

Desalination and California’s Water Problem: The Viability of the Desalination Industry as Examined Through the Lens of California’s New Desalination Rules and Development

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“Long considered the Holy Grail of water supply, desalination offers the potential of an unlimited source of fresh water purified from the vast oceans of salt water that surround us. . . . To avoid new, expensive errors, policymakers and the public need to take a careful look at the advantages and disadvantages of desalination and develop clear guidance on how to evaluate and judge proposals for new facilities.”¹

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1. Heather Cooley et al., *Desalination with a Grain of Salt: A California Perspective*, PAC. INST. 1 (June 2006), <http://pacinst.org/app/uploads/2015/01/desalination-grain-of-salt.pdf>.

INTRODUCTION

“There is broad agreement that [California’s] water management system is currently unable to satisfactorily meet both ecological and human needs, too exposed to wet and dry climate cycles and natural disasters, and inadequate to handle additional pressures of future population growth and climate change.”² On May 6, 2015, four years into a drought that has compounded water supply issues,³ California’s State Water Resources Control Board (“SWRCB”) approved an amendment to the state’s Water Quality Control Plan for the Ocean Waters of California (“Ocean Plan”) to create a legal framework for the expansion of seawater desalination in the state.⁴ Desalination is the process of removing dissolved minerals from saltwater to produce freshwater to be used for municipal needs, such as drinking water and industrial uses.⁵ The new Desalination Amendment marked the first time a U.S. state had adopted guidelines for building and operating desalination plants.⁶ The SWRCB believes desalination can be a “tool to improve water supply reliability and self-reliance at the regional and local level.”⁷ However, critics warn that desalination plants kill marine life and spew greenhouse gases (“GHGs”) into the air from the energy required to run the plants.⁸

Seven months after the SWRCB adopted the Desalination Amendment, Poseidon Water—a water-project developer that specializes in large-scale reverse-osmosis seawater-desalination plants⁹—opened the largest seawater desalination plant in the Western Hemisphere.¹⁰ Located in Carlsbad, in northern San Diego County, the plant cost one billion dollars and produces approximately fifty million gallons per day (“MGD”) of potable water—enough volume to meet

2. CAL. STATE WATER RES. CONTROL BD., FACT SHEET: PROPOSED DESALINATION AMENDMENT: CREATING A CONSISTENT PERMITTING PROCESS 1 (2015), http://www.waterboards.ca.gov/publications_forms/publications/factsheets/docs/desal_fs.pdf [hereinafter FACT SHEET].

3. Peter Fimrite, *Tapping the Ocean for Drinking Water: State Lays Down the Law*, S.F. CHRON. (May 7, 2015, 7:55 AM), <http://www.sfgate.com/science/article/Tapping-the-ocean-for-drinking-water-State-lays-6247262.php>.

4. CAL. STATE WATER RES. CONTROL BD., RESOLUTION 2015-0033, AMENDMENT TO THE STATEWIDE WATER QUALITY CONTROL PLAN FOR THE OCEAN WATERS OF CALIFORNIA ADDRESSING DESALINATION FACILITY INTAKES, BRINE DISCHARGES, AND TO INCORPORATE OTHER NONSUBSTANTIVE CHANGES 7 (May 6, 2015), http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2015/rs2015_0033.pdf [hereinafter RESOLUTION 2015-0033]. The Amendment took effect on January 28, 2016, upon approval by the California Office of Administrative Law. See Notice of Approval of Regulatory Action, Cal. Office of Admin. Law, OAL Matter No. 2015-1214-01 (Jan. 28, 2016), http://www.waterboards.ca.gov/water_issues/programs/ocean/desalination/docs/desal_oal_approval.pdf; CAL. STATE WATER RES. CONTROL BD., WATER QUALITY CONTROL PLAN: OCEAN WATERS OF CALIFORNIA, at iii (2015), http://www.waterboards.ca.gov/water_issues/programs/ocean/docs/cop2015.pdf [hereinafter 2015 OCEAN PLAN].

5. FACT SHEET, *supra* note 2, at 1.

6. Fimrite, *supra* note 3.

7. FACT SHEET, *supra* note 2, at 1.

8. Fimrite, *supra* note 3.

9. *About Poseidon Water*, POSEIDON WATER, http://poseidonwater.com/company/about_poseidon_water (last visited Dec. 5, 2015).

10. Joshua Emerson Smith, *Carlsbad Desal Plant Nears Opening*, SAN DIEGO UNION-TRIB. (Nov. 4, 2015, 12:42 PM), <http://www.sandiegouniontribune.com/news/2015/nov/04/poseidon-desalination-carlsbad-water-facility/>.

about ten percent of San Diego County's water demand.¹¹ More than fifteen additional desalination plants are at least in the planning stages in California.¹²

This Note will explore desalination's advantages and disadvantages through the lens of California's Desalination Amendment and Poseidon Water's Carlsbad desalination plant. First, this Note will discuss the process of desalination and provide an overview of the desalination industry, focusing especially on the Carlsbad plant. Second, this Note will consider the requirements of California Desalination Amendment, and the legal and regulatory frameworks surrounding desalination and water in California.

Ultimately, this Note will analyze the role desalination is likely to have in California going forward. This will involve comparing the advantages and disadvantages of desalination, as well as assessing the potential for legal challenges to proposed new desalination plants. This Note concludes that even though California's Desalination Amendment provides a consistent framework for communities and industry as they consider new desalination projects, the Amendment will ultimately not result in the widespread growth of California's desalination industry. The state desperately needs a bolstered water supply, but negative impacts on marine life, high energy costs, and a multitude of potential legal challenges will limit future desalination development.

