



# Managing California's Water

## From Conflict to Reconciliation

### EXECUTIVE SUMMARY

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*Supported with funding from S. D. Bechtel, Jr. Foundation, The David and Lucile Packard Foundation, Pisces Foundation, Resources Legacy Fund, and Santa Ana Watershed Project Authority*



California faces enormous challenges as it struggles to adapt its water management system to 21st-century conditions. The state's population continues to grow and to urbanize, increasing demands for urban water supply, reliable water quality, and flood protection. At the same time, the state's economy no longer depends as directly on water to generate wealth: agriculture, which still consumes the lion's share of water, represents a small fraction of overall employment and economic output, and manufacturing accounts for only a small fraction of total water use. All this is taking place as California faces the uncertainties of a changing climate—and as environmental concerns take greater precedence than they have in the past, affecting critical decisions in water management.

These changes are leading to a rebalancing of water management objectives and approaches. In recent decades, many federal, state, and local efforts have sought to redress environmental decline, to adjust to the increasing scarcity and unpredictability of water supplies, and to rehabilitate crumbling flood protection infrastructure. But these efforts have proved inadequate. To avoid continued environmental and economic deterioration, California needs to make significant changes in water policy.

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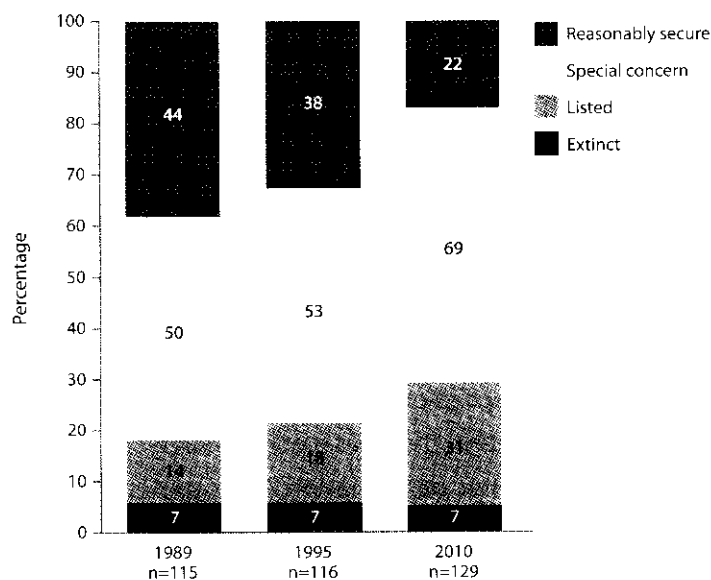
## Major Crises Await

Without reform, current water policies and institutions virtually guarantee that California will experience five major, protracted water crises that will involve widespread environmental and economic losses.

### Extinction and Decline of Native Species

California is endowed with a diverse and unique natural environment, with 140 distinct aquatic ecosystems and many fish and other aquatic and riparian species that live nowhere else on the planet. Over the past 150 years, California's native fishes—a broad indicator of aquatic ecosystem health—have lost almost every conflict with economic development. Among the state's 129 native fish species, 7 have become extinct, 31 are listed as threatened or endangered under the federal and state Endangered Species Acts (ESAs), and another 69 are in decline and will likely qualify for listing in the future. Only 22 native fish species are reasonably secure (Figure 1). The condition of

Figure 1. California's native fishes are in sharp decline



SOURCE: R.B. May Jr., J.M. Katz, and R. Quiñones, "Rapid Decline of California's Native In and Fishes" (Working Paper 7, Center for Watershed Sciences, University of California, Davis, 2010).

NOTE: Extinct = extirpated from California; listed = listed as threatened or endangered under state or federal Endangered Species Acts; special concern = species in decline that could qualify for listing in the future; reasonably secure = widespread, abundant species according to current knowledge.

native fish populations has continued to deteriorate despite decades of well-intentioned but insufficient and poorly coordinated policies to protect them. Efforts to stop these declines now threaten the reliability of water supplies and flood management projects. Yet this deterioration in natural habitat is likely to accelerate with continuing influxes of invasive species and losses of both cold water habitat and stream flow from climate warming.

