California Ocean Wastewater Discharge Report and Inventory

Prepared by Heal the Ocean

March 15, 2010

A compilation and review of information by Heal the Ocean on wastewater treatment and wastewater facilities discharging into the Pacific Ocean along the coast of California.

Online "Google Fly-To" and Interactive Mapping
www.healtheocean.org/research/wdi/resources

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*"The ocean! People don't understand the sustaining capacity and capability of the sea,
the necessity of having clean water. There will be consequences."*

Dr. Howard Kator, Environmental Microbiologist, University of Virginia, College of William & Mary, 1998.

*"California is facing an unprecedented water crisis. The collapse of the Bay-Delta ecosystem,
climate change, and continuing population growth have combined with a severe drought on the Colorado
River and failing levees in the Delta to create a new reality that challenges
California's ability to provide the clean water needed for a healthy environment,
a healthy population, and a healthy economy, both now and in the future."*

State of California Recycled Water Policy (adopted 5/14/2009).

*"Based on the potential for additional recycled water…, recycled water could free up enough fresh water to
meet the household water demands of 30 to 50 percent of… 17 million Californians.
To achieve this potential, an investment of $11 billion would be needed"*

Water Recycling 2030: Recommendations of California's Recycled Water Task Force," 2003.

About Heal the Ocean

Heal the Ocean is a highly regarded non-profit citizens' action group with nearly 3,000 members organized to halt practices that pollute the ocean. Since its formation in 1998, Heal the Ocean has hired engineers, scientists, hydrologists, and researchers to assess problem areas, to conduct testing, and to perform engineering and cost/feasibility studies to find better technological methods of handling human waste.

Heal the Ocean's accomplishments include:

- Successfully lobbying the County of Santa Barbara to establish Project Clean Water;
- Assisting in passage of Measure B to assure robust local funding for water quality programs in the city of Santa Barbara;
- Initiating bacterial DNA typing studies at Rincon Creek;
- Initiating successful septic to sewer projects along seven miles of beach in the Rincon and Carpinteria areas, and in certain areas of the city of Santa Barbara;
- Conducting virus sampling studies at popular swimming beaches;
- Successfully campaigning to end an official waiver at a major sewage treatment plant on the Santa Barbara south coast; and
- Completing of a revolutionary oceanographic/microbiology study of the transport and fate of sewage discharge in shallow water off a popular swimming beach in Montecito, California.

For further details, visit: www.healtheocean.org

Acknowledgments

Heal the Ocean wishes to acknowledge the help of our 3,000 supporters, and in particular, we thank the following people and foundations for the generous support that has funded our report on *Ocean Wastewater Discharge in the State of California:* The Johnson Ohana Family Charitable Foundation; Brian and Laurence Hodges of the WWW Foundation; the Ann Jackson Family Foundation; Adam and Kara Rhodes of the WWW Foundation; Yvon Chouinard; Julia Louis-Dreyfus and Brad Hall of The Hall Charitable Fund; Patagonia; the Tomchin Charitable Foundation, and last but not least, our numerous anonymous donors and foundations who have stuck with us through thick and thin.

We would also like to thank the many facility operators and City and State officials who contributed generously of their time to help provide the data necessary to produce this report.

Hillary Hauser, Executive Director
Heal the Ocean

Executive Summary

California's water supply involves complicated and challenging issues, including population increase (1), drought conditions (2), rising salinity (3), and climate change threats (4) (5) such as reduced snow pack (6) and ocean acidification (7). The use of potable (safe for drinking) water for waste disposal and its discharge to the ocean have become outdated practices and stand out as unwise uses of both our freshwater and ocean resources. Already known to carry a health risk (8), ocean wastewater discharge has become even more questionable as wastewater contains a growing number of contaminants of emerging concern (CECs). The State is taking steps to investigate new and newly suspected pollution problems related to wastewater and may make necessary updates to water quality standards for discharges. A recycled water policy is now in place as a measure to help extend the State's limited water supplies. These efforts must now be focused on solving the problems of ocean pollution and water shortages that come together in the subject of wastewater treatment.

California's coastal wastewater facilities need to increase their contribution toward these aims by reclaiming and reusing a much higher percent of wastewater rather than releasing it to the ocean. Yet before they can increase water reclamation, many plants will need improvements in order to address the problems of salinity and CECs. Successful prioritization and financing of improvements, and effective monitoring and reporting protocols, rely on a clear assessment of ocean discharging wastewater treatment and plants. However, the picture has remained unclear even as the State's wastewater administration has grown more integrated. Lack of a full and detailed overview makes it difficult to pursue coordinated statewide policies and plans. This *Report and Inventory* attempts to bring the picture into better focus.

