Works with California Department of Public Health to ensure that groundwater drinking water supply sources comply with mandated federal drinking water programs and standards. Administers grant and loan programs for water treatment and cleanup.
U.S. Geological Survey	Conducts studies and provides groundwater monitoring for the State Water Resources Control Board's Groundwater Ambient Monitoring and Assessment Program. Monitors national water use and conducts scientific studies.
U.S. Bureau of Reclamation	Monitors the impact of the surface water on groundwater basins in areas of the Central Valley Project, a surface water distribution project similar to the State Water Project.

State Funding for Groundwater Programs

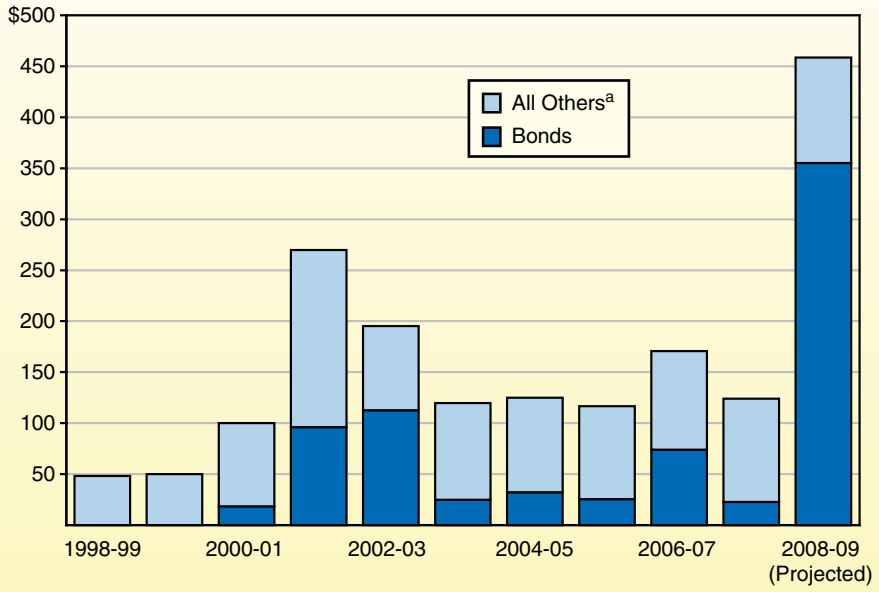
Separating Groundwater Expenditures Difficult. As discussed earlier, many agencies work on groundwater (and related drinking water) issues. However, much of this work is done in conjunction with other programs. For example, a program addressing groundwater contamination might also address surface water and soil contamination. For this reason, groundwater expenditures in state agencies are difficult to separately identify and therefore quantify.

Groundwater Program Expenditures Vary Greatly Over Time. As shown in Figure 7, funding for ongoing groundwater programs has varied greatly over time. Such funding has in many years come heavily from special funds (mainly fees), for such purposes as regulating water quality, reducing leaks from underground storage tanks, cleaning up groundwater sources, and managing groundwater resources. The General Fund has been the main funding source for DPH's drinking water regulatory program, although federal funds and bond funds have been in the main source of support for DPH's financial assistance programs. These programs are designed to assist local and private water agencies in meeting safe drinking water standards.

Figure 7

Groundwater Program Expenditures, by Fund Source

(In Millions)



[a] Excludes about $250 million annual appropriation for Underground Storage Tank Cleanup Fund programs funded by fees.

Bond Funds Provide Large One-Time Influxes. As shown in Figure 7, bond funds have provided large one-time influxes of funding. These funds have been a source of support for many different programs, including drinking water and integrated regional water management. For example, the Groundwater Ambient Monitoring and Assessment (GAMA) program, relies on a $50 million appropriation from Proposition 50 bond funds (in addition to a small amount of baseline special fund support) to conduct a comprehensive multiyear assessment of statewide groundwater quality. In recent years, federal direct spending has supported the GAMA program when bond funds were temporarily unavailable. These federal funds are limited, however, and the program will need to find other funding starting in 2011-12 in order to continue.