I. THE DESALINATION INDUSTRY

Desalination is the process of removing dissolved minerals from saltwater to produce freshwater that can be used for various municipal purposes.¹³ Most existing and planned desalination plants—including the Carlsbad plant¹⁴—use a technology called reverse osmosis for the critical part of the treatment process.¹⁵

A. DESALINATION TECHNOLOGY

Reverse osmosis is currently considered the linchpin of seawater desalination technologies.¹⁶ It involves forcing water through a semipermeable membrane using pressure, producing freshwater on one side and leaving concentrated brine

11. *See id.*; *see also* Morgan Cook, *Desal Plant Launches Amid Ample Water*, SAN DIEGO UNION-TRIB. (Nov. 21, 2015, 8:28 PM), <http://www.sandiegouniontribune.com/news/2015/nov/21/desal-plant-comes-online-amid-ample-water/>.

12. Fimrite, *supra* note 3.

13. FACT SHEET, *supra* note 2, at 1.

14. *Process FAQs*, CARLSBAD DESALINATION PLANT, <http://carlsbaddesal.com/process-faqs> (last visited Sept. 18, 2016).

15. CAL. STATE WATER RES. CONTROL BD., FINAL STAFF REPORT: DESALINATION FACILITY INTAKES, BRINE DISCHARGES, AND THE INCORPORATION OF OTHER NON-SUBSTANTIVE CHANGES 17 (2015), http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2015/rs2015_0033_sr_apx.pdf [hereinafter FINAL STAFF REPORT].

16. Deirdre Lockwood, *Thirsty California Turns to Sea and Sewer*, 1 ACS CENTRAL SCIENCE 108 (2015), <http://pubs.acs.org/doi/ipdf/10.1021/acscentsci.5b00204>.

behind on the other.¹⁷

The first challenge of the desalination process is to withdraw seawater from the ocean. This can be accomplished using surface or subsurface intake pumps.¹⁸ Next, the seawater is pretreated to remove microscopic impurities.¹⁹ Then the desalination plant sends the seawater through a reverse-osmosis system: a series of filtration membranes that remove the salt and any remaining impurities.²⁰ A portion of that filtered seawater—anywhere from thirty percent to eighty-five percent, depending on the initial water quality—becomes high-quality fresh water.²¹ Ultimately, the selection of a desalination process depends on site-specific conditions, including the salt content of the water, economics, the quality of water needed by the end user, and local engineering experience and skills.²²

With any desalination technology, the concentrated salts must be disposed of. A typical reverse osmosis plant uses additional seawater to dilute the salts before returning the water to the ocean as concentrated seawater.²³ According to the SWRCB's Final Staff Report for the Desalination Amendment, "[a]s production efficiency improves and desalination technologies advance, it is possible that some facilities will significantly reduce or eliminate brine discharges."²⁴ However, even if production efficiency reaches one hundred percent—meaning one hundred percent freshwater production with no brine discharge—the salts and other seawater components will still need to be disposed.²⁵

B. THE GLOBAL DESALINATION INDUSTRY

Curaçao opened the first production-scale desalination plant in 1928, and now approximately 130 countries use desalination.²⁶ However, despite the fact that desalination provides a substantial portion of the water supply in several countries—most of them located in the Middle East—installed desalination plants only have the capacity to produce three one-thousandths (i.e., 0.3%) of the world's total freshwater use.²⁷

Israel deals with chronic water scarcity and has traditionally depended on its short rainy season each winter to replenish water supplies.²⁸ It recently experi-

17. *Id.*

18. FINAL STAFF REPORT, *supra* note 15, at 17.

19. *Desal 101*, POSEIDON WATER, http://poseidonwater.com/desalination/desal_101 (last visited Dec. 6, 2015).

20. *Id.*

21. Cooley et al., *supra* note 1, at 15; *see also* POSEIDON WATER, *supra* note 19.

22. Cooley et al., *supra* note 1, at 13.

23. POSEIDON WATER, *supra* note 19.

24. FINAL STAFF REPORT, *supra* note 15, at 17.

25. *Id.*

26. Cooley et al., *supra* note 1, at 11, 19.

27. *Id.* at 19.

28. Josef Federman, *Israel Solves Water Woes with Desalination*, SAN DIEGO UNION-TRIB. (May 29, 2014, 10:33 PM), <http://www.sandiegouniontribune.com/news/2014/may/29/israel-solves-water-woes-with-desalination/>.

enced a drought that saw the northern part of the country—which is Israel's rainiest region—receive only fifty to sixty percent of its annual average rainfall,²⁹ but Israel's desalination program has made it perhaps the best-hydrated country in the region.³⁰ Roughly thirty-five percent of Israel's drinking-quality water came from desalination in 2014, and this number is projected to climb to seventy percent by 2050.³¹ Israel's ability to resist drought comes with a cost, however; desalination plants now consume roughly ten percent of the country's total electricity production.³²

Australia has also made a substantial investment in desalination. Perth, Western Australia, has a climate similar to that of San Diego, with long winter rains and hot summer droughts.³³ During Australia's prolonged period of severe drought, Perth built two desalination plants, which together now supply about forty percent of the city's drinking water.³⁴ Other major Australian cities also built desalination plants around that time, at a cost of about one billion dollars each.³⁵ However, when the rains returned to Australia, a number of those plants were mothballed.³⁶ This illustrates the magnitude of wasted resources that can result when desalination projects are built in response to changes in the local climate that later turn out to be temporary.

