EXECUTIVE SUMMARY

LONG CONSIDERED THE Holy Grail of water supply, desalination offers the potential of an unlimited source of fresh water purified from the vast oceans of salt water that surround us. The public, politicians, and water managers continue to hope that cost-effective and environmentally safe ocean desalination will come to the rescue of water-short regions. While seawater desalination plants are already vital for economic development in many arid and water-short areas of the world, many plants are overly expensive, inaccurately promoted, poorly designed, inappropriately sited, and ultimately useless. To avoid new, expensive errors, policymakers and the public need to take a careful look at the advantages and disadvantages of desalination and develop clear guidance on how to evaluate and judge proposals for new facilities.

In this report, the Pacific Institute provides a comprehensive overview of the history, benefits, and risks of ocean desalination, and the barriers that hinder more widespread use of this technology, especially in the context of recent proposals for a massive increase in desalination development in California.

The potential benefits of ocean desalination are great, but the economic, cultural, and environmental costs of wide commercialization remain high. In many parts of the world, alternatives can provide the same freshwater benefits of ocean desalination at far lower economic and environmental costs. These alternatives include treating low-quality local water sources, encouraging regional water transfers, improving conservation and efficiency, accelerating wastewater recycling and reuse, and implementing

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smart land-use planning. At present, the only significant seawater desalination capacity is in the Persian Gulf, on islands with limited local supplies, and at selected other locations where water options are limited and the public is willing to pay high prices.

In the United States, almost all seawater desalination facilities are small systems used for high-valued industrial and commercial needs. This may be changing. Despite the major barriers to desalination, interest has recently mushroomed as technology has improved, demands for water have grown, and prices have dropped.

Interest in desalination has been especially high in California, where rapidly growing populations, inadequate regulation of the water supply/land-use nexus, and ecosystem degradation from existing water supply sources have forced a rethinking of water policies and management. In the past five years, public and private entities have put forward more than 20 proposals for large desalination facilities along the California coast (Figure ES1; Table ES1). If all of the proposed facilities were built, the state's seawater desalination capacity would increase by a factor of 70, and seawater desalination would supply 6% of California's year 2000 urban water demand. Project proponents point to statewide water-supply constraints, the reliability advantages of "drought-proof" supply, the water-quality improvements offered by desalinated water, and the benefits of local control. Along with the proposals, however, has come a growing public debate about high economic and energy costs, environmental and social impacts, and consequences for coastal development policies. We review and analyze these factors here.

Figure ES1
Map of Proposed Desalination Plants in California, Spring 2006

- ● > 20 MGD (76,000 m^3/d)
- ○ 5 – 20 MGD (19,000 – 76,000 m^3/d)
- ● < 5 MGD (19,000 m^3/d)

Operator	Location	Max Capacity MGD	Max Capacity m^3/d
Marin Municipal Water District	San Rafael	10-15	38,000-57,000
East Bay Municipal Utility District/ San Francisco Public Utilities Commission/ Contra Costa Water District/ Santa Clara Valley Water District	Pittsburg/Oakland/ Oceanside	20-80	76,000-300,000
East Bay Municipal Utility District	Crockett	1.5	5,700
Montara Water and Sanitary District	Montara	N/A	N/A
City of Santa Cruz	Santa Cruz	2.5, possible expansion to 4.5	9,500, possible expansion to 17,000
California American Water Company	Moss Landing	11-12	42,000-45,000
Pajaro-Sunny Mesa/Poseidon	Moss Landing	20-25	76,000-95,000
City of Sand City	Sand City	0.3	1,100
Monterey Peninsula Water Management District	Sand City	7.5	28,000
Marina Coast Water District	Marina	1.3	4,900
Ocean View Plaza	Cannery Row	0.05	190
Cambria Community Services District/ Department of the Army	Cambria	0.4	1,500
Arroyo Grande/Grover Beach/ Oceano Community Services District	Oceano	1.9	7,100
Los Angeles Department of Water and Power	Playa Del Rey	12-25	45,000-95,000
West Basin Municipal Water District	El Segundo	20	76,000
Long Beach Water Department	Long Beach	8.9	34,000
Poseidon Resources	Huntington Beach	50	190,000
Municipal Water District of Orange County	Dana Point	25	95,000
San Diego County Water Authority/ Municipal Water District of Orange County	Camp Pendleton	50, expanding to 100	190,000, expanding to 380,000
Poseidon Resources	Carlsbad	50, possible expansion to 80	190,000, possible expansion to 300,000
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Table ES1
Proposed Plants in California as of Spring 2006

Based on this assessment, we conclude that most of the recent seawater desalination proposals in California appear to be premature. Among the exceptions may be desalination proposals where alternative water-management options have been substantially developed, explicit ecosystem benefits are guaranteed, environmental and siting problems have been identified and mitigated, the construction and development impacts are minimized, and customers are willing to pay the high costs to cover a properly designed and managed plant.