CURRENT ISSUES WITH GROUNDWATER MANAGEMENT

The Groundwater Challenge—When Contamination Reduces Water Supply

The potential to use groundwater to increase water supply, either by introducing water from another source into the ground as a storage basin or encouraging the natural refilling of groundwater basins, is a significant option to address water supply needs. However, there are potential barriers to this water reliability strategy. Communities are increasingly discovering that many primary groundwater basins are contaminated. Pollution from industrial activities (such as military facilities), commercial businesses (such as dry cleaners), leaking underground storage tanks (USTs), septic systems, and agricultural activities have reduced or eliminated the availability of usable groundwater in many parts of the state. In some cases, when a contaminant is discovered, it may take decades to remove pollution and bring the water back to usable condition.

Loss of Water Source Can Be Expensive to Locals. As discussed earlier, while 43 percent of Californians rely in part on groundwater for their drinking water needs, some communities rely on groundwater for 100 percent of their water needs. As part of routine testing of drinking water, the DPH has sometimes discovered that a source of water (such as groundwater) is contaminated to a level that violates state and/or federal safe drinking water standards. Discovery of contamination in a drinking water well often leads to closure of the well. Users of the well must then find replacement sources of water. In areas where other sources such as surface water or alternate groundwater resources are not available, relatively expensive bottled water may be the only available drinking water supply.

The DPH reported that nitrate (a groundwater contaminant) was detected in levels that exceed safe drinking water standards in 921 public drinking water sources, mostly in agricultural areas. In many of these areas, groundwater is the sole source of drinking water for the community.

Cleanup Is Costly. Cleaning up contaminated groundwater can be very expensive. For this reason, the state established an Underground Storage Tank Cleanup Fund in 1989 to provide financial assistance to the owners and operators of USTs containing petroleum. The fund, which is administered by SWRCB and supported by an annual assessment on tank owners, is used to remediate conditions caused by leaking USTs, including the contamination of groundwater supplies. Expenditures from the fund have varied between about $180 million to $280 million annually over the last ten years for hundreds of sites. For 2010-11, the Governor's budget proposes expenditures of $400 million from this fund—the highest level ever.

Most Supply Projections Do Not Account For Groundwater Contamination

In many cases, contamination of a groundwater basin is known to local water managers, who are able to use this information to plan for water supply needs. However, state projections often disregard contamination, particularly where groundwater basins have had historical pollution problems that, when not addressed, remain within that groundwater basin. This situation

Key State Players in Water Quality Regulation

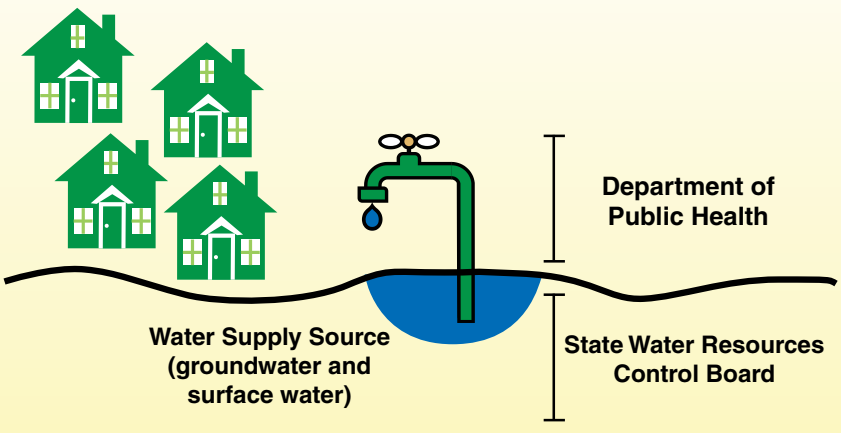
✓ Department of Public Health—Drinking Water Program

- Regulates public water systems with over 15 service connections for drinking water quality; oversees water-recycling projects, permits water treatment devices; and provides various technical assistance and financial assistance programs for water system operators—including bond and federally funded programs for infrastructure improvements in public water systems—to meet state and federal safe drinking water standards.
- Prior to approval of the Proposition 50 bond measure, the department had a limited role direct in groundwater issues through the Public Water Supervision System program funded mainly by fees on public water systems, federal grants, and the General Fund. Propositions 50 and 84 (bond measures) expanded the department's role to include local assistance grant programs for source water protection projects, many of which are groundwater projects.

✓ State Water Resources Control Board

- Primary state entity responsible for meeting state and federal water quality standards within the state.
- State and regional water boards assess groundwater quality, permit pollution discharges which may impact ground and surface waters, and investigate and direct the cleanup of contaminated groundwater resources. May require groundwater monitoring to assess the extent of contamination and impact of treatment technologies.
- Administers the Groundwater Ambient Monitoring and Assessment Program, a multiyear program designed to obtain information on groundwater quality in California.
- Works with Department of Water Resources to administer and set guidelines for the Integrated Regional Water Management Program and other programs where crossovers exist between water quality and water supply.