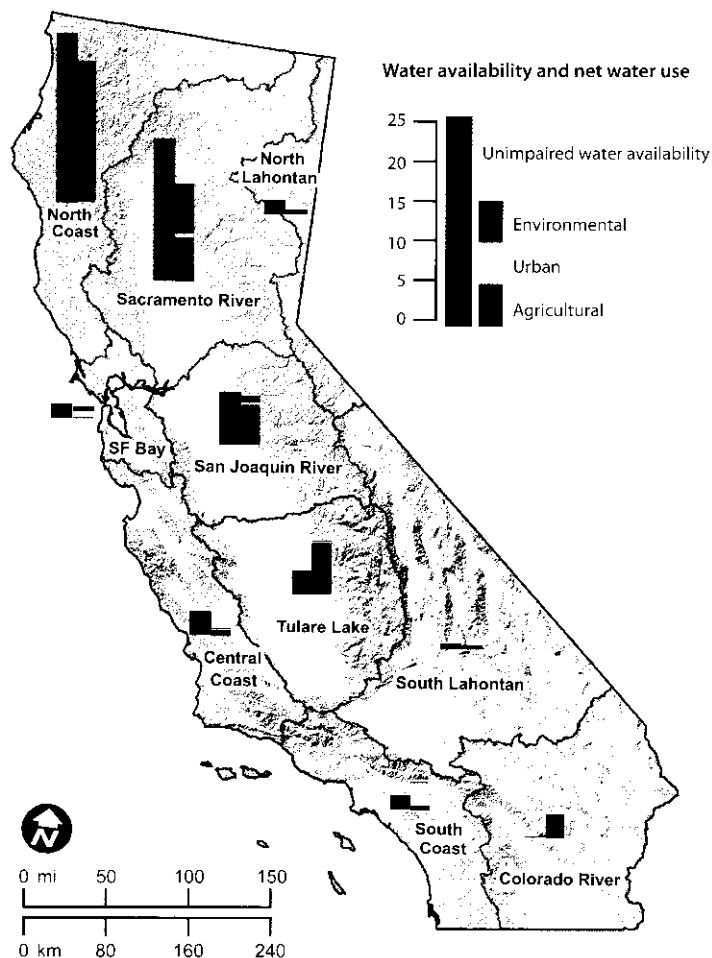
### Catastrophic Floods

California's flood management system has also failed to keep up with changing economic, environmental, and social conditions. The state has some of the most flood-prone land in the nation, much of which has been urbanized. In the Central Valley, growing urbanization in floodplains has rendered a formerly prized century-old flood control system inadequate. A major flood in the Sacramento region would endanger thousands of lives and cost tens of billions of dollars in lost property and economic activity. Unfortunately, recent state efforts to double the urban protection standard in the Central Valley suffer from the same basic weaknesses as federal flood policy. The new standard will promote some strengthening of existing flood defenses but ultimately will increase the economic losses from floods—or flood risk—by continuing to encourage population growth and economic activity behind levees. The frequency of large floods is likely to increase with a warming climate, which is already accelerating the pace of winter and early spring runoff, challenging the capabilities of existing flood protection infrastructure. Moreover, the state's new flood policy does not address high-risk flood areas in Southern California and the San Francisco Bay Area.

### Water Scarcity

In much of California, water must now be managed every year with an eye toward drought. California has run out of cheap sources of new water and will need to manage water more carefully and more flexibly to satisfy competing demands (Figure 2). In recent decades, progress has been made on several fronts: Water use efficiency has improved,

**Figure 2. Net water use far exceeds local supplies in the southern half of the state**



SOURCE: California Department of Water Resources, *California Water Plan Update 2009*, B.1.1, 160-09.

NOTE: The map shows annual average values for 1998–2005 in billions of acre feet.

urban wastewater reuse is expanding, a water market has developed to transfer water from economically lower-value uses to higher-value uses, and groundwater banking has expanded the ability to store water in underground aquifers for dry years. But several regions are relying on unsustainable mining of groundwater basins, and the state's water system is still susceptible to prolonged droughts, which could become more frequent. Institutional rigidities and regulatory gaps are hindering the development of groundwater banking and the expansion of the water market—

two major tools for better managing water in a semiarid climate with a growing population and dynamic economy.

### Deteriorating Water Quality

The passage of clean water legislation in the late 1960s and early 1970s led to a dramatic reduction in water pollution from wastewater and industrial plants. But other major sources of pollution, such as urban and agricultural stormwater runoff and drainage, remain a serious problem. Meanwhile, new chemical threats have emerged and, with few exceptions, have been largely neglected. Water quality problems compound water scarcity problems by increasing drinking water costs, particularly for small rural communities. Treating wastewater and runoff to meet increasingly high standards is also expensive and often insufficient to protect aquatic species from harm.

### Decline of the Sacramento–San Joaquin Delta

All of these problems converge in the Sacramento–San Joaquin Delta—the poster child for California's water woes. Disasters loom for ecosystems, Delta landowners, and agricultural and urban water users in much of the state. The Delta's weak levees, which protect local farmland and the channels that convey freshwater to southern Delta export pumps, risk catastrophic failure from earthquakes and floods. Such a failure would draw saltwater into the Delta, cutting off water supplies for many months and costing the state's economy billions of dollars. The Delta's ecosystem—stressed by loss of habitat, water diversions, contaminants, and a range of other causes—is witnessing a catastrophic decline in its native species, leading to substantial regulatory restrictions on water exports. Over the longer term, additional pressures on this system from sea level rise, warming temperatures, water pollution, and new invasive species will intensify this deterioration, permanently cutting off water supplies and leaving an impoverished ecosystem, with few traces of its original splendor. The economic costs of a permanent loss of Delta water exports will be especially severe if California's climate becomes drier, as some climate models predict.

## Failing Governance Institutions

The inability to prevent these looming crises reflects major weaknesses in California's current system for governing and funding water management. Most of the state's water management is highly decentralized, with many hundreds of local and regional agencies responsible for water supply, wastewater treatment, flood control, and related land use decisions. This system has many advantages but has often resulted in uncoordinated, fragmented water and land use decisions that contribute to chronic groundwater overdraft, impairment of watersheds by a wide range of pollutants,

Coordination failures among state and federal agencies have led to inefficiencies in reservoir operations, ecosystem management, and water marketing, among others.

ineffective ecosystem management, and rapid development in poorly protected floodplains. Similar coordination failures among state and federal agencies have led to inefficiencies in reservoir operations, ecosystem management, and water marketing, among others.