In the United States, the desalination industry is not a significant producer of freshwater. The total volume of seawater desalination production in the United States (excluding the Carlsbad plant) does not even equal what the Carlsbad plant produces on its own.³⁷ The United States has historically not needed freshwater from desalination—it is filled with freshwater lakes and rivers, and much of the country receives plenty of rain.³⁸ Average water prices in the United States are notably low—on average, less than half of the prices in Australia and European nations.³⁹ Major users of desalination, like countries in the Middle East, tend to have drier climates and therefore more expensive alternate sources of water.⁴⁰

29. *Id.*

30. *Id.*

31. *Id.*

32. *Id.*

33. Neil Palmer, *Australia's Desal Experience Bodes Well for California*, SAN DIEGO UNION-TRIB. (Nov. 28, 2015, 10:09 AM), <http://www.sandiegouniontribune.com/opinion/commentary/sdut-water-desalination-australia-palmer-2015nov28-htlmstory.html>.

34. *Id.*

35. Lockwood, *supra* note 16, at 2.

36. *Id.* Australia poured more than \$12 billion into desalination plants, only to mothball four plants in 2012 due to the returning rains that overfilled the country's reservoirs. See Michael Hiltzik, *Desalination Plants Aren't a Good Solution for California Drought*, L.A. TIMES (Apr. 24, 2015, 7:59 PM), <http://www.latimes.com/business/hiltzik/la-fi-hiltzik-20150426-column.html>.

37. Amanda Little, *Can Desalination Counter the Drought?*, THE NEW YORKER (July 22, 2015), <http://www.newyorker.com/tech/elements/can-desalination-counter-the-drought>.

38. *Id.*

39. *Id.*

40. Cooley et al., *supra* note 1, at 11.

C. DESALINATION PROJECTS IN CALIFORNIA

Aside from the new fifty-MGD Carlsbad plant, California has minimal desalination capacity, consisting of several small facilities, many of which operate only intermittently.⁴¹ The combined production capacity of these other California desalination facilities is approximately 6.1 MGD.⁴²

1. Existing Desalination Facilities and Planned Expansion

The largest continuously operating desalination facility is located at the Diablo Canyon Nuclear Power Plant and is capable of producing 0.576 MGD, which is used for the power plant's operational needs.⁴³ In terms of municipal-use desalination capacity, California only has a scant capacity of 0.9 MGD: 0.3 MGD from Sand City's municipal plant⁴⁴ and 0.6 MGD from Morro Bay's intermittently used plant.⁴⁵ California's largest municipal plant, located in Santa Barbara, has a capacity of 8.9 MGD, but the project has been idle since the 1990s.⁴⁶

Years of drought have forced municipalities to think about expanding alternative water supplies, and several large seawater desalination facilities are being considered or are under construction along the California coastline to augment water supplies. These include facilities in Oceanside, Camp Pendleton, Dana Point, Huntington Beach, El Segundo, Ocean, Cambria, Monterey Bay, Santa Cruz, Moss Landing, and Pittsburg.⁴⁷ As of 2014, the projected combined production capacity of proposed desalination plants was between 250 MGD and 370 MGD.⁴⁸ These plants would exponentially increase desalination capacity in California but would still satisfy only five to seven percent of the average urban demand in the state.⁴⁹

2. The Carlsbad Desalination Project

The Carlsbad Plant in San Diego County opened in December 2015 and produces fifty MGD.⁵⁰ It provides San Diego County with approximately ten

41. FINAL STAFF REPORT, *supra* note 15, at 18–19.

42. *Id.* at 18.

43. *Id.*

44. Sand City's desalination plant is the only such facility filling the needs of an entire municipality. It has been supplying water to Sand City's 334 residents since 2010. See Kevin Fagan, *Desalination Plants a Pricey Option if Drought Persists*, S.F. CHRON. (Feb. 15, 2014, 10:52 PM), <http://www.sfgate.com/news/article/Desalination-plants-a-pricey-option-if-drought-5239096.php>.

45. FINAL STAFF REPORT, *supra* note 15, at 18–19.

46. Santa Barbara began building the \$34 million desalination plant during the drought-stricken 1980s, but by the time it was completed in 1992, the rains had returned and the facility was unused and partially dismantled after pilot testing. The city is now contemplating restarting the plant at a cost of \$40 million, plus \$5 million per year in operating costs. That would place the cost of desalinated water at about \$3000 per acre-foot and drive up average monthly household water bills to \$108 from \$78 today. Hiltzik, *supra* note 36.

47. FACT SHEET, *supra* note 2, at 1.

48. FINAL STAFF REPORT, *supra* note 15, at 21–22.

49. *Id.*

50. *Project Overview*, CARLSBAD DESALINATION PLANT, <http://carlsbaddesal.com/> (last visited Oct. 30, 2016).

percent of its total water supply⁵¹ and is the result of seventeen years of planning, permitting, and construction.⁵² The plant is operated by IDE Technologies, a private company that partners with public agencies to deliver water infrastructure projects, with a focus on large-scale reverse-osmosis seawater-desalination plants.⁵³ Poseidon began construction on the one billion dollar project in 2012.⁵⁴ Even though it is now complete, required permit renewals and planned upgrades will trigger the plant's compliance with the Desalination Amendment in a few years, potentially requiring millions of dollars in facility upgrades.⁵⁵

Presently, the project includes three main components: (1) the desalination plant adjacent to the Encina Power Station on Agua Hedionda Lagoon; (2) a ten-mile pipeline connecting the plant to the San Diego County Water Authority's regional distribution system; and (3) upgrades to Water Authority facilities for distributing desalinated seawater throughout the region.⁵⁶ A thirty-year Water Purchase Agreement is in place between the Water Authority and Poseidon Water for the entire output of the plant. Under this Agreement, the County must pay for 48,000 acre-feet of water from the plant every year,⁵⁷ whether it needs the water or not.⁵⁸ The water will cost approximately \$2257 per acre-foot, about double the price of the Water Authority's most expensive current supply, which is water imported from the Sacramento-San Joaquin Delta more than 400 miles away.⁵⁹ Therefore, the County will be paying at least \$110 million per year for the plant's water, and San Diego water bills are projected to rise by an average of five to seven dollars per month to cover that cost.⁶⁰ That is far more expensive than the County's existing water sources: San Diego currently pays \$923 per acre-foot for treated water from the Metropolitan Water District of Southern California.⁶¹

51. *Projects*, POSEIDON WATER, <http://www.poseidonwater.com/projects.html> (last visited Aug. 19, 2016).