Two State Agencies Regulate Drinking Water Quality



poses challenges for estimating how much water is available for water supply and the cost to treat contaminated water. In some cases, this is because of a lack of adequate monitoring of water quality in groundwater basins, and in others it is because groundwater monitoring data that is gathered is not shared systematically or comprehensively with state agency officials.

Land Use Decisions May Also Be Affected. Chapter 642, Statutes of 2001 (SB 221, Kuehl), requires land use developers to prove that water is available before proceeding with a development of over 500 units or other specific size requirements. However, the measure does not explicitly require that the developer prove that the groundwater supply that a project may be relying upon, for purposes of showing the availability of water, is actually usable. Most local land use development does not have to take into account likely trends for current and future groundwater contamination when determining the availability of water supplies to serve the new development. This can be the case where the inhabitants of a proposed development would have to rely on wells that have contaminants that cause public health concerns, either as the result of natural sources of contamination (such as from the leaching of arsenic into the water supply) or human causes (such as pollution by perchlorate). Land use decisions about such new development projects do not always take into account the potentially high cost on an ongoing basis of treating water supplies for the new residents.

The "Disconnect" Between Groundwater Law and Science

Groundwater and Surface Water Interconnected. In a 2003 publication, DWR describes groundwater and surface water as being physically connected. Groundwater aquifers are portrayed as a sort of sponge, with the water that fills the area between soil particles akin to an expansion of the sponge. If a stream or river moves through, in, and around that sponge, the two interact. If the groundwater sponge is dry, some water from the surface stream will be pulled into the groundwater area. If the groundwater basin is full (picture a fully expanded sponge) and the stream is dry, water will leach into the stream, providing it water. In this way, most groundwater (usually called "percolating groundwater") can be understood to have a direct physical connection to surface water, rather than existing as a separate entity or underground river.

State Water Laws Do Not Reflect Accepted Science. Despite this scientific understanding of how groundwater works, under California law, water is characterized as either surface water, subterranean streams, or percolating groundwater. Water rights are required to use water taken from surface water and subterranean streams, but not for percolating groundwater.

This legal scheme for permitting of water rights, however, is inconsistent with hydrological science, because it does not taken into account the interactions discussed above between groundwater and surface water. According to a report on water rights commissioned by SWRCB, "the (legal) distinction between percolating groundwater and subterranean streams is meaningless, or nearly so."

In some cases, the SWRCB has attempted to address this problem by administratively defining the groundwater surrounding a number of rivers (currently less than 15 statewide) as subterranean streams, which are within the purview of water rights permitting. However, these conflicts between state law and scientific reality make

regulating groundwater difficult and mean that litigation is often necessary to adjudicate groundwater rights issues.

Practical Implications of State's Gaps in Groundwater Management

Added Difficulties in State Water Planning. Currently, the DWR is charged under state law with assessing California's urban, agricultural, and environmental water needs; evaluating potential water supplies; and reviewing whether any actions are needed to reduce demand to help address any shortages. As part of the assessments prepared for these purposes by DWR every five years (commonly referred to as the California Water Plan), the department estimates groundwater basin yields and attempts to take into account general water quality efforts (including those related specifically to groundwater). However, as discussed below, the state's water planning efforts are impeded by weaknesses in the statewide management of groundwater.

In its 2009 update to the California Water Plan, the department reports on a number of problems it faces with estimating groundwater supply, including a lack of data that would indicate what role groundwater can play in addressing statewide water needs. Our analysis of the available data similarly indicates that the lack of information about groundwater quality can lead to incorrect conclusions about the availability of groundwater supplies. For example, this disconnect between actual groundwater supply and reported supply might prompt the state to make inaccurate assumptions about overall water supply. In doing so, state funds appropriated for water management purposes may not be going to projects that reflect the least cost and highest gain for water supply, either on a local or statewide basis.

As groundwater quality and supply challenges grow, the cost to the department to make accurate estimates, having to use disparate and conflicting information to create a statewide water supply picture, could increase. Integrating data from multiple sources, which are generally not standardized in their presentation, is a very difficult task. The cost to create new information technology programs to integrate these data can also be very expensive.