In this decentralized system, gaps in the development and analysis of key technical and scientific information are a severe problem; state agencies often lack the resources needed for analysis and sometimes even the authority to gather information from the field. As state and federal agencies have shifted their efforts in recent decades from infrastructure construction to regulation, they have lost much of their former capacity for scientific and technical analysis and strategic planning. Distressed state and local funding systems, as well as increasingly restrictive rules for levying fees and property assessments, have made it difficult to support flood protection, environmental mitigation and pollution control, and state planning and analysis functions. The lack of a strong state technical and scientific program is allowing advocacy-funded "combat science" to take

### Goals for water policy reform

In developing a new water policy, California should seek to attain five broad societal goals:

**Public health, safety, and welfare.** Water management should support the well-being of the state's residents.

**Ecosystem health.** Ecosystems are not just a source of water for direct human uses—they are also a source of broader social and economic well-being and must be protected.

**Balance.** In recognition of environmental values, new policies must explicitly consider and balance tradeoffs between ecosystem benefits and traditional management of water supply and flood protection.

**Efficient allocation and use.** California water policy and law, embodied in Article X, § 2 of the state constitution, reflect the importance of efficient allocation and use of water and the need to adapt water uses to changing economic conditions. Policies supporting this goal need to be strengthened in response to unmet environmental demands and changing climatic conditions.

**Fairness.** New policies must be perceived as fair, not selectively supporting one interest at the expense of others. Efforts should be made to ease the costs of policies that harm disadvantaged groups.

Although conflicts among these goals are inevitable, all elements of society have a long-term interest in achieving a balance among them rather than adopting extreme solutions that are unsustainable in environmental, economic, or social terms. These societal goals translate into five objectives for water system management:

**Reliability and sustainability.** Some degree of stability and predictability in water policy is essential to support continuing economic well-being.

**Reasonable cost.** Where possible, water management must reduce the costs of delivering services to the state's residents, without neglecting social and environmental costs.

**Adaptability to changing conditions.** Effective water policy must incorporate mechanisms for anticipating change and incorporating scientific projections and uncertainties into management.

**Integration.** Modern policy must continue current trends toward integrating water management for diverse purposes, linking policies that govern water supply and quality, flood management, and ecosystem health.

**Transparency, clarity, and enforceability.** Transparency is essential to support the societal goal of fairness. New policies need better legal mechanisms to enforce compliance and better information systems to support decisionmaking and enforcement.

center stage—fueling overly simplistic and wrong-headed, but politically convenient, views of California's water problems and potential solutions.

## Promising Directions for Water Policy

Given the scope of California's water problems, a broad and ambitious agenda of reforms is critical. This agenda should focus on four mutually reinforcing approaches:

1. Reconciling environmental and human water uses through more comprehensive and focused ecosystem management;
2. Expanding and integrating the use of portfolio approaches for water supply, water quality, and flood management;
3. Enhancing the system's balance and flexibility by strengthening the role of water as a public commodity; and
4. Making water management institutions more effective, integrated, and adaptive.

Some parts of this reform agenda build on existing policies and trends, but others will require major shifts in policy direction. Similarly, existing laws and regulatory authority are adequate to implement many important reforms, but some will require changes in state and federal laws.

Taken together, these approaches form the basis for a new era in water management. Below, we fill in the outlines of this reform agenda.

### Reconciling Environmental and Human Water Uses

A central task in a new era of water policy and management will be to reverse the decline in California's native aquatic and riparian diversity. Single-species management under the Endangered Species Acts, which has tended to focus on mitigating individual causes of ecosystem stress, has had little success in protecting ecosystems or preventing new listings. Simply tinkering with current approaches is unlikely to make things much better. Instead, environmental management must focus on improving broad ecosystem function, aiming to create better conditions for

multiple desirable species and addressing multiple causes of stress to the system. In California's highly altered environment, "reconciliation" approaches—which acknowledge the continued presence of human land and water uses—are likely to have more promise than "restoration" approaches that seek to return ecosystems to an approximation of their native states. In general, the aim should be to maintain a diverse range of functioning ecosystems, while prioritizing areas and actions with the greatest chance of success.

Strategies should include removing or setting back levees in some locations to promote seasonal floodplain inundation, reducing the discharge of contaminants, limiting the introduction of invasive species, and reoperating (and, in some cases, removing) dams to facilitate fish passage and reduce the harmful downstream effects of diversions. In some watersheds, better control of groundwater pumping is essential, because pumping is depleting stream flow. In addition, the state's fish hatchery programs—which have negative unintended consequences for native species—are in dire need of reform. Finally, some specialization of streams for environmental purposes may be desirable.

### Reconciling the Delta

Reconciliation strategies aim to improve ecological function alongside continued human uses of land and water resources. The Delta provides a prime example. In a reconciled Delta, dams and water diversions would be reoperated to create a "natural flow regime" that captures or accentuates some of the variability under which native species once thrived, thereby also making conditions less favorable for some invasive species. A peripheral canal or tunnel, diverting water exports around or underneath the Delta, would allow some water exports to continue while ending the disruptive effects of pumping water through the heart of the Delta. Eco-friendly agriculture—with fish-friendly water intakes and better control of harmful chemicals—would continue in much of the Delta, supporting habitat for sandhill cranes and other wildlife, whereas some islands would be allowed to flood, returning to open water habitat. Contaminants from urban wastewater would be reduced, and hatcheries would be managed to lessen competition with wild salmon. Recreational uses of the Delta would increase, but new urban development would be prevented in fragile, low-lying areas. Similar reforms could be made throughout the Sacramento–San Joaquin River system and in California's other watersheds.

Achieving change will require strategic shifts in the scientific and institutional orientation of aquatic ecosystem management. Although this will be challenging, it can largely be accommodated within existing law. In particular, both the state and federal ESAs allow multispecies, ecosystem-based approaches to mitigation. Large-scale regional habitat conservation plans—such as the one now being developed in the Delta—are an example. And although ESA regulators have tended to focus on single causes of stress, the law is sufficiently flexible to accommodate a broader consideration of actions.

