Seawater Desalination
And the California Coastal Act

California Coastal Commission
March 2004

[this page intentionally blank]

TABLE OF CONTENTS

[this page intentionally blank]

EXECUTIVE SUMMARY

In view of evolving issues relating to adequacy of water supplies to meet the state's projected population growth, desalination will obviously be an important part of California's water future. The question is not whether, but rather how, where, when, by whom, and under what conditions will desalination projects be designed, built, and operated.

There is growing interest and concern about seawater desalination along the California coast. The interest is due in large part to recent technological developments that reduce the costs and energy requirements of producing desalinated water. Additionally, many water agencies and purveyors are interested in reducing their dependence on imported water supplies and view desalination as providing a reliable and local source of water. The concerns about desalination are due primarily to its potential to cause adverse effects and growth that are beyond the capacity of California's coastal resources.

There are currently about two dozen seawater desalination facilities being proposed along the California coast, including some that would be the largest in the U.S. The state does not have a great deal of recent experience or expertise in evaluating the environmental impacts or the public resource issues associated with desalination, and this report is meant to identify many of the elements that will likely be a part of these upcoming evaluations.

The California Coastal Commission will be involved in nearly all coastal desalination proposals, either through planning, permitting, permit appeals, or other forms of review. This report from Commission staff is meant to help with those reviews in several ways:

- It provides general information for the Commission, applicants, and the interested public about the issues related to desalination along the California coast, and desalination's possible effects on coastal resources and coastal uses;
- It describes the status of seawater desalination in California and the proposed facilities now being planned;
- It identifies and discusses Coastal Act policies most likely to apply to proposed desalination facilities; and,
- It identifies much of the information likely to be required during coastal development permit review for proposed facilities.

Additionally, the report is based on several key points:

- ***It is meant to be informational only:*** The report does not create new regulations or guidelines for reviewing proposed desalination facilities. Rather, it describes desalination issues as they relate to existing Coastal Act policies, and discusses how these policies are likely to apply to a proposal.

- ***It is based on the need to provide case-by-case review:*** Because each proposed desalination facility will have unique design and siting characteristics, each is likely to be subject to a different set of Coastal Act policies and will likely conform to those policies in different ways. This report, therefore, makes no overarching recommendations in support or opposition to desalination. Some desalination proposals may be environmentally benign or may even provide environmental benefits, while others may cause significant adverse impacts. Determining whether a proposed project will conform to the Coastal Act will therefore be done on a case-by-case basis.

- ***It is written in a precautionary tone:*** Many of the concerns and issues involved in large-scale coastal desalination have not yet been tested in California, and much of the information about desalination, when it is available, has not yet been compiled in a comprehensive and useful way. As a result, much of this report is written in a precautionary tone. Some of the facilities being proposed raise significant public policy and environmental issues, and the consequences of some of those issues, such as the cumulative impacts of desalination on the marine ecosystem or the implications of consumptive use of ocean water under international trade agreements, are still emerging. It is therefore likely that upcoming reviews of proposed facilities will require comprehensive, detailed, and specific analysis to ensure the facilities meet applicable policies and allow the state to maintain and protect its coastal resources.

The report is also being issued as part of a larger statewide interest in determining the implications of desalination to California. In 2004, the Department of Water Resources convened a task force, pursuant to AB 2717, to identify the opportunities and constraints for desalination to provide part of the state's water supply, and to evaluate whether the state should play a role in supporting desalination. This report incorporates the work of the task force, as appropriate. It also incorporates many of the comments received during a ninety-day public review period in the fall of 2004 on a draft version of this report so as to more fully reflect concerns and issues related to desalination and Coastal Act policies.

INITIAL FINDINGS

Some of the key findings in this report include:

- ***Each proposed desalination facility will require case-by-case review:*** As stated above, because each facility has unique design, siting, and operating characteristics, different Coastal Act policies are likely to apply differently to each one. This will require case-by-case review to determine Coastal Act conformity, adverse impacts, and the measures necessary to avoid and mitigate for those impacts.

- ***Coastal Act policies do not suggest overall support of, or opposition to, desalination:*** The Coastal Act allows many types of development to occur within the coastal zone, as long as they conform to Coastal Act policies. Properly designed and operated desalination is one of these types of development.

- ***There may be differences in applying Coastal Act policies to public or private desalination facilities:*** The Coastal Act is based in part on many of the coastal resources of California being public resources, and the consumptive use of seawater by private entities will require thorough evaluation and adequate assurances that public uses and values will be protected. There are also numerous concerns about how various international trade agreements may affect implementation of not only the Coastal Act, but many other state and local environmental or public interest regulations.

- ***The most significant potential direct adverse environmental impact of seawater desalination is likely to be on marine organisms:*** This impact is due primarily to the effects of the seawater intake and discharge on nearby marine life; however, these effects can be avoided or minimized through proper facility design, siting, and operation.

- ***The most significant potential indirect adverse impacts are likely to be those associated with growth-inducement:*** Review of coastal desalination facilities will likely need to assess whether the water supply provided by then new facilities comes with assurances that the resulting growth will not exceed the capacity of coastal resources.

- ***Desalination facilities proposing to co-locate with coastal power plants will raise unique issues and will need to be reviewed differently than facilities proposing to locate independently:*** The largest proposed desalination facilities would be located at coastal power plants that use ocean water for cooling. While this co-location may offer some advantages, review of such facilities will need to consider the combined and incremental effects caused by operating desalination facilities at coastal power plants using up to hundreds of millions of gallons per day of seawater.

SUMMARY OF PUBLIC COMMENTS

Commission staff received numerous comments during public review of the draft version of this report. The primary types of comments are summarized below:

Regarding the benefits of desalination: Commenters suggested the report describe more of the benefits associated with desalination, such as reducing dependence on imported water supplies, providing better quality drinking water, reducing pressure on other surface water sources, etc.

In response, the report now includes descriptions or acknowledgement of several additional benefits that may result from desalination. It has kept its overall cautionary tone, however, in recognition of the high degree of uncertainty about the effects of desalination on a variety of coastal resources.

Regarding growth-inducement: Comments ranged from recognizing this as the most critical aspect associated with desalination's effects on the coast to statements that the Coastal Act does not allow the Coastal Commission to review growth-inducing aspects of development.

In response, the report retains and clarifies its discussion on growth-inducement as a part of Coastal Act review, and also recognizes that some aspects of this issue are often addressed through other local, regional, or state processes.

Regarding desalination effects on water quality and marine biology: Comments ranged from recognizing these as potentially significant impacts to recommending the Coastal Commission defer evaluation of these issues to other agencies.

In response, the report retains and clarifies discussion of these issues and emphasizes the Coastal Commission's role in maintaining, restoring, and enhancing coastal water quality and habitats.

Regarding co-locating desalination facilities with power plants: Commenters suggested the report emphasize the benefits of co-locating with existing power plants using once-through cooling. Other commenters expressed concerns that co-location could allow continuation and expansion of environmentally harmful effects associated with once-through cooling system.

In response, the report includes a separate section on this issue and describes both the advantages and concerns that may be brought about by co-location.

Regarding public, private, and international trade issues: Comments ranged from those recognizing these issues as critical in the Commission's deliberations about desalination and other issues that could affect coastal resources to those strongly suggesting these issues had no place in this report.

In response, and with additional research, the report retains its discussion of these issues, although with more recognition of the questions still needing to be answered than the answers themselves.

Regarding "coastal-dependency": Several commenters suggested for various reasons – its dependence on seawater, its similarity to other uses so designated, etc. – that desalination should be considered "coastal-dependent" for purposes of Coastal Act review.

In response, the report re-iterates the likelihood that portions of many desalination facilities may be considered "coastal-dependent" and that other portions might not be. It also provides a more detailed description of related policies and examples of other similar situations in which distinctions were made between "coastal-dependent" and non-"coastal-dependent" portions of proposed developments.

CHAPTER 1: INTRODUCTION AND BACKGROUND

Chapter Sections:

1.1 PURPOSE OF REPORT

For years, desalination has been considered as a possible source of fresh water for areas of coastal California. Along many parts of the coast, the amount of available water has been one of the primary limits on the rate of growth. However, despite the abundance of water in the Pacific Ocean, desalination's relatively high costs and energy requirements have resulted in coastal areas getting most of their water supply from other sources such as groundwater and imported water or from water conservation measures.

Recent changes in desalination technology have reduced its costs to levels closer to those of some of these other sources. Additionally, many are looking at desalination as a way to provide a more reliable supply of water during the state's recurring droughts and to reduce the dependence of coastal communities on water imported from inland areas. Additional interest has been generated by recently implemented state laws that require proposed developments to provide more certainty of adequate water supplies during environmental or permit review. As a result, desalination is currently being considered as a more feasible source of water in many areas of the California coast than it had been previously.

Seawater desalination also raises concerns about how it will affect marine life, water quality, public access, and other coastal resources. Numerous studies and reports identify the adverse effects of pollution, overfishing, and other unsustainable practices on water quality and marine life along the California coast, and poorly designed desalination facilities, particularly at the scale of some proposed in California, could not only cause significant adverse impacts on their own, but could add substantially to the cumulative detrimental effects already occurring.

Desalination facilities proposed along California's coast will require review by the California Coastal Commission to determine whether the proposal conforms to the policies of the California Coastal Act. This report, by Coastal Commission staff, addresses many of the issues that are likely to be considered during such a review, and is meant to serve a number of purposes:

- It provides information to the Coastal Commission, applicants, and the interested public about many of the issues related to desalination along the California coast, especially as they relate to the Coastal Act.

- It describes much of the information and evaluation that will likely be needed as part of the Coastal Commission's review of proposed facilities to determine whether the proposals conform to Coastal Act policies.
- It summarizes the status of desalination along the coast and lists the known anticipated facilities now being planned.

- It updates the Coastal Commission's 1993 report, Seawater Desalination in California, to reflect changes in desalination technology, improved understanding of coastal resources, and additional policy considerations of the Coastal Act. When the 1993 report was published, the state was just coming out of a period of several years of low water supplies, and there were about a dozen relatively small desalination facilities along the California coast, producing relatively expensive water primarily for drought relief, emergency supply, or for use in areas isolated from other water sources. Since that time, with increasing pressures on other available sources of water and decreasing economic costs of desalination, facilities being proposed would increase seawater desalination eighty-fold along the coast.

- It reflects some of the recent work done by two working groups looking at desalination in California. One group, a state desalination task force convened by the California Department of Water Resources, was formed pursuant to AB 2717 and was asked to identify the opportunities and constraints for desalination in the state and determine what role, if any, the state should play in furthering desalination technology. This group developed a number of findings and recommendations, many of which are incorporated into this report. Another group, convened by the Monterey Bay National Marine Sanctuary as part of the Sanctuary's Management Plan Update, developed recommendations regarding desalination for the Sanctuary's update of its Management Plan. While this latter group's efforts focused on desalination within the Sanctuary boundary, much of its work is applicable to the entire California coast.

- Finally, pursuant to Coastal Act Section 30006.5, the report is meant to provide "sound and timely scientific recommendations to the Coastal Commission" to use during deliberations on significant issues related to coastal resources.

CAVEATS

Several important caveats should be noted regarding this report:

- Because the report evaluates desalination in general rather than reviews a specific proposal, it is not meant to represent the definitive set of issues and concerns that would be addressed during review of any particular proposal. Each review will likely raise unique Coastal Act conformity issues based on the location, design, and operation of each proposed facility. The report, however, does describe a fairly complete range of the more significant issues that may be involved in reviewing any given proposed facility.

- The report is focused primarily on how proposed seawater desalination facilities are likely to be evaluated for conformity to Coastal Act policies. It is not meant to identify all the other issues that may come up during review under other regulations, such as local zoning

ordinances, health department requirements, or others, although many may be the same or similar to those discussed herein.

- While the report mentions some of the broader issues involved in planning for state or regional water supplies, such as discussing the role of imported water, conservation, or elements that may be included in a comprehensive water portfolio, it is not meant to replace the more detailed planning needed at the state, regional, or local level to fully evaluate the mix of sources and uses for a community's water supply.

- Finally, given the state's limited experience with large-scale seawater desalination and the many uncertainties about how such facilities may affect coastal resources, the report is written in a cautionary tone. There is relatively little information available on many aspects of desalination – such as its effects on particular marine species or habitats, whether monitoring requirements at existing facilities adequately characterize the effects the facilities are having, and the potential cumulative impacts of water withdrawals and discharges from multiple desalination facilities or other types of facilities in a waterbody – and so, absent a large body of research or scientific certainty, the report attempts to make it clear that review of a proposed project may require significant information to provide the level of certainty needed to determine whether a facility will conform to the Coastal Act.

1.2 PRIMARY FINDINGS AND RECOMMENDATIONS

The report makes a number of findings and recommendations related to project review, protection of coastal resources, and the applicability of various Coastal Act policies, including the following:

GENERAL FINDINGS AND RECOMMENDATIONS

The report neither supports nor opposes desalination. Desalination has been identified as an important part of the state's future water supply. The California Department of Water Resources as well as a number of local or regional water agencies have identified desalination as providing a portion of the water they expect to provide to the state over the next several decades. If properly sited, designed, and operated, some desalination facilities could be operated in an environmentally benign manner and conform to Coastal Act requirements, and may even result in some environmental benefits, while other proposed facilities would likely cause significant adverse effects and not conform to applicable regulations.

Desalination facilities will require case-by-case review. Because each proposed facility would have a different design and location, each will also raise different issues of concern and likely be subject to a different mix of Coastal Act policies. Therefore, the information provided in this report recognizes that each desalination proposal will require case-by-case review. This approach will allow each proposal to be reviewed based on the specific characteristics of the proposed facility and the particular coastal resources of concern at specific sites, and will allow necessary mitigation measures to be tailored to each. Although each facility will undergo case-by-case review and a location-specific evaluation, this report is meant to provide sufficient general information about the types of review and the level of detail likely to be required to complete Coastal Commission review.

PLANNING

A desalination facility's most significant effect could be its potential for inducing growth. The existing pressures on California's coastal resources are substantial, even with the protections provided by such measures as the Coastal Act and other laws. If desalination removes the limits imposed on growth along the coast due to the current limited supply of water, the degradation of coastal resources could increase beyond sustainable levels. Adequate, comprehensive review of these issues will be a critical part of reviewing proposed facilities to ensure the California coast remains a place of environmental value and public enjoyment.

Desalination proposals should be reviewed in the context of an overall water management plan. A proposed desalination facility should not be reviewed in isolation – it should be part of a comprehensive water management approach that identifies other water sources, incorporates conservation methods, and assesses alternative methods of providing a community's water supply. A comprehensive plan should identify and implement all opportunities for water conservation and reclamation that would reduce impacts on coastal resources. As part of this approach, Local Coastal Programs (LCPs) should incorporate and encourage use of conservation and reclamation measures to reduce the need for new water projects. LCPs should also specify the quantity of water supplies that will be needed for the planned levels of development.

There may be significant differences in determining whether public or private desalination facilities conform to Coastal Act policies. The Coastal Act is based largely on coastal resources being public resources. Private consumptive use of these resources will likely result in a different type of review than public use. Water is often the limiting factor for potential development projects and growth within a community. Because the form of ownership and operation of a desalination facility may contribute to whether its water allocations are consistent with the development priorities mandated in the Coastal Act or incorporated in a certified LCP, the Commission should evaluate whether special or additional conditions may be necessary or appropriate based on a proposed facility's form of ownership.

The cumulative impacts of a proposed desalination projects should be thoroughly evaluated during environmental review. Coastal Commission staff should work with the applicant, other agencies, and the interested public to consider the potential cumulative impacts of desalination projects. Among the important issues to address are the impacts of building a number of small facilities versus a few larger ones, the cumulative impacts on growth from the additional water supplied by new facilities, and the environmental effects of additional power production needed to operate the facilities.

REVIEW PROCEDURES

There should be early coordination between project proponents and involved agencies. The Coastal Commission staff should become involved in a desalination project proposal as early as possible in the applicable planning processes, including but not limited to those

mandated under CEQA and/or NEPA, and those carried out by local or regional water supply agencies.

FACILITY DESIGN AND OPERATIONS

The most significant direct adverse environmental impacts of seawater desalination facilities are likely to be their effects on marine organisms. Seawater desalination facilities that draw water directly from the open ocean or estuaries entrain and kill many small marine organisms, such as plankton, larvae, and fish eggs. In some cases, this impact could be significant, especially with a large or poorly sited intake. However, there are several alternative designs and mitigation measures that could completely avoid or substantially reduce this impact. Subsurface intakes, such as beach wells or infiltration galleries, where feasible, have the significant advantage of eliminating impingement and entrainment impacts. Applicants are encouraged to use subsurface intakes whenever feasible, and where they will not cause significant adverse impacts to either beach topography or potable groundwater supplies. Projects proposing to use open water intakes should expect to provide information about their effects on marine organisms as part of their permit applications.

Facilities should be designed to avoid or minimize the use of hazardous chemicals. Applicants are encouraged to select technologies and processes that minimize or eliminate the need for hazardous chemicals. This will reduce the disposal requirements for such substances, lessen the impacts of potential spills or releases from the facility, and reduce discharges of hazardous constituents into the ocean. Applicants should also select the least environmentally damaging options for feedwater treatment and cleaning of plant components.

Facilities should incorporate any of several ways to avoid or minimize adverse impacts associated with desalination discharges. Applicants should provide information about the potential impacts to marine resources from the proposed discharges. This information may be obtained from survey results, pre-operational monitoring, monitoring results from other desalination plants, or other sources. The information will then be reviewed by the Coastal Commission staff in consultation with the RWQCB with jurisdiction in the area where the facility is proposing to locate. Applicants should also evaluate options for combining brine discharges with discharges from a power plant or a sewage treatment plant. Combining the desalination discharge with other discharges may be preferable to direct discharges of brine and may result in fewer overall impacts, but this will require case-by-case review. When the brine will be combined with other discharges, the applicant should clearly identify which party or parties will be responsible for monitoring the discharges and for providing corrective measures for any adverse impacts that occur.

1.3 REPORT ORGANIZATION

Chapter 1 of this report provides a brief introduction, a description of existing and proposed desalination facilities along the California coast, and some of the current local, state, and federal initiatives on desalination. **Chapter 2** provides a summary of the Coastal Act – including its background, some of its policies and definitions, and its review process – and discusses how some of these issues are likely to be incorporated into the review of proposed desalination facilities. **Chapter 3** follows with a description of the main methods used in desalination and a discussion of desalination costs and energy requirements. **Chapter 4** discusses the primary public resource issues related to reviewing proposals for conformity to the Coastal Act, including the Public Trust Doctrine, issues of public or private ownership, international trade, and several specific Coastal Act policies. **Chapter 5** discusses some environmental effects that desalination may have on various coastal resources, in particular those associated with marine biology and water quality. **Chapter 6** provides a brief description of some other regulatory issues and the local, state, or federal agencies likely to be involved in desalination review. **Appendix A** includes a glossary of desalination-related terms. For ease of reading, many sections of the report start with **Main Points** that are then discussed in greater detail within that section of the report. In addition, many sections end with **What's Likely Needed During Review?**, describing information about a proposed project that may be needed during Coastal Act review.

1.4 EXISTING AND PROPOSED DESALINATION FACILITIES ALONG THE CALIFORNIA COAST

There are currently about a dozen existing desalination facilities along the California coast (see Table 1) and at about two dozen facilities being considered (see Table 2). Comparing the two tables gives a sense of the current high level of interest in desalination along the coast and the scale of the changes being considered. Existing coastal desalination facilities are relatively small, and in total, can produce up to a maximum of about 3300 acre-feet per year. The total output of all the currently proposed coastal facilities, including some that would be the largest in the country, would be about 260,000 acre-feet per year, which represents roughly a 80-fold increase in production.

TABLE 1: EXISTING DESALINATION FACILITIES ALONG THE CALIFORNIA COAST

Operator/Location/Purpose/ Public or Private:	**Purpose/ Public or Private:**	**Maximum Capacity:**	**Status:**
Chevron/ Gaviota	- Industrial processing - Private	410,000 gpd/ 460 AF/yr.	Active
City of Morro Bay	- Municipal/domestic - Public	830,000 gpd/ 929 AF/yr.	Intermittent use
City of Santa Barbara	- Municipal/domestic - Public	N/A	Inactive
Duke Energy/ Morro Bay Power Plant	- Industrial processing - Private	430,000 gpd/ 482 AF/yr.	Not known
Duke Energy/ Moss Landing Power Plant	- Industrial processing - Private	480,000 gpd/ 537 AF/yr.	Active
Marina Coast Water District	- Municipal/domestic - Public	300,000 gpd/ 335 AF/yr.	Active
Monterey Bay Aquarium	- Aquarium visitor use - Non-profit	40,000 gpd/ 45 AF/yr.	Active
PG&E/ Diablo Canyon	- Industrial processing - Private	576,000 gpd/ 645 AF/yr.	Not known
Santa Catalina Island	- Municipal/domestic - Private	132,000 gpd/ 148 AF/yr.	Not known
U.S. Navy/ Nicholas Island	- Municipal/domestic - Government	24,000 gpd/ 27 AF/yr.	Not known
Various offshore oil & gas platforms	- Platform uses - Private	2,000–30,000 gpd/ 2–33 AF/yr.	Active
Total Production:	***~ 3 million gallons per day /3300 acre-feet per year***		

Note: gpd = gallons per day, and AF/yr. = acre-feet per year. There are approximately 326,000 gallons in an acre-foot, which represents the amount of water it takes to cover an acre of land one foot deep. Typically, a household will use one to two acre-feet per year.

TABLE 2: PROPOSED DESALINATION FACILITIES ALONG THE CALIFORNIA COAST

Operator/ Location:	**Purpose, and public or private:**	**Maximum Capacity:**	**Status:**
Cambria Community Services District	- Municipal/ domestic - Public	500,000 gpd/ 560 AF/yr.	Planning
Ocean View Plaza/ Monterey	- New development - Private	5,000 gpd/ 6 AF/yr.	Planning
Carmel Area Wastewater District	- Municipal/ domestic - Public	Not known	Not known
City of San Buenaventura	- Municipal/ domestic - Public	Not known	Not known
City of Sand City	- Municipal/ domestic - Public	27,000 gpd/ 30 AF/yr.	Planning
City of Santa Cruz	- Municipal/ domestic - Public	2.5 million gpd/ 2800 AF/yr.	Planning
East-West Ranch/ Cambria	- New development - Private	Not known	Withdrawn
Marina Coast Water District/ Fort Ord	- Municipal/ domestic - Public	2.68 million gpd/ 3000 AF/yr.	Planning
Long Beach	- Research - Public	300,000 gpd/ 335 AF/yr.	Design phase
Long Beach	- Municipal/ domestic - Public	10 million gpd/ 11,000 AF/yr.	Planning
Los Angeles Dept. of Water and Power	- Municipal/ domestic - Public	10 million gpd/ 11,000 AF/yr.	Planning
Monterey Bay Shores	- New development - Private	20,000 gpd/ 22 AF/yr.	Not known
Monterey Peninsula Water Mgmt. District / Sand City	- Municipal/domestic - Public	7.5 million gpd/ 8,400 AF/yr.	Planning
Cal-Am/Moss Landing Power Plant	- Municipal/domestic	9 million gpd/ 10,000 AF/yr.	Planning
Municipal Water District of Orange County / Dana Point	- Municipal/domestic - Public	27 million gpd/ 30,000 AF/yr.	Planning
Poseidon Resources / Huntington Beach	- Various - Private	50 million gpd/ 55,000 AF/yr.	Draft EIR completed
San Diego County Water Authority / San Onofre Nuclear Generating Station	- Municipal/domestic - Public	TBD	Planning
San Diego County Water Authority / South County	- Municipal/domestic - Public	50 million gpd/ 55,000 AF/yr.	Planning
San Diego County Water Authority & Poseidon Resources /Carlsbad	- Municipal/domestic - Public/private	50 million gpd/ 55,000 AF/yr.	Planning
U.S. Navy / San Diego	- Municipal/domestic - Government	700,000 gpd/ 780 AF/yr.	Not known
West Basin Municipal Water District	- Municipal/domestic - Public	20 million gpd/ 22,000 AF/yr.	Planning
Total Proposed Production:	***~ 240 million gallons per day / 260,000 AF/yr.***		

1.5 OTHER STATE, FEDERAL, AND LOCAL DESALINATION INITIATIVES

There are a number of efforts currently underway in California to study, promote, or anticipate the need for additional water supplies using desalination or other methods. Some of the main ones are listed below.