The potential for local groundwater plans to advise state water planning efforts is far from being met. With the passage of AB 3030 in 1992, groundwater management plans prepared locally were voluntarily submitted to DWR in attempt to support local management of groundwater while allowing the state some certainty that locals had a plan for future management of their groundwater. As we discussed, these plans (generally called AB 3030 plans) are required to be developed in a local public process and the law provides local fee and assessment powers to implement the plans. Over 140 plans have been submitted statewide.

The mandated AB 3030 groundwater management plans generally have not been used in statewide water planning because (1) the plans were voluntary, and a number of jurisdictions did not submit plans or did not submit complete and useful plans, and (2) there were no requirements that the plans that were submitted be implemented or improve the balance of the groundwater in the affected basin, the original plans have largely have been of little practical use to the department.

Notably, the information contained in the plans reflects data from a single point in time

that is not presented in a standard format that would permit comparisons in the status among groundwater basins. This makes it difficult to publicize the data in a meaningful way or use the data to make policy decisions from a statewide perspective. The legislation did prompt some local governments that might not otherwise have done so to take an active role in managing their groundwater basin. However, lacking any plans for some areas of the state, DWR has not used the plans as a basis to prioritize state funding for groundwater management efforts.

The department neither was charged with determining an AB 3030 plan's accuracy nor were they given the authority or funding to review the validity of a plan. In some cases, AB 3030 plans are no more than a page long, though many are relatively comprehensive. The department still is not funded to review these plans, and while they may help the department paint the picture for water supply statewide, the plans have not become a solid tool for consolidating information about groundwater management statewide.

State and Federal Government Response—Well Drilling and Cleanup. Often when wells run dry, either in a series of dry years or even under normal pumping practices, locals turn to the state for assistance. Similarly, when wells become contaminated and are unable to be used, locals may turn to the state or federal government for assistance in providing clean water supplies.

For example, the Office of Emergency Services (now known as the California Emergency Management Agency, or CalEMA) spent $5 million in 2000-01 to pay for a well in Klamath County to respond to a water shortage emergency that resulted when several wells went dry. In that same year, the Coastal Conservancy spent $1 million to fix septic systems that were polluting groundwater that flowed out to the ocean. From 1997 to 2007, the Department of Toxic Substances Control spent over $177 million to clean up groundwater contamination at the Stringfellow hazardous waste site in Riverside County, which posed a major public health risk to local water supplies. In 2009, the federal government authorized $40 million in economic stimulus funds to drill wells in drought-stricken areas of the state.

OTHER STATES HAVE TAKEN STRONGER APPROACHES TO GROUNDWATER MANAGEMENT

As shown in Figure 8 (see next page), California differs from other western states in its relative lack of regulation and management of groundwater. For the most part, these other states go further than California in their approach to groundwater and offer specific policies the state may wish to consider to more effectively manage groundwater.

Permitting, Public Reporting, and Monitoring. Most other western states have some form of permitting system for extraction of, or the right to use, groundwater. Most of these states also require well data to be made public and these states either meter, measure, or otherwise actively monitor groundwater. For example, Texas allows local agencies to regulate groundwater

use, but requires well data to be submitted to the state in a standardized format, and makes this data public on the Internet. As will be described in more detail below, Texas (as well as other states) set up specific management areas for those groundwater basins that have the greatest potential for overdraft, or face significant risks of contamination.

Active Management Areas (AMAs). Groundwater flows by nature tend to overlap political boundaries, making it more difficult to manage these water resources. Local interests in one area, for example, may wish to withdraw water at a more rapid rate than their neighbors, setting up a potential conflict over management of a groundwater basin they share. In some cases, such conflicts have led either to the overdrafting of a basin or expensive court adjudication of water rights among the competing water users.

To deal with this problem, most western states have established AMAs that cross the boundary lines of local jurisdictions. In general, in an AMA, a water user may withdraw and use groundwater only in accordance with the specific rules governing the storage of water from surface water sources, withdrawal and use of water, and reporting of well logs and extraction. All users in the AMA are known, and their water use tracked carefully, to ensure the area's groundwater supply is moving toward a long-term equilibrium between the water coming into the aquifer and the water being pumped out for water supplies.

Often the state defines the boundaries of the AMA, and provides technical assistance to water users in the area in negotiating overall water use levels. Some states set rules and goals for management of AMAs, including provisions regulating the overdraft, replenishment, and recharge of groundwater aquifers.