52. *Nation's Largest Seawater Desalination Plant Enhances Water Supply Reliability for San Diego County*, CARLSBAD DESALINATION PLANT (Dec. 14, 2015), <http://carlsbaddesal.com/nations-largest-seawater-desalination-plant-enhances-water-supply-reliability-for-san-diego-county>.

53. *Id.*

54. *Id.*

55. See Chris Nichols, *New Desal Rules Costly, but Offer Road Map for Industry*, SAN DIEGO UNION-TRIB. (May 16, 2015, 6:00 AM), <http://www.sandiegouniontribune.com/news/2015/may/16/sacramento-desalination-carlsbad-poseidon-water/>.

56. CARLSBAD DESALINATION PLANT, *supra* note 52.

57. One acre-foot is enough to serve two average homes for a year. Matt Weiser, *California Looks to the Ocean to Fix Drought*, GOVERNING (Nov. 6, 2014), <http://www.governing.com/topics/transportation-infrastructure/california-looks-to-the-ocean-to-fix-drought.html>.

58. *Id.*

59. *Id.*

60. Hiltzik, *supra* note 36.

61. *Id.* The Pacific Institute reported in 2012 that San Diego could obtain recycled water for as little as \$1200 per acre-foot, and that the marginal cost of water obtained through conservation and efficiency measures was as little as \$150. *Id.*

II. CALIFORNIA'S DESALINATION AMENDMENT

In the past, coastal regional water boards permitted new or expanded facilities using “best professional judgment” on a case-by-case basis.⁶² This required significant time and resources due to the complexity of evaluating the technical and biological issues related to desalination.⁶³ This approach also led to varying decision criteria between the various regional boards for permitting new desalination facilities.⁶⁴ Additionally, according to the SWRCB, before the Desalination Amendment there were “few existing provisions in the Ocean Plan that specifically protect[ed] beneficial uses⁶⁵ from the potential impacts associated with desalination facilit[ies].”⁶⁶

A. PURPOSE AND GOALS OF THE DESALINATION AMENDMENT

Faced with a severe drought and the possibility of a booming desalination industry in the state, the SWRCB adopted the new Desalination Amendment in order to “ensure an efficient approach to permitting desalination facilities to address needed water supplies, while carrying out [the SWRCB’s] legislative mandate to require that seawater intakes utilize the best available site, design, technology and mitigation measures feasible to minimize intake and mortality of all forms of marine life.”⁶⁷ Ultimately, according to the SWRCB, the Amendment will “protect and maintain the highest reasonable water quality possible for the use and enjoyment of the people of the state while supporting the use of ocean water as an alternative source of water supply.”⁶⁸

B. THE DESIGN AND FUNCTIONING OF THE AMENDMENT

The Amendment is part of the state’s Ocean Plan⁶⁹ and is implemented through National Pollutant Discharge Elimination System (“NPDES”) permits or Waste Discharge Requirements issued by the applicable regional water board in consultation with the SWRCB.⁷⁰

62. FINAL STAFF REPORT, *supra* note 15, at 27.

63. *Id.*

64. *Id.*

65. The 2015 Ocean Plan states that the following “beneficial uses” of California’s ocean waters shall be protected: “industrial water supply; water contact and non-contact recreation, including aesthetic enjoyment; navigation; commercial and sport fishing; mariculture; preservation and enhancement of designated Areas of Special Biological Significance (ASBS); rare and endangered species; marine habitat; fish migration; fish spawning and shellfish harvesting.” 2015 OCEAN PLAN, *supra* note 4, at 3.

66. FINAL STAFF REPORT, *supra* note 15, at 27.

67. *Id.* at 28.

68. *Id.* at 26.

69. The Ocean Plan establishes water quality objectives for California’s ocean waters and provides the basis for regulation of waste discharges into the state’s coastal waters. *Id.* at 24.

70. *Id.* at 11.

The Amendment established a uniform statewide approach for protecting beneficial uses of ocean waters from degradation caused by seawater intake and discharge of brine wastes from desalination facilities.⁷¹ The SWRCB aimed to create certainty in the permitting process statewide by providing direction on how to best assess and minimize environmental impacts associated with desalination.⁷²

The Amendment includes four primary components intended to control potential adverse impacts to marine life from desalination facilities. The Amendment: (1) clarifies the SWRCB's authority over desalination facility intakes and discharges; (2) provides direction to regional water boards about how to evaluate the best available site, design, technology, and mitigation measures to minimize the intake and mortality of marine life; (3) includes a narrative receiving-water limitation for salinity to ensure that brine discharges do not adversely affect aquatic-life beneficial uses; and (4) outlines monitoring and reporting requirements that include monitoring of effluents, water-column bottom sediment, and benthic-community health.⁷³

The Amendment⁷⁴ applies to existing,⁷⁵ expanded,⁷⁶ and new⁷⁷ desalination facilities, and requires that a regional water board conduct an analysis of all new and expanded facilities under California Water Code section 13142.5(b).⁷⁸ Section 13142.5(b), which was previously applicable only to power plants, requires that a regional water board analyze and require "the best available site, design, technology, and mitigation measures feasible . . . to minimize the intake and mortality of all forms of marine life."⁷⁹ "Feasible," for the purposes of the Amendment, means "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental,

71. *Id.*

72. FACT SHEET, *supra* note 2, at 1.

73. FINAL STAFF REPORT, *supra* note 15, at 11.

74. This Note cites to the Desalination Amendment by referencing its location in the Ocean Plan. *See generally* 2015 OCEAN PLAN, *supra* note 4. For a version that displays how the Amendment modified the Ocean Plan, see CAL. STATE WATER RES. CONTROL BD., OCEAN PLAN WITH THE FINAL DESALINATION AMENDMENT AND OTHER NON-SUBSTANTIVE CHANGES IN BLUE STRIKEOUT OR UNDERLINE ASSOCIATED WITH THE ADOPTION OF RESOLUTION 2015-0033 (May 5, 2015), http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2015/rs2015_0033_desalamd.pdf.