STATE

California Department of Water Resources (DWR): DWR is one of the lead agencies in the state for developing and allocating water resources. Its current work includes the following:

- ***Update of the California Water Plan for 2003:*** The draft Plan identifies the need for the state to have a balanced and integrated water portfolio and includes seawater desalination as one of over twenty sources for the state's water supply (along with surface flows, reclaimed water, groundwater, etc.). The Plan considers it moderately likely that seawater desalination could provide up to 200,000 acre-feet per year of the state's water demand by 2030.

- ***Desalination Task Force (per Assembly Bill 2717):*** This task force was charged with identifying the opportunities and constraints for desalination in providing some of the state's water supply, and to examine whether the state should play a role in furthering the use of desalination. In October 2003, the Task Force completed its work and published its findings and recommendations (see http://www.owue.water.ca.gov/recycle/desal/desal.cfm). Selected findings and recommendations have been incorporated into relevant sections of this report. As a follow-up to the work of the Task Force, DWR will continue to coordinate much of the desalination research and information available at the state level.

California Energy Commission:

- ***Review of entrainment studies:*** The CEC is compiling information about existing studies that have been used to evaluate the effects of coastal power plants on marine organisms. The compilation is meant in part to identify the adequacy and applicability of these studies to current environmental conditions near the plants, and to identify where updated studies are needed. Many of the report's findings will likely be applicable to desalination facilities proposing to co-locate at coastal power plants.

- ***Energy demand:*** Energy Commission staff is compiling data to help determine how the energy demand of proposed desalination facilities will affect the state's power grid.

FEDERAL

Bureau of Reclamation: The Bureau has several research initiatives underway. It is working with Sandia National Laboratories on a Desalination and Water Purification Technology Roadmap, primarily to identify and prioritize areas where technological efficiencies in desalination might be most effective. It is also coordinating several of the desalination research initiatives under "Water 2025", a federal program meant to manage water resources in the Western U.S. The Bureau is also working with the City of Long Beach Water Department to

develop a nanofiltration desalination technology which is anticipated to be much more energy-efficient than other types of reverse-osmosis membrane technology. The two agencies are developing a pilot project to test various techniques and types of equipment. The project would be located at the Haynes Generating Station in Long Beach.

Monterey Bay National Marine Sanctuary: The Sanctuary is updating its Management Plan and will consider including recommendations about desalination facilities that may be proposed within Sanctuary boundaries. The recommendations were developed by a desalination workgroup representing a number of interests and stakeholders in the Monterey Bay area, were evaluated by both the Sanctuary Advisory Group and the public during review of the Draft Management Plan during the summer and fall of 2003, and will be considered for adoption as part of the final Management Plan sometime in 2004. The workgroup's recommendations include the following:

- Develop a regional planning program for desalination.
- Develop facility siting guidelines, including identifying preferred conditions and habitats, areas that should be avoided, etc.
- Define standards for entrainment and impingement caused by desalination facilities and limits for brine discharges to Sanctuary waters.
- Determine which water quality models are suitable for determining discharge plumes for desalination outfalls.
- Identify the minimum required information for permit applications.
- Develop a regional monitoring program to determine cumulative impacts of multiple desalination facilities.
- Develop an education and outreach program for desalination issues.
- Track and evaluate emerging desalination activity and technology and outside the Sanctuary.

Several of these recommendations have been incorporated into applicable sections of this report.

LOCAL AND REGIONAL

A number of local or regional water districts are also considering desalination programs to provide a portion of their water supplies. Although desalination is still more expensive than existing supplies, there is a growing interest by water supply agencies to diversify their water sources and to decrease their reliance on imported water. Major efforts include:

- **Metropolitan Water District (MWD) of Southern California:** MWD is considering proposals to build and operate coastal desalination facilities within its Southern California service area. To further this goal, MWD has offered to subsidize desalination production at the rate of $250 per acre-foot for up to 25 years. At this time, five of the proposals shown in Table 2 are being considered:
  - Long Beach Water Department
  - Los Angeles Department of Water and Power
  - Municipal Water District of Orange County
  - San Diego County Water Authority/Poseidon Resources
  - West Basin Municipal Water District

The purposes of this program include reducing Southern California's dependence on imported water supplies, enhancing the portfolio of supplies available to the area, and providing an incentive to develop desalination as an additional water source in Southern California.

- **Long Beach Water Department (LBWD):** The Department recently started construction of a desalination test facility that will evaluate several desalination techniques, including one patented by the Department that may provide greater efficiencies and lower energy use.

- **San Diego County Water Authority (SDCWA):** The SDCWA recently circulated a Draft EIR for its Regional Water Facilities Master Plan that identified development of large-scale desalination facilities (up to 100,000 acre-feet per year) as its preferred alternative to provide for regional growth through 2030.

[this page intentionally blank]

CHAPTER 2: ELEMENTS OF COASTAL ACT REVIEW

Chapter Sections:

Most, if not all, seawater desalination facilities will require review for conformity to the Coastal Act due to their proposed use of seawater and their location on or near the coast. This chapter provides an overview of the Coastal Act and some of the key aspects of the Act that will likely apply to proposed desalination facilities during these reviews. It summarizes some of the Act's history and goals, its jurisdictional boundaries, and some key terms used in Coastal Act review, including "feasibility", "alternatives analysis", "mitigation", and "coastal-dependency". More information about each of these issues is available at the Coastal Commission's web site, at: www.coastal.ca.gov.

2.1 ABOUT THE CALIFORNIA COASTAL ACT

In 1976, the state Legislature enacted the California Coastal Act to provide long-term protection of the state's coastline. The Act grew out of a 1972 citizens' initiative (Proposition 20) passed to ensure protection of the California coast. The Act includes a number of policies related to:

- Protection and expansion of public access to the shoreline;
- Protection, enhancement, and restoration of important habitats and biological communities;
- Protection of areas of the coast used for priority purposes, such as coastal recreation, coastal agriculture, and others;
- Preventing sprawl;
- Providing public education about the coast and coastal issues; and,
- Establishing local controls for coastal development.

The Coastal Act is implemented through a combination of state and local jurisdictions within the state's Coastal Zone.

COASTAL ZONE

The Coastal Act applies within the state's Coastal Zone, which encompasses an area along the state's entire 1100-mile coastline, starting three miles offshore and extending inland at distances ranging from several blocks to about five miles from the ocean[1]. Additionally, the Coastal Commission has jurisdiction in matters requiring federal permits or approvals in the federal waters beyond the three-mile boundary of state waters.

[1] ***Note:*** The Coastal Commission's jurisdiction does not extend into San Francisco Bay. Areas in and around the Bay inside the Golden Gate are under the jurisdiction of the San Francisco Bay Conservation and Development Commission.

COASTAL COMMISSION

The Coastal Commission consists of twelve voting members, with four each appointed by the Governor, the head of the Senate Rules Committee, and the Speaker of the Assembly, and four non-voting members (the Secretaries of the Resources Agency and the Business and Transportation and Housing Agency, the Chair of the State Lands Commission, and the Director of the Trade and Commerce Agency). As explained below, the Commission has permit authority in those parts of the Coastal Zone without a certified Local Coastal Program, and has the ability to review and determine appeals of some local decisions.

LOCAL COASTAL PROGRAMS

Local Coastal Programs (LCPs), when adopted by local governments and certified by the Commission establish development controls for areas of local jurisdictions within the coastal zone. The Coastal Commission retains its permit jurisdiction, however, in coastal waters and tidelands and for certain types of facilities, including major public works projects. The Commission also hears appeals of local decisions in areas of an LCP designated as within the Commission's appeal jurisdiction.

PERMITS AND APPROVALS

The Coastal Act requires that many development activities and uses within the Coastal Zone obtain a permit. The types of development requiring a permit are defined in Coastal Act Section 30106:

> *"Development" means, on land, in or under water, the placement or erection of any solid material or structure; discharge or disposal of any dredged material or of any gaseous, liquid, solid, or thermal waste; grading, removing, dredging, mining, or extraction of any materials; change in the density or intensity of use of land, including, but not limited to, subdivision pursuant to the Subdivision Map Act (commencing with Section 66410 of the Government Code), and any other division of land, including lot splits, except where the land division is brought about in connection with the purchase of such land by a public agency for public recreational use; change in the intensity of use of water, or of access thereto; construction, reconstruction, demolition, or alteration of the size of any structure, including any facility of any private, public, or municipal utility; and the removal or harvesting of major vegetation other than for agricultural purposes, kelp harvesting, and timber operations which are in accordance with a timber harvesting plan submitted pursuant to the provisions of the Z'berg-Nejedly Forest Practice Act of 1973 (commencing with Section 4511).*
>
> *As used in this section, "structure" includes, but is not limited to, any building, road, pipe, flume, conduit, siphon, aqueduct, telephone line, and electrical power transmission and distribution line.*

COASTAL DEVELOPMENT PERMIT PROCESS

Reviewing a proposed project for conformity to Coastal Act requirements may encompass a wide range of issues, depending on the type of proposal, its location, and its potential to affect coastal resources. A permit review commonly addresses issues such as public access, environmental effects, priority coastal uses, visual resources, and others.

2.2 KEY COASTAL ACT TERMS

This section of the report describes several key terms used in the Coastal Act that will likely apply during review of a proposed desalination facility. How these terms are applied could determine whether a proposal is approved and how it might be sited, designed, or operated. This section first discusses three general terms – "feasibility", "alternatives" and "mitigation" – and how they may be used in Coastal Act review. The report next describes two terms specific to the Coastal Act – "coastal-dependency" and "coastal-related", and how they may affect the review of proposed desalination facilities.

2.2.1 "FEASIBILITY", "ALTERNATIVES", AND "MITIGATION"

Main Point:

- ***Many Coastal Act policies applicable to desalination facilities require incorporating feasible alternatives and mitigation measures into project design and operation.***

The three terms above are important in determining the extent of review under the Coastal Act. A key element in many decisions for proposed projects requiring Coastal Act permits is how well the design and siting incorporate considerations of feasibility, alternatives, and mitigation into the proposal.

FEASIBILITY

"Feasible" is defined in both the Coastal Act (at Section 30108) and in CEQA as "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors". The Coastal Act includes two main uses of "feasibility" – first, as it relates to project alternatives, and next, as it relates to mitigation measures. Primary examples include:

> ***From Section 30230 (Marine Resources):*** *"Marine resources shall be maintained, enhanced, and where feasible, restored".*
>
> ***From Section 30231 (Biological Productivity and Water Quality):*** *"The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored…"*

> ***From Section 30233(a) (Diking, Filling, or Dredging):*** *"The diking, filling, or dredging of open coastal waters, wetlands, estuaries, and lakes shall be permitted in accordance with other applicable provisions of this division, where there is no feasible less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects…"*
>
> ***From Section 30251 (Scenic and Visual Resources):*** *"Permitted development shall be sited and designed to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural land forms, to be visually compatible with the character of surrounding areas, and, where feasible, to restore and enhance visual quality in visually degraded areas."*
>
> ***From Section 30260 (Coastal-dependent Industrial Facilities):*** *"…where new or expanded coastal-dependent industrial facilities cannot feasibly be accommodated consistent with other policies of this division, they may nonetheless be permitted… if (1) alternative locations are infeasible or more environmentally damaging; (2) to do otherwise would adversely affect the public welfare; and (3) adverse environmental effects are mitigated to the maximum extent feasible."*
>
> ***From Section 30235 (Shoreline Construction):*** *"Existing marine structures causing water stagnation contributing to pollution problems and fish kills should be phased out or upgraded where feasible".*

It is also included as part of one of the Act's goals, in Section 30001.5: to "protect, maintain, and where feasible, enhance and restore the overall quality of the coastal zone environment and its natural and artificial resources".

Coastal Act review may consider at least four distinct feasibility factors, each of which can be addressed separately, but which also must be brought together when determining whether a proposed alternative or mitigation measure is feasible. The four aspects are:

- ***Environmental factors:*** refers to selecting mitigation measures that can successfully respond to the environmental impact being addressed, that have a strong likelihood of success, and that do not cause other undesirable environmental impacts.

- ***Technological factors:*** refers to the engineering and operational ability to implement an alternative or mitigation measure. For desalination, an example may be to consider treating water using ultraviolet light rather than chemicals. The end result may be the same – water treated to a desirable level – but the method using ultraviolet light would result in fewer environmental impacts. This aspect of feasibility may also be applied when considering combined benefits – for example, a facility near the ocean may be required to put up screens or panels to reduce its visual impacts, and those panels may also result in lower maintenance costs at the facility due to reduced exposure to salt spray or wind.

- ***Social factors:*** refers primarily to the public's acceptance or non-acceptance of certain measures. An example of social feasibility related to desalination is the potential to desalinate treated wastewater instead of seawater. While this alternative is feasible in many ways – it can be done technologically, it is less expensive than desalting seawater, and it may result in fewer environmental impacts due to discharging the waste in the ocean – it is also viewed by many members of the public as less desirable. Part of the consideration in reviewing social feasibility may be to determine what effort it would take to have some measures could gain public acceptance.

- ***Economic factors:*** generally includes determining the environmental impacts of a proposal along with the economic costs of mitigating those impacts through alternatives, avoidance, minimization, or other means. The review may also compare the mitigation costs with the overall project costs to determine whether mitigation costs represent a reasonable proportion of the project costs. Two aspects of desalination – its relatively high capital and operating costs, and its potential to cause significant adverse environmental impacts – could make extensive mitigation measures both necessary and feasible. For example, a project with significant environmental impacts and capital costs of $200 million would spend only five percent of that amount to produce $10 million worth of mitigation measures. In some cases, economic feasibility may also include determining the opportunity costs gained or lost by using a coastal site for one activity rather than another. This is generally an element of the Coastal Act policies related to priority uses, but may also be included in feasibility in some instances. Economic factors may also come into play in combination with the others – for example, in determining that it is both technically and economically feasible to use a less hazardous membrane cleaning method at a facility. [See also Chapter 3.2 for more detailed discussion of how costs may be incorporated into Coastal Act review.]

ALTERNATIVES AND MITIGATION

Coastal Act review generally evaluates a proposed project to determine whether there are alternative versions of the project that may be less environmentally harmful. Not only are alternatives and mitigation measures required to be feasible, but for some Coastal Act policies, all feasible alternatives and mitigation measures must be implemented[2]. Review of a desalination proposal, therefore, will likely require an alternatives analysis to identify whether there are other feasible alternatives that better conform to Coastal Act requirements, and an assessment of mitigation measures available to avoid or reduce its impacts.

[2] Mitigation measures are generally considered in sequence based on their effectiveness in avoiding or alleviating an impact. The "mitigation sequence", as defined in CEQA Section 15370, consists of:
(a) Avoiding the impact altogether by not taking a certain action or parts of an action.
(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
(c) Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.
(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
(e) Compensating for the impact by replacing or providing substitute resources or environments.
For purposes of this report, the term "minimize" is defined as "to reduce to the smallest possible level."

Some examples of possible alternatives and mitigation measures to be considered include:

- ***Conservation:*** This could include incentive-based or voluntary measures, ranging from urging landowners to use drought-resistant native plants to regulatory requirements, such as requiring new developments to use only low-flow water fixtures. Many conservation measures provide a dual advantage, in that not only are they effective in reducing water demand but often cheaper than providing additional water. A November 2003 report by the Pacific Institute states that California could increase its urban water supplies by 85% by using available and cost-effective measures, such as installing low-flow fixtures, timers, and other devices[3]. Many California communities have already implemented these measures, and are part of a comprehensive local or regional strategy to reduce water demand. The state Desalination Task Force recognized this when it included as one of its recommendations:

  > *Include desalination, where economically and environmentally appropriate, as an element of a balanced water supply portfolio, which also includes conservation and water recycling to the maximum extent practicable.*

- ***Using reclaimed or recycled water:*** This will likely depend on the availability of nearby sources, the infrastructure needs to make these sources available to end users, the degree of certainty that those sources will be available when needed, and other similar factors.

- ***Reallocating existing supplies:*** This could include a number of approaches, such as retiring existing water rights or assigning those rights to be used for various conservation purposes (e.g., fish flows, instream values, etc.).

- ***Market-based measures:*** This could include measures such as trading water rights, using a rate structure that charges different amounts for different sources of water or for water use during different times of day.

Additional alternatives and mitigation measures are discussed in other sections of this report as they apply to particular topics.

WHAT'S LIKELY NEEDED DURING REVIEW?

Evaluation of alternatives and mitigation measures considered and how those were determined to be feasible or infeasible: As part of a desalination permit application, an applicant should be prepared to describe and evaluate the existing conservation measures being implemented in a proposed service area, whether there are comprehensive conservation plans or water use reduction plans in place, the effectiveness of such measures to reduce overall water consumption, and additional feasible measures that could reduce impacts associated with a constructing or operating a desalination facility. In many areas, this will likely require tying the proposed desalination facility to adopted local or regional water management plans, growth projections, local coastal programs, and other planning documents.

[3] Gleick, Dr. Peter, Waste Not, Want Not: The Potential for Urban Water Conservation in California, November 2003.

The application will also likely need to describe what considerations were used to determine whether particular designs, locations, and mitigation measures were determined to be feasible or infeasible. The most documentation should probably be provided for those aspects of a proposed project that would have the greatest effect on avoiding or reducing adverse impacts.

2.2.2 "COASTAL-DEPENDENT" AND "COASTAL-RELATED"

Main Points:

- ***The Coastal Act allows many types of development in the coastal zone, and recognizes that some uses are "coastal-dependent" in that they require a site on or immediately adjacent to the ocean. The Act also defines "coastal-related" uses as being those that depend on "coastal-dependent" uses.***
- ***Desalination, in and of itself, is not "coastal-dependent".***
- ***While desalination processing facilities are not likely to be considered "coastal-dependent", their associated pipelines may be. If the pipelines for a desalination facility using seawater are considered "coastal-dependent", the associated processing facility would be considered "coastal-related".***

The Coastal Act includes policies that acknowledge the limited amount of coastal land in California, the need for certain activities to be located on the coast, and the public's interest in having land available for those activities and uses. One of the primary determinations to be made during review of many projects proposed to be sited in or next to the ocean is whether they are "coastal-dependent" or "coastal-related". Section 30101 of the Coastal Act defines a "coastal-dependent development or use" as "any development or use which requires a site on, or adjacent to, the sea to be able to function at all," and Section 30001.2 further describes "coastal-dependent" developments as including "ports and commercial fishing facilities, offshore petroleum and gas development, and liquefied natural gas facilities"[4]. Section 30101.3 of the Act defines a "coastal-related development" as "any use that is dependent on a coastal-dependent development or use".

The issue of "coastal-dependency" is not a concern within the entire width of the coastal zone, only for those developments proposing to locate on or immediately adjacent to the ocean. The issue of "coastal-dependency" is generally not an issue for projects proposed to be located at some distance inland from the ocean but still within the Coastal Zone – for example, on the landward side of a coastal highway or on a parcel not bordering coastal waters.

[4] This section further distinguishes between "coastal-dependent" facilities and other facilities such as electrical generating facilities and refineries, which it recognizes may be necessary to locate in the Coastal Zone, although not necessarily on or adjacent to the ocean.

IS DESALINATION "COASTAL-DEPENDENT"?

While a facility dependent on seawater may, at first glance, appear to fit this definition, desalination, in and of itself, is not necessarily a coastal-dependent development or use. Many desalination facilities are located at inland locations where the source water is brackish water, groundwater, reclaimed water, or similar sources other than seawater. Similarly, providing a water supply is not necessarily a coastal-dependent use, as most potable water is provided from sources other than seawater. Even for facilities using seawater, the actual processing of that water does not depend on being in or adjacent to the ocean.

While a desalination facility itself might not be coastal-dependent, the pipelines for getting seawater to and from the facility may be. The desalination processing facility may only need to be located close enough to the water to feasibly pump the source water inland from the shoreline. For many proposals, this may require no more than being located across the street from the ocean rather than right on the ocean.

In some cases, the pipelines, too, might be found to not be "coastal-dependent" – if, for example, the facility can get its source water from wells located near, but not directly on the shoreline rather than from open intakes in the ocean.

> ***Example of a development considered partially "coastal-dependent" and partially "coastal-related":*** In a decision on the Las Flores Canyon oil and gas processing facility in Santa Barbara County, the Commission found that the pipelines providing oil and gas from offshore oil platforms were considered "coastal-dependent", but that the facility used to process the oil and gas was not "coastal-dependent". However, because the processing facility was dependent on the use of those "coastal-dependent" pipelines, it was considered "coastal-related". This allowed project elements needing to be sited on or adjacent to the water to be sited there and resulted in other parts of the development being located some distance away from the shore.
>
> The Commission has made similar determinations in several instances that aquaculture dependent on seawater is not necessarily "coastal-dependent", since it, too, can be located at some distance inland from the shoreline, although the water supply lines may be considered "coastal-dependent."

WHY IS "COASTAL-DEPENDENCY"IMPORTANT?

Whether all or part of a proposal is "coastal-dependent" is important in several ways:

- Priority uses: Recognizing the limited amount of coastal land in the state, the Coastal Act includes several policies that prioritize coastal-dependent development for coastal areas. Section 30255, for example, states that coastal-dependent development has priority over other development on or near the shoreline and that it should be within reasonable proximity of the coastal-dependent uses it supports. [These priority uses are discussed further in Chapter 4.3.2.]

- Placing fill: To place fill in coastal waters, a proposed development must fall within one of the eight categories listed under Coastal Act section 30233(a)[5]. Just one of these eight categories (Category 1 – port, energy, and coastal-dependent industrial facilities) is likely to apply to desalination, but only for the parts of the facility that have been determined to be coastal-dependent (e.g., the intake and outfall pipelines). Further, the fill allowed under this policy is subject to two additional measures – there must be no feasible less environmentally damaging alternative, and feasible mitigation measures must minimize adverse environmental effects.

  Unless designed and operated to avoid impacts, seawater intakes and outfalls are likely to cause adverse effects to coastal resources, primarily due to "entraining" marine organisms (see Chapter 5.1.1 of this report) and due to the highly saline discharge back to the ocean (see Chapter 5.1.2.). Therefore, the review for proposed pipelines considered "coastal-dependent" will need to determine whether there are feasible alternatives, including other locations, water sources, or methods such as beach wells, infiltration galleries or other types of subsurface intakes or outfalls, as well as existing intakes and outfalls, that are less environmentally damaging.

[5] Section 30233(a): The diking, filling, or dredging of open coastal waters, wetlands, estuaries, and lakes shall be permitted in accordance with other applicable provisions of this division, where there is no feasible less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects, and shall be limited to the following:
(l) New or expanded port, energy, and coastal-dependent industrial facilities, including commercial fishing facilities.
(2) Maintaining existing, or restoring previously dredged, depths in existing navigational channels, turning basins, vessel berthing and mooring areas, and boat launching ramps.
(3) In wetland areas only, entrance channels for new or expanded boating facilities; and in a degraded wetland, identified by the Department of Fish and Game pursuant to subdivision (b) of Section 30411, for boating facilities if, in conjunction with such boating facilities, a substantial portion of the degraded wetland is restored and maintained as a biologically productive wetland. The size of the wetland area used for boating facilities, including berthing space, turning basins, necessary navigation channels, and any necessary support service facilities, shall not exceed 25 percent of the degraded wetland.
(4) In open coastal waters, other than wetlands, including streams, estuaries, and lakes, new or expanded boating facilities and the placement of structural pilings for public recreational piers that provide public access and recreational opportunities.
(5) Incidental public service purposes, including but not limited to, burying cables and pipes or inspection of piers and maintenance of existing intake and outfall lines.
(6) Mineral extraction, including sand for restoring beaches, except in environmentally sensitive areas.
(7) Restoration purposes.
(8) Nature study, aquaculture, or similar resource dependent activities.

Note: Category 5 of this policy, which includes "incidental public services" has generally been intepreted by the Commission to include only temporary impacts, such as construction- or maintenance-related activities. The Commission has generally not interpreted this section to allow ongoing impacts that might be associated with an open intake, such as entrainment or impingement of marine species.

- Proposals that don't fully meet applicable Coastal Act policies: Section 30260 of the Act recognizes that some facilities that are "coastal-dependent" might not conform to all applicable policies of the Coastal Act:

  Coastal-dependent industrial facilities shall be encouraged to locate or expand within existing sites and shall be permitted reasonable long-term growth where consistent with this division. However, where new or expanded coastal-dependent industrial facilities cannot feasibly be accommodated consistent with other policies of this division, they may nonetheless be permitted in accordance with this section and Sections 30261 and 30262 if (1) alternative locations are infeasible or more environmentally damaging; (2) to do otherwise would adversely affect the public welfare; and (3) adverse environmental effects are mitigated to the maximum extent feasible.