When the barriers to desalination are overcome, carefully regulated and monitored construction of desalination facilities should be permitted. We urge regulators to develop comprehensive, consistent, and clear rules for desalination proposals, so that inappropriate proposals can be swiftly rejected and appropriate ones identified and facilitated. And we urge private companies, local communities, and public water districts that push for desalination facilities to do so in an open and transparent way, encouraging and soliciting public participation and input in decision making.

Is desalination the ultimate solution to our water problems? No. Is it likely to be a piece of our water management puzzle? Yes.

Is desalination the ultimate solution to our water problems? No. Is it likely to be a piece of our water management puzzle? Yes. In the end, decisions about desalination developments will revolve around complex evaluations of local circumstances and needs, economics, financing, environmental and social impacts, and available alternatives. We urge that such decisions be transparent, open, public, and systematic. To that end, we offer a set of **Conclusions and Recommendations** that will help water users and planners interested in making desalination a more significant part of international, national, and local water policy. Our intention is to provide information to help the public and policymakers understand and evaluate the arguments being put forward by both proponents and opponents of the current proposals.

Desalination Conclusions and Recommendations

Economic Costs of Desalination

The cost of desalination has fallen in recent years, but it remains an expensive water-supply option. Desalination facilities are being proposed in locations where considerable cost-effective conservation and efficiency improvements are still possible.

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- Water planners, agencies, and managers must comprehensively analyze all options, including conservation and efficiency, and pursue less costly, less environmentally damaging alternatives first.
- Desalination facilities should be approved only where water agencies have implemented all cost-effective water conservation and efficiency measures.

Desalination costs are influenced by many factors, making comparisons difficult and estimates uncertain.

- All cost estimates should explicitly state the underlying assumptions.
- Cost comparisons must be made on a comparable basis.

The assumption that desalination costs will continue to fall may be false. Further cost reductions may be limited, and future costs may actually increase.

- Projected costs must be justified over the lifetime of the facility, taking into account possible changes in the cost of energy and construction materials, limits to membrane performance, and other factors.

More energy is required to produce water from desalination than from any other water-supply or demand-management option in California. The future cost of desalinated water will be more sensitive to changes in energy prices than will other sources of water.

- Project proponents should estimate and publicly disclose the full energy requirements of each proposed project and provide details of energy contracts.

- Project proponents should explicitly evaluate energy price risk, including year-to-year variation and trends over time, in the revenue requirement of water utilities that invest in or purchase water from ocean desalination.

Public subsidies for desalination plants are inappropriate unless explicit public benefits are guaranteed.

- Decisionmakers should offer public subsidies to desalination facilities only when the facilities come with a guarantee of public benefits, such as restoration of ecosystem flows.

More research is needed to fill gaps in our understanding, but the technological state of desalination is sufficiently mature and commercial to require the private sector to bear most additional research costs.

- Public research funds should be restricted to analyzing the public aspects of desalination projects, including environmental impacts, mitigation, and protection.

Reliability and Water-Quality Considerations

Desalination plants offer both system-reliability and water-quality advantages, but other options may provide these advantages at lower cost.

- Water agencies should estimate the value of reliability or water-quality advantages in general, regardless of how that reliability or water-quality improvement is achieved.

- Water agencies should compare the cost of providing reliable or high-quality water from various sources, including ocean desalination. Water managers must still apply the standard principles of least-cost planning.

Desalination can produce high-quality water but may also introduce biological or chemical contaminants into our water supply.

- In order to ensure public health, all water from desalination plants must be monitored and regulated.

- When new or unregulated contaminants are introduced, new legislation, regulatory oversight, or standards may be needed.

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Desalination can produce water that is corrosive and damaging to water-distribution systems.

- Additional research is needed to determine the impacts of desalinated product water on the distribution system.
- Water-service providers must ensure that distribution systems are not adversely affected.

Environmental Considerations

Desalination produces highly concentrated salt brines that may also contain other chemical pollutants. Safe disposal of this effluent is a challenge.