Other environmental laws may need adjustments to be more effective in the face of changing conditions, including climate change. The federal Clean Water Act and the state Porter-Cologne Act prohibit California from allowing water quality to decline in ways that affect existing beneficial uses. For instance, reimposing environmental variability (in salinity, for example) would suppress invasive species in the Delta but would likely harm some current beneficial uses of Delta waters—thus, this strategy would be incompatible with current legislation. In addition, climate warming will make it increasingly difficult to meet water quality standards

### Managing reconciled ecosystems

Incorporating human and environmental uses into ecosystem management is challenging. Managing reconciled ecosystems requires:

- basing adaptive management on models and treating management actions as experiments;
- managing for or recreating environmental variability;
- understanding the needs of desirable species, especially with climate change;
- accepting that 'new' reconciled ecosystems may differ greatly from both current and pre-development ecosystems;
- focusing on preventive actions to avoid invasions of new species, effects of new toxins, and new endangered species;
- basing decisions on scientific research and monitoring;
- recognizing that decisions can and must be made despite uncertainties; and
- ensuring adequate funding and creating effective institutions.



*Fish kills are common in areas where pollution, dams, and algae create poor water quality, such as in the Klamath River.*

that depend on temperature, and thus more flexible implementation of rules will be necessary. Under a reconciliation strategy, the best option may be to adjust to changing conditions.

Similarly, the state and federal Endangered Species Acts lack provisions for conservation strategies that could allow a listed species to go extinct in the wild as part of a broader effort to protect ecosystems. Yet these types of tradeoffs may become necessary, as some species become so fragile and compromised that costly—and likely futile—efforts to save them may threaten protection of a range of other species. Properly designed and prudently administered, endangered species triage might become necessary to allow environmental regulators to focus on integrated ecosystem management and aggregate species recovery.

### Expanding and Integrating Portfolios

To better serve both economic and environmental objectives, the management of water supply, water quality, and floods must employ a broader range of tools than it has in the past. Traditional approaches in all three areas have relied heavily on major public works—dams, levees, conveyance facilities, and treatment plants. Although the state will need some new infrastructure, the era of large-scale infrastructure development is now largely past. New management approaches offer more promise.

**Water supply priorities**

Water supply management has seen the most progress in portfolio approaches, as numerous nontraditional tools have been tapped to cope with increasingly tight water supplies. Expanded efforts should:

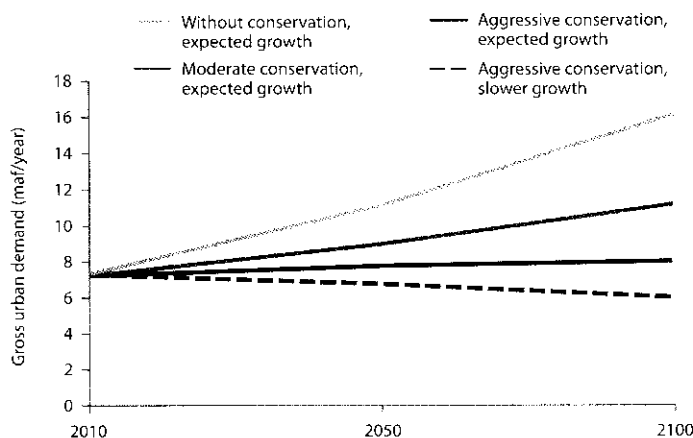
**Increase urban conservation.** Although per capita urban water use has been falling, Californians still use much more water than other economically advanced populations that share a similar climate, such as Australia, Israel, Italy, and Spain. Aggressive conservation could curb urban demand growth, despite population and economic growth (Figure 3). Our modeling results show that a focused conservation strategy—reducing average water use to about 155 gallons per capita per day (30 percent below 2000 levels)—would significantly reduce demand for Delta exports and lessen the costs of export cutbacks for San Joaquin Valley farm communities. Water rate reform, using tiered rates with variable base allowances, can promote conservation in a flexible and fiscally responsible way.

**Encourage groundwater banking.** Expanding underground storage can be much more cost effective than

building new surface storage. Groundwater banking can both stretch available water supplies and replace the storage lost by a shrinking Sierra Nevada snowpack. But legal uncertainties over storage rights and the ownership of stored water are impeding the development of groundwater banking outside adjudicated basins and special groundwater management districts. In many areas, comprehensive basin management is needed to facilitate banking and related water transfers and to limit the harmful environmental effects of pumping.

**Improve water transfers.** Water marketing is an equitable way to accommodate changing demands for water, by compensating water rights holders for moving water from low-value uses. Opportunities for market development are still considerable, because many acres of farmland are still planted in low-value crops. But the water market has stagnated since the early 2000s. Cumbersome state procedures for environmental approvals, lack of groundwater basin management in many counties, local resistance to sales involving agricultural land fallowing, and new restrictions on Delta exports have all hindered water market development. Steps are needed to reduce barriers in all these areas.

**Figure 3. Successful conservation efforts could significantly slow urban water demand growth**



SOURCES: A. Sanstad, J. Johnson, N. Golstein, and G. Franco, *Long-run Socioeconomic and Demographic Scenarios for California*, Report C-500-2009-013-I (Sacramento: California Energy Commission, 2009); unpublished estimates from Hans Johnson, 2009.