  This section, therefore, provides that coastal-dependent industrial facilities not consistent with other applicable policies of the Coastal Act may be permitted if the Commission finds that they meet a three-part test:

  - Are alternative locations infeasible or more environmentally damaging?;
  - Would doing otherwise adversely affect the public welfare?; and,
  - Are adverse environmental effects mitigated to the maximum extent feasible?

Similar to the tests described above in Section 30233(a) for proposals involving placing fill, the review of desalination facilities or pipelines considered "coastal-dependent" will need to evaluate whether there are other feasible or less environmentally damaging locations and determine what measures are needed to mitigate adverse environmental effects to the maximum extent feasible. Again, this review is likely to include an evaluation of whether the facility can be located and operated to avoid entraining and impinging marine organisms and whether the outfall can be designed to avoid or minimize harmful discharges to the ocean.

CHAPTER 3: TECHNICAL AND ECONOMIC ASPECTS OF DESALINATION

Chapter Sections:
3.1 Desalination Methods and Processes
3.2 Desalination Economics and Energy Use

Desalination refers to any of several methods that remove dissolved salts and other chemicals from water. Desalination is most well known as a way to treat seawater to provide drinking water, but it is also used to treat sources of water other than seawater, including brackish groundwater, recycled or reclaimed wastewater, agricultural runoff water, and others[6]. It can provide different levels of treatment to allow a source water to be used for drinking, industrial processes, agricultural uses, or other uses that may allow for a particular concentration of dissolved solids and other materials in the water.

The desalination process generally involves drawing in source water (e.g., brackish or salt water) and separating it into two streams – a stream of desalted water that contains a minimal concentration of dissolved salts and minerals (the product water), and a stream of liquid containing the residual dissolved solids, including salts and other minerals and compounds. Depending on which desalination method is used, every 100 gallons of seawater can produce 15 to 50 gallons of potable water and discharge 50 to 85 gallons of effluent containing higher concentrations of the removed solids[7].

3.1 DESALINATION METHODS AND PROCESSES

There are a number of desalination methods, including reverse osmosis, distillation, electrodialysis, and vacuum freezing. Reverse osmosis and distillation represent the predominant technologies currently being used around the world, and those are the two methods briefly described below. Most of the facilities being proposed along the California coast would use reverse osmosis methods, and this report focuses, for the most part, on that method.

DISTILLATION

This process requires the intake water to be heated to produce a vapor, which is then condensed to produce water with a low concentration of dissolved salt and other minerals. This method essentially mimics the hydrological cycle that occurs in nature. The most common methods of distillation include multistage flash (MSF), multiple effect distillation (MED), and vapor compression. Distillation plants generally require less pretreatment of feedwater than is

[6] "Brackish" water has a salt content of 5 to 20 parts per thousand (ppt), while seawater has salt content of over 20 ppt. The salt content of seawater along the California coast averages from about 32 to 34 ppt.

[7] In this report, the concentrated solution of salts and other constituents remaining after potable water is extracted from seawater is referred to as "desalination discharge". Other documents refer to it as "brine", "desalination concentrate", "seawater concentrate" "effluent", etc. For some facilities, the discharge may be only brine – which is defined as water with a high concentration of salts; in others, the discharge may contain concentrations of materials other than salt.

necessary in reverse osmosis, and they can generally use feedwater of lower quality. Distillation plants also do not need to shut down production for cleaning or replacement of equipment as often as reverse osmosis plants, and they do not generate waste from backwash of pretreatment filters. The most significant disadvantage of distillation is that it is extremely energy intensive, which typically limits its use to areas where energy costs are not as critical an issue. These facilities have most commonly been used in the Middle East. Scaling and corrosion of distillation plants are the major maintenance concerns, due to the exposure of the unprotected evaporator components to corrosive feedwater.

REVERSE OSMOSIS

This process involves pumping feedwater at high pressure through semi-permeable membranes to separate salt and other minerals from the water. The pores in the membrane are large enough to allow water molecules to pass through, yet are too small to allow the passage of salt and other minerals. Reverse osmosis facilities generally involves four separate processes: pretreatment, pressurization, membrane separation, and post-treatment stabilization. Both physical and chemical pretreatment can be used to remove suspended particles from the source water to keep the membrane surfaces clean and to treat the water to prevent growth of microbes on the membranes. The feedwater is then pressurized to about 800-1000 pounds per square inch (psi), a process that results in most of the energy demand for the reverse osmosis desalination method. The pressurized feedwater is then forced through the reverse osmosis membrane. Product water quality is sometimes improved by passing the water through a second set of membranes. Once the feed water is separated into two streams, the product water is treated to meet drinking water requirements, and then to the water distribution or storage system. Many reverse osmosis facilities are built using modular components that allow production to be expanded relatively easily. Many are built with multiple treatment "trains" that allows for some, but not all, production to be curtailed during cleaning or maintenance or during times of less demand. Some facilities include systems that separate most of the suspended solids and treatment chemicals from the waste stream so they can be sent separately to a wastewater treatment facility or dewatered and shipped to a landfill.

Reverse osmosis has several advantages over distillation, including:

- Less energy required;
- Its discharge has lower thermal impacts since the feedwater does not have to be heated;
- Fewer corrosion problems;
- Higher recovery rates – up to about 50% for seawater; and,
- Less surface area than distillation plants for the same amount of water production.

Reverse osmosis also has several disadvantages:

- It is generally more sensitive to poor water quality, resulting in the need to shut down facilities during severe storms or periods of high runoff when there are increased amounts of suspended particulates in the feedwater.
- It usually requires more frequent cleaning and maintenance, often using various chemicals and cleaning agents, and often requiring full or partial shutdowns during cleaning.

- The membranes are sensitive to fouling due to bacterial contamination or other causes, which may require more frequent replacement and result in higher costs.
- It requires more extensive pretreatment, often with the use of biocides, coagulants, and other compounds.
- The process and its use of cleaning agents generate wastes that may include toxic chemicals, metals, and other constituents that are either discharged to surface waters or are separated and sent to a wastewater treatment facility or landfill.

3.2 DESALINATION ECONOMICS AND ENERGY USE

Main Points:

- ***It is difficult to determine the full range of costs and benefits of any water supply, including desalination.***
- ***For water purveyors, one advantage to coastal desalination facilities is that, from an economic standpoint, seawater is considered free.***
- ***Energy costs are the most expensive part of the desalination process.***
- ***Desalination remains more expensive than other water sources, but its higher price is seen by some as a premium paid for a local and more reliable water supply.***
- ***Coastal Act review includes consideration of a proposed development's energy consumption and requires energy use to be minimized.***
- ***Coastal Act review includes consideration of costs associated with a project to assess feasible alternatives and mitigation measures.***

INTRODUCTION

It is difficult to determine the full economic cost of any source of water. Providing water supplies generally require both relatively direct and easily determined economic outlays – such as the capital cost to construct treatment plants and pipelines, the costs of operating and maintaining a water supply system, and the cost of electricity needed to pump water from one location to another – as well as indirect and non-monetary costs that are usually more difficult to determine – such as the environmental costs associated with lost streamflow or reduced watershed health caused by exporting water out of an area (e.g., fewer fish, smaller wetlands), societal costs (e.g., fewer recreational opportunities, decreased tourism), the costs of centralized infrastructure instead of dispersed systems, and others. These indirect costs may result in more significant economic, social, political, and environmental effects than the direct economic costs.

Adding to the difficulty of determining the overall costs of a water supply is that those costs are often countered by indirect or non-economic benefits – for instance, moving water from a stream to a distant reservoir may result in the loss of recreational opportunities in one location that are offset by increased recreational opportunities in another. Moving water from an area with a smaller population and lower economic demand into an area with a larger population and larger existing economic infrastructure may create more extensive economic benefits related to increased development. Another difficulty in determining costs is that these indirect economic considerations may or may not be evaluated as part of any particular water system depending on the level of public oversight, public interest and review, the perceived values of the affected resources, and other factors.

WHAT INFLUENCES DESALINATION COSTS?

Given the caveats above, some of the primary variables that determine costs for desalinated water are described below, along with some general comparisons between the costs of desalination and the costs of other water supplies. Many costs, such as those associated with storing or transporting water, are common to almost all water sources.

- **Energy use and costs:** Review under the Coastal Act includes consideration of a proposed development's energy consumption. Section 30253 of the Act requires, in part, that energy consumption of new development be minimized.

  Energy represents the single largest direct cost in producing desalinated water. Advances in desalination technology over the last ten years have significantly reduced the amount of energy needed to produce a given amount of water; however, energy continues to represent about one-third to one-half of the cost of desalination. As a result, desalination costs are relatively sensitive to the cost of energy – it is estimated that each one-cent difference in the price per kilowatt-hour of electricity causes about a fifty-dollar difference in the cost to produce an acre-foot of desalinated water. For example, water produced by desalination at a cost of $800 per acre-foot with electric rates at $0.05 per kilowatt-hour would cost $1050 per acre-foot if the electricity instead cost $0.10 per kilowatt-hour.

  Ocean water is generally more expensive to desalt than brackish water due to its higher concentration of dissolved solids. Brackish water, with salinity ranging from about 5 to 20 parts per thousand, generally requires less energy to desalt than ocean water, which has salinity levels greater than 20 parts per thousand.

  Along with the energy costs to produce the water, desalination also requires energy to transport water to its end users. This is a cost common to nearly all water sources, as water is a relatively heavy commodity and energy costs to lift water uphill or to pump it long distances can be the single largest expense for many water systems. Because seawater desalination facilities located along the coast will generally be located at the lowest elevation of a water service area, they could have significant "lifting" and distribution costs to get the water to the end users.

- **Water source:** There are two main cost components related to the source of water – the initial cost of the water, and the level of treatment needed to produce water of a desired quality. Regarding the initial costs, from the predominant economic standpoint, one of the primary benefits of seawater as a source of potable water is that it generally has a direct monetary price of zero. Seawater is seen as inexhaustible and noninterruptible, and therefore not subject to price variations due to scarcity or supply and demand. If a proposed desalination facility is co-located with a facility using an existing seawater supply, such as a power plant that uses ocean water for cooling, there may additional costs savings by not having to site, design, and construct new intake and outfall systems needed to use seawater as the source water. [Note: advantages and disadvantages of co-location are discussed in more detail in Chapter 5.1.3.] Sources of water other than seawater, such as agricultural water transfers, reclaimed, or recycled water, may have to be purchased from suppliers and may be subject to supply variability. However, these sources are often easier and less expensive to

treat to drinking water standards, because of their lower levels of dissolved solids. One of the primary issues related to many of these sources is the public perception that a particular source, such as treated wastewater, is unsuitable as drinking water, despite the ability of a properly operating desalination system to remove the harmful components in that water.

Regarding the costs associated with treatment, the general relationship is that the better the source water quality, the less expensive it is to treat. This is similar to brackish water requiring less energy to treat than seawater – the fewer contaminants, such as various chemicals or organisms (e.g., algal blooms), the less pre-treatment or treatment required, and thus lower costs. Some of these costs may be reflected in either the frequency of cleaning or maintenance required due to contaminants in the source water – for example, reverse osmosis membranes generally operate less effectively when there are high levels of dissolved solids, so such systems often need pre-treatment through sand filters or other types of filters before the water reaches the final reverse osmosis membranes. This situation can also increase the long-term maintenance requirements at a facility if the membranes need to be replaced more often due to water quality issues.

- **Desalination method:** Of the two primary desalination methods, distillation generally has higher energy costs than reverse osmosis because of the need to heat the source water. The cost differential between the two methods can be reduced somewhat if the source water is pre-heated or if it derives waste heat from another process, such as discharged cooling water from a coastal power plant, which may be 20^{o} C. above ambient ocean water temperature.

- **Scale and capacity of facility:** Some desalination facilities are likely to benefit from economies of scale, although this is likely to depend on the particular characteristics, location, and capacity of a given facility.

- **Infrastructure:** A desalination facility must be able to either connect to an existing distribution system or construct new pipelines or a distribution system to get water to the end users. This cost will vary by location, size of the service area, and other factors. This may be a significant cost in much of coastal California, where most water delivery systems were engineered to move water from inland areas to the coast, not the other way around. When required as part of a proposed seawater desalination facility, some of the impacts associated with the distribution infrastructure may be part of Coastal Act review.

- **Maintenance and Cleaning:** Each desalination facility requires some level of anti-fouling treatment and regular maintenance and cleaning, which will vary based on the desalination method used, the type of materials used, and other factors. Recent developments in membrane technology have extended the expected lifespan of many membranes, filters, and associated materials; however, several of these improvements have not been thoroughly tested in a production environment. Additionally, like other water sources, once treated water is in the distribution system, it must be kept clean until it reaches the end users, so there are ongoing costs associated with maintenance and cleaning the water supply system.

- **Conformity with existing water supplies:** When various sources of water are mixed in a distribution system, they must be chemically compatible. For example, mixing water treated with chlorine and water treated with chloramines may cause problems in the system and to the end users.

- **Desired quality of end product:** Not all desalinated water is intended to be used as drinking water, and costs will vary depending on whether the water will be for purposes needing higher- or lower-quality water, such as manufacturing, irrigation, or agriculture. The standards that apply to the end product water will also affect costs – for example, a facility producing drinking water may be subject to stringent treatment requirements, more extensive sampling and monitoring of both its water quality and its production methods, and other conditions meant to protect public health.

- **Full-time or part-time operation:** Facilities that operate part time or to provide back-up supply are likely to have higher costs per acre-foot of produced water since the capital and maintenance costs must be paid even when the facility is not producing.

Other variables may include easily-determined costs and benefits such as sales revenue or financial incentives such as subsidies and grants, as well as less easily-determined considerations such as the value to a water purveyor or to end-users of having a reliable supply, increased control over future supplies, and the avoided costs of treatment, storage, and conveyance from other sources (from the 2000 Urban Water Management Plan, San Diego County Water Authority).

REDUCED COST DIFFERENCE BETWEEN DESALINATION AND OTHER SOURCES

A significant economic change during the last decade is the reduced difference in cost between desalinated water and other water sources. In its 1993 report, the Coastal Commission found that desalination cost between $1000 and $4000 per acre-foot (including operation and maintenance costs, along with capital costs amortized over an assumed plant life of 20 to 30 years). While there are currently no large-scale coastal desalination facilities operating in Southern California and therefore no actual costs to provide an accurate comparison, estimated costs from several facilities being proposed along the California coast represent a substantial decrease from 1993 cost estimates (see Table 3)[8].

[8] Additionally, the San Diego County Water Authority recently studied some of the economic considerations that went into planning the 25 mgd desalination facility built in Tampa Bay, Florida. Water produced from that facility had been estimated to cost between $560-680 per acre-foot due in part to several economically advantageous aspects of the proposal:

- The source water in Tampa Bay has lower salinity than ocean water (about 26 ppt vs. 35 ppt);
- Power costs are just under $0.04 per kWh.
- The facility would use the existing intake and outfall from the adjacent power plant.
- Its relatively high capacity of 25 mgd allows for some economies of scale.

(from the SDCWA Urban Water Management Plan, 2000).

This facility opened in March 2003, but has been shut down or operating at lower production rates for most of the time since then, due to unanticipated processing problems, maintenance requirements, and financial difficulties. The eventual costs will likely be higher than the estimates cited above.

TABLE 3: PLANNED COSTS OF SEVERAL SOUTHERN CALIFORNIA DESALINATION PROPOSALS

Facility:	***Capacity (in million gallons per day):***	***Capital Cost (in millions):***	***Production Cost (per acre-foot, w/$0.05 kWh electricity):***
Los Angeles Department of Water and Power	12	$70	$1033
Long Beach Water District	9	$62-92	$711-1171
Orange County Municipal Water District	25	$114-140	$860-1007
San Diego County Water Authority	50	$272	$909
West Basin Municipal Water District	20	$130	$904

(from Shahid Chaudhry, California Energy Commission – Unit Cost of Desalination presentation to State Desalination Task Force, July 30, 2003.)

Note: These figures are based on energy costs of $0.05 per kWh. Under current requirements and market conditions, energy costs are in the range of $0.08 to $0.13 per kWh, so the production costs noted above should be adjusted upward by $150 to $350 per acre-foot.

During the same period, the costs of several other existing water sources have increased. For example, in 1991, the Metropolitan Water District (MWD) of Southern California paid approximately $27 per acre-foot for water delivered from the Colorado River and $195 per acre-foot for water from the California Water Project. The MWD now pays an average of $460 per acre-foot of delivered water. As a result of the cost increase for imported water and the cost decrease for desalination, the difference between the costs of the two sources has declined from up to 3000 percent in 1993 to roughly 50 to 100 percent today. Although desalination still costs more, there is apparently a willingness by some suppliers and users to pay a premium for water not subject to drought and less vulnerable to disruption.

Even with the trend towards reducing the cost difference between it and other sources, desalinated water is still likely to cost more for the foreseeable future. The higher costs, therefore, represent, at least in part, the costs associated with the perceived benefits of having a local and drought-proof supply.

HOW ARE ECONOMIC COSTS INCORPORATED INTO COASTAL ACT REVIEW?

Review under the Coastal Act requires evaluating the adverse environmental effects of proposed projects, and identifying the feasible alternatives that would be less environmentally damaging and the mitigation measures that would avoid or minimize those effects. "Feasibility" is defined in section 30108 of the Coastal Act as "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors". Cost, therefore, is one element considered in determining which alternatives and mitigation measures are to be included as part of a proposed project for it to conform to the Coastal Act. Chapter 2.2.1 of this report discusses "feasibility" in greater detail.

WHAT'S LIKELY TO BE NEEDED DURING REVIEW?

Realistic assessment of project costs: At the very least, this should include costs of the various project components that may affect coastal resources and therefore may require an assessment of alternatives or mitigation measures, and should also include the assumptions used to establish these costs. It may be most efficient to include a comprehensive benefit/cost analysis as part of the initial environmental review of a proposed project so these issues can be addressed early in the process.

CHAPTER 4: COASTAL ACT PUBLIC RESOURCE POLICIES RELATED TO DESALINATION

Chapter Sections:

This chapter provides some background to the Coastal Act's underlying public resource principles and policies and the relationship of those Coastal Act elements to recent trends in privatization and international trade agreements. It starts with a discussion of coastal resources as part of the public "commons", and includes a brief description of the Public Trust Doctrine, one of the underlying legal constructs of the Coastal Act. The chapter next discusses the potential shift of seawater from a public and "commons" resource to a private and commodity resource. It also discusses possible differences in issues that might be evaluated in the context of coastal resource impacts and Coastal Act policies, depending on whether a proposed desalination facility is a public or a private commercial venture. Although Coastal Act policies must be applied equally to public and private commercial projects, different issues may be raised by virtue of the different nature of each type of entity. These sections are followed by a discussion of emerging issues relating to the possible implications of international trade agreements on the ability of state and local communities to effectively implement coastal resource protection policies in connection with the regulation of certain private commercial desalination projects. All of these sections address a common element of the Coastal Act – that many coastal resources in general, and ocean water, in particular, are public resources that must be protected for the benefit of current and future generations. This chapter then closes with discussions of specific Coastal Act public resource policies, including those related to growth inducement, priority uses, public access, and recreation.

4.1 COASTAL RESOURCES AS PUBLIC RESOURCES

Main Points:

- ***Ocean water and its associated uses and values are public resources.***
- ***Approved uses of ocean water must ensure protection of public rights, interests, and values for ongoing navigation, fishing, recreation, and ecosystem preservation pursuant to the Public Trust Doctrine and Coastal Act policies.***
- ***Coastal desalination represents a shift in the use of seawater from primarily non-consumptive uses to a consumptive use, which has implications for how seawater is perceived and valued.***

4.1.1 SEAWATER AS PART OF THE PUBLIC "COMMONS"

A fundamental Coastal Act principle is that many coastal resources are imbued with a public interest and value that must be vigorously protected for the benefit of current and future generations. Unlike many coastal resources that are privately owned, ocean water, and the uses and values it embodies, constitute a public trust resource held in common for public use and

enjoyment. This principle is codified in numerous federal and state laws and regulations, including the Coastal Act (see The Public Trust Doctrine, next page). Notwithstanding the public nature of coastal ocean waters, use of such waters and of living and non-living resources in and under them have historically been allowed for non-public purposes.

Ocean water serves a number of beneficial uses and vital environmental, social, and economic functions. It is part of the shared public "commons", it serves as habitat for a multitude of species, it is a source of food and livelihood for society, and it is used to support transportation, commerce, recreation, and other important societal uses. For the most part, these uses are non-consumptive and sustainable, in that using ocean water for one of these purposes does not necessarily impair its ability to be used for others.

SEAWATER AS A "COMMON" RESOURCE OR COMMODITY?

Using seawater as a source of potable water would represent a shift from it being subject to primarily non-consumptive uses to including a consumptive use. The scale of ocean water consumption due to proposed desalination would be extremely small compared to the overall size of the resource; however, there could be significant local or regional direct or cumulative impacts to the uses or values associated with ocean water. The economic dynamics and considerations involved in the consumptive use of a resource are significantly different from those of a non-consumptive use. One of these differences is that seawater is transformed from a public trust resource held in common for public use to that of a commodity[9] to be taken out of the larger resource to be sold and consumed. This "commodification", or conversion of a resource from being subject to mostly non-market social rules to market rules, is generally accompanied by significant shifts in how it is perceived and managed, and changes the basis of decision-making about the resource from being guided by non-market social rules to being directed primarily subject to market economic rules[10].

This shift is not unique – to some degree, many other public goods or resources have become commodities, including fresh water (through appropriative water rights, water marketing, interbasin transfers, etc.), clean air (through emissions trading), and public land (through grazing permits, timber harvests, mineral extraction, etc.). Each of these shifts has been accompanied by changes in how these resources are perceived and managed – for example, the public or private rights conveyed by their use, the interests, values and responsibilities involved in decision-making about them, and changes in both anticipated and unanticipated costs and benefits resulting from the manner in which they are used.

[9] Commodity: "1. Something useful that can be turned to commercial or other advantage…; 2. An article of trade or commerce, especially an agricultural or mining product that can be processed and resold." From The American Heritage® Dictionary of the English Language, Fourth Edition.

[10] From Gleick, Peter, Gary Wolff, Elizabeth Chalecki, and Rachel Reyes. The New Economy of Water: The Risks and Benefits of Globalization and Privatization of Fresh Water. Pacific Institute for Studies in Development, Environment, and Security, February 2002.

SEAWATER DESALINATION AND THE CALIFORNIA COASTAL ACT
– MARCH 2004 –

THE PUBLIC TRUST DOCTRINE: The Public Trust Doctrine is a legal construct that predates by centuries the origins of the U.S. and the many other Western countries where it applies. The doctrine reflects English Common Law dating from the era of the Magna Carta in the 13th Century, which is, in turn, based on the Justinian Code of the Roman Empire.

Public trust resources are those that cannot be fully owned by a private entity and are held and managed by the state (the trustee) for the benefit of all. Some core principles of managing such a trust are: the trustee works solely on behalf of the beneficiaries (the public); the productive capacity of the trust is to be protected; and, the benefits and productivity are to be perpetual[1]. In practice, the Public Trust Doctrine requires that resources subject to the public trust (e.g., tidal and submerged lands) must be used in a manner that is consistent with public trust purposes and values even when private uses of such resources are permitted. The Doctrine's most common uses have been to ensure that navigable waters, tidelands, and submerged lands are protected for navigation, commerce, and fishing, although the flexibility inherent in the general Doctrine has resulted in somewhat different applications in different states. In California, it is codified in portions of the state Constitution[2]. California courts have determined the doctrine applies not only to the land underlying the water but also to the water itself[3], and applies not only to navigation[4], commerce and fisheries, but also to water quality "…boating, swimming, fishing, hunting, and all recreational purposes"[5], "preservation"[6], and other "ecological and aesthetic values"[7]. While private uses are allowed, they are generally limited to those that would not harm or interfere with public trust values, including the uses identified above.

In California, while the state legislature and the State Lands Commission, and, ultimately the courts are the primary guardians of land and water resources impressed with public trust values and interests, other public agencies and policies, such as the Coastal Commission and the Coastal Act, share public trust stewardship responsibilities and represent additional statutory codification of the Doctrine. The Commission's review of proposed coastal desalination facilities using seawater from the open ocean, bays, or estuaries must address the question whether the proposal is consistent with public trust principles as embodied in Coastal Act policies. As a basic underpinning of the Coastal Act, the Doctrine informs the Commission's interpretation and application of the Act's policies, and when applying those policies in its decisions, the Commission manifests and implements its public trust responsibilities to protect marine organisms, ecological functions and habitat, aesthetics, and other public trust interests and values.