In producing this work, Heal the Ocean hopes to provide a tool for use in understanding the big picture of wastewater disposal in the ocean and recommendations that will inspire political and financial support for infrastructure and administrative improvements to end ocean wastewater discharges in California. In doing so, we hope to contribute to the resolution of two major problems: pollution of the ocean and insufficient water to sustain California's social, economic and environmental future.

Key Points

1. In California, 43 wastewater treatment facilities discharge approximately 1.35 billion gallons daily (~1.5 million acre feet per year (AFY)) of treated effluent directly into the Pacific Ocean.[1]
2. These facilities reclaim or divert for reclamation only approximately 312 million gallons daily (MGD) (~ 200,480 AFY) for beneficial reuse.[2] Based on the volume discharged daily by the 43 facilities, about four times more than this amount could be reclaimed.
3. Increasing reclaimed water for reuse would decrease the demand on locally available water as well as dependence on imported supplies, reduce (or in some cases eliminate) ocean discharges, and reduce the stress on the environment that is caused by diversion of water from its natural flows.
4. Wastewater treatment facility discharges into the Pacific Ocean contain substantial volumes of materials known or suspected to cause environmental damage and/or to pose a risk to human health (8). Their discharge is monitored on an individual rather than integrated system-wide basis, which could potentially ignore or create cumulative environmental effects and human health risks.
5. Most CECs are not currently regulated and require research to better determine their risks to human health and to the environment. This is true particularly for those CECs that are not removed from most wastewater streams.
6. Existing treatment technology – including extended secondary treatment using longer retention times – is capable of removing some CECs (9), but many of the plants studied would need improvements or upgrades to achieve the treatment levels necessary.[3]

1 Source: treatment plant wastewater discharge requirements mainly for 2005, some for different year closest to time of data collection.
2 Source: responses from treatment plant operators with information on 38 (88%) of the 43 facilities surveyed; additional information from plant websites.
3 For a review of treatment processes needed to remove certain CECs, see Wastewater Treatment to Control CECs, Part two.

7. Institutional and financial barriers exist to increasing reclaimed water. Improved treatment methods make some regulations on reuse unnecessarily restrictive. However, funds for wastewater treatment plant improvements and upgrades to ensure high quality reclaimed water have been limited and difficult to obtain. This has resulted in a significant funding gap identified by the U.S. Environmental Protection Agency (U.S. EPA)(10). If substances presently identified as CECs become regulated, further wastewater plant improvements and upgrades would be needed to meet new water quality requirements.
8. Wastewater treatment plant standards are set on an individual basis in order to account for local conditions. However, reporting requirements are not standardized within California. Therefore it is: 1) difficult to compare wastewater treatment plant operations statewide; and 2) difficult to understand the magnitude of challenges and opportunities presented by the current status of wastewater treatment plant operations. The highly beneficial services provided by wastewater treatment plants are literally invisible to and barely understood by most of the public. Statewide, coordinated educational measures are needed to help raise public awareness about wastewater treatment plant processes, proper disposal of household chemicals (which include many CECs), and effects of consumer product choice on wastewater treatment plant operations and cost. Such measures, in addition to increased pretreatment by large scale and key sources (e.g., hospitals and industrial operations) would lead to fewer pollutants being added to wastewater and result in greater conservation of water.

Recommendations

Wastewater treatment plants are a key part of efforts to end ocean pollution and the release of pollutants into the environment in general. Although the State requires treatment plants to remove high percentages of numerous pollutants, it has not yet created legislation for the removal of CECs. Due to the potential risks of these contaminants, it is essential to advance wastewater plant operations and bring standards, source control, infrastructure, treatment, and public awareness up to date across California. In light of the information in this *Report and Inventory*, Heal the Ocean makes the following recommendations:

Recommendation 1:
Improve and upgrade existing wastewater treatment plants.

- Ensure optimum treatment levels with the aim of maximum removal of contaminants and in a manner that allows for efficient additional modifications in the future.
    - Apply best methods to do so on a case-by-case basis depending on influent, site location, populations served, types of reuse, etc., tailoring treatment accordingly.
    - Emphasize advanced secondary treatment (mainly longer holding times) as a means to decrease the necessity for and maximize the efficiency of advanced treatment.
- Capture methane to offset costs of improvements and increase energy efficiency.
- Utilize potential for treatment plant sites to generate non-waste fuel alternative energy.
- Prioritize the upgrade of ocean discharging plants ahead of inland plants, given the proximity of ocean discharges to major protected areas and areas of recreation and economic ocean uses, such as fishing, and given that less discharge to the ocean will help to balance natural water flows within watersheds.

Recommendation 2:
Increase the use of reclaimed water as a more economic alternative to potable water for non-potable uses.