"Show Me the Water"—Arizona's Approach. Arizona generally requires its industries (including both those in urban areas and agriculture) to prove the availability of water for a project's use over a lengthy period of time, according to a set of laws. Arizona's unique approach to water management began in the 1970s when it became apparent that its water supplies would not satisfy its population growth under then-current practices. As Arizona negotiated a multistate compact for a share of Colorado River water, it initiated a sweeping change to its water laws, including those for groundwater. The state looked out decades into the future to determine how to grow with a limited water supply. Toward this end, the state:

Figure 8

California Lagging Other Western States in Groundwater Management

	California	Arizona	Texas	Colorado	New Mexico
Groundwater Management Components:					
Statewide groundwater use permitting	—	X	—	X	X
Active management areas	—	X	X	X	X
Statewide policy—well data made public	—	X	X	X	X
Statewide policy—metering, measurement, and reporting requirements	—[a]	X	—	X	X

[a] SBX7 6 provides for statewide measurement (at the basin level), but not metering of water extraction.

- Strengthened the state's system for allocating water rights and established a water permitting system. Parties who had water rights that existed prior to 1980 were not subject to all of the new restrictions.

- Prohibited a net increase in agricultural land use in order to restrain overall water use, and strengthened existing statutes giving urban water use priority over agricultural water uses. Placed restrictions on future municipal use of groundwater.

- Enacted strict rules regulating wells, including permitting, monitoring, and standardized reporting of groundwater use.

- Began a major effort to store excess Colorado River water in groundwater basins, as opposed to surface storage, given the high amount of evaporation in hot areas.

- Mandated conservation measures for urban, industrial, and agricultural users. Required new development to assure a 100-year water supply either through surface water or groundwater.

The revamped Arizona laws have been generally accepted and are being met with compliance, though in individual cases the rules have proved controversial. Local control over water resources remains an issue, particularly since the state administers all water rights under the Arizona system. However, the state has made an effort to work with local authorities to maintain a balance of power, with economic development and industrial growth encouraged where available water supply makes this possible.

Updating Groundwater Law. Many western state water laws were initially written in the 1800s and early 1900s, when the scientific knowledge of groundwater was extremely limited. Much like California, most states had statutory definitions of groundwater that had no basis in hydrology. Colorado and New Mexico are among the states that have taken steps to modernize their definitions of groundwater, linking surface water and groundwater in law. Arizona, through its major permitting law change, also allows for the interaction between surface water and groundwater to be reflected in the allocation of water rights.

Financing Groundwater Management Programs. Funding of state and local groundwater management programs is often a challenge. Most states we surveyed, such as Texas, use some amount of their General Fund monies to support state mapping and technical assistance programs. However, states that directly operate groundwater permitting programs generally use fees to at least partially support these activities, including the resources needed for planning and technical assistance to local agencies for groundwater programs. In all states we surveyed except Arizona, local districts or management areas have the authority to recover their groundwater program costs from the users of the water, whether through direct permitting fees or other types of fees for water use.

RECOMMENDED STEPS TO MORE EFFECTIVELY MANAGE CALIFORNIA'S GROUNDWATER

The Stakes Are High in Groundwater Management. As we have mentioned, the potential to use groundwater to increase water supply, either by introducing water from another source into the ground as a storage basin or by encouraging the natural refilling of groundwater basins is a significant option to address the state's water supply needs. However, successful implementation of this solution into the state's management of water is hampered by the state's lack of regulation or monitoring of groundwater resources. Management of groundwater supplies—to the extent that it does occur—resides mainly at the local level and thus, by its very nature, does not address water needs from a statewide perspective. As a result, groundwater quality is not protected under state regulation and enforcement as comprehensively as surface water quality. As we have discussed, the consequences of insufficient action to protect these water resources are high. Once contaminated, groundwater loses some of its potential to serve as a water supply source. The situation has already led to costly emergency efforts to clean up contaminated supplies and to provide substitute sources of water to communities dependent upon groundwater.

For the reasons stated above, and to build upon the work the Legislature has already done, we recommend that the Legislature adopt four fundamental changes to the way the state manages groundwater. These recommendations, which are summarized in Figure 9, represent the first steps that the state could take so that, in the long run, it is in a position to more strongly and effectively manage its groundwater resources. We recommend a shift to a more comprehensive groundwater management regime, similar to those being implemented successfully by other states, in order to avoid future water emergencies from the contamination of groundwater supplies and to make California's statewide water supply system more reliable.