---

[1] Fairfax, Sally. "Trusts and the Public Trust Doctrine", from Tomales Bay Institute speech given November 14, 2000.

[2] California Constitution, Article 1, Section 25: "The people shall have the right to fish upon and from the public lands of the State and in the waters thereof, excepting upon lands set aside for fish hatcheries, and no land owned by the State shall ever be sold or transferred without reserving in the people the absolute right to fish thereupon; and no law shall ever be passed making it a crime for the people to enter upon the public lands within this State for the purpose of fishing in any water containing fish that have been planted therein by the State; provided, that the legislature may by statute, provide for the season when and the conditions under which the different species of fish may be taken."

[3] *National Audubon Society v. Superior Court*, (1983) 33 Cal.3d 419.

[4] *People v. Gold Run Ditch and Mining Co.* (1884) 66 Cal. 138.

[5] *People v. Mack*, 19 Cal. App. 3d 1040, 1045, 97 Cal. Rptr. 448 (1971).

[6] *Marks v. Whitney*, 6 Cal.3d 251, 259, 491 p.2d 374, 98 Cal. Rptr. 790 (1971) – "[O]ne of the most important public uses of the tidelands… is the preservation of these lands in their natural state…"

[7] *National Audubon Society v. Superior Ct.*, 33 Cal.3d 419, 435, 658 P.2d 709, 189 Cal. Rptr. 49 (1983) – "The principal values plaintiffs seek to protect, however, are recreational and ecological – the scenic views of the lake and its shore, the purity of the air, and the use of the lake for the nesting and feeding by birds. Under *Marks v. Whitney, supra*, 6 Cal. 3d 251 [491 P.2d 374, 98 Cal. Rptr. 790] (1971), it is clear that protection of these values is among the purposes of the public trust." Also *City of Berkeley v. Superior Court*, 26 Cal.3d 515, 521, 606 P.2d 362, 162 Cal. Rptr. 327 (1980) – "Although early cases expressed the scope of the public's rights in tidelands as encompassing navigation, commerce and fishing, the permissible range of public uses is far broader, including the right to …preserve the tidelands in their natural state as ecological units for scientific study."

Additionally, these "commons" resources – fresh water, clean air, public land – were initially thought of as limitless, renewable, or sustainable, at least at their historic levels of use. With increasing pressures at local or regional scales, however, these resources have in many places shifted from being used at renewable levels to being degraded, used at unsustainable levels, or otherwise used in ways that reduce their availability to the public at large. Increased consumptive uses and the industrial processes associated with those uses can create localized adverse impacts, either directly – through facility siting, entrainment of marine organisms, or pollution discharges – or indirectly – due to poorly planned infrastructure systems, induced growth, or the numerous cascading environmental consequences that occur subsequent to many of the direct impacts. For example, trading emissions credits between air basins may result in an overall air quality improvement, but may cause one local population to suffer some loss of a common good (healthful air quality) due to improvements gained by another population. Similarly, a large-scale interbasin transfer of fresh water to a heavily-populated area may create shortages of a previously "common" good in the extraction area where economic considerations and pressure for development are not as great as in the areas to which the water is being transferred.

This increase in consumptive use may also increase the pressure to emphasize the market value i.e., the "commodification") of ocean water relative to its "commons" value. Currently, seawater is generally considered a limitless resource, just as the other resources of the commons were thought of in the past. And like the use of those other resources, consumptive uses of seawater and the industrial processes associated with those uses can result in significant direct or cumulative adverse environmental impacts at the local or regional level, resulting in effects such as species decline, reduction in bio-diversity, decline in water quality, degradation of scenic resources, development pressure, beach closures, or other adverse effects on coastal ecosystems. While ocean water desalination may not raise precisely the same concerns as interbasin transfers of surface or subsurface freshwater noted above, there are parallels – for example, a seaside community may be asked to absorb the adverse effects of a desalination facility, such as the impacts of the seawater intake and brine discharge on local beaches and marine life, while another community elsewhere on the coast or located some distance inland may reap the benefits of the produced water supply.

One significant difference between the proposed use of seawater for desalination and the other examples above is that the shift from a public trust or "common" resource to that of a privatized, marketable commodity has not yet happened in California. This provides an opportunity for a timely assessment and deliberative public discussion of the relative merits and demerits, and the potential comparative costs and benefits of allowing, or not allowing, a shift to a new form of appropriation of a common public resource (i.e., ocean water) imbued with public trust values.

4.1.2 COASTAL ACT CONSIDERATIONS OF PUBLIC OR PRIVATE OWNERSHIP OF WATER SERVICES

Main Points:

- ***Public not-for-profit and private commercial desalination facilities may raise different types of coastal resource impact concerns. Although the same Coastal Act policies generally apply to both public and private facilities, determining whether each type of facility conforms to those policies may require different types of information and may result in different decisions or conditions of approval to ensure coastal resources are adequately protected.***
- ***Private seawater desalination may result in an inherent conflict between the interest of a community in having a local and reliable supply of water while at the same time placing the decisions about how that water is used, priced, and managed outside of the community's control.***

The prevalent mechanism for water commodification is "privatization", or the transfer of some or all assets or operations from public to private entities. The legal and institutional nature of public and private entities delivering water services to communities of consumers exist on a continuum. There are purely "public" and purely "private" entities, with many variations in between[11]. The institutional arrangements between public and private entities can vary based on financing, production, operation, maintenance, management, marketing, pricing, public accountability, and distribution of water for various uses. Examples range from a situation where a public agency contracts with a private firm only to construct a new facility that is to be operated by the public entity, to the "design-build-own-operate" approach in which the private entity is contracted to take on all, or many, of a public agency's role in providing water services.

In California, water provision has most commonly been a service supplied by some type of public agency, municipal water district, or mutual water company, with a smaller number provided by investor-owned utilities[12]. The public agencies are generally subject to the types of standards and practices common to other public entities, such as transparency of decision-making by elected or appointed officials, requirements for public notice, public hearings and opportunity for public comment and oversight, and other similar measures. Public agencies subject to California Public Utility Commission (PUC) rate-setting regulations have consumer rates set at levels needed to cover costs of capitalizing facilities and operating the water service. The PUC also establishes rates for some private commercial for-profit operators which allow for

[11] For example, Coastal Act Section 30114(a) defines "public works", in part as: "production, storage, transmission, and recovery facilities for water, sewerage, telephone, and other similar utilities owned or operated by any public agency or by any utility subject to the jurisdiction of the Public Utilities Commission, except for energy facilities."

[12] A public agency or municipal water district is meant to operate on behalf of the public that it serves. It is generally managed by a board that is either publicly-elected or appointed by elected officials. A mutual water company is generally a not-for-profit private company whose shareholders are the local property owners that use the water supply provided by the company. A private, or investor-owned company is organized as an investment venture to generate profit for its owners or shareholders, who may or may not be local users of the water supply.

The California Department of Water Resources reports that in 1994-96, of the 2850 water agencies in California, 195 (or about 7%) were private investor-owned facilities (Source: California Water Plan Update: Bulletin 160-98).

a reasonable profit on investment incorporating a variety of factors, including maintaining service quality, accountability, maintenance of the system, security, competition with other providers and users, and longevity of operations. There are also some private entities not subject to PUC rate-setting authority or associated regulatory oversight.

Two converging trends in this arena evident today are the allure of "privatization" and the perception of "water services" as a profit-making venture. As public entities face growing budgetary constraints, many local elected officials are attracted to the perceived benefits of "privatizing" all or some of their water service responsibilities. Concurrently, a number of domestic and multinational business entities have identified providing water or "water services" as an attractive profitable investment opportunity. Recent trends towards utility deregulation and interest by government entities to privatize public services are creating opportunities for private investors to take on some risks and responsibilities of providing water to the public in exchange for some level of compensation and profit. Additionally, some government and business sectors see water and water services as a marketable commodity rather than as a natural resource held in common for the public good or as a responsibility reserved for government implementation. Even assuming some financial benefit for public agencies, the combination of seawater desalination and the current interest in deregulation, privatization, and "running government like a business" creates a potential for commodification and privatization of ocean waters that, from the served community's perspective, may prove to be environmentally, socially, and economically ill-advised.

There have been a number of risks identified in privatizing the provision of water, which at the very least, may need to be addressed by governmental entities considering such a move:

- Will the privatization agreements protect public ownership of water and water rights?
- Will there be adequate public oversight and monitoring?
- What measures will be implemented to protect ecosystems or other water users, for both water quantity and water quality?
- What effect will privatization have on water-use efficiency and conservation?
- How will it affect under-represented or under-served communities, and what effect will it have on economic inequities?
- What measures are in place to rescind the agreements if privatization does not work or causes problems?[13]

A government entity considering a transfer of water-related assets from public to private control should, at the very least, incorporate answers to these questions into its considerations.

APPLYING COASTAL ACT POLICIES TO PUBLIC OR PRIVATE FACILITIES

Although public and private development proposals are generally held to the same Coastal Act standards when determining conformity with Coastal Act requirements, the law and its application in practice may result in some differences when reviewing one or the other type of proposal. Determining whether a proposal conforms to Coastal Act policies may require additional or different evaluations depending on the public or private nature of the entity

[13] From Gleick et. al, *ibid.*

proposing the new development. Recognizing that the same policies apply in either case, examples of possible differences include:

- Assessing the growth-inducing consequences of a desalination facility, including whether water service can be provided outside of existing community service areas.

- Identifying how and where a new water supply will be used to support other development, and whether that development, if in the coastal zone, is supportive of coastal priority uses – for example, a public facility is likely to factor into its water service decisions the need to provide for priority uses, whereas a private facility may make its service decisions based on the profitability of selling to one user over another.

- Determining incentives for project operators to implement effective water conservation measures that provide coastal resource protection benefits.

- Determining whether the project might compromise the fiscal viability of existing community services, or creates the potential to transfer responsibility for service to the public if a private water service venture either fails to obtain necessary financing (as was apparently the case with the recent Tampa Bay, Florida desalination project), or fails financially and ceases operations.

A key underlying difference between a public and private entity – the degree to which each is subject to public scrutiny and accountability – may result in a need for different types of assurances or permit conditions for each to ensure conformity to Coastal Act policies. Several areas where these differences are likely to show up – such as growth-inducement, "coastal-dependency", priority uses, and others – are discussed in later sections of this report.

In addition to these potential differences in determining whether a public or private development conforms to particular Coastal Act policies, there are broader implications that may affect how other aspects of the Coastal Act are implemented. Allowing ocean waters to become a commodity and marketed for profit would result in a substantial change in how seawater is used and valued by society. As a privatized commodity, water and water services would be developed, managed, and marketed as a for-profit product subject to market forces and practices significantly different from the values and decision-making involved when that same water is subject to the full range of public interest values. While the focus of regulatory and planning review pursuant to the Coastal Act must be on coastal resource impacts and conformity to the Act's policies, neither the Commission nor the public is likely to ignore the differences between a project driven by market forces serving the interests of investors and one driven by a public agency acting in what is required to be for the best interests of the community and coastal resources.

Private corporations are at the forefront of the drive to privatize public-serving water systems around the country and in the world. Unlike public agencies, which generally have an obligation to incorporate numerous social, environmental, health, and safety considerations into their decision-making, the primary purpose of private corporate commercial entities is to maximize profits for shareholders. It is the institutional nature of the corporation, and the responsibility of corporate directors and officers, to maximize return on investment, which is not necessarily in

the best interest of the local community or the environment. This invariably affects the way business is conducted and the way decisions are made, resulting in what can be significant impacts on consumers, the community, and the environment. Accordingly, if corporations are allowed to own, operate and profit from water services, pressure will inevitably be brought to bear on ways to increase profits through means such as expansion of service area, rate increases and higher consumption, which are not necessarily in the public interest.

Where profit is the primary motive underlying the ownership and provision of water services, it would not be unreasonable to conclude that water conservation, water reclamation, water quality, minimization of growth-inducing effects, and safeguarding community serving water systems against destructive hostile action may be compromised. Unlike public agencies not in pursuit of financial gains, privatized systems can reasonably be expected to provide only those environmental protections and other system safeguards that government regulations require or that marketing and tax write down incentives offer as economic benefits. For example, if conservation is seen as being in the public interest, a public agency might more strongly emphasize water conservation over water production, even if foregoing increased production would bring in less revenue. A private, for-profit facility, on the other hand, is more likely to emphasize the opportunity for increased profits that come with increased production. In addition, given the importance of community water systems, it is necessary and appropriate to expect the owner-operator to take all necessary and appropriate steps to ensure public safety by protecting the integrity of the system against hostile action (disruption or contamination of water supply). Public agencies have responsibilities to do so as a matter of their fundamental structure and duty notwithstanding the costs involved. Privately owned and operated for-profit systems are not driven by similar considerations, and may more readily chose to do no more than the minimum required to ensure basic protection of the system.

Several recent experiences in several areas of the U.S. and other parts of the world suggest that user rates, quality of customer service, infrastructure maintenance and upgrades, system reliability and water pressure may suffer if water services are privatized. Examples of private entities leaving the public to absorb the consequences, often at great public expense, are many[14]. The Coastal Commission has experience with failed privately owned projects (e.g., fiber-optic cable projects, coastal hotels, etc.) that adversely affected public resources but did not adequately provide some of the amenities necessary to mitigate for those effects. Other examples include public agencies having to take on the work and expense of cleaning up toxic contamination on sites abandoned by or transferred to the public by private commercial users. A local example is a recent public buy-back of the water system in Montara, California, which required passage of an $11 million bond by the local water users.

[14] Various reports and articles note difficulties with privitization in communities including Montara, California; Tampa Bay, Florida; Atlanta, Georgia; Stockton, California; New Orleans, Louisiana; Indianapolis, Indiana; Lawrence, Massachusetts.; the counties of Duval, Nassau and St. John's in Florida; Huber Heights, Ohio; Chattanooga, Tennessee; Washington Court House, Ohio; Peoria, Illinois; Pekin, Illinois; Angleton, Texas, and others.

The privatization and commodification of water services and water raises questions and concerns both directly and indirectly relevant to implementing Coastal Act policies. Many of these issues are part of a larger public policy debate, and raise questions about the implications of shifting control from public to private, such as the following:

- Should seawater, a public resource held in common for the benefit of current and future generations, be allowed to be expropriated by private business for profit?

- Is it in the public interest, and is it good public policy, for community-serving water systems to be bought by, or turned over to for-profit corporations?

- Does privatization of seawater desalination, with its decision-making by non-elected, non-appointed, and non-local interests, contradict the desire of communities to have a local and reliable water supply?

- Does the public or private nature of a community-serving water system result in a different level of security regarding protection of public health, protection from water supply disruption due to threats, or other related issues?

- What is the potential that international trade agreements could be used to override or impair state and local regulation of desalination facilities owned and operated by multi-national companies? This is a serious concern and is discussed in the next section of this report.

The profound changes in the world of water services discussed above are concurrent with technological advances that are making seawater desalination more feasible. Water providers along the California coast are proposing or considering numerous large-scale proposals to tap into the Pacific Ocean for potable water at economic costs approaching those of some other current sources, such as water imported from the Central Valley or the Colorado River. While many issues associated with the shifting legal landscape of providing water services in California lie within the purview of other government bodies, including various federal agencies, the California Public Utilities Commission, or the State Water Resources Control Board, the Coastal Commission still retains has important responsibilities in determining whether proposed desalination projects are consistent with the public policies related to coastal resource protection.

4.2 POTENTIAL EFFECTS OF INTERNATIONAL TRADE AGREEMENTS ON WATER SERVICES

Main Points:

- ***California expects that its laws and regulations apply as written and implemented; however, there are concerns that recent international agreements and legal decisions relating to free trade could be construed as limiting the ability of state and local governments to effectively regulate the activities of multinational corporations as they relate to environmental protection.***
- ***These concerns about how current and proposed international trade agreements will affect state and local agencies' abilities to regulate proposed desalination facilities are based in part on the stated purpose of many of these agreements, which is to remove as many barriers to trade as possible. In some cases, this may include environmental protection statutes, such as those contained in the Coastal Act.***
- ***Desalination projects proposed by multinational interests will undergo careful review and evaluation to ensure international trade agreements allow conformity to the Coastal Act.***

INTRODUCTION AND BACKGROUND

This section summarizes some of the complex underpinnings and possible consequences of the growing body of international trade agreements and international law that could ultimately change the governance of public resources (see Primary Multinational Agreements, next page). California expects that its laws and regulations will apply as written and implemented; however, arguments are being made that some existing and proposed agreements might limit the ability of state and local agencies to review and regulate projects for the purpose of environmental protection in cases that involve private entities with multinational ties. Agreements not yet adopted but currently being negotiated arguably could have even greater potential to affect state and local government regulation.

Provisions of the North American Free Trade Agreement (NAFTA), the General Agreement on Trade in Services (GATS), the General Agreement on Trade and Tariffs (GATT), and resulting changes in international law have created a new generation of complex, binding and enforceable trade agreements that raise potential conflicts with state and local regulatory authority, and may make nation-states liable for, among other things, lost corporate profits and investment expectations. There are differences between the various multinational agreements as to their extent into regulatory issues, their enforcement and monitoring provisions, whether signatory nations "opt in" or "opt out" of various provisions, and others. Within the various types of agreements, there are also different methods for implementing the agreements, each of which may affect local or state decision-making to a different degree. They range from the less restrictive "Most Favored Nation" status to provisions that limit the ability to apply domestic regulations to multinational entities. However, the common focus of these agreements is to remove as many barriers to trade as possible, which could include removing or weakening many domestic environmental, safety, and health standards. There are also similar bilateral agreements now in place or being negotiated that have a similar focus.

Primary Multilateral Agreements

Trade agreements provide a legal framework that defines the rules of international trade, a dispute resolution process for the interpretation of those rules, and the enforcement mechanisms necessary to ensure compliance of those rules.

GATT - The General Agreement on Tariffs and Trade, first negotiated in 1947, represents the primary foundation for modern multilateral trade agreements. Most recently renegotiated in 1994, GATT remains the primary agreement addressing the trade in goods. It also provides the basic framework for international trade and lays down many of the principles used in subsequent agreements. GATT is a voluntary organization, and it possesses few enforcement mechanisms.

WTO - The World Trade Organization agreement was negotiated in the Uruguay Round of trade talks and took effect in 1995. Currently, 142 countries are parties to the agreement. The WTO is the umbrella organization that covers about 60 agreements and separate commitments (called schedules). The WTO agreement is considered as a "single undertaking" agreement, meaning that by joining the WTO, a party (member nation) agrees to all of the covered agreements. The WTO, unlike its GATT predecessor, has real authority and disciplinary power.

NAFTA - The North American Free Trade Agreement was negotiated between Mexico, Canada and the United States and took effect in 1994. It seeks to eliminate all trade restrictions between the three countries and create a single trade region.

FTAA - The Free Trade Area of the Americas is now being negotiated and will encompass 34 of the 35 nations of North, Central and South America (excluding Cuba). The details are not yet known, but all indications are that it is being modeled after NAFTA.

GATS – The General Agreement on Trade in Services is part of the WTO and is under current negotiation (although the framework itself is not still under negotiation). A service is an intangible product of human labor. The GATS would create new trade rules that will affect the ways in which services are provided, including essential services such as public water supplies, public health care and public education. The stated goal of the GATS is the progressive liberalization of trade in services, which means removing as many barriers to trade as possible.

From the California State Senate Select Committee on International Trade Policy and State Legislation Factsheet: "Terms of International Trade".

APPLICABILITY OF TRADE AGREEMENTS TO SEAWATER DESALINATION

Water provision is not yet specifically listed as a "service" covered by the GATS, and has not yet been included by the U.S. as a specific service commitment; however, numerous water-dependent services have been included, and European Union proposals to include water as a "service" are currently being negotiated. If this occurs, it will mean that several of the more far-reaching provisions of GATS will apply to the provision of water services, including those provided through seawater desalination. Indeed, there is a strong push from several of the more powerful negotiating countries to include all services unless specifically exempted.

As noted in the previous section, the provision of water in urban areas has until recently been primarily a not-for-profit public service provided by public agencies, municipal water districts, or by mutual water companies controlled by shareholders who are the consumers living within the service area. Over the last decade, however, there has been a global push and trend to privatize water supplies and treat water as a for-profit commodity. Because of global consolidation within the water industry over this period, most private entities active in the industry today are subsidiaries or affiliates of multinational corporations. Three such entities (Vivendi, Suez Lyonnaise and RWE) now control more than 50% of the global water market[15].

These agreements are not limited to those trade activities that occur across national boundaries, but also includes entirely local transactions that involve a multinational corporation. The GATS defines "trade in services" broadly enough to apply to entirely local transactions if one of the entities is a multinational doing business in the territory of another member[16]. Under GATS, once a country has committed to apply GATS to a specific service sector, domestic laws relating to the provision of covered "services" must be based on "objective and transparent criteria", and not be "more burdensome than necessary"[17]. A report produced for the Council of Canadians states, "When transnational corporations become partners in a public-private partnership relationship, what would otherwise be entirely a matter of domestic regulation and contract becomes subject to international trade regulation"[18]. This means that a multinational corporation based in a NAFTA-member country or another country party to a similar agreement, (of which there are many) that is intending to operate a private desalination facility in California, even if only for local water distribution, could claim investor rights under NAFTA's Chapter 11. Moreover, the home country of the multinational could challenge the state's regulatory requirements under GATS, possibly subjecting the state's regulatory requirements to legal challenge at the international level. Challenges could be brought, for example, against Coastal Act policies relating to concentration of development, siting, habitat protection, agricultural preservation, or mitigation requirements for impacts related to entrainment, discharge, or runoff. Additionally, and importantly, if a multinational corporation invokes the WTO or NAFTA rules to challenge an action taken by the Commission or any other local or state agency, the party to the proceedings is not the agency whose action is being challenged, but the federal government.

The various trade agreements generally recognize the need for some level of health, safety, and environmental laws and regulations – for example, NAFTA, GATS, and GATT, all contain a provision supporting rules necessary to protect human, animal, or plant life or health. However, even with these provisions, thus far, and with one limited exception, all decisions on challenges to environmental laws under NAFTA and GATT have favored the multinational corporations.

---

[15] *Thirst for Control*, Steven Shrybman, 2002, p. 23.

[16] General Agreement on Trade in Services, Article 1:2 (c), (d).

[17] Trade & Investment in Services, The Alliance for Sustainable Jobs and the Environment, 2002, p. 7.

[18] *Thirst for Control*, Steven Shrybman, 2002, p. 11.

Examples include:

- A NAFTA tribunal ruled that Mexico must pay Metalclad Corporation $16.7 million to compensate for the refusal by a Mexican municipality to allow Metalclad to run a hazardous waste dump after the federal government had assured the investor that it had all the necessary approvals, and the investor had sunk a lot of money into the project. With regards to the case, the Supreme Court of British Columbia opined that NAFTA's expropriation rule, (takings provisions for foreign investors) is "sufficiently broad to include a legitimate rezoning by a municipality or other zoning authority,"[19] which could pave the way for multinational corporations to make claims that go well beyond "takings" claims allowed under the U.S. Constitution's 5th Amendment.

- Aguas del Tunari, a subsidiary of the American-based Bechtel Corporation is currently suing the government of Bolivia for $25 million in lost profits from a failed privatization scheme in the city of Cochabamba. The dispute is being heard pursuant to a bilateral treaty between the Netherlands and Bolivia and a World Bank lending requirement. The tribunal hearing the dispute, the World Bank's International Center for the Settlement of Investment Disputes, has determined the case does not allow public participation or public access to the proceedings or to its associated documents.

- Several countries brought a challenge to the WTO against the U.S. requirement for shrimpers to use turtle-excluding devices on their nets. The tribunal upheld the right of the U.S. to impose requirements on shrimpers who catch shrimp for sale in the U.S., but also determined that the U.S. regulations were too strict. The federal government chose to resolve the issue by suspending the regulations relating to turtle-excluding devices and on-board monitors, and subsequently re-write them in what some say is substantially weakened form.

- In a case pending before the NAFTA tribunal, Methanex Corporation, maker of the gasoline additive MTBE, is seeking $970 million in damages due to California's phase-out of that additive, which Methanex characterizes as a barrier to free trade.

If the U.S. were to agree to include the provision of water as a service subject to GATS, Coastal Act policies as applied to private desalination facilities could potentially be interpreted as barriers to free trade if the Commission or local government imposed permit conditions that were found to be "overly burdensome" or "subjective" by a WTO tribunal, or because they exceed regulations imposed by other countries for similar activities[20]. Indeed, the Coastal Act is not the only regulatory program that could be at risk. Challenges could be lodged against government action under CEQA, the Clean Water Act, the Clean Air Act, and any other state, federal and

[19] The United Mexican States vs. Metaclad Corporation, 2001 BCSC 664.