- Create financial incentives to utilize reclaimed over potable water for non-potable uses.
- Use reclaimed water as a major supply for toilet flushing and irrigation–two significant ways in which potable water is wasted where recycled water can be easily substituted, recognizing that initial costs may be high, but that non-action will cost far more.
- Use reclaimed water as a major source for ground water recharge and other indirect potable use, where highly treated municipal water is discharged directly into groundwater or surface waters in order to augment water

supplies. In this application, treatment must remove all contaminants (including CECs).

- Increase storage and delivery capacity for reclaimed water.
- Reclaim all wastewater presently discharged to the ocean.

Recommendation 3:
Make public education and consumer awareness a priority

- Improve public education about wastewater treatment plant processes and effects of consumer product choice on wastewater treatment plant operations and cost.
- Aid consumers in making smart decisions about their choice and disposal of personal care products, chemicals, pharmaceuticals, and sodium and potassium-based water softeners.
- Educate the public about the benefits of high quality recycled water and the facts about its safety. Demonstrate its potential to be cleaner than many drinking water supplies in order to increase water conservation, support for needed legislative and regulatory changes, and public acceptance of reclaimed water.

Recommendation 4:
Support and increase efforts to prevent pollution at source.

- Make it easy for the public to dispose of products in ways that lessen the burden on wastewater treatment plants.
- Support and expand adequate pretreatment of wastewater from industrial, medical, and similar sources as another important way to lessen the burden on treatment plants.
- Increase and/or establish restrictions on manufacturing uses of contaminants of emerging concern and on products containing these substances, especially where better alternatives exist.
- Increase restrictions on the use of sodium and potassium-based water softeners to prevent an unnecessary increase in the salinity or chloride content of wastewater reaching the treatment plant and the resulting increased expense of reclaiming high quality water.

Recommendation 5:
Revise legislation and regulation as soon as possible to overcome barriers to use.

- Legislative revisions at the State level should be introduced and structured to accommodate new standards for safe levels of contaminants of emerging concern in water and wastewater.
- Make legislation and regulation consistent throughout the State.
- Tailor revisions deliberately to ensure the existence of outlets for reclaimed water throughout California and to avoid situations where restrictions on reuse lead to wasteful discharge, particularly of tertiary-treated wastewater.

Recommendation 6:
Support and expand collaborative planning and research.

- Support a State-funded assessment of the toxicity of contaminants of emerging concern through continued research on their effects on humans, other organisms, and the environment.
- Encourage further research exchange and partnerships at and across international, national, state, regional, and local levels by water, wastewater, and public health authorities, research scientists, political representatives, engineers, and additional stakeholders, such as the U.S. Department of Fish & Game, environmental groups, and public and corporate water users.

- Establish pilot projects in a range of locations to test the viability of new monitoring techniques, equipment, treatment, etc.

Recommendation 7:
Provide government support and funding mechanisms.
The $11.1 billion bond bill proposed during fall 2009 in the California legislature demonstrates political recognition of the State's water resource problems. However, carefully crafted and more focused legislation could help to secure California's water supply over the long term, and provide better incentives for water reclamation without measures that would be harmful to the environment, such as dam building and other projects which would divert natural water supplies.

- Maximize State funding mechanisms including those noted in the State's new Recycled Water Policy.

- Increase State, regional, and local aid for treatment plant upgrades to expand and ensure usable reclaimed water supplies.

- Provide adequate funding to increase storage and delivery capacity, including recycled water pipes needed to reach consumers.

Recommendation 8:
Revise the reporting protocols of the State Water Resources Control Board (SWRCB) and attendant regional boards.
Statewide reporting revisions are needed to address inconsistencies in levels and types of reporting by wastewater treatment plants. Reporting changes are also needed in order to address the fragmentation, incompleteness, and lack of reliability of the State's sources of information on wastewater operations and compliance.

- Continue measures to implement reliable statewide reporting, free of potentially distorting features, in formats that are easy to access and analyze.

- Require uniform statewide reporting formats to ensure consistency and clarity.

- Include reporting requirements that shed clearer light on treatment plant operations, measures to enhance water quality, and water reclamation.

- Revise wastewater standards to impose limits on contaminants of emerging concern, particularly to ensure the safety of recycled water.

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Additional Online Resources

Can be found on the Heal the Ocean's Website: http://www.healtheocean.org/research/map *and include:*

- Online Summaries and Sources
- Interactive Maps:
  - Google Earth Map:
    California Ocean Discharging Treatment Plant and Outfall Locations
  - Heal the Ocean Interactive Online Site:
    Produced in ArcGIS Online by David Greenberg, Ph.D.

PART ONE

California Ocean Discharges and Wastewater Treatment

Introduction

In 2005, Heal the Ocean began an inventory of the amount of wastewater being discharged into the Pacific Ocean throughout the State of California. Our aim was simple: we wanted to create a perspective, as accurately as possible given the resources and technology we had at the time, about what goes into the ocean from coastal communities along the Pacific Ocean shoreline of California. The figures reported in the original *Ocean Wastewater Discharge Inventory for the State of California* turned out to be staggering, showing that over a billion gallons of treated effluent are discharged daily into ocean waters.