NOTES: Expected population growth scenarios are 59.2 million in 2050 and 85.3 million in 2100 (Sanstad). Slower growth projections are 51.7 million and 64.6 million, respectively (Johnson). Moderate conservation assumes 20 percent reduction by 2050 (180 gpcd) and 30 percent by 2100 (143 gpcd). Aggressive conservation assumes 30 percent reduction by 2050 (143 gpcd) and 50 percent reduction by 2100 (109 gpcd).

**Water quality priorities**

The primary successes of water quality management have been in reducing pollution from wastewater and industrial plants (with treatment before discharge) and removing pollution from drinking water (with treatment before use). Priority actions should now be taken to:

**Manage pollution sources.** Treatment is more costly for “nonpoint” pollution sources, such as stormwater and irrigation water runoff, than for “point” sources such as industrial plants. Therefore, policies have focused on encouraging best management practices to reduce runoff. Limits on the total maximum daily loads of some pollutants are also being set for some water bodies, to be met jointly by point and nonpoint dischargers. To implement these standards cost effectively, California should develop pollution trading schemes. Such “cap and trade” programs are encouraged



*The Yolo Bypass provides valuable ecosystem services in addition to flood protection for the City of Sacramento.*

under federal law, and they have worked well in the energy sector for some air pollutants. With cap and trade, performance standards can more readily be extended for some problematic types of runoff from farms and urban landscapes, including salts, nitrates, and pesticides.

**Control contaminants.** Source management of toxic contaminants poses a major challenge for California. Federal efforts are not sufficiently comprehensive. California should pursue its recent Green Chemistry Initiative, to encourage the use of chemicals less harmful to humans and the environment. It also should continue to build upon the regulatory model of Proposition 65, the Safe Drinking Water and Toxics Enforcement Act of 1986, which shifts the burden of proof to manufacturers, relies on multiple data sources, and allows private sector enforcement.

#### Flood management priorities

In its 2007 flood legislation, California broke with federal policy by setting higher protection standards for new development in the Central Valley. But the focus is still largely on improving flood protection infrastructure, using levees and reservoirs to limit the frequency of flooding. To limit California's growing flood risk and the negative environmental consequences of flood infrastructure, new approaches must:

#### Regulating toxins

One of California's most successful efforts to date at regulating harmful substances has been Proposition 65, which prohibits the discharge of toxic substances (those that cause cancer or reproductive harm) into drinking water or onto lands that allow toxics to pass to drinking waters. This law also requires that businesses post warnings of listed toxic substances. The California Office of Environmental Health Hazard Assessment has listed 834 chemicals under this law, and subsequently delisted 11 of them ([oehha.ca.gov](http://oehha.ca.gov)). Proposition 65 shifts the burden of proof to businesses using toxic products. It relies on multiple data sources to establish a California list of toxic substances. And it provides for private enforcement, because anyone can sue to enforce Proposition 65. However, Proposition 65 is limited in its scope, because chemicals can appear on the list only if a government (federal, state, or international) has tested it and found it to cause cancer or reproductive harm in humans.

Currently, the California Department of Toxic Substances Control is promoting a Green Chemistry Initiative. The program seeks to accomplish the following goals: (1) create an online product ingredient network, based on manufacturers' disclosures; (2) create a complementary online toxics clearinghouse, with known information about ecological and public health properties of chemicals made available for use in the state; and (3) encourage the development of manufacturing chemicals and processes that reduce effects on the environment. By making information on product ingredients and properties available to the public, this initiative could, like Proposition 65, create incentives for manufacturers to limit the use of harmful chemicals.

**Reduce flood vulnerability.** To reduce risk, land use planning and regulation should focus on limiting the location of new development in flood-prone areas, improving building codes, and expanding flood insurance requirements to all properties within the 500-year floodplain (current federal requirements apply only to properties in the 100-year floodplain). As with fire hazards, mandatory insurance is the most direct way to reward local communities for their flood management investments and to reduce the losses from inevitable flooding.

**Create locally generated, risk-based investments.** Despite \$5 billion in recent state bond funds, California's flood protection system remains woefully underfunded. Higher local contributions are needed, and properties facing higher risk should pay higher fees—a model already used in the

Sacramento area. Scarce state and federal investments likewise should be allocated based on cost-effectiveness, which will depend not only on the costs of the investments but also on the value of assets being protected.

**Provide environmentally beneficial flood protection.**

Approaches should include expanding flood bypass capacity—a strategy used effectively in the early 20th century and largely neglected since then. This approach, which can be both cost-effective and environmentally beneficial, will require compensation of local landowners and local governments for their loss of revenues from forgone development.

**Develop a statewide focus.** State policy has focused on the Central Valley, where the state operates a large flood control project and faces extensive liability from flood damage. But many areas of California face growing risks from flooding, and state policies to reduce flood risk should be statewide. For instance, the new requirement to provide annual flood risk disclosures to Central Valley residents living behind levees should be extended to all flood-prone regions.

**Integrating actions**

Many of these actions can be mutually reinforcing, providing multiple benefits. For example, flood bypasses can protect residents from floods, provide valuable habitat, and recharge groundwater basins. Urban conservation can reduce both water demand and polluted runoff. Groundwater banking can expand drought storage and provide reservoir capacity during the flood season. Stormwater capture can reduce water pollution and recharge groundwater basins.

But to work well, many of these actions need to be coordinated across functions that are often managed separately and across broader geographic scales than the boundaries of many existing agencies. Local actions must become better integrated at the scale of groundwater basins and watersheds, and regional actions must become better integrated with statewide objectives for balancing economic and environmental performance.