[20] "Standards imposed by, and practices employed in, other countries can create *de facto* standards that may be treated as demonstrating the existence of a "less burdensome alternative" for purposes of GATS Article VI:4(b) and VI:5(a). In addition, GATS envisions that reviewing bodies will look to "international standards of relevant international organizations" in determining whether a member is complying the "objective and transparent criteria" and "no more burdensome than necessary" standards. Art. VI:5(b)."

local environmental protection law that regulates land and water use, or the quality of water, air, or other resources where multinational entities are involved.

Because these emerging changes in international law are evolving and are subject to interpretation by private trade tribunals, they raise more questions than this report can definitively answer. It is likely that the full scope of the effects of NAFTA, GATS and other trade agreements on California's coastal management program will not be fully understood unless and until tested through the various dispute resolution processes, and perhaps not even then. To compound the situation, the impact and implications of these treaties are constantly shifting as a result of ongoing rounds of progressive trade agreement negotiations. If the U.S. were to agree to expressly include water as a service subject to GATS, it would create the potential for new and broader challenges along these lines. In the rush to address California's growing water needs, the consequences of international trade agreements constitute a profound, though not well understood, challenge to protecting public trust resources and implementing coastal resource protection policies pursuant to the Coastal Act at the state and local level.

Water Privatization in California: Of the approximately two dozen desalination projects currently proposed along the coast, at least six are proposed as privately-held facilities or public/private partnerships, including two (in Huntington Beach and Carlsbad) that would be the largest coastal desalination facilities in the U.S.

Other multinational private entities involved in supplying water to California include:

- ***US Filter***, a subsidiary of the French company Vivendi, purchased about 45,000 acres of farmland in the Imperial Valley with access to water rights totaling approximately 250,000 acre-feet per year, representing about 8% of the amount used by San Diego County.
- ***California-American Water Company*** (Cal-Am), which owns several water utilities in the state (in Sacramento, Sonoma, and Monterey Counties, and in the communities of Montara, Moss Beach, Felton, Thousand Oaks, Camarillo, Coronado, and Imperial Beach) is owned by American Water Works, which in turn is owned by Thames Water, the largest water company in England, which in turn was recently purchased by RWE, a firm based in Germany. Cal-Am is proposing a desalination facility at Moss Landing.
- ***Poseidon Resources***, proponent of the largest desalination facilities being proposed along the coast, has partnerships with a number of multinational companies, including Suez Lyonnaise and U.S. Filter.
- ***OMI-Thames***, a joint venture involving Thames Water, now operates the water utility for the City of Stockton through a 20-year, $600 million contract.

CONCLUSIONS AND POSSIBLE ACTIONS

The California Coastal Act is widely regarded among international coastal managers as the strongest and most effective of integrated coastal management programs. Given the risks to the program, to the state's coastal resources, and to most of the state's other significant environmental, health, and safety requirements meant to protect the public and the state's

resources, California should proceed cautiously in reviewing proposals to further privatize water and water services, particularly those involving seawater desalination. Such privatization coupled with uncertainty about the effects of international trade agreements may compromise the ability of state and local governments to effectively protect the environmental quality and integrity of life in natural and human communities along the coast.

Possible Commission actions to consider include the following:

- Increase awareness and understanding of the potential impacts of international trade rules on coastal management. In addition to a focus on desalination facilities, legal research on this topic should look into a broader range of coastal uses and on overall implementation of coastal resource protection policies by the Commission and local government. Collaboration with other state agencies and the state Attorney General's office is important.

- Before international trade agreements are invoked for "for-profit" water projects, undertake a thorough analysis of how the state will be able to implement Coastal Act and other policies through existing review and permit processes without provoking a trade challenge.

- In collaboration with the Coastal States Organization (CSO), undertake review of this issue area to identify concerns in common with other coastal states so that California can be part of a unified voice before Congress calling for safeguarding state's rights relative to the implementation of coastal management programs at the state and local level.

- The Commission, in collaboration with other appropriate state agencies, California's Attorney General, the Senate Select Committee on International Trade, and the Coastal States Organization, should monitor ongoing international trade negotiations by reviewing trade proposals listed in the federal register and provide comments to the U.S. trade representatives and the state's Congressional delegation about how proposed trade rules could affect implementation of California's coastal resource protection policies pursuant to the Coastal Act and federal consistency provisions of the federal Coastal Zone Management Act.

- Members of the California Legislature have repeatedly asked that state and local government regulatory authority to protect public health, safety and welfare be excluded from the operative provisions of international trade and investment agreements.[21] California should continue to voice its concerns about language that may compromise its regulatory authority. Specifically, California should request that U.S. trade negotiators support the position that water is not a "service" to be included as a sector-specific commitment under GATS.

In closing, it is clear that desalination projects proposed by private or multinational applicants must be carefully evaluated for possible implications relative to the effectiveness of coastal resource protection resulting from the possible operation of international trade treaties.

[21] Letter to USTR Rep Bob Zoellick from 29 members of Ca. Legislature, dated 3/28/03; SJR 40 (Kuehl), chaptered Aug 2002.

4.3 COASTAL ACT PUBLIC RESOURCE POLICIES

This section of the report describes several Coastal Act policies associated primarily with the public's use of the coast, including those related to growth-inducement, priority uses, public access, and recreation. Review of a proposed project for conformity to these policies may differ for some based on whether it is public or private; for others, the review may be the same.

4.3.1 GROWTH-INDUCEMENT

Main Points:

- ***The Coastal Act allows growth and development in the coastal zone when it will not have significant individual or cumulative impacts on coastal resources.***
- ***In some areas along the coast, the water supply provided by desalination may remove the primary constraint to growth and result in significant effects on coastal resources.***
- ***Determining the "growth-inducing" impacts of a particular desalination facility will vary based on its service area, the growth allowed under certified Local Coastal Programs or other adopted plans, its interconnections with other water supplies or water purveyors, and whether it is a public or private facility.***

One of the Coastal Act's primary principles is that growth and development within the coastal zone be allowed when it will not cause significant adverse effects to other coastal resources. In some areas along the coast, desalination could remove what may be the single largest constraint to growth, a limited supply of potable water. In turn, this additional water could result in new and unanticipated pressures on local populations and infrastructure. Without adequately evaluating these increased stresses on local carrying capacity, the additional water available could cause growth beyond identified planned local or regional growth levels, and have significant adverse effects on coastal resources.

There are two main Coastal Act policies that require review of a proposal's growth-inducing effects[22]. The crux of these policies is that development in the coastal zone not significantly diminish other coastal resources. First, Coastal Act Section 30250(a) states, in part:

> *New residential, commercial, or industrial development, except as otherwise provided in this division, shall be located within, contiguous with, or in close proximity to, existing developed areas able to accommodate it or, where such areas are not able to*

[22] In addition, the CEQA Guidelines at 15126.2(d) provide further guidance on how growth-inducing impacts of proposed projects should be evaluated:
"Growth-Inducing Impact of the Proposed Project. Discuss the ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment. Included in this are projects which would remove obstacles to population growth (a major expansion of a waste water treatment plant might, for example, allow for more construction in service areas). Increases in the population may tax existing community service facilities, requiring construction of new facilities that could cause significant environmental effects. Also discuss the characteristic of some projects which may encourage and facilitate other activities that could significantly affect the environment, either individually or cumulatively. It must not be assumed that growth in any area is necessarily beneficial, detrimental, or of little significance to the environment."

> *accommodate it, in other areas with adequate public services and where it will not have significant adverse effects, either individually or cumulatively, on coastal resources…"*

By requiring new development be located close to areas of existing development or in areas with adequate public services, this section of the Act is intended to prevent new development from outpacing the ability of local communities to provide necessary public services. This requirement is further supported by section 30254 of the Coastal Act, which states, in part:

> *New or expanded public works facilities shall be designed and limited to accommodate needs generated by development or uses permitted consistent with the provisions of this division… Where existing or planned public works facilities can accommodate only a limited amount of new development, services to coastal dependent land use, essential public services and basic industries vital to the economic health of the region, state, or nation, public recreation, commercial recreation, and visitor-serving land uses shall not be precluded by other development.*

Taken together, these policies generally require new development be located within or next to existing developed areas able to accommodate such development or in other areas with adequate public services, and provide that public works facilities be sized based on the ability to maintain, enhance, or restore coastal resources, and that development allow all coastal resources to remain viable. New development must also conform to the policies and standards contained in any applicable Commission-certified LCPs. These policies may relate to regional water and growth management goals or how limited water resources are allocated.

In addition to these Coastal Act policies, the state Desalination Task Force, in recognizing the importance of this issue, included as one of its findings:

> *Growth inducing impacts of any new water supply project, including desalination, must be evaluated on a case-by-case basis through existing environmental review and regulatory processes.*

EVALUATING THE GROWTH-INDUCING IMPACTS OF COASTAL DESALINATION PROPOSALS

Reviewing a facility's potential growth-inducing impacts may cover a wide range of questions and issues, depending on the characteristics of the proposal. Questions and issues for desalination proposals may include:

- ***Is the project meant to provide a baseline supply of water or is it to be used only for emergencies or drought relief?*** Projects meant to provide water only during emergencies are likely to have fewer growth-related impacts than projects providing an ongoing baseline supply. If a proposed project is intended to provide only emergency or drought-related water supplies, and evaluation under the Coastal Act reviews only those intended purposes, then any permit issued for such a project will likely include conditions requiring additional review if the capacity of the project changes.

- ***Does the project replace an existing supply of water or provide a new one?*** Some facilities are meant to replace water from a supply that may no longer be available to a community, such as a surface or groundwater source that has become contaminated, or a source that is overallocated or has been overdrawn. Other desalination facilities are meant to provide water in addition to existing supplies. The scope of review for each type of proposal will differ. When a desalination facility is meant to replace an existing supply and therefore avoid or minimize growth-inducing impacts, the review will need to identify the specific measures that assure the existing supply will be retired. For example, if a facility is proposed as a means to replace water currently being withdrawn from a river, the proposal should include specific measures describing how that water will remain in the river for non-consumptive purposes, and any permit issued should ensure those measures are appropriate and enforceable. For proposals meant to augment existing supplies, project review should determine whether growth related to the increased availability of water would occur within allowable limits or projections identified in Local Coastal Programs or other local or regional planning efforts. An example of how these reviews may differ is the desalination facility currently being considered at the Moss Landing Power Plant on Monterey Bay. The primary proposal would provide just enough water to replace some currently being withdrawn from the Carmel River. An alternative proposal being considered would have the facility provide much more water to serve areas of Monterey County not currently within the service district. These two proposals will undergo very different evaluations to determine their growth-inducing impacts.

  Where applicable, the review should also evaluate benefits that may result from the proposed project. For example, desalination could reduce or eliminate withdrawals from surface water bodies, resulting in more natural streamflows and improved fish or wildlife habitat. If desalination is meant to replace groundwater withdrawals, it could in some areas reduce subsidence or seawater intrusion. In areas where surface or groundwater sources have been contaminated, desalination could provide an alternative source of potable water while allowing necessary treatment or remediation of the contaminated water source.

- ***Where will the water go?*** A desalination facility may be intended to provide water to a relatively confined service area with known end users, or may be meant to provide water to a more extensive and less well-defined service area and user base. Determining the growth-inducing impacts of a proposal must include a description of the service area, the maximum build-out of that area, and how much growth could be a result of the water supply provided by the facility. The complexity of this review will vary based on several issues. Review for growth-inducement and its effect on coastal resources will be simpler in cases where the service area is well defined, the distribution system is not connected to other systems, and where the level of development or build-out within the service area is known. Review will be much more complex and difficult for large-scale proposals that would provide water through a connected series of distribution systems to a much larger service area both within and outside the coastal zone. For example, desalinated water produced along the Southern California coast and distributed through the Metropolitan Water District's system could affect water supplies from Ventura to San Diego and inland as far as east as Riverside and San Bernardino Counties. Determining how the growth induced by this additional water will affect coastal resources will be challenging.

The review should consider whether the water produced is subject to delivery requirements and restrictions, long-term contracts, or other binding agreements. It may also be necessary to identify the capabilities and limits of the associated infrastructure, such as the ability of existing or proposed water pipelines to deliver water to the service area. The review may also consider whether the facility's location will result in changes to the delivery area. For example, a desalination facility built at some distance from its service area may result in pressure to provide a portion of that water supply nearer the facility. In some less developed areas, this could lead to growth outside of existing service boundaries and could provide for growth beyond levels identified in local planning efforts.

As trends towards water marketing and the potential for interbasin or even international water transfers increase, any difference in oversight over public or private facilities is likely to have more far-reaching growth-inducing consequences. Longer distance transfers also raise issues associated with determining whether local impacts to coastal resources can be mitigated by benefits that may accrue elsewhere, including some that may occur some distance from the coast.

- ***Will the development serve "coastal priority" uses?*** One concern to be addressed during review is how the water from a facility will be allocated. The Coastal Act mandates that certain types of development along the coast receive priority over other types. These include visitor and recreation facilities (in section 30213), facilities designed to enhance public opportunities for coastal recreation (section 30222), aquaculture facilities (section 30222.5), facilities serving commercial fishing and recreational boating (section 30234), and coastal-dependent development (section 30255). Without adequate public oversight, new development capable of providing its own water may be able to proceed while other higher priority development cannot, thus allowing non-priority development that includes desalination capability and reducing the ability of priority developments to occupy coastal areas. [See also Chapter 4.3.2.] Additionally, the review may consider the form of ownership (public or private) and the degree of oversight in how the facility's water supplies are allocated.

- ***Is there adequate public oversight for the facility?*** Public control of desalination facilities would generally provide more apparent mechanisms to ensure the capacity is linked to local growth management plans, goals, and priority uses, and would allow the necessary involvement by the interested public in decision-making. Public ownership is also likely to allow for a more comprehensive approach to resolving issues related to regional growth, the types of development to be considered, and the directions in which it occurs. As stated in sections 30250(a) and 30254 above, new development must be tied to the capabilities of public services and public works facilities. For proposed private desalination facilities, review under the Coastal Act is likely to require specific evaluation of whether they will incorporate a level of public oversight, decision-making, and consolidation of public interests necessary to ensure public resources are properly managed.

POTENTIAL MITIGATION MEASURES TO AVOID OR MINIMIZE GROWTH-INDUCING IMPACTS

Possible mitigation measures that will likely be evaluated to avoid or minimize impacts include:

- ***Implement local or regional water conservation and reclamation measures to reduce the need for new water projects:*** In some areas, effective water conservation and reclamation measures may, in many cases, provide as much or more water than a proposed desalination project at less cost and with fewer adverse effects. Review of a proposed project should identify measures such as these as part of the alternatives analysis done for a proposed facility.

- ***Link plant capacity to the planned level of development authorized by the certified Local Coastal Program for the area:*** Desalination plants and their accompanying water distribution system should be sized to match the planned level of development authorized by an area's certified Local Coastal Program. The design, review, and approval of proposed projects should include a description of the anticipated level of development, and should tie the permitted activity to that particular development level. This includes assessing the long-term growth-inducing potential of projects. It may also assess capacity of water delivery lines, delineation of the service area, identifying legal instruments available to provide a particular growth level in the area, and other similar measures.

  This issue has been addressed in some previous Commission decisions on similar projects involving growth-inducing impacts. For example, a permit for a water supply pipeline included a condition requiring the permittee to apply for an amendment if the proposed development in the area went above a specific level.

- ***Siting plants near existing water distribution systems and energy sources:*** This may allow a desalination facility to operate using existing infrastructure for both water supply and energy, and not require additional infrastructure build-out and the growth that may be associated with such a build-out.

WHAT'S LIKELY NEEDED DURING REVIEW?

Issues that may be addressed during the review include:

- Identify service area and end users (e.g., are there binding contracts for particular areas or users for certain amounts of water?).
- Identify the types of development to be served.
- If the facility is meant to provide replacement water to allow another existing source to be "retired", what mechanisms ensure the other use is discontinued?

4.3.2 PRIORITY USES

Main Points:

- ***Coastal Act review of a proposed desalination facility may need to evaluate how the facility would affect priority uses along the coast.***
- ***The review for determining conformity to the Coastal Act's priority use policies is likely to differ for public or private desalination proposals.***

The Coastal Act establishes several types of priority uses in the coastal zone. The main purpose of including these in the Act is to ensure that uses strongly associated with the coast and found to be in the public interest remain viable. These types of uses and development (and the corresponding sections of the Coastal Act where they are listed) include:

- Lower-cost visitor and recreation facilities (Section 30213).
- Visitor-serving commercial recreational facilities designed to enhance public opportunities for coastal recreation (Section 30222 – this section also prioritizes those facilities over private residential, general industrial, or general commercial development, but not over agriculture or coastal-dependent industry).
- Aquaculture facilities (Section 30222.5).
- Upland areas for coastal recreation (Section 30223).
- Recreational boating and associated facilities (Section 30224).
- Commercial fishing and recreational boating facilities (Section 30234).
- Prime agricultural land (Section 30241).
- Coastal-dependent development (Section 30255).
- Priority developments must not be precluded by other development due to the limited capacity of public works facilities (Section 30254).

These designations do not mean that these are the only uses that can be located within the Coastal Zone. Part of Coastal Act review, however, may consider whether the site of a proposed development is suitable for priority uses. For a proposed desalination facility, the review may evaluate at least two aspects of priority use policies:

- ***How would the proposed facility itself directly affect priority uses?*** A desalination facility located on or adjacent to coastal zone sites suitable for higher-priority developments could remove or reduce land available for such developments. Desalination facilities may result in several types of adverse effects on coastal resources – visual, noise, public access, water quality, etc. – any of which, even if mitigated, could reduce the ability of priority developments to be sited nearby. This would in turn diminish the coastal uses associated with these priority developments, and may therefore be inconsistent with Coastal Act goals. For example, in a decision several years ago, the Commission determined that a desalination facility being considered in the coastal zone near the cities of Marina and Seaside and adjacent to a State Park would diminish public access and recreational opportunities in that area, and further concluded that a feasible, less environmentally damaging alternative site was available east of Highway 1 away from the shoreline area.

- ***How will the water supply provided by the facility affect priority uses?*** Coastal Act review may also consider how the water supply provided by a desalination facility might be used to either support priority uses or make them less viable. For example, if an inadequate water supply is limiting the opportunity for low-cost visitor serving facilities, or coastal agriculture, a desalination facility may be able to provide the water necessary for those uses. In other cases, the water from a desalination facility may be too expensive for such priority uses and only affordable by higher-cost visitor serving facilities. The increased development pressures on these areas may result in non-priority development, especially if the desalination water supply is more costly than certain priority uses can afford – for example, agriculture and low-cost visitor serving facilities are not likely to be able to afford water from a desalination facility when a high-cost visitor facility could.

  Support for priority uses could also be affected by whether the water is provided by a public or private facility. In areas where development is limited by the available water, private facilities that provide their own water might be able to proceed while other higher priority developments that do not have the ability to provide their own water might not. A private, non-priority development could therefore override Coastal Act preferences for priority coastal uses or might not be subject to water allocation decisions made by a local public water purveyor. Because desalination remains a relatively costly process, a development's ability to provide its own desalinated water may be largely based on financial considerations rather than whether the proposed development is recognized as a priority development for coastal areas. A lower-cost visitor and recreation facility, for instance, may not be able to compete with the ability of a higher-cost facility to provide its own water, and so a coastal site suitable for either type of development may end up used by the latter at the expense of the former. One other consequence of this issue could show up during difficult financial times, in that a private development dependent on its own water supply may, for various reasons, no longer be able to afford the costs of desalination and instead increase the burden on the local public water purveyor. This additional burden could further limit the ability of public agencies to allocate water or land to priority coastal uses. A similar resource-allocation issue may arise due to the relatively high electrical demand associated with desalination, in that the demand from a desalination facility used by a non-priority development could limit or preclude the ability of local electrical supplies to support priority developments.

  Public ownership and oversight of desalination facilities, especially in areas with certified LCPs, is more likely to ensure that water allocations will occur in a manner consistent with the priority developments identified in the Coastal Act and in the LCP. Allocations from public facilities are likely to be subject to more ongoing public review, whereas allocations from private facilities may be primarily market driven and might not adequately reflect Coastal Act priorities. This difference in how public or private entities might allocate water is likely to be moderated in areas where the state Public Utility Commission has provided exclusive retail rights to a municipal water district. In these areas, a private desalination facility would be able to act only as a water wholesaler and sell only to the water district where the allocation decisions would be made.

4.3.3 PUBLIC ACCESS AND RECREATION

A primary focus of the Coastal Act is its extensive provision for public access to the California coast. The Act includes a number of policies related to public access and recreation, most of which provide strong support for the public's ability to use and enjoy coastal areas (see the main policies listed on the next two pages).

Desalination facilities proposing to locate near the coast will likely require assessment of their effects on public access to the shore and their potential impacts on recreation. This review generally evaluates both relatively short-term effects, such as those related to construction, and the long-term effects related to a facility's ongoing operations. Review may include consideration of a range of issues from how the facility's location affects parking near the coast to how the facility's discharge may affect water-based recreation.

Public access and recreation issues may also be incorporated into the review of other Coastal Act policies – for example, projects proposing shoreline protection structures must generally provide information not only about the site conditions related to erosion and coastal processes, but also provide information about how the structure could affect public access to that portion of the shoreline. For facilities proposing to co-locate within the boundaries of an existing power plant or industrial site, the review may be less extensive, although it will likely need to at least identify incremental changes to the existing impacts that may be caused by the addition of the desalination facility.

WHAT'S LIKELY NEEDED DURING REVIEW?

Identification of short-term impacts, such as:

- Changes in parking and traffic
- Temporary beach closures due to construction.
- Project timing (e.g., will there be closures or traffic and parking restrictions during the peak times of visitor use?).

Identification of long-term impacts, such as:

- Effects of facility location on access.
- Effects of facility operation on recreation.

PRIMARY COASTAL ACT POLICIES RELATED TO PUBLIC ACCESS AND RECREATION:

Public Access policies:

Section 30210: In carrying out the requirement of Section 4 of Article X of the California Constitution*, maximum access, which shall be conspicuously posted, and recreational opportunities shall be provided for all the people consistent with public safety needs and the need to protect public rights, rights of private property owners, and natural resource areas from overuse.

Section 30211: Development shall not interfere with the public's right of access to the sea where acquired through use or legislative authorization, including, but not limited to, the use of dry sand and rocky coastal beaches to the first line of terrestrial vegetation.

Section 30212:
(a) Public access from the nearest public roadway to the shoreline and along the coast shall be provided in new development projects except where:
(1) It is inconsistent with public safety, military security needs, or the protection of fragile coastal resources,
(2) Adequate access exists nearby, or,
(3) Agriculture would be adversely affected. Dedicated accessway shall not be required to be opened to public use until a public agency or private association agrees to accept responsibility for maintenance and liability of the accessway.

(b) For purposes of this section, "new development" does not include:
(1) Replacement of any structure pursuant to the provisions of subdivision (g) of Section 30610.
(2) The demolition and reconstruction of a single-family residence; provided, that the reconstructed residence shall not exceed either the floor area, height or bulk of the former structure by more than 10 percent, and that the reconstructed residence shall be sited in the same location on the affected property as the former structure.
(3) Improvements to any structure which do not change the intensity of its use, which do not increase either the floor area, height, or bulk of the structure by more than 10 percent, which do not block or impede public access, and which do not result in a seaward encroachment by the structure.
(4) The reconstruction or repair of any seawall; provided, however, that the reconstructed or repaired seawall is not a seaward of the location of the former structure.
(5) Any repair or maintenance activity for which the commission has determined, pursuant to Section 30610, that a coastal development permit will be required unless the commission determines that the activity will have an adverse impact on lateral public access along the beach.

As used in this subdivision "bulk" means total interior cubic volume as measured from the exterior surface of the structure.
(c) Nothing in this division shall restrict public access nor shall it excuse the performance of duties and responsibilities of public agencies which are required by Sections 66478.1 to 66478.14, inclusive, of the Government Code and by Section 4 of Article X of the California Constitution*.

Section 30212.5: Wherever appropriate and feasible, public facilities, including parking areas or facilities, shall be distributed throughout an area so as to mitigate against the impacts, social and otherwise, of overcrowding or overuse by the public of any single area.

Section 30213: Lower cost visitor and recreational facilities shall be protected, encouraged, and, where feasible, provided. Developments providing public recreational opportunities are preferred. The commission shall not: (1) require that overnight room rentals be fixed at an amount certain for any privately owned and operated hotel, motel, or other similar visitor-serving facility located on either public or private lands; or (2) establish or approve any method for the identification of low or moderate income persons for the purpose of determining eligibility for overnight room rentals in any such facilities.