75. 2015 OCEAN PLAN, *supra* note 4, at 34. Existing facilities are desalination facilities that have been issued a NPDES permit and all building permits and other governmental approvals necessary to commence construction for which the owner or operator has relied in good faith on those previously-issued permits and approvals and commenced construction of the facility beyond site grading prior to January 28, 2016. *Id.*

76. 2015 OCEAN PLAN, *supra* note 4, at 35. Expanded facilities are those for which, after January 28, 2016, the owner or operator does either of the following in a manner that could increase intake or mortality of all forms of marine life beyond that which was originally approved in any NPDES permit or Water Code § 13142.5(b) determination: (1) increases the amount of seawater used either exclusively by the facility or used by the facility in conjunction with other facilities or uses; or (2) changes the design or operation of the facility. *Id.*

77. New facilities are simply not existing or expanded facilities. *Id.*

78. 2015 OCEAN PLAN, *supra* note 4, at 36.

79. CAL. WATER CODE § 13142.5(b) (West 2016).

social, and technological factors.”⁸⁰

The water board must consider all four factors (i.e., best available site, design, technology, and mitigation measures) collectively to determine the best combination of feasible alternatives for a desalination facility that will minimize intake and mortality of marine life.⁸¹ One of the most important considerations is that the Amendment explicitly states a preference for subsurface intakes, and provides that subsurface intakes “shall not be determined to be economically infeasible solely because [they] may be more expensive than surface intakes.”⁸² This will likely be an important factor in future desalination-plant plans, as the desalination industry favors screened intakes, because they are cheaper and easier to build than subsurface intakes.⁸³

The Desalination Amendment also includes specific environmental requirements. Surface-water intake screens must have one-millimeter slots,⁸⁴ and brine discharges must not exceed natural background salinity by more than two parts per thousand on a daily average basis.⁸⁵ Operators of desalination facilities must also submit a monitoring and reporting plan to the regional water board for approval.⁸⁶ The Amendment aims to give both regulators and industry a better idea of how desalination facilities will be regulated in the future.

III. THE FUTURE OF DESALINATION IN CALIFORNIA

Despite California’s water challenges, and its attempt to prepare a regulatory framework for future desalination development, multiple factors will hinder the continued development of desalination facilities unless the drought continues to worsen.

A. THE ARGUMENTS FOR DESALINATION

Desalination improves the reliability of municipalities’ water supplies. California’s population has grown from twenty million in 1970 to thirty-nine million today, but water infrastructure has not kept pace.⁸⁷ That growth coincides with the state’s precipitation, which was unusually high in the early twentieth century before declining to its long-term climate norm.⁸⁸ With more than half of California’s water supplies coming from the Colorado River in the south and the

80. 2015 OCEAN PLAN, *supra* note 4, at 54.

81. *Id.* at 36.

82. *Id.* at 39.

83. *See* Weiser, *supra* note 57.

84. 2015 OCEAN PLAN, *supra* note 4, at 40.

85. *Id.* at 47.

86. *Id.* at 50.

87. *See* Bradley J. Fikes, *Desalination Event Returns to San Diego*, SAN DIEGO UNION-TRIB. (Aug. 9, 2015, 7:39 PM), <http://www.sandiegouniontribune.com/news/2015/aug/09/desalination-congress-san-diego/>.

88. *Id.*

Sacramento River in the north, the state's water supply problems will continue to worsen if the drought continues.⁸⁹

Desalination offers California a reliable source of fresh water,⁹⁰ which is particularly valuable in the arid and semi-arid climates of Southern California, where weather variability is high.⁹¹ Production of desalinated water depends on the operation of desalination infrastructure, which is more reliable than depending on precipitation to replenish the water supply.⁹²

B. THE ARGUMENTS AGAINST DESALINATION

The appeal of a reliable source of fresh water is strong, but it is tempered by the many disadvantages of desalination. These include: (1) high energy usage and cost, (2) short- and long-term environmental costs, and (3) a multitude of potential permitting and legal challenges.

1. High Energy Costs

High energy costs are a significant disadvantage to desalination. The average price per acre-foot⁹³ for water produced by seawater desalination is several times higher than water from other sources.⁹⁴ Over the past twenty years the cost of seawater desalination has declined, but less-expensive water alternatives still exist, such as improving conservation, harvesting rainwater through "green infrastructure," and accelerating wastewater recycling.⁹⁵

California's water-management system is already "extremely energy-intensive."⁹⁶ Water-related energy use is responsible for nineteen percent of the state's electricity consumption, thirty percent of its natural gas use, and eighty-eight billion gallons of diesel fuel used each year.⁹⁷ A stronger emphasis on desalination infrastructure in the future will only serve to increase California's reliance on high-energy freshwater production.