Strengthen Monitoring Requirements

The state needs, but now lacks, comprehensive data on groundwater extraction, ground-

Figure 9

LAO Recommendations for Improving Groundwater Management

Problem	Recommendation
Monitoring not comprehensive statewide	Phase in a comprehensive monitoring system to allow the state to focus funding and technical assistance efforts to the areas in greatest need.
Current management efforts not necessarily focused on most challenged groundwater areas	Establish Active Management Areas where groundwater overdraft potential and/or extent of pollution problems are the highest.
Groundwater law does not reflect scientific reality	Bring science and law together by modernizing groundwater law to accurately reflect the physical interconnection of surface water and groundwater.
Groundwater use and rights unclear, leading to distribution and management issues	Consider establishing statewide groundwater permitting over a multiyear period based on data from expanded monitoring requirements. Maintain local control over implementation of state permit granted at either district or basin level to the extent possible.

water levels, and groundwater quality. For this reason, we recommend that the state phase in a comprehensive groundwater monitoring program over a period of years modeled after the best such measures adopted by other western states. Our analysis of other states finds that while no other single state program is an obvious perfect fit as a model for California, there is much to be learned from the examples of other state programs. Building on recent legislation that strengthens monitoring requirements, the Legislature should further require local water districts to submit standardized extraction data from all groundwater wells, as in Texas and Arizona.

The DWR should be directed to assess and integrate this information into the California Water Plan, thereby helping the state to more effectively plan for future water supplies, especially during dry years. The state will then be in a position to target assistance to groundwater basins with supply or contamination problems, while allowing local authorities who do not need state fiscal or technical assistance in their management of groundwater supplies to continue working on their own.

Establish AMAs

In some areas of the state, local management will be sufficient to both plan for and manage groundwater basins. Indeed, many areas of the state are successful in their management of groundwater, as is demonstrated by the Orange County Water District's approach to water management (see box on next page). There, a long-term approach to groundwater management has led to relatively reliable water supply, with a significant portion derived from groundwater.

However, for those groundwater basins with the potential for established overdraft or with groundwater pollution, we recommend the state establishment of an AMA, as is the policy in most western states. In these basins, the state would recognize that issues of statewide importance—ensuring the preservation of water quality and reliability of the state's water supply—must in some instances take precedence over a local desire for full control over management in the basin. However, as in Arizona, it is possible for there to be significant local input into the AMA process and for each AMA to have varying goals that reflect each locality's unique circumstances. For example, some AMAs may require restrictions on certain uses of water for a period of time (such as the imposition of certain conservation measures), while others may have more stringent or permanent rules aimed at restricting overdrafting of the basin as a whole.

Bring Law and Science Together

The erroneous distinction now reflected in California law between surface water and groundwater is an impediment to the establishment of surface water rights that accurately reflect the science of water. As DWR has stated, and as is acknowledged in other western states, groundwater can have a significant impact on the availability of surface water supplies. Indeed, all groundwater at some time starts as surface water. The lack of legal and regulatory acknowledgement of this interaction has led to time-consuming and expensive litigation involving both public and private entities. As a starting point for reform in this area, we recommend that the Legislature amend statute to remove the current legal distinction between percolating groundwater and subterranean streams. This is a necessary step to allowing the interaction of surface and groundwater to be integrated into the administration of water rights in the state.

Consider Groundwater Permitting, While Maintaining Some Local Control

Our prior three recommendations provide a good starting point for improving state groundwater policy, in that they (1) provide better information through monitoring on the status of groundwater supplies, (2) integrate science and law in this area, and (3) test AMAs as a tool to manage these water supplies primarily locally. However, the Legislature may ultimately determine that further steps are needed in the longer run to address the state's groundwater problems. Thus, we recommend that the Legislature consider phasing in the establishment of a state-administered water rights system for groundwater as is the case in most other western states.

Additional information is expected from DWR in 2012 regarding the status of the state's major groundwater basins. Once it has reviewed this additional information, the Legislature should evaluate how a groundwater permitting system could complement the Legislature's policy as reflected in existing groundwater statutes, and in conjunction with any existing AMAs. The Legislature would then be in a position to direct both DWR and SWRCB to develop an appropri-

Orange County Water District: A Long-Term Approach To Groundwater Management

Following a precipitous drop in groundwater levels in some areas of the Orange County groundwater basin, the Orange County Water District was formed in 1933 by an act of the Legislature to "represent the water users and landowners of the Coastal Plain in all litigation involving outsiders." The basis for the creation of the district was to protect the water supply serving the over 160,000 acres of then-mainly agricultural land in the district.