To achieve these goals, California must move beyond the current voluntary approach to integrated water

management, which entices local entities to collaborate in exchange for state bond support for infrastructure projects. This voluntary approach is not very effective, and it is financially unsustainable. Instead, a regional planning and management framework is needed to guide local actions. We propose the creation of regional stewardship authorities (either replacing or supplementing existing regional water quality control boards) to coordinate and focus the supply, quality, flood, and ecosystem management efforts of local entities. These regional authorities could be state institutions (like the regional boards) or delegated consortia of local agencies (similar to the Santa Ana Watershed Project Authority) operating under state authority. This regional framework could foster more systematic and strategic decisions on resource management to benefit the state's residents and its aquatic ecosystems.

**Managing Water as a Public Commodity**

Successful water management in the new era will require recognition that water is a public commodity, having both economic and broad public value. Striking a balance among competing uses and objectives is the core principle of managing water as a public commodity. Flexibility—or the ability to adapt—is essential for achieving this balance given California's continuing demographic, economic, and environmental changes. At its core, California water law—especially the foundational doctrines of reasonable use and the public trust—has remarkable capacity for creating balance and flexibility. Building on these doctrines, a public commodity policy would result in better water pricing and regulatory decisions, while sustainably funding environmental reconciliation efforts and providing a more adaptable framework for water management for human uses.

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The 2009 legislative package on water takes several steps in this direction, including new targets for urban water conservation, new requirements to monitor groundwater levels, and the establishment of a new Delta governance framework to balance human and environmental uses of the Delta. But further reforms should:

**Provide equal treatment for groundwater.** California's failure to regulate groundwater has harmed fish and aquatic wildlife, compromised groundwater quality, generated conflicts among water users, and prevented the development of groundwater banking and water marketing. Comprehensive basin management, which treats groundwater and surface water in an integrated, sustainable manner, is needed to improve economic and environmental performance of California's water system. The ideal way to proceed is for the legislature to extend State Water Resources Control Board jurisdiction to all groundwater extraction, and for the board to require that local water districts establish effective basin management protocols. Barring this, the reasonable use doctrine may provide the courts and in some cases the board with the means to move toward more comprehensive management.

**Streamline and strengthen environmental review of water transfers.** To improve water market efficiency, programmatic environmental assessments should be prepared for potential transfers from regions most likely to sell water. This would facilitate preapproval of a range of transfer volumes, depending on hydrologic and market conditions. To protect private and public interests, these assessments should consider potential negative effects of transfers that currently require mitigation under state law (i.e., effects on other surface water users), as well as effects on groundwater users and local economies.

**Create a water transfer clearinghouse.** California's interconnected water supply grid is a major asset for managing supplies as they become scarcer. But the system is institutionally fragmented, split across state, federal, and local operators. Although cooperative agreements have improved operations, the rules for transferring water from different types of agencies are cumbersome. We propose creating a

new clearinghouse, modeled after the independent system operator for the state's electricity grid, to manage the water market in a more integrated and efficient manner.

**Fund the public goods aspects of water management.**

For the foreseeable future, state general funds are unreliable and unsuitable for managing the public aspects of water management—which include planning, enforcement, science, and ecosystem management. California should learn another lesson from the electricity sector and introduce a public goods charge on water use. This charge—a small volumetric fee—would also be a more appropriate funding source for regional water projects than the general obligation bonds that have been used recently. Specific fees for environmental mitigation, including dam removal and control of contaminants, are also appropriate. Water quality permit fees, which now fund regulatory administration, also should be augmented to support ecosystem management. Fees covering broader purposes than regulatory administration will likely require legislative approval. As noted above, local contributions to flood works will also be needed, ideally on a regional scale (Table 1).

Table 1. Fee-based funding for 21st-century water management

<b>Public goods charge</b>
Ecosystem reconciliation
Regional water supply reliability and infrastructure
Administration (Department of Water Management, Department of Fish and Game, regional stewardship authorities)
Research and development
<b>Special mitigation fees</b>
Dam removal and mitigation of effects on fish
Chemical contaminants surcharge
<b>Water quality permit fees</b>
Ecosystem reconciliation
Administration (state agencies and regional stewardship authorities)

**Improving Water Governance**

Sustainable management of California's fresh water requires not only good policies but also effective, integrated, and adaptive governmental institutions. We recommend the following actions:

**Increase information and analysis.** Despite California's role as one of the centers in the world's information economy, the state woefully lags on information and analyses of water use, flows, quality, and costs—essential tools to support modern water management goals. Most information will need to be developed locally and regionally, but the state must ensure that adequate data are collected and made available in a useable format for policymakers, stakeholders, and the public at large.

**Promote integration, coordination, and coherence.** As mentioned, California should create new regional stewardship authorities to coordinate actions regionally. In

addition, state water agencies need an overhaul (Figure 4). The State Water Resources Control Board should be merged with the nonproject functions of the Department of Water Resources to form a new Department of Water Management, with responsibilities for water quality, water rights, flood management, and statewide planning. The regional stewardship authorities would report to this new department. The State Water Project should be managed as an independent utility as a public benefit corporation. At the federal level, the National Marine Fisheries Service (now in the Department of Commerce) should be merged with the Fish and Wildlife Service (Department of the Interior) to eliminate unproductive fragmentation of responsibility for the Endangered Species Act.