The Carlsbad desalination plant, for example, requires forty-seven percent more energy by volume than State Water Project Transfers, which are the next

89. See Jeff Kray, *Planned Water Desalination Plant in California Approved Over Opposition Regarding Marine Impacts, Energy and Climate Costs*, MARTEN LAW (Sept. 9, 2009), <http://www.martenlaw.com/newsletter/20090909-calif-deslination-plant-approved>.

90. See Cooley et al., *supra* note 1, at 1.

91. See *id.* at 45.

92. See *id.*

93. An acre-foot equates to roughly 326,000 gallons of water. *Id.* at VIII.

94. NAT. RES. DEF. COUNCIL, NRDC ISSUE BRIEF—PROCEED WITH CAUTION: CALIFORNIA'S DROUGHT AND SEAWATER DESALINATION 2 (May 2014), <http://www.nrdc.org/oceans/files/ca-drought-seawater-desalination-IB.pdf> [hereinafter NRDC].

95. *Id.* at 3.

96. *Id.*

97. *Id.*

most energy-intensive source of water.⁹⁸ Water from the plant will cost more than \$2,100 per acre-foot,⁹⁹ which costs roughly twice as much as importing water or recycling wastewater: according to the California Department of Water Resources, as quoted by the National Resources Defense Council, the “‘estimated range of capital and operational costs of water recycling range from \$300 to \$1,300 per acre-foot’ depending on local conditions.”¹⁰⁰

Water bills in San Diego County will increase by sixteen percent in 2016 as the County begins its guaranteed payments to Poseidon water under the Water Purchase Agreement.¹⁰¹ San Diego County residents will likely see additional rate hikes of 6.4% in July 2017, 5% in July 2018, and 7% in July 2019.¹⁰² That equals a forty percent compounded rate hike in just four years.¹⁰³ According to Sara Aminzadeh, executive director of the California Coastkeeper Alliance, “[Desalination is] just not a good option from a cost and energy standpoint.”¹⁰⁴

Even if higher rain levels return to Southern California, water costs will remain high for County taxpayers due to the County’s contract with Poseidon.¹⁰⁵ This is because the County contracted to pay for thirty years of water from the Carlsbad plant, whether the County needs the water or not.¹⁰⁶

2. High Environmental Costs

A second disadvantage of desalination is the high environmental cost associated with it. Seawater intakes and brine discharges may harm sea life directly and, because desalination is an energy-intensive process, it increases fossil-fuel use and GHG emissions.

Both the surface and subsurface intakes that seawater-desalination facilities use to access source water can cause marine life mortality.¹⁰⁷ Surface intakes draw water directly from a water source, whereas subsurface intakes draw water through pipes installed under the seafloor.¹⁰⁸ Environmental groups now consider open ocean-surface intakes outdated technology.¹⁰⁹ The process can kill billions of fish eggs, adult fish, and other marine life each year through entrainment and

98. *Id.*

99. Fikes, *supra* note 87.

100. NRDC, *supra* note 94, at 2 (quoting 2 CAL. DEP’T OF WATER RES., CALIFORNIA WATER PLAN UPDATE 2009 11-10 (2009), http://www.water.ca.gov/waterplan/docs/cwpu2009/0310final/v2c11_recycmuniwtr_cwp2009.pdf).

101. David Garrick, *Water Rates to Spike 16 Percent in San Diego*, THE SAN DIEGO UNION-TRIB. (Nov. 17, 2015, 5:33 PM), <http://www.sandiegouniontribune.com/news/2015/nov/17/drought-water-rate-hikes-recycling-potable/>.

102. *Id.*

103. *Id.* The San Diego City Council also increased rates for irrigation water by 117 percent. *Id.*

104. Little, *supra* note 37.

105. See Phil Diehl, *Carlsbad Desalination Project Nears Completion*, SAN DIEGO UNION-TRIB. (Apr. 11, 2015, 5:00 PM), <http://www.sandiegouniontribune.com/news/2015/apr/11/carlsbad-desalination-project-nears-completion/>.

106. Weiser, *supra* note 57.

107. FACT SHEET, *supra* note 2, at 1–2.

108. *Id.* at 1.

109. NRDC, *supra* note 94, at 3.

impingement.¹¹⁰ Entrainment occurs when organisms are drawn in with source water and enter a facility's water-processing system.¹¹¹ Impingement occurs when organisms become trapped on the screens that cover the surface intake pipe openings.¹¹² The size of the gaps in the screens will determine which organisms are protected; many small organisms pass through the screens but larger organisms can become impinged.¹¹³

Marine life can also be harmed by the brine discharged by desalination facilities after the purification process. Discharged brine is composed of highly concentrated components normally found in seawater, such as magnesium, boron and sulfate, and the brine is often combined with chemicals used during the desalination process, such as aluminum chloride, polyphosphates, and biocides.¹¹⁴ This mixture can lead to acute and chronic toxicity if improperly discharged into ocean waters.¹¹⁵ Discharged brine may be warmer than the receiving water, which can cause thermal pollution.¹¹⁶ Brine may also accumulate on the sea floor and damage bottom-dwelling marine life communities, including fish, plants, and algae.¹¹⁷

Although the Desalination Amendment was designed to help reduce environmental risks, the Amendment does not directly address the GHG emissions that result from the energy-intensive nature of the seawater desalination process.¹¹⁸ In California, the Los Angeles County Economic Development Corporation found that ocean desalination indirectly creates more GHGs than any other water source.¹¹⁹ According to the California Air Resources Board's 2008 Climate Change Scoping Plan, one way to reduce GHG emissions is to replace existing water supply and treatment processes with more energy-efficient alternatives.¹²⁰ A greater reliance on seawater desalination plants would do the opposite by increasing the energy needed to provide a healthy freshwater supply, which means the extensive development of desalination could lead to greater depen-

110. *Id.*

111. FACT SHEET, *supra* note 2, at 2.

112. *Id.*

113. *Id.*

114. NRDC, *supra* note 94, at 4.

115. *Id.*

116. *Id.*

117. FACT SHEET, *supra* note 2, at 2.

118. See RESOLUTION 2015-0033, *supra* note 4, at 6 (explaining that the SWRCB identified (1) "potentially significant indirect impacts from greenhouse gas emissions" expected to result from compliance with the Amendment and (2) potential measures to mitigate those impacts, but because the SWRCB lacks the authority to require air-related mitigation measures, the Amendment does not address the mitigation of greenhouse gas emissions from desalination).