Section 30214:
(a) The public access policies of this article shall be implemented in a manner that takes into account the need to regulate the time, place, and manner of public access depending on the facts and circumstances in each case including, but not limited to, the following:
(1) Topographic and geologic site characteristics.
(2) The capacity of the site to sustain use and at what level of intensity.
(3) The appropriateness of limiting public access to the right to pass and repass depending on such factors as the fragility of the natural resources in the area and the proximity of the access area to adjacent residential uses.
(4) The need to provide for the management of access areas so as to protect the privacy of adjacent property owners and to protect the aesthetic values of the area by providing for the collection of litter.
(b) It is the intent of the Legislature that the public access policies of this article be carried out in a reasonable manner that considers the equities and that balances the rights of the individual property owner with the public's constitutional right of access pursuant to Section 4 of Article X of the California Constitution*. Nothing in this section or any amendment thereto shall be construed as a limitation on the rights guaranteed to the public under Section 4 of Article X of the California Constitution.
(c) In carrying out the public access policies of this article, the commission and any other responsible public agency shall consider and encourage the utilization of innovative access management techniques, including, but not limited to, agreements with private organizations which would minimize management costs and encourage the use of volunteer programs.

Recreation policies:

Section 30220: Coastal areas suited for water-oriented recreational activities that cannot readily be provided at inland water areas shall be protected for such uses.

Section 30221: Oceanfront land suitable for recreational use shall be protected for recreational use and development unless present and foreseeable future demand for public or commercial recreational activities that could be accommodated on the property is already adequately provided for in the area.

Section 30222: The use of private lands suitable for visitor-serving commercial recreational facilities designed to enhance public opportunities for coastal recreation shall have priority over private residential, general industrial, or general commercial development, but not over agriculture or coastal-dependent industry.

Section 30222.5: Ocean front land that is suitable for coastal dependent aquaculture shall be protected for that use, and proposals for aquaculture facilities located on those sites shall be given priority, except over other coastal dependent developments or uses.

Section 30223: Upland areas necessary to support coastal recreational uses shall be reserved for such uses, where feasible.

Section 30224: Increased recreational boating use of coastal waters shall be encouraged, in accordance with this division, by developing dry storage areas, increasing public launching facilities, providing additional berthing space in existing harbors, limiting non-water-dependent land uses that congest access corridors and preclude boating support facilities, providing harbors of refuge, and by providing for new boating facilities in natural harbors, new protected water areas, and in areas dredged from dry land.

**** Note:*** *Per the references in Sections 30210, 30212(c), and 30214(b), California Constitution, Article X, Section 4 states: "No individual, partnership, or corporation, claiming or possessing the frontage or tidal lands of a harbor, bay, inlet, estuary, or other navigable water in this State, shall be permitted to exclude the right of way to such water whenever it is required for any public purpose, nor to destroy or obstruct the free navigation of such water; and the Legislature shall enact such laws as will give the most liberal construction to this provision, so that access to the navigable waters of this State shall be always attainable for the people thereof."*

[this page intentionally blank]

CHAPTER 5: COASTAL ACT ENVIRONMENTAL POLICIES RELATED TO DESALINATION

Chapter Sections:

This chapter describes the primary environmental policies in the Coastal Act that will likely need to be addressed during review of proposed desalination facilities. The chapter's primary focus is on the Coastal Act's marine biology and water quality policies. It discusses how desalination facilities can adversely affect marine biological resources and ocean water quality, and discusses how facilities are likely to be evaluated as part of coastal development permit review. It discusses separately the effects associated with intakes and those associated with outfalls, and describes several unique issues associated with desalination facilities proposing to co-locate with coastal power plants that are cooled with ocean water.

The chapter then more briefly describes several other Coastal Act environmental policies that may be involved in reviewing proposed desalination facilities, including spill prevention, hazard prevention, and environmentally sensitive habitat areas. These policies are dealt with more briefly since reviewing a desalination facility's conformity to those policies will likely be similar to the review done for many other types of proposed development along the coast, in there will be similar issues and concerns about how a proposal may affect public access or visual and scenic resources, how to prevent hazardous conditions and avoid spills, determining the effect on nearby sensitive areas, and the like. This chapter provides only a general discussion of how a desalination facility might affect these coastal resources – this should not be construed as treating these coastal resources as less important; it means only that they are likely to be evaluated in ways similar to many other developments that have undergone review under the Coastal Act.

5.1 POTENTIAL IMPACTS ON THE MARINE ENVIRONMENT

Main Points:

- ***Desalination facilities can cause significant adverse effects on marine organisms unless properly designed, sited, and operated.***
- ***Reviewing desalination intakes and outfalls – both open-water and subsurface – will require evaluating alternative locations and mitigation measures that avoid or minimize adverse effects on marine biological resources and that, where feasible, restore those resources.***
- ***Desalination facilities proposing to co-locate with coastal power plants raise unique issues with respect to conformity to some Coastal Act policies.***

Seawater is not just water, but habitat. It provides the matrix within which innumerable organisms live, and serves a critical role in everything from the food web to the climate. Although there is a vast amount of seawater on the planet, and along the California coast, it is subject to significant adverse effects at the local or regional scale that can diminish its ecosystem value and its value to society. Common examples of these impacts range from the loss of species diversity to a decline in the number of organisms in a given area to beach closures caused by bacterial contamination in the water.

The two components of desalination with the most potential for causing direct adverse impacts to marine life and water quality are the facility's seawater intake and its discharge. The intake system can cause significant levels of impingement and entrainment[23] that can degrade the local or regional marine ecosystem, and the facility's discharge of brine and possibly other contaminants can be harmful to marine life. The severity of these impacts can be mitigated, and in some cases avoided entirely, through proper facility design, siting, and operation. Without proper measures, however, the impacts can be substantial. For example, a desalination facility producing 50 million gallons per day of drinking water would pull in at least 100 million gallons per day of seawater and discharge at least 50 million gallons per day of highly saline brine[24]. Since each gallon of seawater can contain hundreds of organisms, this amount of water could have significant adverse effects on marine life and water quality at the local or regional level.

The report first discusses the impacts associated with the intake – entrainment and impingement – and then discusses the impacts associated with the discharge – primarily increased salinity and the presence of chemicals or various contaminants. It then discusses some unique issues associated with desalination facilities proposing to co-locate with coastal power plants, and how the review of those facilities may be different from the review of projects proposed to be sited independently. Of the current proposals along the California coast, the largest are those considering co-location, and while this approach has some advantages, it also raises significant issues for Coastal Act conformity. All three of these sections emphasize the need to evaluate alternatives and mitigation measures that would avoid or minimize the associated effects.

Along with the concerns raised about its potential to cause significant adverse impacts to water quality and marine biology, there is recognition that desalination could result in some beneficial changes. One possible benefit could come by using desalinated seawater to replace water withdrawals from coastal streams. Another possible benefit, on a more conceptual level, could be that public perception and practices could change if seawater were to be seen as drinking

[23] These terms are discussed in more detail later in this chapter. Impingement occurs when fish or larger marine animals are pulled into a seawater intake and are trapped against screens within the intake. They die or are injured due to water pressure, abrasion, thermal effects, or other causes. Entrainment occurs when an intake draws in small organisms such as plankton, larvae, fish eggs, and other animals along with seawater. These organisms are small enough to be pulled through the intake screens, and they are then heated or crushed as they are drawn through the facility. Entrainment is considered to cause 100% mortality to the entrained organisms, which occurs either as the organisms pass through the facility or shortly after they are discharged alive but injured.

[24] Reverse osmosis facilities generally operate at efficiencies between 15 and 50 percent, so for every gallon of drinking water they produce, they may need from one to about six gallons of seawater and can discharge from one to about six gallons of effluent. A 50 million gallon per day facility, for example, would pull in and discharge from 100 to 300 million gallons per day (although the lower the efficiency, the lower the salinity in the discharge).

water – this could lead to more thought and care about how the ocean is treated, what materials are allowed to or prevented from running into the ocean, and a stronger sense of connectedness between the coast and everyday practices. On a more pragmatic note, this could also result in lower treatment costs if the seawater being desalted was cleaner than it might otherwise be.

PRIMARY APPLICABLE COASTAL ACT POLICIES

The primary Coastal Act policies related to marine biological resources and water quality are:

Section 30230:

> *Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.*

Section 30231:

> *The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface water flow, encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams.*

These policies establish strong standards for protecting water quality and marine life. They require not only that biological productivity be maintained and enhanced, but that where feasible, it be restored. They also specifically require sustained biological productivity and minimization of entrainment-related effects. By requiring restoration where it is feasible, these policies recognize that coastal development permit decisions may be based on, and mitigation required for, measures that go beyond just maintaining what may be a low or poorly functioning baseline condition. Reviewing proposed desalination facilities will likely require determining an appropriate environmental baseline and evaluating appropriate alternatives and mitigation measures that avoid or minimize adverse effects to the marine community and water quality.

Other Coastal Act policies relate to protecting water quality or marine biological resources either directly or indirectly. These include Sections 30234.5, which requires supporting the marine environment for commercial and recreational fishing, and recognizes the role of marine life not only as part of the environment, but as an important part of the state's economy:

> *The economic, commercial, and recreational importance of fishing activities shall be recognized and protected.*

They also include Section 30220, which helps establish the need to protect water quality to allow for recreation:

> *Coastal areas suited for water-oriented recreational activities that cannot readily be provided at inland water areas shall be protected for such uses.*

Another Coastal Act policy that may significantly affect the design and operation of some facilities is the fill policy discussed in Chapter 2.2.2. The consequences of placing fill for intakes and outfalls deemed coastal-dependent may require design changes to ensure adverse effects to marine life and water quality are minimized to the maximum extent feasible.

In addition to the above policies, the recently completed work of the state's Desalination Task Force included a number of findings and recommendations related to protection of the marine environment. Among its recommendations are:

> *Ensure seawater desalination projects are designed and operated to avoid, reduce or minimize impingement, entrainment, brine discharge and other environmental impacts. Regulators, in conjunction with the public, should seek coordinated mechanisms to mitigate unavoidable environmental impacts.*
>
> *Where feasible and appropriate, utilize wastewater outfalls for blending/discharging desalination brine/concentrate.*

In addition to review by the Coastal Commission for conformity to policies specific to the Coastal Act, other agencies may be involved in reviewing different aspects of a proposed desalination facility, including the state and regional water quality boards, the Department of Fish and Game, and others. The Coastal Act policies, for example, supplement and support the requirements of the California Ocean Plan, which the state and regional boards help implement. The Ocean Plan includes narrative and numeric standards for allowable discharges, and identifies "Areas of Special Biological Significance" in which discharges are prohibited or curtailed. The complementary relationship between the various agencies, their likely role in reviewing desalination proposals, and the potential for coordination among them is discussed in Chapter 6.

5.1.1 EFFECTS OF DESALINATION INTAKES ON MARINE BIOLOGY AND WATER QUALITY

The most significant direct adverse environmental impacts of a desalination facility are likely to be caused by its intake. These impacts also can be completely eliminated by using alternative designs and mitigation measures.

Most desalination facilities currently under consideration are proposing to use an open water intake, which pulls in water directly from the water column. The primary adverse effects of these types of intakes are ***impingement*** and ***entrainment***. It is relatively easy to avoid or reduce impingement; entrainment, however, requires more substantial effort to adequately mitigate.

IMPINGEMENT

Impingement refers to causing injury or death to marine organisms by pulling them into an intake system where they cannot escape due to high water velocity, the length of the intake pipe, or other aspects of a facility's design, and they are eventually trapped against a fish screen. Rates of impingement are primarily a function of the intake's location and the velocity of water being drawn into the intake.

ENTRAINMENT

Entrainment refers to the death or injury of the relatively small marine organisms, such as plankton, larvae, and fish eggs, that are too small to be screened out by fish screens and are pulled through the screens into the processing system of a facility using seawater. Any open water intake will result in some level of entrainment. Entrainment is most commonly associated with thermal power plants (coastal or inland) that use once-through cooling systems, but also occurs in other types of facilities using open water intakes. Entrained organisms are killed due to high pressures or temperatures within the power plants, or in the case of desalination facilities, due to the high pressure when water is forced against filters or membranes.

Unlike impingement, which is relatively easy to mitigate through structural or operational changes to open water intakes, mitigating entrainment requires more significant measures. While the significance of both impacts is related to the location of an intake, impingement rates are primarily a function of intake velocity, while entrainment is more closely linked to the overall volume of water drawn into a facility.

Most studies and findings related to entrainment have been done to determine the effects of power plant once-through cooling systems on marine biology. Coastal power plants using hundreds of millions of gallons per day of ocean water can entrain and kill trillions of organisms annually and can cause substantial changes to the local or regional biological community. The mortality rate for entrainment in power plants is considered to be 100%, due to the thermal effects and pressure changes experienced by the organisms. The mortality rate for desalination facilities would be essentially the same, since the seawater they use is forced through filters or membranes at high pressures to remove particles, including the small organisms that may be in the water.

The most common way to determine entrainment effects is by conducting what is known as a "316(b)" study, named after the section of the federal Clean Water Act. These studies help determine whether power plants are in compliance with the Clean Water Act requirement to minimize adverse environmental impacts by using the "Best Technology Available." The study involves taking water samples at various depths over the course of a year at both the intake site and a nearby control site, identifying the organisms in these samples, and then using various modeling techniques to determine the types and numbers of species that would be affected and the effect on the local or regional population of marine organisms. The results help determine what alternatives and mitigation measures are needed to avoid or minimize impacts.

Three of the seventeen power plants along the California coast (Moss Landing, Morro Bay, and Diablo Canyon) recently completed 316(b) or equivalent entrainment studies, and a study is currently underway at Huntington Beach. These studies were done as part of the California Energy Commission's review of proposed power plant upgrades and installation of new power generating units. The studies helped update previous studies done in the 1970s and 80s and established the existing baseline conditions at these facilities for purposes of their recent review. The rest of the coastal power plants use studies also done about twenty-five years ago. These older studies will need to be updated to address proposed changes at these power plants, such as co-location of a desalination facility (see Chapter 5.1.3 for additional discussion). These older studies are out-of-date for several reasons – they describe physical or biological conditions that may no longer exist, they were conducted using sampling techniques and modeling approaches that do not reflect our current understanding of science and marine biology, and some were done at locations far removed from the site of the power plant that may not reflect actual conditions at the impact site. The state Desalination Task Force also recognized the need to update these studies in one of its findings:

> *The appropriate State regulatory agencies[25] have indicated that the siting of a new desalination facility, which utilizes any new or existing open water feedwater intakes, will require a current assessment of entrainment and impingement impacts as part of the environmental review and permitting process.*

An entrainment study may be fairly extensive and may be required by several different agencies as part of their permit reviews. Additionally, the findings of these types of studies may result in substantial changes to how a proposed facility is designed, sited, or operated. Therefore, it would be more effective and efficient for the studies to be done as part of a proposal's initial environmental review using protocols agreed upon by the various agencies. This would allow entrainment impacts to be identified early in project review and allow necessary mitigation measures to be incorporated into decision-makers' deliberations.

ALTERNATIVES AND MITIGATION MEASURES

There are two main approaches to avoid or minimize entrainment and impingement impacts. The first is to use a subsurface intake, such as a beach well or infiltration gallery, which would allow these impacts to be avoided entirely. Where subsurface intakes are infeasible, open water intakes may be designed and located so that entrainment and impingement are reduced, but usually not entirely eliminated.

Subsurface intakes: The primary way to avoid both impingement and entrainment is to use a subsurface intake, such as a beachwell or infiltration gallery, rather than an intake that draws in water directly from the water column. Because the way a desalination facility takes in water has the most potential to affect marine biology, the feasibility of this alternative should be one of the first considered during the conceptual design stage of a proposal, and will also likely be evaluated during environmental review.

[25] State agencies represented on the Task Force included the Coastal Commission, the State Water Resources Control Board, a Regional Water Quality Control Board, the Department of Fish and Game, and the Bay Conservation and Development Commission.

Subsurface intakes, such as beach wells or infiltration galleries, are placed below the water column and pull in seawater through the overlying substrate, which acts as a natural filter. At least four of the existing desalination facilities along the coast use beach wells as their feedwater system, and at least six of the currently proposed facilities are considering using beach wells. Here in California, the largest existing subsurface intake for a desalination facility takes in less than one million gallons per day, but elsewhere in the world, they provide up to 25 million gallons per day.

The amount of water that can be taken in by subsurface intakes is a function of the type of substrate, its permeability, and other geotechnical characteristics. Properly designed subsurface systems are likely to completely eliminate impingement and entrainment impacts. Some can be installed so they are completely below grade at or near beach areas, and some can be located at some distance inland from the shoreline if water is available below the surface due to naturally occurring or induced seawater intrusion. Designed with appropriate intake velocities and installed at the proper depth within the substrate, beach wells or infiltration galleries can operate with little, if any, noticeable effect on local marine life.

Subsurface intakes may offer additional operational advantages, such as reduced chemical use and reduced operating costs. The natural filtering effect of the overlying substrate may provide a buffer to changes in water quality due to storms or runoff. It may also provide some part of the pre-treatment needed before the seawater goes through the desalination filters or membranes, thus eliminating part of the chemical or physical treatment that would otherwise be required. While subsurface intakes may have higher initial construction costs, they may result in long-term operational savings due to their having fewer pre-treatment and chemical requirements. They may also be able to operate during times when facilities with open water intakes would have to shut down due to water conditions.

Additionally, there is some research available that suggests wells used to dewater areas below a beach may provide some degree of shoreline stabilization[26]. While currently inconclusive, the research suggests that beach wells may in some locations increase shoreline stability or accretion rates, although it appears to depend on a number of site-specific characteristics related to the depth to groundwater, presence of a coastal aquifer, amount of sediment transport, and others.

Subsurface intakes may not be feasible in all locations. They may not work well in areas where the substrate is silt, clay, or unfractured rock. In areas with sandy substrates, the sand should be relatively stable or deep enough to the intake is not exposed during seasonal sand movement or storms, and should be permeable enough to allow seawater to be pumped through to the facility. In some areas with less permeability, larger infiltration galleries or multiple beach wells may be needed to pull in the desired amount of water. However, even in some areas where the existing substrate may make a subsurface intake infeasible, an intake could be designed with an artificial

[26] See, for example:
Turner, Ian L. and Stephen P. Leatherman. Beach Dewatering as a 'Soft' Engineering Solution to Coastal Erosion – A History and Critical Review, Journal of Coastal Research, Fall 1997.
– and –
Waterways Experiment Station, U.S. Army Corps of Engineers. Field Evaluation/Demonstration of a Multisegmented Dewatering System for Accreting Beach Sand in a High-Wave-Energy Environment. July 1988.

substrate around the intake opening. For example, adding a concrete box around the opening of a surface intake and filling it with sand or other suitable material could transform an otherwise high entrainment intake to one with little or no entrainment. This contained cover system would likely require more extensive design considerations and some ongoing monitoring, but may still provide a feasible method to avoid all or most entrainment impacts.

Open water intakes: Where subsurface intakes are determined to be infeasible, the review of a facility proposing to use an open water intake may require evaluation of numerous measures to reduce adverse effects and may need to consider compensatory mitigation measures. For new or modified intakes, this will likely require review under both the Coastal Act's marine biology/water quality policies and its fill policy. [See Chapter 2.2.2.]

Mitigation measures to address impingement effects may be different from those meant for entrainment effects. Three effective mitigation measures for impingement are:

- ***Low intake velocity rate:*** The amount of impingement at a facility is largely a function of the intake water velocity. When intake velocities are kept below about 0.5 feet per second, fish and other organisms are generally able to avoid being pulled in, or if they are pulled in, can generally swim against the current and escape. The rate of 0.5 fps is considered a "Best Technology Available" for purposes of Clean Water Act compliance. Facilities can be designed and operated to keep the velocity at or below 0.5 fps through a combination of pumping rates and intake design.

- ***Velocity caps:*** Fish are generally better able to detect a horizontal change in water velocity than a vertical change. Many intake structures were built with openings that pull water in from above, causing a change in velocity that fish cannot sense as well. Velocity caps, which are structures usually made of concrete placed over the intake with a gap between the cap and the intake, change the predominant intake water flow from vertical to horizontal. Impingement rates often drop significantly after a velocity cap is added, and once installed, they require very little ongoing maintenance.

- ***Screens, traveling screens, and fish return systems:*** Screens are generally sized to prevent fish from entering an intake system while still allowing adequate water flow. Traveling screens allow fish to be moved out of an intake system, often unharmed. They are generally built at the landward end of an intake pipe, often in a forebay area, and are often built in conjunction with a fish return system, which routes fish and part of the intake water back to the source waterbody. These systems can be fairly effective in reducing impingement, but require ongoing maintenance and personnel to operate them.

Mitigating entrainment effects is usually more difficult. The measures above are generally not effective in minimizing entrainment, since the organisms subject to entrainment are too small to be screened out without significantly reducing water flows into the intake system, and since they are generally less responsive to changes in water velocity. Other structural measures, such as aquatic filter barriers, are still considered experimental in the marine environment and may cause substantial impacts on their own. Therefore, the primary mitigation approaches to minimize entrainment impacts have been to first determine the least environmentally damaging location for an intake and to then develop compensatory mitigation to make up for the lost marine life.

Determining an appropriate location is necessary to reduce both entrainment and impingement. This may require not only an entrainment study, but a study of currents, wave, and tidal patterns and their relationship to nearby biologically important areas to use in designing the entrainment study. The rates and types of entrainment vary significantly based on the location and depth of the intake, as well as where the intake is sited in relation to areas of biological importance (e.g., at the mouth of a bay or estuary, near kelp beds, hard bottom habitat, or areas of upwelling, etc.). Even after selecting the least environmentally damaging location and incorporating structural mitigation measures, an open water intake has the potential to cause significant entrainment effects, which in turn could require compensatory mitigation. Compensatory mitigation is usually the last and least desired form of mitigation considered as part of "mitigation sequencing", which requires first that adverse effects be avoided and then minimized; then that the affected environment be restored; and finally that impacts be compensated for by providing a replacement or substitute resource or habitat. In the past, forms of mitigation have included fish hatcheries, fishing limits, habitat enhancement, or other similar "out-of-kind" or offsite measures.

Determining the necessary level of mitigation for most proposals would be based in part on results of a 316(b) study or its equivalent. Developing such measures would require an extensive evaluation of the impacts and determination of both the feasibility and effectiveness of making up for the lost marine organisms. In some cases where significant entrainment effects remain even after all structural mitigation measures have been provided, the impacts may be so extensive as to make compensatory mitigation insufficient to adequately address the problem. For example, a large facility pulling in tens of millions of gallons of water per day may cause impacts that require dozens or hundreds of acres of habitat to replace the lost organisms or lost biological functions. It is likely to be challenging to identify enough nearby suitable areas to create, restore, or enhance the necessary amount of habitat value, and for some projects, this may result in denial of a permit.

An additional and more recent concern with using compensatory mitigation for entrainment impacts is due to a federal circuit court decision regarding cooling water intakes for power plants. The court ruled that the Clean Water Act limits the use of such measures as mitigation for those intake systems (see additional discussion in Chapter 5.1.3).

Another mitigation approach to reduce entrainment that is still under development is the use of aquatic filter barriers. These systems consist of fine-screened mesh placed around the area of an intake. To be effective in screening out organisms and at the same time allow enough water through, some of these filters at larger facilities must be up to several hundred feet long. While they have seen some use in riverine environments, they have not yet been proven effective in the ocean environment. Additionally, due in part to their size, they create additional concerns that would have to be addressed during review, including how they affect other uses in the water such as navigation, and what would happen if they were to break away from their moorings.

One additional option that may be worthwhile is to retrofit an open water intake so that it becomes a subsurface intake. This could be done by constructing a structure around the intake opening that is filled with sand, cobble, or other material that prevents or reduces entrainment.

WHAT'S LIKELY NEEDED DURING REVIEW?

Evaluate the feasibility of subsurface intakes: Given the potentially significant entrainment impacts caused by open water intakes, this will likely be one of the main parts of reviewing proposed desalination facilities. The default intake design should be one that does not cause entrainment – that is, a subsurface intake. The applicant for a proposed facility will likely bear the burden of proof as to whether a subsurface intake is feasible.