The act did not restrict water use within the basin. Rather, it allowed the district to charge water users to both protect existing water supply as well as to purchase or develop water supplies from outside sources to satisfy the demand of water users in the district. In 1953, a replenishment assessment ("pump tax") and monitoring program was established by amending the original act. Those who pumped groundwater were required to report twice per year the amount of groundwater extracted (a district-run water quality monitoring program was later added), and to pay an assessment per acre-foot of water extracted.

Using mainly income from the pump tax, the district's activities have included (1) efforts to reduce sea water intrusion (a situation in which groundwater levels drop below sea level, allowing salt water to enter the groundwater); (2) the extensive purchase of surplus water from outside sources, including from the State Water Project and Colorado River supplies, to offset overdraft in the basin; and (3) the development of a project to de-mineralize and purify wastewater into pure drinking water, known as Water Factory 21. The efforts of the basin are largely considered a success as they have been able to hold back seawater intrusion into the groundwater basin and to maintain an adequate level of water supply for customers using their various groundwater management methods.

ate groundwater rights system that, as we discuss below, maintains local control to the extent possible and that is based off of standardized monitoring data and established science. We do not, however, recommend that the state mirror entirely the existing water rights system that now exists in California for surface water. To acknowledge the significant achievements of local groundwater management efforts, and to build on our recommendations for increased monitoring and establishment of AMAs, we recommend the Legislature consider establishing statewide groundwater use permitting while retaining some local control. To accomplish this, permits could be granted at either the basin or district level (rather than to individual water users), thereby allowing locals some discretion as to the use of water within their jurisdictional boundaries. We recommend that DWR have the authority to set levels of water use within a basin as a whole for each water user if more deliberate management is required due to overdraft problems or the contamination of groundwater supplies.

We recommend phasing in this new statewide permitting system over a ten-year period after other strategies have been put in place that are a prerequisite to establishing an effective permitting system. Specifically, the state at present does not have standardized groundwater use reporting, nor does it have a clear picture of the full extent to which groundwater supplies are being contaminated. By first implementing comprehensive groundwater monitoring and establishing AMAs, the SWRCB would be in a better position to work with locals to establish clear parameters for groundwater-related water rights based on standardized data and established science. It would also have the experience of managing groundwater within AMAs.

New Groundwater Strategies Likely to Result in Long-Term Savings

In the short term, implementation of the various recommendations we have proposed above would result in modest administrative costs for state and local water agencies. We recommend that these costs be offset by fees similar to the way the state pays for the regulation of surface water use and water quality. We believe a strong case can be made for having groundwater users and polluters of groundwater pay for the costs of state groundwater regulatory programs.

In the long term, we believe it is likely that the set of strategies we propose would result in savings to public and private entities across the state. This is because these efforts would eventually decrease the need for costly water rights adjudications and help to avoid the cost of clean up or treatment of degraded groundwater for use in water supply. There would also likely be reduced long-term future costs related to overdrafting of groundwater basins, including emergency response measures to aid communities for which valuable groundwater supplies have been depleted.

Fine-Tuning These Reform Concepts

This report addresses, in a high-level conceptual way, the basic set of changes we have concluded are needed to improve groundwater monitoring and management from the state's perspective. However, implementation of these concepts would involve resolving many important technical issues. If the Legislature wishes to pursue the approaches we have outlined, we recommend that it direct the three state agencies primarily responsible for groundwater management—the DPH, DWR, and SWRCB—to jointly report at hearings on the groundwater management models we have identified in other states

and their practical application for California. The hearings would engage the departments and other important stakeholders, such as local water jurisdictions, in a review of other state models relevant to the management and regulation of groundwater. California state agencies should weigh in on the implications of changes on local control, statewide planning, information gathering, and forecasting. The Legislature could then be apprised of current best practices in the field of groundwater management most suitable to protect the state's valuable liquid asset, its groundwater.

LAO Publications

This report was prepared by Catherine Freeman with assistance from Heather May, and reviewed by Mark Newton. The Legislative Analyst's Office (LAO) is a nonpartisan office which provides fiscal and policy information and advice to the Legislature.

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