119. NRDC, *supra* note 94, at 3 (citing L.A. CTY. ECON. DEV. CORP., WHERE WILL WE GET THE WATER? ASSESSING SOUTHERN CALIFORNIA'S FUTURE WATER STRATEGIES (Aug. 14, 2008), http://www.laedc.org/sclc/documents/Water_SoCalWaterStrategies.pdf).

120. NRDC, *supra* note 94, at 3, (citing 1 CAL. AIR. RES. BD., CLIMATE CHANGE SCOPING PLAN APPENDICES C-134 (2008), https://www.arb.ca.gov/cc/scopingplan/document/appendices_volume1.pdf).

dence on fossil fuels, and a subsequent increase in GHG emissions.¹²¹ The new Carlsbad plant will arguably be moderating the effects climate change has had on San Diego County, but the plant will also be contributing to the GHG emissions that help cause global climate change.¹²²

3. New Desalination Projects Will Face Many Legal Challenges

Legal challenges are another hurdle for the growth of the desalination industry in California. Poseidon's Carlsbad plant needed more than fifteen years to develop from concept to construction and the plant survived numerous legal challenges over that time period.¹²³ Due to the highly regulated nature of California's coastal zone, the Carlsbad plant also required land use and environmental permits from the City of Carlsbad, the California Regional Water Quality Control Board, the California Department of Health Services, the California Coastal Commission, and the California State Lands Commission.¹²⁴ Overall, the permitting process took more than six years to complete, and the plant's permits included local land use permits, a state drinking water permit, a coastal development permit, and a water quality discharge (i.e., NPDES) permit under the federal Clean Water Act.¹²⁵

Along with the extensive permitting process, the Carlsbad plant faced heated opposition from environmental groups, including legal challenges to the plant's permits by the Surfrider Foundation and the San Diego Coastkeeper.¹²⁶ In two separate court orders in 2009, a San Diego County Superior Court judge upheld the state Coastal Commission and Lands Commission's respective approvals of the plant.¹²⁷ In the Lands Commission case, the environmental petitioners had alleged that the Commission violated the California Environmental Quality Act ("CEQA") by allowing the plant to go forward without analyzing how certain changes in the project would impact marine life, GHG emissions, and global warming.¹²⁸ The trial judge rejected the petitioners' challenge,¹²⁹ and the Lands

121. See Cooley et al., *supra* note 1, at 7.

122. See Hiltzik, *supra* note 36.

123. Weiser, *supra* note 57.

124. Kray, *supra* note 89.

125. *Id.*

126. *Id.*

127. See *Surfrider Found. v. Cal. Coastal Comm'n*, No. 37-2008-00075727 (San Diego Cty., Cal. Super. Ct., May 7, 2009); *Surfrider Found. v. Cal. State Lands Comm'n*, No. 37-2008-00092607-CU-WM-CTL (San Diego Cty., Cal. Super. Ct., Oct. 6, 2009). Surfrider initially appealed the Coastal Commission case decision in July 2009, and later that month agreed to a settlement and abandoned its appeal. See Black & Veatch, *Carlsbad Desalination Project Independent Engineer's Report* 7–10 (Dec. 3, 2012), in CALIFORNIA POLLUTION CONTROL FINANCING AUTHORITY, LIMITED OFFERING MEMORANDUM FOR WATER FURNISHING REVENUE BONDS, SERIES 2012 (Dec. 20, 2012), <http://www.sdcwa.org/sites/default/files/files/finance-investor/carlsbad-desal-project-limited-offering-memorandum.pdf>.

128. *San Diego Coastkeeper v. Cal. State Lands Comm'n*, 2010 Cal. App. LEXIS 9797, at *19 (Cal. Ct. App. Dec. 10, 2010).

129. *Id.* at *20.

Commission's approval of the Carlsbad plant was upheld on appeal.¹³⁰ Surfrider also challenged the Regional Water Quality Control Board's approval of the NPDES permit for the Carlsbad desalination facility.¹³¹ That permit was upheld by the trial court in 2011¹³² and on appeal in 2012.¹³³ Later in 2012, after the years of hearings and environmental lawsuits had ended, construction finally began.¹³⁴

Another anti-desalination lawsuit concerned a proposed plant in Marin County, California. North Coast Rivers Alliance claimed that the CEQA-required environmental impact report ("EIR") for the proposed desalination plant failed to adequately analyze the adverse environmental consequences of the project.¹³⁵ The trial court agreed with the Alliance; however, the appellate court reversed, finding that, among other things, impacts from shock-chlorination of intake pipes would be "less than significant"¹³⁶ and the EIR's mitigation measure for visual impacts was definite enough to comply with CEQA.¹³⁷ Just as the earlier unsuccessful lawsuits by environmental groups had stalled the Carlsbad project, the Alliance's suit also delayed the Marin desalination project for years.¹³⁸ Marin ultimately halted further desalination planning after the county's water use declined, though as one member of the county's water board noted, "it would be good to have [desalination] on the back burner" in case of extreme drought.¹³⁹

The next plant scheduled to be built in California will be located in Huntington Beach, and is also being developed by Poseidon.¹⁴⁰ Environmental groups, including Surfrider, have pledged to continue the fight against the desalination industry. According to Surfrider, the organization "will continue to monitor and stay engaged in these projects and others proposed around the country to ensure that desal[ination] projects are limited to the minimum necessary, environmentally responsible approaches are taken (including compliance with California's

130. *Id.* at *3.