The review may require information such as:

- ***A bathymetric survey*** of proposed intake locations and sub-bottom profiles showing location and thickness of sand cover or other substrate over bedrock.
- ***Results of sediment core samples***, including grain size, vertical and horizontal transmissivity, the presence or absence of impermeable layers, etc.
- ***Written and graphic descriptions of historic and current seasonal beach profiles*** in the area of a proposed intake, including post-storm profiles.
- ***Cost estimates and comparisons*** for constructing and operating surface and subsurface intakes. This should include an evaluation of the operating cost advantages that may accrue due to desalination facilities that use subsurface intakes requiring less pre-treatment than those that use open-water intakes.
- ***Examination of regional sediment transport patterns***, sediment sources and sinks, and an analysis of the anticipated long-term stability of the substrate that would be used for the intakes.
- ***Monitoring plan*** for ensuring stability of sand cover.
- ***Mitigation plan*** for potential sand loss (e.g., augment sand cover, deepen well, reduce intake velocity, etc.).

In addition, where a standard subsurface intake is found to be infeasible, or in some cases, when considering a retrofit of an existing open water intake, evaluate the potential for constructing and maintaining artificial cover at the intake location by using a contained cover system with sand, gravel, or cobble.

For open water intakes, determine the least environmentally damaging location and mitigate the remaining entrainment and impingement effects: Where subsurface intakes are determined to be infeasible, review will likely require several studies to determine what available location is least damaging and what entrainment effects would still occur. The default protocols for an entrainment study are those used in the 316(b) studies, though in some cases, different study parameters may be proposed. In some cases, the review may be able to use other recent and local entrainment data – for example, a recently completed 316(b) study at a nearby site, if applicable to the proposed desalination site. Other studies similar to the ones listed above for subsurface intakes may be needed to identify locations with suitable substrates to support a pipeline, acceptable sand movement and deposition patterns, and the like.

Review should also evaluate potential structural and operational measures, including:

- ***Velocity caps:*** The intake structure should be designed so that water is pulled in horizontally rather than vertically to allow fish to better sense the intake.
- ***Velocity rates:*** The facility should be designed so that the size of the pipeline and the pumps result in a water velocity of less than 0.5 feet per second.
- ***Screens:*** These may include various types of screening devices, based on the type of impingement impact identified for a facility. For example, a facility with a location and design that results in very little impingement and no impingement of sensitive species may have fewer concerns about screening than a facility with more significant impingement impacts.
- ***Compensatory mitigation proposals:*** Proposed compensatory mitigation measures may include a wide range of approaches – from fish hatcheries to habitat replacement to preservation of various types of areas – depending on the effects being mitigated and the available mitigation options. Proposed measures should consider such elements of a mitigation plan as performance standard, contingencies for possible problems or failure of a particular measure, and others.

All these mitigation measures should be developed in conjunction with the various regulatory agencies involved in reviewing, permitting, or monitoring the facility. Some measures that may be more desired by the proponent – for example, certain compensatory mitigation measures – may be less acceptable to various agencies, so these issues should be worked out early in the project review stage.

5.1.2 EFFECTS OF DESALINATION DISCHARGES ON MARINE BIOLOGY AND WATER QUALITY

The desalination process results in an effluent that is high in salts and that may contain various contaminants, such as chemicals or cleaning compounds. The discharge also carries with it what may be a large volume of biomass made up of the entrained organisms that were drawn through the facility. Each of these constituents of the discharge is discussed below. There are also likely to be other types of impacts when desalination discharges are combined with other discharges from coastal power plants, wastewater treatment facilities, or others types of facilities (see the discussion in Section 5.1.3 of issues related to co-located desalination facilities).

HIGH SALINITY

The ambient salinity of seawater varies due to seasonal changes, upwellings, or other natural phenomena. Salinity in the Pacific Ocean off California, for example, averages about 33 parts per thousand, with a typical variation of about plus or minus 10%. The discharge from a desalination facility may locally increase salinity levels by up to 100%, or about double the normal salinity level for seawater. Local marine species are usually adapted to an area's natural salinity levels, but few, if any, are likely to be adapted to the increased salinity of a desalination discharge. These species may also be adapted to the natural variation in salinity that occurs seasonally or due to natural phenomena such as upwellings or freshwater inputs, but they may not be adapted to sudden exposure of those same levels when not caused by natural event out of season – for example, an organism may be able to handle a gradual 10% salinity increase on a seasonal basis but not sudden exposure to a plume with salinities of 10% above ambient conditions. Even where a higher salinity level does not kill organisms directly, it may have sublethal effects that stress them so that they are more susceptible to other stressors, such as increased levels of other pollutants. Further, organisms may be sensitive to different salinity levels based on their life stage – for instance, an adult fish may not be harmed by a higher salinity concentration or may be able to swim away from it, whereas the eggs, larvae, or juveniles of the same species may be harmed at the same concentration.

CHEMICALS OR CLEANING COMPOUNDS

Seawater desalination facilities require a variety of chemicals and compounds to treat the water, clean the desalting equipment, and prepare the desalted water for distribution through the water supply system. Many of these compounds are neutralized or removed from the waste stream before being discharged, though some may remain. Chemicals used during the desalination process included chlorine, ozone, or other biocides, various coagulants, acids, antiscalants, and others. Additionally, some materials used in the pipes, filters, or other structural elements of a desalination facility may corrode during the desalination process and add metals or other compounds to the discharge stream. Finally, compounds or elements that occur naturally in the water column, or that may be present due to pollution, will be concentrated during the desalination process and may be discharged at levels up to twice the concentration in the source water.

BIOMASS FROM ENTRAINED ORGANISMS

The desalination process involves either heating seawater or forcing it through membranes at very high pressure, as described in the previous section of this report. Both processes generally kill all of the organisms present in the seawater, and those dead organisms become part of the facility's discharge. At a large facility, this could result in a substantial amount of organic material, which can cause water quality problems by itself or can provide a matrix for growing bacteria and other organisms. This type of discharge can be harmful to human health.

ALTERNATIVES AND MITIGATION MEASURES

There are a number of ways to avoid or minimize adverse effects caused by desalination discharges, many of which can be used in combination. Mitigation measures that may be evaluated during review include:

- **Proper location:** The discharge should be located in an area where it will not harm nearby sensitive marine life. For example, discharges should be located well away from areas of kelp, hard bottom habitat, or other areas where resident species may be more sensitive to such changes in water quality.

- **Subsurface outfalls:** Similar to the benefits created by subsurface intakes, discharges from subsurface outfalls may be buffered and diffused by passing through substrate before they reach open water or the biologically active zone of the seafloor.

- **Structural measures – diffusers or multiport outfalls:** These structural components allow a discharge to be split into several streams or released over a larger area, resulting in quicker diffusion in the receiving water.

- **Minimizing chemical use or using alternative treatments:** These include using non-corrosive or less corrosive materials in the facility and adequately treating the chemicals before discharge to ensure they are neutralized. The review of proposed facilities may also consider the types and amounts of chemicals proposed to be used and evaluate whether there are less persistent or less harmful chemicals or methods that would achieve the same treatment purpose (e.g., using ultraviolet light instead of biocides).

- **Wastewater treatment systems or on-land disposal:** During some processes, such as membrane cleaning, desalination facilities may generate wastes with contaminant concentrations too high to be discharged to the ocean. Facilities can be designed to separate these flows and send them to a wastewater treatment system, or to separate out many of the solids removed from the seawater for disposal in a landfill. This same approach can be used to separate constituents in the water column that might be concentrated during the desalination process (e.g., copper or petroleum products as mentioned above), and disposed of in ways other than discharge to the ocean.

- **Co-located or combined outfalls:** In some cases, discharges from a desalination facility may be combined with other existing discharges, such as the discharge from a wastewater treatment system or a coastal power plant (see the following section of this report for additional evaluation of co-location with power plants). Combining the two discharges may result in fewer overall adverse effects compared to having separate discharges – for example, by allowing the high-saline desalination discharge to mix with a low-saline wastewater discharge, the overall discharge may mix more readily with the ocean water, allowing it to more quickly match background salinity levels. The degree to which the combined discharge will mix will vary depending on the contribution of each facility to the overall discharge – for example, wastewater flows are generally much lower at night than during the day, so a steady-state desalination discharge would provide a higher proportion of the overall amount at night.

Ocean discharges will also be subject to review and permitting by the Regional Water Quality Control Boards for an NPDES (National Pollutant Discharge Elimination System) permit, and will likely be subject to ongoing monitoring requirements.

WHAT'S LIKELY NEEDED DURING REVIEW?

The review should include descriptions and analyses of:

- Ambient or background conditions, including daily and seasonal variations, the existing level of water quality impairment, etc.
- Facility operating rates and discharge constituents at those rates.
- Types and amounts of chemicals and compounds used during the processes and maximum expected concentrations in the discharge.
- Plume modeling showing areal extent of salinity ranges in various conditions (including worst-case).
- Capacity of wastewater treatment or landfill to allow separation of solids or chemicals from the discharge.
- Fate and transport modeling showing how the discharge would interact with the receiving water.
- The "worst-case" situation – i.e., the conditions during which the facility would have the greatest adverse effects – for example, when the facility operates at full capacity with during an ebb tide and no or low currents so that very little mixing occurs.
- Marine organisms present and how they would be affected by salinity changes, including how the affects may vary by life stage.

For combined discharges, in addition to the above considerations, the review should describe the typical operating conditions for each facility and the amount of flow each would contribute to the overall discharge at various operating configurations. The "worst-case" scenarios for a combined discharge will also likely require identifying the highest and lowest levels of salinity and other contaminants that could reasonably occur during various operating conditions and the environmental characteristics of the receiving waters.

5.1.3 ISSUES RELATED TO CO-LOCATING DESALINATION FACILITIES AT COASTAL POWER PLANTS

Main Points:

- ***Desalination facilities proposing to co-locate with coastal power plants using "once-through" cooling would link providing water supply with what in many cases may be an out-of-date and environmentally harmful technique.***
- ***Most proposals for co-located desalination facilities will need updated entrainment studies, since most coastal power plants do not have current entrainment data.***
- ***Review under the Coastal Act will require identifying, at minimum, the incremental impacts caused by the desalination facility beyond those caused by the power plant.***

The largest desalination facilities currently being considered in California are proposing to use the cooling water intakes and outfalls of existing coastal power plants. While there may be a number of operational advantages when desalination facilities co-locate with power plants, there are also some unique and potentially significant issues and adverse environmental impacts different from those that would be evaluated for an independently-sited desalination facility[27].

Most coastal power plants using a "once-through" cooling system were designed and sited several decades ago when environmental issues were not as much of a concern as they are today and when the adverse effects of once-through cooling were not as well understood. Many of the intakes and outfalls are located in areas that would likely not be acceptable under current requirements, due to their significant impacts on the marine biological community or their contribution to water quality problems. Additionally, many of these power plants have never gone through a comprehensive environmental review such as that required under CEQA and have not been evaluated for Coastal Act conformity.

---

[27] Many of these advantages and disadvantages of co-location are recognized in the findings and recommendations of the state Desalination Task Force, which include:

- *Advantages of co-locating desalination facilities with coastal power plants using once-through cooling may include: compatible land use, use of the existing infrastructure for feedwater intake and brine discharge, location security, use of the warmed power plant cooling water as the feedwater for the desalination facility, reduction of the power plant discharge thermal plume, and the potential to purchase power from the host power plant at prices below retail rates.*

- *Co-locating a desalination facility with a coastal power plant may provide a justification for the continued use of once-through cooling technology. Once through cooling technology has well-documented environmental impacts, including impacts on marine organisms.*

- *The appropriate State regulatory agencies have indicated that the siting of a new desalination facility, which utilizes any new or existing open water feedwater intakes, will require a current assessment of entrainment and impingement impacts as part of the environmental reivew and permitting process.*

- *For proposed desalination facilities co-locating with power plants, analyze the impacts of the desalination facility operations apart from the operations of the co-located facilities. This will identify the impacts of the desalination facility operations when there are reductions in cooling water quantities. This recommendation is not intended to dictate California Environmental Quality Act alternatives that must be evaluated.*

Even recognizing that existing baseline environmental conditions are, in part, a result of decades of power plant operation, the ongoing adverse impacts of these cooling water systems can be significant. Coastal power plants typically take in several hundred million gallons of seawater per day, with some taking in over a billion gallons each day. This is a significant amount of water by almost any measure – for example, a 500 million gallon per day cooling system takes in enough water each day to cover over two square miles of land one foot deep. When this amount of water is translated into habitat value, with densities of hundreds or thousands of organisms per cubic foot of water, this translates into a substantial loss of marine life, especially in areas where biological productivity may have already been reduced by other stressors or in important habitats such as estuarine or nearshore areas.

ADVANTAGES OF CO-LOCATION

Co-location is seen by many as providing several advantages, including:

- **Water use:** Most of the water used by a co-located desalination facility would be water also used by the power plant. For some such proposals, the incremental entrainment and impingement caused by the desalination facility might result overall in fewer additional impacts to the marine environment than a similarly sized desalination facility sited independently and drawing in water from its own intake system. This will require case-by-case evaluation, however, and would vary by location and by how each facility is operated.

- **Shared discharge:** The high salinity discharge from the desalination facility could be mixed with what would usually be a much higher volume of cooling water from the power plant. This would allow some salinity dilution before the combined discharge enters the ocean.

- **Use of existing intakes and outfalls:** By using the power plant's existing intake and outfall structures, there would be no need for additional inwater structures.

- **Available electricity:** The power plant could provide much of the energy used by the desalination facility, which could allow the desalination facility to be built with less need to increase transmission capability elsewhere on the energy grid. Additionally, in some cases, a co-located desalination facility may be able to pay less for the electricity due to low or no transmission costs.

- **Use of an existing industrial site and associated infrastructure:** Where a co-located desalination facility is located entirely within an existing power plant site, it may use much of the existing infrastructure needed for a desalination facility – such as parking, security, etc. – that is already in place. This could result in overall fewer impacts by having two facilities share an existing site rather than develop a new site. Additionally, many desalination facilities are likely to be relatively small in scale compared to the power plants, so their visual impacts may be subordinate to the existing visual effects of the power plants.

- **Existing data and studies:** For those power plants with up-to-date environmental studies, the proposed desalination facility could be reviewed based in part on those studies.

DISADVANTAGES AND CONCERNS

Along with these advantages, proposed co-location raises several concerns that are different from those involving independently-sited desalination facilities. Review for conformity to Coastal Act policies is likely to be different for proposed co-located desalination facilities than for facilities using their own intake or outfall structures. Several types of these issues are discussed below.

Entrainment, Impingement, and Discharges: One of the advantages sometimes cited for co-location is that a desalination facility would cause no additional entrainment or impingement beyond that already caused by the power plant. This is rarely likely to be the case, as the desalination facility would probably cause additional impacts for several reasons:

- ***Design and Location:*** Most of California's coastal power plant intakes were sited several decades ago in what were not necessarily the least environmentally harmful locations. Their designs and locations do not reflect current understanding of the effects of once-through cooling on the marine biological community. Some of their cooling water intakes are located in areas where the biological resources have been, and continue to be, entrained at very high rates. A co-located desalination facility using these intakes would likely continue and increase entrainment or impingement impacts at rates that might otherwise not occur at a facility that was sited based on current environmental information or that found it feasible to use a subsurface intake. Facilities proposing to co-locate should not presume that joint use of the cooling system is the best available alternative, but should conduct the necessary feasibility study to determine whether subsurface intakes would work in the area.

- ***Characteristics of Combined Operations:*** The particular operating relationship between a desalination facility and a power plant will affect their combined entrainment/impingement rate. This can take several forms:

    - A desalination facility may result in an increase in power plant operations that would not otherwise be needed – for example, a desalination facility operating twenty-four hours a day may require a power plant to operate at times when it would otherwise be shut down or operate at lower capacity due to lack of energy demand. It typically takes from 15,000 to 40,000 gallons of cooling water to produce a megawatt of electricity, and about 13 megawatts of electricity to produce a million gallons of desalted water. Therefore, a 25 million gallon per day desalination facility would require the power plant to pull in about five to 13 million gallons of cooling water each day to produce the electricity necessary to process the 50 million gallons of source water needed for the desalination process.

    - When a power plant is not producing electricity and therefore does not need water for cooling, it usually continues to pull in some amount of water to keep the intake, outfall, and various condenser components from fouling. During these times, entrained organisms may be subject to pressure changes but not thermal changes as they pass through the cooling water system, which may allow some higher percentage of these organisms to live. However, desalination facilities that are operating at these times could cause organisms that might otherwise survive to perish due to their coming into contact with the desalination filtering or pre-treatment systems.

- At some facilities, cooling water from the power plant condensers may be too hot for the desalination equipment, and the facility will have to pull in additional seawater that bypasses the power plant and allows the power plant discharge to be cooled to a temperature that does not damage the desalination filters and membranes.

Project review, therefore, should identify how the operations of the two facilities will be coordinated. Desalination facilities located at power plants that produce a baseload supply of electricity and operate continually will likely create fewer additional entrainment impacts than those located at power plants that usually operate only during peak energy demands. The review should also identify the amount of time the power plant is shut down for various lengths of time due to maintenance requirements or market conditions. At power plants with multiple generating units and multiple intakes for those units, the review for the desalination facility may also identify whether it is feasible to locate the facility at the intake that operates the most (i.e., the intake providing water for the most efficient power generating unit).

The review will need to reflect the existing conditions at the power plant, which will likely be based on representative operations at or near the time of the review. If, as in many cases, the power plant has generally operated at less than full capacity, existing conditions would likely be based on this actual level of operation rather than its maximum permitted output.

Adequate review will also depend on the recency and adequacy of entrainment data at the power plant. Entrainment studies for most of the state's coastal power plants date from the 1970s and 1980s, and the data from these studies generally do not adequately identify the existing and ongoing level of impact caused by the power plant's once-through cooling system, and do not accurately describe the existing environmental conditions as required under CEQA and the Coastal Act. These studies do not reflect more recent improvements in sampling protocols, species identification, and modeling methods, and are not based on our improved scientific understanding of marine ecosystems. Additionally, while most power plants have been reviewed at various times for conformity to state and federal water quality standards, many have not been reviewed for conformity to Coastal Act policies or CEQA[28]. In such cases, there may be no "baseline" of environmental effects that can be used for Coastal Act review, although, data collected as part of a recent entrainment study under the Energy Commission's "CEQA-equivalent" review may serve as an appropriate baseline.

- ***Temporary or permanent change in power plant operations:*** As power plants undergo review for proposed new generating units, new requirements may result in replacement of their once-through cooling systems with systems that are less harmful to the marine environment, such as dry cooling, recycled or reclaimed water, or other methods. The U.S. EPA recently adopted rules related to the allowable level of adverse entrainment and impingement effects associated with once-through cooling. These new rules require significant reductions in entrainment and impingement rates, which could reduce the advantages of co-location if the power plants must make significant design or operational changes to the power plant to decrease their cooling water use.

[28] Older power plants that have undergone review only for NPDES discharge permits also may not have established appropriate baseline conditions for CEQA, since the NPDES permit review for existing discharges is exempt from CEQA requirements (per CEQA Guidelines, Section 15263 – Discharge Requirements).

- ***Thermal discharges:*** In addition to the discharge characteristics discussed in the previous section of this report – high salinity, chemicals, and biomass – review of a combined discharge must consider the thermal discharge from a power plant's cooling system. Most coastal power plants are allowed to discharge water up to 20^{o} F over the ambient ocean water temperature, with some having higher permit limits. The effect of combining a desalination discharge with this higher temperature discharge from the power plant will vary based on the operational characteristics of the two facilities, but could result in effects significantly different than those created by the power plant discharge alone.

"COASTAL-DEPENDENCY"

Some sites along the coast, including those of many existing coastal power plants, are designated in the applicable certified Local Coastal Program for coastal-dependent uses. Unless a desalination processing facility proposed for such a site is determined to be coastal-dependent, it may require a change in the land use designation to allow it to be sited there. The intake and outfall proposed to be used by the desalination facility are more likely to be considered coastal-dependent than the facility's processing units are. [See also Chapter 2.2.2.]

WHAT'S LIKELY NEEDED DURING REVIEW?

Along with the need for recent and applicable entrainment/impingement data, it is likely that most, if not all, the reviews for desalination facilities proposing to co-locate with power plants will need to distinguish between the power plant operating by itself and the two facilities operating together. The desalination facility will very likely operate on its own at some time during its operating life, due to power plant shutdowns for maintenance or other reasons. The review will include determining what effects the facility causes when it operates on its own, what incremental effects it may cause above and beyond those of the power plant when they are both operating, and may also involve partitioning responsibility for the environmental impacts and mitigation measures between the two facilities. This might best occur during CEQA review as part of a "reasonable worst case" evaluation of entrainment and discharge effects, or could be done during review for a coastal development permit. Once the incremental increase in entrainment and impingement is known, it can be compared to the effects that would occur at other available locations or that would result from using other intake methods.

Review of facilities proposing to co-locate will also likely include an evaluation of the combined effect of their discharges. This will likely include a determination of salinity effects, effects of combining the chemical and biological discharges of a desalination facility with the thermal discharge of the power plant, and other synchronistic effects that may occur.

5.2 OTHER COASTAL ACT ENVIRONMENTAL POLICIES

As stated at the beginning of this chapter, many Coastal Act policies are likely to apply to desalination facilities in a manner similar to how they apply to other facilities. These policies include those discussed below. Many of the studies and considerations necessary when reviewing a proposed project for conformity to these policies may be done earlier than Coastal Act review, either during CEQA or during the initial conceptual design stage of a proposal. Early consideration of these issues may result in fewer changes later in the review and permitting processes.

5.2.1 SPILL PREVENTION AND RESPONSE

Coastal Act section 30232 states:

> *Protection against the spillage of crude oil, gas, petroleum products, or hazardous substances shall be provided in relation to any development or transportation of such materials. Effective containment and cleanup facilities and procedures shall be provided for accidental spills that do occur.*

This policy includes two primary requirements – first, that developments protect against spills; and second, that developments include effective measures to clean up spills should they occur. Desalination facilities will likely be subject to spill prevention, response, and cleanup requirements similar to those for other industrial facilities in the coastal zone. Many of the chemicals that desalination facilities will use for water treatment, membrane cleaning, and other purposes, are toxic. Spills or releases could cause significant biological damage and in some cases, severe risk to human health. Since many facilities are proposed to be located on or near the shoreline, or at locations with easy access to the water, they will be required to develop a comprehensive spill prevention and response plan.

WHAT'S LIKELY NEEDED DURING REVIEW?

The primary requirement will be submittal of an acceptable spill response plan. For proposals to co-locate a desalination facility with other existing facilities such as power plants or wastewater treatment plants, the existing spill plan for that plant may only need to be updated to incorporate issues related to the desalination facility.

5.2.2 HAZARDS AND EROSION

Coastal Act section 30253 states, in part:

> *New development shall:*
> *(1) Minimize risks to life and property in areas of high geologic, flood, and fire hazard.*
> *(2) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs…*

This policy essentially requires that the risks at proposed locations due to various hazards be considered as part of project review and that the location and design of a proposed development include measures to minimize those risks. Desalination facilities should either be sited where risks associated with these hazards are minimal or be designed to reduce those risks. Review under this policy also requires a determination that the development will not require protective devices in the future.

Additionally, Coastal Act 30235 will likely apply to desalination facilities proposing to locate near the shoreline:

> *Revetments, breakwaters, groins, harbor channels, seawalls, cliff retaining walls, and 1other such construction that alters natural shoreline processes shall be permitted when required to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion, and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply. Existing marine structures causing water stagnation contributing to pollution problems and fish kills should be phased out or upgraded where feasible.*

This policy describes situations where shoreline stabilization structures may be allowed. Generally, these structures may be permitted for coastal-dependent uses or for existing developments in danger from erosion, but not for new facilities. The policy also limits these structures where they are required to protect existing development, not when such structures might be needed at some point in the future.

WHAT'S LIKELY NEEDED DURING REVIEW?

Review of desalination facilities is likely to require studies related to site geology, hydrology, and erosion, including identifying likely seismic events, the potential for tsunamis, liquefaction, shoreline erosion, and other hazards common in coastal areas. Review for facilities proposing to locate near the shoreline may also require studies to determine the rate of shoreline erosion in the area to anticipate whether shoreline protective devices might be needed to protect the facility during its operating life. These reviews may result in all or part of a facility being relocated at alternative sites or at alternative locations within a site.

5.2.3 UPLAND HABITATS AND ENVIRONMENTALLY SENSITIVE HABITAT AREAS (ESHAS)

Coastal Act Section 30240 states:

> *(a) Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas.*
> *(b) Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas.*

The review will likely evaluate the physical and biological effects of the proposed facility on surface water sources, riparian and wetland communities, special habitat sites, and other similar areas with high environmental values.

WHAT'S LIKELY NEEDED DURING REVIEW?