- More comprehensive studies are needed to adequately identify all contaminants in desalination brines and to mitigate the impacts of brine discharge.
- Water managers should carefully monitor, report, and minimize the concentrations of chemicals in brine discharges.
- Federal or state regulators should evaluate whether new water-quality regulations are needed to protect local environments or human health.
- Under all circumstances, water managers must minimize brine disposal in close proximity to sensitive habitats, such as wetlands.
- Disposal of brine in underground aquifers should be prohibited unless comprehensive and competent groundwater surveys are done and there is no reasonable risk of brine plumes appearing in freshwater wells.

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- The effects of impingement and entrainment require detailed baseline ecological assessments, impact studies, and careful monitoring.
- Intake pipes should be located outside of areas with high biological productivity and designed to minimize impingement and entrainment.

Subsurface and beach intake wells may mitigate some of the environmental impacts of open ocean intakes. The advantages and disadvantages of subsurface and beach intake wells are site-specific.

- For all desalination projects, proponents should evaluate the advantages and disadvantages of these options, including a review of impacts on freshwater aquifers and the local environment.

Desalination may reduce the need to take additional water from the environment and, in some cases, offers the opportunity to return water to the environment.

- Desalination proposals that claim environmental benefits must come with binding mechanisms to ensure that these benefits are delivered and maintained in the form, degree, and consistency promised.

Climate Change

Desalination offers both advantages and disadvantages in the face of climatic extremes and human-induced climate changes. Desalination facilities may help reduce the dependence of local water agencies on climate-sensitive sources of supply.

- Desalination proposals should evaluate the long-term climatic risks and benefits.

Extensive development of desalination can lead to greater dependence on fossil fuels, an increase in greenhouse gas emissions, and a worsening of climate change.

- Plans for desalination must explicitly describe the energy implications of the facility and how these impacts fit into regional efforts or requirements to reduce greenhouse gas emissions or meet regional, state, or federal clean air requirements.
- Regulatory agencies should consider requiring desalination plants to offset their greenhouse gas emissions.

Coastal desalination facilities will be vulnerable to the effects of climate change, including rising sea levels, storm surges, and extreme weather events.

- Planners should design and construct all desalination facilities using estimates of future, not present, climate and ocean conditions.
- Regulatory agencies should permit desalination facilities only when consideration of climate change factors and other hazards has been integrated into plant design.

Siting and Operation of Desalination Plants

Ocean desalination facilities, and the water they produce, will affect coastal development and land use.

- Project proponents must evaluate the growth-inducing impacts of desalination facilities on a case-by-case basis and not assume these impacts to be incidental, minimal, or secondary.
- Desalination proponents must identify to the public and appropriate regulatory agencies all buyers and potential buyers of project water.
- California coastal development permits should be denied to desalination plants that will induce growth beyond levels projected in certified Local Coastal Programs.

There are unresolved controversies over private ownership and operation of desalination facilities.

- Negotiations over project contracts should be open, transparent, and include all affected stakeholders.

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- Contracts that lay out the responsibilities of each partner are a prerequisite for the success of any project. These contracts must include explicit dispute resolution mechanisms and provisions addressing financial risks in the event of project failure.
- Independent technical and contract review should be standard.

Co-location of desalination facilities at existing power plants offers both economic and environmental advantages and disadvantages.

- Proponents should not use desalination to keep once-through cooling systems in operation longer than would otherwise be permitted under current or proposed regulations.
- Regulators should not issue exemptions to permit once-through cooling systems to remain in operation solely to service desalination plants.
- Project proponents must assess the effects of desalination independently of the power plant due to uncertainty associated with once-through cooling system systems.
- Additional research is needed to determine whether there are synergistic effects caused by combining desalination's high salinity discharge with the high temperatures and dead biomass in power plant discharge.

Siting, building, and operation of desalination facilities are likely to be delayed or halted if local conditions and sentiments and the public interest are not adequately acknowledged and addressed.

- The process of designing, permitting, and developing desalination facilities must be transparent and open.
- Draft contracts, engineering designs, and management agreements should be widely available for public review beginning in the early stages of project development.
- Project developers and local water agencies should commission and make publicly available independent review of the social and economic impacts of desalination facilities on local communities.
- Affected community members should be invited to participate in desalination project planning, implementation, and management during the early stages of the process.

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- Federal, state, and local policies should standardize and clarify the regulation of desalination.
- Desalination should not be hindered by inappropriate regulation nor accelerated by regulatory exemptions.