131. *Surfrider Found. v. Cal. Reg'l Water Quality Control Bd.*, 149 Cal. Rptr. 3d 763, 767 (Cal. Ct. App. 2012).

132. Black & Veatch, *supra* note 127, at 7–11.

133. *Surfrider Found.*, 149 Cal. Rptr. 3d at 768.

134. *See* Nichols, *supra* note 55.

135. *N. Coast Rivers All. v. Marin Mun. Water Dist. Bd. of Dirs.*, 157 Cal. Rptr. 3d 240, 245 (Cal. Ct. App. 2013).

136. *Id.* at 260.

137. *Id.* at 254.

138. *See id.* at 247 (lawsuit filed in 2009). The suit concluded in 2013 when the Supreme Court of California declined the Alliance's petition for review. *N. Coast Rivers All. v. Marin Mun. Water Dist. Bd. of Dirs.*, 2013 Cal. LEXIS 7497 (Cal. Sept. 11, 2013).

139. *Marin County Water Use Dropped Significantly in Last Decade*, MARIN INDEP. J. (May 2, 2016, 9:22 PM), <http://www.marinij.com/environment-and-nature/20160502/marin-county-water-use-dropped-significantly-in-last-decade>.

140. *Huntington Beach Project*, POSEIDON WATER, http://poseidonwater.com/our_projects/all_projects/huntington_beach_project/ (last visited Aug. 27, 2016).

new Desalination Amendment), and will continue to promote water conservation.”¹⁴¹

With the framework for plant development now in place, proposed plants can expect to face litigation over the meaning and effect of the Desalination Amendment, in addition to the type of challenges that the industry has experienced in the past. Environmental groups will likely attempt to resolve any questions about the Amendment’s meaning so as to minimize the expansion of desalination. As discussed above, “feasible,” for the purposes of the Amendment, means “capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors.”¹⁴² According to San Diego Coastkeeper staff member Matt O’Malley:

[B]y failing to clearly state that environmentally superior technologies, designs and site locations are the absolute preference of this policy, the amendment unfortunately sets up the case where each future desalination project proposal will require the strictest scrutiny by the environmental community and will likely result in significant disputes over their compliance with the law.¹⁴³

C. OTHER FACTORS THAT MAY LIMIT THE EXPANSION OF DESALINATION

1. Lack of Viable Sites for New Desalination Projects

Developers must consider that desalination facilities need to be built in coastal areas without destroying the qualities that attract people to the shoreline. Desalination plants need to be built close to customers, with enough room for pumps, pipelines, inflows, and outfalls.¹⁴⁴ According to Poseidon Vice President Scott Maloni, desalination plants are most efficient when they are built large enough to reap economies of scale.¹⁴⁵ This required combination of size and proximity to scenic, developed areas—combined with the state’s stringent permitting process—limits the number of viable sites in the state.¹⁴⁶

141. Ian Cecere, *Surfrider Protecting Our Ocean From Desal*, SURFRIDER FOUNDATION (Aug. 13, 2015), <http://www.surfrider.org/coastal-blog/entry/surfrider-protecting-our-ocean-from-desal>.

142. 2015 OCEAN PLAN, *supra* note 4, at 54.

143. Chris Jennewein, *Coastkeeper Criticizes California’s Support for Desalination*, TIMES OF SAN DIEGO (May 7, 2015), <http://timesofsandiego.com/politics/2015/05/07/coastkeeper-criticizes-californias-support-for-desalination/>.

144. Hiltzik, *supra* note 36.

145. Daniel Potter, *Why Isn’t Desalination the Answer to All California’s Water Problems?*, KQED SCIENCE (Dec. 18, 2015), <https://ww2.kqed.org/science/2015/12/18/why-isnt-desalination-the-answer-to-all-californias-water-problems/>.

146. *Id.*

2. Cheaper Alternatives May Meet Some Localities' Needs

Orange County, which lies directly north of San Diego County, tackled its water problem by developing wastewater recycling.¹⁴⁷ That development started decades ago as a desperate move to prevent groundwater basins from being contaminated by seawater.¹⁴⁸ Using similar technology to the Carlsbad plant, Orange County's Groundwater Replenishment System supplies approximately 100 MGD of recycled water, which is sent back into groundwater basins that provide local water supply.¹⁴⁹

CONCLUSION

California's desalination industry will likely not experience rapid growth in the near future. California's Desalination Amendment provides a framework for the industry to move forward in the state, but the environmental rules included in the Amendment could add hundreds of millions of dollars to the cost of desalination plants.¹⁵⁰ According to industry officials, projects will continue to move forward, but it is still an open question whether the technology will ever flourish in California.¹⁵¹

San Diego, which is more dependent on outside water than most California cities, may be a prime location for a large desalination project.¹⁵² However, multiple other California water districts have considered desalination and decided against it due to its expense and environmental concerns.¹⁵³ Instead of aggressively pursuing desalination projects, even with the Desalination Amendment, California municipalities will likely explore lower-cost alternatives that include treating low-quality local water sources, encouraging regional water transfers, improving conservation and efficiency, and accelerating wastewater recycling and reuse.¹⁵⁴

147. Fikes, *supra* note 87.

148. *Id.*

149. *Id.*

150. *See* Nichols, *supra* note 55.

151. *Id.*

152. Hiltzik, *supra* note 36.

153. *Id.*

154. Cooley et al., *supra* note 1, at 1–2.