**Create expert agencies.** To improve the timeliness and scientific underpinnings of policy decisions, the state should move from management through board structures toward

Figure 4. Changes in state water governance structure would increase integration and adaptive capacity

**Existing structure**

**State Water Resources Control Board**  
Water rights  
Water quality

**Nine regional water quality control boards**  
Water quality permits  
Regional water quality plans

**Fish and Game Commission**  
Fishing and hunting regulation  
Species protection  
Department of Fish and Game policy

**Department of Fish and Game**  
Implementing Fish and Game Commission policies

**Department of Water Resources**  
State Water Project (SWP)  
Flood management  
Statewide planning and coordination  
Four district offices

**Proposed structure**

**Department of Water Management**  
Water trustee (director)  
Water rights (with public trust advocate)  
Water quality and permitting  
Flood management  
Statewide planning and coordination

**Nine regional stewardship authorities**  
Each with regional water quality, flood management, ecosystem, supply and land use planning/coordination authorities

**Department of Fish and Game**  
Expanded executive authority over policies and listings  
Independent check on flows  
Fish and Game Commission retains hunting and fishing regulation policies

**State Water Project Utility**  
Independent public benefit corporation  
State-owned  
Holds SWP rights and assets

**Water Independent System Operator (ISO)**  
Grid operator, transfer clearinghouse

**ISO members**  
SWP (independent public utility)  
Central Valley Project  
Local water projects (encouraged to join)

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**Provide equal treatment for groundwater.** California's failure to regulate groundwater has harmed fish and aquatic wildlife, compromised groundwater quality, generated conflicts among water users, and prevented the development of groundwater banking and water marketing. Comprehensive basin management, which treats groundwater and surface water in an integrated, sustainable manner, is needed to improve economic and environmental performance of California's water system. The ideal way to proceed is for the legislature to extend State Water Resources Control Board jurisdiction to all groundwater extraction, and for the board to require that local water districts establish effective basin management protocols. Barring this, the reasonable use doctrine may provide the courts and in some cases the board with the means to move toward more comprehensive management.

**Streamline and strengthen environmental review of water transfers.** To improve water market efficiency, programmatic environmental assessments should be prepared for potential transfers from regions most likely to sell water. This would facilitate preapproval of a range of transfer volumes, depending on hydrologic and market conditions. To protect private and public interests, these assessments should consider potential negative effects of transfers that currently require mitigation under state law (i.e., effects on other surface water users), as well as effects on groundwater users and local economies.

**Create a water transfer clearinghouse.** California's interconnected water supply grid is a major asset for managing supplies as they become scarcer. But the system is institutionally fragmented, split across state, federal, and local operators. Although cooperative agreements have improved operations, the rules for transferring water from different types of agencies are cumbersome. We propose creating a

new clearinghouse, modeled after the independent system operator for the state's electricity grid, to manage the water market in a more integrated and efficient manner.

**Fund the public goods aspects of water management.** For the foreseeable future, state general funds are unreliable and unsuitable for managing the public aspects of water management—which include planning, enforcement, science, and ecosystem management. California should learn another lesson from the electricity sector and introduce a public goods charge on water use. This charge—a small volumetric fee—would also be a more appropriate funding source for regional water projects than the general obligation bonds that have been used recently. Specific fees for environmental mitigation, including dam removal and control of contaminants, are also appropriate. Water quality permit fees, which now fund regulatory administration, also should be augmented to support ecosystem management. Fees covering broader purposes than regulatory administration will likely require legislative approval. As noted above, local contributions to flood works will also be needed, ideally on a regional scale (Table 1).

Table 1. Fee-based funding for 21st-century water management

<b>Public goods charge</b>
Ecosystem reconciliation
Regional water supply reliability and infrastructure
Administration (Department of Water Management, Department of Fish and Game, regional stewardship authorities)
Research and development
<b>Special mitigation fees</b>
Dam removal and mitigation of effects on fish
Chemical contaminants surcharge
<b>Water quality permit fees</b>
Ecosystem reconciliation
Administration (state agencies and regional stewardship authorities)

greater use of expert agencies. Thus, the functions of the State Water Resources Control Board, whether it remains in its current form or is merged into a new Department of Water Management, should be headed by an appointed state trustee. The responsibilities of the Fish and Game Commission should be limited to setting hunting and fishing regulations, with other responsibilities reassigned to the Department of Fish and Game.

**Protect the public trust.** The state should develop structures and mechanisms to ensure that the public trust in water is better protected. For instance, the legislature should create a public trust advocate, to be located either in the new Department of Water Management (or in the existing State Water Resources Control Board). The Department of Fish and Game should retain authority over environmental flows and serve as an independent, environmentally oriented check on the authority of the State Water Resources Control Board to issue and oversee water use permits.

**Build adaptive capacity.** Adaptive capacity is particularly important given the many continuing changes in California's economy, society, and environment. One key institutional issue is to avoid unnecessarily locking in decisions for lengthy time periods. Permits, licenses, and contracts can limit the government's adaptive capacity when they do not allow for modification during their terms, last for long time periods, and carry a presumption of renewability. Both the state and federal governments should reevaluate whether current terms and conditions for dam licenses, water contracts, and water rights permits should be revised.

## Facilitating and Sequencing Reform

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Changes to the status quo are never easy, and many of the reforms we propose will meet resistance from stakeholders who fear the loss of control or the potential costs of change. Even when reforms would benefit society as a whole, they

often impose transition costs on some stakeholders. A new policy to restrict groundwater overdraft, for example, would require at least some existing groundwater users either to reduce their water use or find other, probably more expensive, water sources. However, numerous approaches are available to lessen this resistance and lower the costs of reform.