Facilities should be located and designed to avoid sites in and near with sensitive habitat areas. Studies needed during review will likely include biological surveys and descriptions of nearby wetlands, coastal scrub-shrub habitats, and other habitat types recognized as deserving of special protections. For facilities proposing to locate near such habitats, mitigation measures to avoid and reduce potential adverse effects should be evaluated, including controlling runoff from the facility, reducing glare from facility lighting, housing machinery within sound-dampening materials to reduce noise impacts, and other similar measures.

5.2.4 VISUAL AND SCENIC RESOURCES

Proposed desalination facilities along the coast will be subject to Coastal Act section 30251:

> *The scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designed to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural land forms, to be visually compatible with the character of surrounding areas, and, where feasible, to restore and enhance visual quality in visually degraded areas. New development in highly scenic areas such as those designated in the California Coastline Preservation and Recreation Plan prepared by the Department of Parks and Recreation and by local government shall be subordinate to the character of its setting.*

This policy establishes four requirements related to the visual and scenic quality of proposed developments:

1) Permitted development must be sited and designed to protect views to and along the ocean and scenic coastal areas.
2) The development must minimize the alteration of natural landforms.
3) It must be visually compatible with the character of the surrounding areas.
4) In visually degraded areas and where feasible, the development must restore and enhance visual quality. This requirement includes a three-part test:
   a) Is the area visually degraded?;
   b) If so, are there measures that would restore or enhance visual quality?; and,
   c) If so, are those measures feasible?

This review will likely include determining which locations within a site result in the fewest visual impacts. Measures meant to reduce a facility's visual impacts may also have other beneficial results – for example, putting equipment within buildings or behind screens may reduce the amount of maintenance and repair that would be necessary if the equipment were exposed to salt air or coastal winds. These considerations would likely be a part of a determination of feasibility for those facilities in visually degraded areas.

WHAT'S LIKELY NEEDED DURING REVIEW?

For coastal desalination facilities, review is likely to include the following considerations:

- Determine the views that will be affected by the proposed facility.
- Determine measures that will protect those views, such as restricting the height of the facility, selecting colors that will not detract from the views, placing elements of the facility that are "visually chaotic" (e.g., unscreened industrial equipment, machinery, pipes and tubing, etc.) either inside, behind architectural screens, or behind vegetation, and other similar measures.
- Determine whether the facility is compatible with other nearby uses or facilities.
- If the area is considered visually degraded, determine what feasible measures are available to restore or enhance the area's visual qualities, which may include measures that go beyond just screening a facility from view.

5.3 CUMULATIVE IMPACTS

The Coastal Act includes several policies requiring the evaluation of a proposed development's cumulative effects, including Section 30250(a), which states, in part:

> *New residential, commercial, or industrial development, except as otherwise provided in this division, shall be located…where it will not have significant adverse effects, either individually or cumulatively, on coastal resources.*

The Act defines "cumulative effects" in Section 30105.5[29]:

> *"Cumulatively" or "cumulative effects" means the incremental effects of an individual project shall be reviewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.*

Coastal desalination facilities are likely to raise substantial and complex concerns about cumulative impacts. Different elements of a desalination facility – its location, its service area, its design and operational characteristics – can contribute to different types of cumulative impacts associated with the full range of coastal resources – environmental, visual, public access, and many others. For example, regarding environmental concerns, the most likely cumulative impact analysis needed will be related to marine biology and water quality. Many coastal areas, nearshore waters, and marine ecosystems are significantly degraded due to existing levels of impacts caused by a wide variety of stressors – the effects of development, pollutant discharges, natural or synthetic shifts in local species diversity, global climatic changes, and other

[29] Note: The Coastal Act definition is broader than than the definition under CEQA Section 15355, which states: "Cumulative impacts" refers to two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts.
(a) The individual effects may be changes resulting from a single project or a number of separate projects.
(b) The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time."

conditions. Seawater intakes can also contribute to cumulative impacts, especially in areas of the coast that may be subject to the effects of other intake structures. The growth associated with a desalination facility may also need to be reviewed for potential cumulative impacts, although in some cases, this analysis may have been done to some degree as part of a local or regional planning document.

One significant question related to cumulative impacts that may arise for some proposals is whether a single large-scale facility has more or fewer cumulative impacts than several smaller-scale desalination facilities. Like many of the issues identified in this report, it may be best to address this question thoroughly early in the design process of proposed facilities so that significant changes aren't required later.

WHAT'S LIKELY NEEDED DURING REVIEW?

While the particular aspects of the necessary cumulative impact analysis will vary by facility and location, there are several that will likely be common to all or most proposed facilities. Examples include:

- ***Marine Biology/Water Quality:*** The review should consider, for example, the effects of nearby intakes or outfalls of various types on an area's marine biological resources and water quality, as well as the likely effects of the proposed facility on the existing conditions in the affected waterbody.

- ***Growth-related:*** For some proposed projects, this will require a relatively uncomplicated assessment – for instance, where a relatively small facility is providing water to a limited service area with a known allowable level of build-out. For other projects, assessing growth-related cumulative impacts may be much more complicated and may be, for many potential impacts, inconclusive. The types of impacts to be considered may range from assessing the effects of additional runoff reaching coastal waters, additional traffic and its affects on coastal access, the need for additional infrastructure to support that growth, and others.

- ***Power production:*** for large-scale facilities, the amount of power required to produce the desalinated water may create substantial demands on local power sources, resulting in additional air or water pollution. The review of such facilities should assess the impacts associated with this additional power production and identify ways to minimize those impacts.

CHAPTER 6: OTHER REGULATIONS AND PERMITS

Chapter Sections:
6.1 California Environmental Quality Act (CEQA)
6.2 Agencies With Jurisdiction (including Local, Regional, State, and Federal)

Main Points:
- ***Only after other local and state permits and approvals are received can a coastal development permit application be considered complete.***
- ***Early coordination among project applicants and the various agencies will likely result in a more efficient review process.***

Seawater desalination facilities raise issues related not only to coastal resources, but also related to public health, drinking water supply and safety, cost, energy use, land use, and others. As such, these facilities will be subject to regulations, review, and permit approval by a number of agencies. Each facility will need to conform to a different set of regulations, based on its design and location, and based on the local, state, and federal requirements that apply to it.

For purposes of review by the Coastal Commission, an applicant will need to provide other local and state permits or preliminary approvals before their coastal development permit application is considered complete. This generally results in the Commission's coastal development permit being the last of the local and state permits to be reviewed, and allows the Commission's review to benefit from knowing more complete details about a proposed project, what conditions may have been imposed by other agencies, and what measures may be incorporated into the project that affect coastal resources.

The discussion below provides a general overview of the permits that will most likely be necessary for coastal desalination facilities. Given the number of regulations involved in siting such a proposal – a facility meant to provide drinking water located in an area subject to high public scrutiny – it may be important for project proponents and the various involved agencies to coordinate closely with each other and with the interested public. For the review process to be both effective and efficient, there will likely need to be open distribution of information among the various parties to allow issues of common interest to be identified and resolved early in the process rather than later.

6.1 CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)

Desalination facilities are likely to require comprehensive environmental review under CEQA, most likely through the Environmental Impact Report (EIR) process. With the number of agencies involved in desalination and the number of permits likely to be required, it is important to have a thorough and comprehensive CEQA review. Reviews for many permits, including coastal development permits, often require more detailed information than might be provided during CEQA; however, if agencies are involved in the CEQA review early and thoroughly, and much of the information they need is provided as part of that review, it may result in a more efficient and shorter decision-making process overall for a proposed facility.

TABLE 4: PERMITS/APPROVALS LIKELY REQUIRED FOR A COASTAL DESALINATION FACILITY

AGENCY	PERMIT OR APPROVAL	NOTES
Federal:		
Army Corps of Engineers	• Section 404 permit • Section 10 permit	• To place fill in navigable waters. • To place a structure in navigable waters.
Coast Guard	Consultation with Corps	
National Marine Fisheries Service	Endangered Species Act, Section 7 consultation	For federal permits that may affect endangered species.
National Oceanic and Atmospheric Administration	Permits and/or consultation	For projects in national marine sanctuaries.
U.S. Fish & Wildlife Service	Endangered Species Act, Section 7 consultation	For federal permits that may affect endangered species.
State:		
Coastal Commission	• Coastal Development Permit • Consistency with Coastal Zone Management Program	• For projects affecting coastal waters. • For projects requiring federal permits and approvals.
Department of Fish & Game	• Stream Alteration Agreement • California Endangered Species Act	
Department of Health Services	• State Safe Drinking Water Act • Federal Surface Water Treatment Rule	
Department of Parks & Recreation	Approval for facilities within or near state parks	
Department of Transportation	Encroachment permit	For utilities crossing state highways.
Department of Water Resources	Approval for use of state water conveyance facilities.	
Public Utilities Commission	Regulates water services, rates, and service areas.	
State Lands Commission	Land Use Lease	
State Water Resources Control Board / Regional Water Quality Control Boards	• Water quality certification • NPDES permit	
Local & Regional:		
City or County / Local utilities / Water Management Districts	These will vary by local jurisdiction and may include building permits, health department certifications, operating permits, or other types of approvals.	

6.2 AGENCIES WITH JURISDICTION

The list below includes agencies, laws, and regulations that are most likely to be involved in reviewing desalination proposals, along with a brief description of how they are likely to be involved.

LOCAL AND REGIONAL JURISDICTIONS

Each local jurisdiction has unique review, permit, and approval requirements. Facilities will be subject to local zoning requirements, land use ordinances, growth management objectives, and other similar approvals, and will need to meet local requirements for public notices, public hearings, appeals, and other similar requirements. Permits needed may include grading permits, building permits, approval from the local fire marshal, and the like. Other local or regional permits may be required from air pollution control agencies, water districts, local utilities, and city or county health departments.

Generally, desalination facilities will need a coastal development permit from both the local jurisdiction, if it has a certified Local Coastal Program, as well as from the Coastal Commission. In such cases, the local government's jurisdiction generally includes most upland areas within the coastal zone, while the Coastal Commission's retained jurisdiction includes areas near coastal waters, areas below the mean high tide line, and other areas[30]. Additionally, some desalination facilities will be located within the Coastal Commission's appeal jurisdiction[31]. In these situations, a local jurisdiction's decision on a coastal development permit may be appealed to the Coastal Commission. In such cases, the Coastal Commission may review the appeal to determine whether the local decision conforms to the applicable policies of the Local Coastal Program.

STATE

Desalination facilities will likely require permits or approvals from the state agencies listed below. Unless otherwise noted, these approvals are generally required before the coastal development permit application to the Coastal Commission is considered complete.

---

[30] Coastal Act Section 30601: Prior to certification of the local coastal program and, where applicable, in addition to a permit from local government pursuant to subdivision (b) or (d) of Section 30600, a coastal development permit shall be obtained from the commission for any of the following:

1) Developments between the sea and the first public road paralleling the sea or within 300 feet of the inland extent of any beach or of the mean high tide line of the sea where there is no beach, whichever is the greater distance.
2) Developments not included within paragraph (1) located on tidelands, submerged lands, public trust lands, within 100 feet of any wetland, estuary, stream, or within 300 feet of the top of the seaward face of any coastal bluff.
3) Any development which constitutes a major public works project or a major energy facility.

[31] The Commission's appeal jurisdiction varies by locale, but is generally with 300 feet of mean high tide or between the sea and the first public road, within 300 feet of the top of coastal bluffs, within 100 feet of wetlands, streams, and other areas. Additionally, Coastal Act section 30603 provides the Commission with appeal jurisdiction over major energy facilities and major public works projects, so local decisions on most desalination facilities are likely to be appealable to the Commission, regardless of their location in the coastal zone.

State Lands Commission: The State Lands Commission manages most of the state's tidelands and lands lying under coastal waters. Desalination facilities proposing to place new intakes or outfalls on state tidelands, or to change the use of existing intakes and outfalls, will generally be required to obtain a lease or lease modification from the Commission.

In some coastal areas, the state has granted tidelands to a local jurisdiction. Coastal development permit applications to build structures in these areas will need to include a lease from the local jurisdiction. In these areas, the local jurisdiction's lease decision may be subject to review and approval by the State Lands Commission.

State Water Resources Control Board (SWRCB) and Regional Water Quality Control Boards (RWQCBs): The SWRCB is responsible for allocating water rights within California and establishing many of the state's water quality protection measures. Nine Regional Boards develop and enforce water quality objectives and implementation plans in particular regions of the state.

- ***Water Rights:*** The SWRCB reviews and authorizes water rights in California, which are required for consumptive uses from enclosed water bodies within the state. Water rights are likely not needed for proposed desalination facilities using water from the open ocean, but may be needed by facilities proposing to use water from enclosed or semi-enclosed areas, such as bays or estuaries, or saline groundwater. Applicants and lead agencies should contact the State Board to determine whether a specific proposal will require a water right.

- ***Water Quality:*** The State Board and its nine Regional Boards share key responsibilities for implementing the state's water quality requirements. The State Board establishes statewide standards, including the state's Ocean Plan, and hears appeals of Regional Board decisions. Each of the state's nine Regional Boards is responsible for water quality permitting within its region. Parts of six Regional Boards are located along the California Coast and would regulate the discharges of desalination facilities within their jurisdiction. The two most common RWQCB permits likely to be needed for a coastal desalination facility are a water quality certification and a discharge permit:

    - Section 401 water quality certification: This permit is required when proposing to place fill in a waterbody. It is issued by the state in conjunction with a Section 404 permit from the U.S. Army Corps of Engineers (see below). "Fill" includes intake or outfall pipelines, beach wells, transmission lines, or other similar structures. Desalination facilities involving new intakes or outfalls or requiring modification of existing outfalls are likely to require a 401 water quality certification.

    - National Pollutant Discharge Elimination System (NPDES) permit: allows pollutants to be discharged to waters of the U.S. Desalination facilities proposing a new outfall will likely need a new NPDES permit. For desalination facilities proposing to use existing outfalls at already-permitted facilities, such as power plants or wastewater treatment facilities, the RWQCB may choose to modify the existing permit or may require a new permit. [For a discussion of impacts related to discharges, see Chapter 5.1.2.]

NPDES permits almost exclusively regulate the discharge of pollutants from point sources, such as industrial effluent from an outfall pipe or stormwater from a municipal storm system. The primary exception applicable to coastal desalination facilities is that NPDES permits are also used to regulate intakes used by thermal power plants that use ocean water for cooling. An NPDES permit for these facilities must determine that these systems use the best technology available to minimize adverse impacts due to their location, design, construction, and capacity. Desalination facilities proposing to co-locate with these types of power plants may therefore be subject to NPDES requirements associated with their intakes.

- ***Coordination between the Coastal Commission and the State/Regional Boards:*** The Coastal Commission often works with the Regional Boards to coordinate review when there is shared jurisdiction of proposed projects. Although the State and Regional Boards operate primarily under the California Water Code while the Coastal Commission acts pursuant to the Coastal Act, there are several areas of shared responsibility and common requirements. For example, both the Commission and the Boards are directed to maintain and restore coastal waters, although the focus and implementation of each agency in carrying out this directive may differ. Additionally, Section 30412 of the Coastal Act establishes some common policies for the Commission and the State and Regional Boards and also recognizes some of the different aspects of their jurisdictions.

  For many projects, including proposed desalination facilities, the Commission and Boards may require similar information during project review. For some aspects of a proposal, however, the Coastal Commission may require some information not requested by a Regional Board, in part because the Coastal Act has different requirements and because Coastal Act review is equivalent to CEQA, while the NPDES review process is exempt from CEQA. For proposed coastal desalination facilities, it may be best for a project applicant to request that the involved agencies identify the applicable standards, necessary studies, and likely requirements as early in the proposal process as possible, either during environmental review or even earlier during conceptual design of a proposed facility, to allow better coordination by all the involved parties.

Energy Commission: For desalination facilities proposing to locate at power plants, the Energy Commission is likely to review proposed changes to the power plant needed to accommodate the desalination facility. Some of those changes may require approval from the Energy Commission. The review may also evaluate the effects of the desalination facility on the power plant's operations, its effect, if any, on the local or regional transmission lines, and other aspects of the desalination facility's impact on energy use.

Department of Fish and Game: The Department requires a stream alteration permit for activities within inland waters and within some areas of bays and estuaries. It also reviews projects for potential impacts to listed species.

Public Utilities Commission (PUC): Desalination facilities may be subject to water rates established by the PUC. The PUC also establishes service areas for water districts, so water provided by a desalination facility may be subject to limits on where it can be sent and the price that may be set.

Department of Health Services: Equipment and processes used in desalination facilities will likely be subject to review and approval for use as drinking water. This review may include specific performance standards for construction and operation of a facility, evaluation of the integrity of equipment used at the facility, determining the required response by the facility operator to various problems, and other requirements.

Other: Other state permits may be required, depending on the facility location, from the state Departments of Parks and Recreation, Transportation, Boating and Waterways, and others.

FEDERAL

Coast Guard: Structures in navigable waters, such as intake and outfall pipelines, may require approval to ensure they don't adversely affect navigation. The Coast Guard may also require buoys or markers to be maintained over the structures. The applicant may also be required to submit information about the structures to include on nautical charts.

U.S. Army Corps of Engineers: A desalination facility may require a Section 404 permit from the Corps if it involves placing fill in navigable waters, and a Section 10 permit if the proposal involves placing a structure in a navigable waterway.

National Marine Fisheries Service and/or U.S. Fish and Wildlife Service: Facilities may require review from these services for their potential effects on endangered, threatened, or other sensitive species. They may also require review for effects on protected marine mammals and migratory birds.

Other: Other permits may also be required from the federal Bureau of Reclamation, Environmental Protection Agency, Minerals Management Service, and others.

WHAT'S LIKELY NEEDED DURING REVIEW?

Local and state approvals must be submitted as part of a complete coastal development permit application. Additionally, the applicant must provide the lease or approval of the landowner for the proposed project. For some projects, this will require approval from the upland landowner as well as from the State Lands Commission for portions of the project on state tidelands.

BIBLIOGRAPHY

Bay, Steven M. Investigation of Desalination Plant Toxicity. Southern California Coastal Water Research Project, September 1993.

Buros, O.K. The ABCs of Desalting. International Desalination Association, February 2000.

California Coastal Commission. Seawater Desalination in California, October 1993.

California Department of Water Resources. The California Water Plan Update: Bulletin 160-98, January 1998.

_____. The California Water Plan Update 2003: Bulletin 160-03, June 2003.

_____. Issue Papers of the Desalination Task Force, October 2003

_____. Water Desalination in California: Findings and Recommendations, October 2003.

California Resources Agency. California's Ocean Resources: An Agenda for the Future, March 1997.

California State Lands Commission. Public Trust Policy for the California State Lands Commission, adopted September 17, 2001 (see http://www.slc.ca.gov/Policy%20Statements/Policy_Statements_Home.htm).

California State Senate Select Committee on International Trade Policy and State Legislation. Various analyses and fact sheets, 2003.

Caplan, Ruth. Trading Away Our Water: How Trade Agreements Promote Corporate Water Profiteering. Alliance for Democracy, Washington D.C., n.d.

Fairfax, Dr. Sally. Trusts and the Public Trust Doctrine, a speech given at the Tomales Bay Institute, November 14, 2000.

Gleick, Dr. Peter. The Human Right to Water. Pacific Institute for Studies in Development, Environment, and Security, July 1999.

Gleick, Dr. Peter, Gary Wolff, Elizabeth Chalecki, and Rachel Reyes. The New Economy of Water: The Risks and Benefits of Globalization and Privatization of Fresh Water. Pacific Institute for Studies in Development, Environment, and Security, February 2002.

Gleick, Dr. Peter, Gary Wolff, and Dan Haasz. Waste Not, Want Not: The Potential for Urban Water Conservation in California. Pacific Institute for Studies in Development, Environment, and Security, November 2003.

Holt, Tim. The Next War May Be Over Water, from High Country News, January 12, 2004.

Lattemann, Sabine, and Thomas Höpner. Seawater Desalination – Impacts of Brine and Chemical Discharge on the Marine Environment. Institute for Chemistry and Biology of the Marine Environment, University of Oldenburg, Germany, April 2003.

Metropolitan Water District of Southern California. Request for Proposals for Participation in the Seawater Desalination Program, RFP No. WRM-3, November 28, 2001.

National Council for Public-Private Partnerships. Critical Choices: The Debate Over Public-Private Partnerships and What it Means for America's Future, 2003.

_____. For the Good of the People: Using Public-Private Partnerships To Meet America's Essential Needs, n.d.

Ofiara, Douglas and Joseph J. Seneca. Economic Losses from Marine Pollution: A Handbook for Assessment. Island Press, Washington, D.C. 2001.

Pew Oceans Commission. America's Living Oceans Report: Charting a Course for Sea Change, June 2003.

San Diego County Water Authority. 2000 Urban Water Management Plan. November 2000.

Shrybman, Steven. Thirst for Control. Council of Canadians, January 2002.

Turner, Ian L. and Stephen P. Leatherman. Beach Dewatering as a 'Soft' Engineering Solution to Coastal Erosion – A History and Critical Review, Journal of Coastal Research, Fall 1997.

Urban Water Council. Public/Private Partnerships in Municipal Water and Wastewater Systems: Case Studies of Selected Cities. United States Conference of Mayors, February 2000.

Waterways Experiment Station, U.S. Army Corps of Engineers. Field Evaluation/Demonstration of a Multisegmented Dewatering System for Accreting Beach Sand in a High-Wave-Energy Environment, July 1988.

Western Water. Tapping the World's Largest Reservoir: Desalination. Water Education Foundation, January/February 2003.

Yamada, Robert R., Jack K. Laughlin, and Dennis K. Wood. Co-located seawater desalination/power facilities: practical and institutional issues. In *Desalination*, 102 (pp. 279-286), Elsevier Publishing. 1995.

APPENDIX A: GLOSSARY AND ACRONYMS

Acre-foot (AF): A unit for measuring the volume of water. One acre-foot equals 325,851 gallons (the volume of water that will cover one acre to a depth of one foot). One million gallons equals 3.07 acre-feet.

Biocide: A chemical used to kill biological organisms (e.g., chlorine).

Brackish water: Water with salt concentrations of between 5 and 20 parts per thousand (ppt). Seawater generally has salt concentrations of greater than 20 ppt.

Brine: Water that contains a high concentration of salt. Brine discharges from desalination plants may include constituents used in pretreatment processes, in addition to the high salt concentration seawater.

Coagulation: A pretreatment process used in some desalination plants. A substance (e.g., ferric chloride) is added to a solution to cause certain elements to thicken into a coherent mass, so that they may be removed.

Cogeneration: A power plant that is designed to conserve energy by using "waste heat" from generating electricity for another purpose.

Distillation: A process of desalination where the intake water is heated to produce steam. The steam is then condensed to produce product water with low salt concentration.

Entrainment: Entrainment occurs when small organisms, such as plankton, larvae, and fish eggs, are drawn into a water intake past any screening equipment and are subjected to pressure or temperature changes. Entrainment is generally considered to result in the death of all the entrained organisms, if not immediately, then shortly after they are discharged back into the environment where they become prey for other animals.

Feedwater: Water fed to the desalination equipment. This can be source water with or without pretreatment.

Impingement: Impingement occurs when fish and other aquatic organisms are trapped against screens used in intake systems. Impingement usually results in either injury or death to the organisms, although some systems include features that allow some individuals to be moved away from the screens unharmed.

Infiltration Gallery: A structure used to draw in water using perforated pipes buried below land or below the bottom surface of a water body. Water in the saturated zone of the substrate is pulled into the perforated pipes.

Kilowatt (kW): A thousand watts. The watt is a measure of power used by electricity generating plants. One watt is equivalent to 1 Joule/second or 3.4127 Btu/hour.

Megawatt (MW): A million watts.

Minimize: To reduce to the smallest possible level.

Mitigate: The California Environmental Quality Act (at Section 15370) defines "mitigation" and the sequence of mitigation as:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.
(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
(c) Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.
(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
(e) Compensating for the impact by replacing or providing substitute resources or environments.

Reverse Osmosis (RO): A process of desalination where pressure is applied continuously to the feedwater, forcing water molecules through a semipermeable membrane. Water that passes through the membrane leaves the unit as product water; most of the dissolved impurities remain behind and are discharged in a waste stream.

Total Dissolved Solids (tds): Total salt and calcium carbonate concentration in a sample of water, usually expressed in milligrams per liter (mg/L) or parts per million (ppm). The state-recommended Maximum Contaminant Level (MCL) drinking water standard for total dissolved solids is 500 mg/L, the upper MCL is 1,000 mg/L, and the short-term permitted level is 1,500 mg/L. Seawater contains roughly 30,000 mg/L.

[this page intentionally blank]