### Cooperative Approaches

In California's decentralized system, the concept of cooperative federalism—whereby higher levels of government set performance standards for lower levels of government—is essential to effective policy reform. The state has an interest in establishing goals and standards for the management of

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The state should move from management through board structures toward greater use of expert agencies.

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groundwater, nonpoint pollution, flood risk, and watershed integration. But these management solutions will benefit from local innovation, achieve greater local buy-in, and be more cost-effective when local entities are allowed to develop implementation and enforcement plans. The state's role should be to set deadlines and guidelines for local compliance, stepping in only where local entities do not step forward. The state can also encourage lower costs for local actors by facilitating the use of flexible compliance tools, such as cap and trade for water pollution management and water markets.

### Compensation

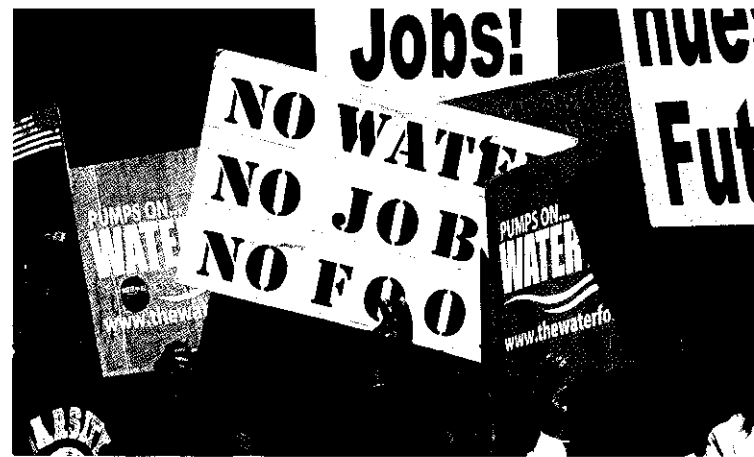
Although few water policy changes legally require compensation from the government, compensation may be warranted to facilitate some economically and environmentally beneficial reforms. For water marketing, more attention should be devoted to mitigating economic harm to third parties in regions exporting water—including workers who may become unemployed and local governments that may

incur higher social service costs and lower tax receipts. This is of particular concern when water is made available by taking farmland out of production—one of the main ways to achieve net water savings in agriculture. Mitigation is not legally required in these cases, but an equitable water policy should encourage buyers and sellers to fund programs to address significant negative local effects resulting from major transfers. Compensation also may be appropriate to ease transitions for Delta landowners facing island flooding. And, as noted above, local governments (in addition to affected landowners) also should be compensated for forgone tax revenues as part of new flood easements. In general, compensation should be funded by beneficiaries rather than the government, to limit burdens on public budgets.

### Flexible Timing

Some elements of this reform agenda are urgent, but not every reform to California water policy needs to be immediate. In some cases, waiting may produce valuable information or new technologies or save on administrative expenses. Waiting for better information on whether the future climate will be wetter or drier before building new surface storage is an example, because new storage is expensive and will have little added value in a drier climate with less water available to fill reservoirs. Urgent actions are those that help to avoid irreversible losses (as with species protection) or that help avoid catastrophic costs to the economy (as with the Delta or with development in floodplains).

Flexibility can also help lower transition costs for stakeholders. For groundwater management, phasing in reforms (focusing initially on regions with the most severe problems) may be appropriate. Delayed implementation is another transition tool. For instance, even though efforts should start immediately to limit floodplain development and to improve building codes, the implementation of risk-based flood management should reasonably be delayed to allow time for the development of adequate planning systems. New conservation requirements also seem good candidates for delayed implementation, to allow time for new technologies and habits to become familiar.



*Mitigation funds can ease transitions for low-income groups harmed by new water policies.*

### Acting Now to Avert Crisis

Without bold action, California will be subjected to a succession of protracted water crises. In fact, crises have motivated most water reforms in California's history. But by the time a crisis strikes, political positions may have become too entrenched to overcome, many of the best options may be precluded or difficult to implement, and costs may be greater.

Even with measures to reduce costs to stakeholders and to ease transitions, the reforms outlined here will not be easy. But California possesses strong foundations for implementing a bold agenda of reforms to meet the needs of changing times. The state has opportunities to significantly reduce urban water use without reducing quality of life and to equitably and responsibly transition some water from low-value agricultural activities. Diverse, flexible strategies are available for improving water quality and reducing flood risk in environmentally responsible ways. These actions will be costly in the short term but will pay off many times over by enabling the economy and society to thrive and by more effectively safeguarding California's unique natural environment. Change is never easy, but Californians need to have the courage and foresight to create a sustainable and prosperous water future. ●

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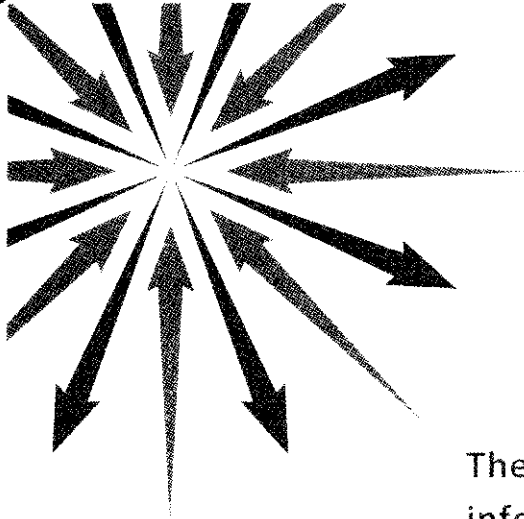
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