We discovered that two small treatment plants were discharging into the intertidal zone with no dilution of effluent, while other plants discharged into a marine sanctuary or an area of special biological significance (ASBS) under exemption from policies to protect such areas. We noted the coastal outfalls that discharge into shallow areas, close to shore, very near to the places where people swim in the ocean. As a result of these findings, Heal the Ocean contracted with environmental microbiologist Howard Kator to produce a report, "The dangers of swimming in secondary sewage," (included in the National Resources Defense Council's 2004 report to U.S. Congress, "*Swimming in Sewage,"* and provided in the Additional Online Resources for this report).

Almost immediately after distributing the *Inventory* we received comments pointing out errors and omissions. We took these constructive criticisms seriously and this newly revised *Ocean Wastewater Discharge in the State of California Report and Inventory* addresses those criticisms and other issues that have emerged since that earlier publication.

Heal the Ocean prepared this *Report and Inventory* for another important reason: the information it contains (including the compilation of treatment plant information) has not existed in any one place, including within any California agency, such as the State Water Resources Control Board (SWRCB). Our aim is to provide a resource to the SWRCB, State officials, related agencies, and researchers, to call out the risks and opportunities of the ongoing discharge of treated effluent, and also to make it easier to examine the environmental pressure these discharges put on the Pacific Ocean, including nearshore areas where people swim and surf. We have produced this report also to examine the opportunities to reclaim the wastewater presently discharged to the ocean. Reclaiming wastewater would help California to end the dangerously outdated practice of wasting enormous amounts of water while searching for new sources of water and devising expensive means of transporting water around the State. Diverting water from new sources instead of reclaiming water also makes little sense when a large proportion of fresh supplies ends up similarly discharged and therefore wasted.

California is divided into a total of nine regions administered by individual regional water quality control boards (RWQCBs) in the State (see Figure 1.1). The facilities included in this report are located within the six coastal regions. The wastewater treatment plants range from Crescent City, about 20 miles south of the Oregon border, to the International Wastewater Treatment Plant on the San Diego/Tijuana international boundary. Populations served by these treatment plants range from 12 people to over five million. This report shows that roughly half of the treated solids released into the ocean every day (more than 70 tons of the total 134 short tons released) receive only primary or secondary treatment <u>without disinfection</u>. These solids are suspended in 629 million gallons of the 1.35 billion gallons of treated effluent discharged daily.

The objective of eliminating ocean pollution by wastewater treatment plants clearly converges with the need to conserve California's water supply. Advanced treatment technologies can serve as mechanisms to help to achieve both. Extended and thorough treatment at all levels offers the best protection of the ocean and recreational beaches against the full set of contaminants, particularly those of emerging concern, and produces water that can be reclaimed for many beneficial uses.

Research for this report reveals a correlation between a measure of the relative efficiency (of removal of solids) of individual wastewater treatment plants[4] and their

4 Treatment plant efficiency calculated as a measure of total suspended solids divided by population (figures mainly from 2005; population used as a proxy for measure of influent).

ability to treat water at a tertiary level. Nine of the ten plants found to be most efficient (based on 2005 data) were processing at least a portion of their influent at a tertiary level. Presently, 20 of the 43 ocean-discharging facilities along the California coast have at least some tertiary capacity. This raises the need to research additional factors affecting efficiency and the potential for further improvements in water quality. Many plants lacking tertiary capacity divert a portion of their influent for tertiary treatment by other, more advanced, plants. While cost and site constraints act as obstacles, the lack of an overall State strategy for sewage treatment must also contribute to the variation of treatment capacity and persistence of large-scale discharge, including undisinfected effluent.

Aims:
In light of the wide range of treatment levels, and of the depth, distance, and quantities of treated wastewater discharges, this *Report and Inventory* aims to contribute to a broader perspective by:

- **Providing a complete statewide overview of specific features of coastal wastewater treatment plants and their ocean outfalls:**
    - Outfall location (depth & distance from shore), treatment plant processes, and amount of treated effluent and total suspended solids discharged.
- **Presenting a summary of important pollutant issues posing a challenge to wastewater treatment and water reclamation and reuse.**
- **Reviewing methods and issues related to assessment of plant performance in order to achieve:**
- Consistent and expanded reporting formats and support of continued work toward a reliable statewide reporting system;
    - Further coordination and alignment of treatment plant awards toward State policy and goals particularly for water reclamation.
- **Mapping and reporting on the spatial relationship[5] between wastewater discharge locations and beaches adjacent to 303(d) listed impaired water bodies and other sensitive ocean ecosystems throughout California.**

In this way, this *Report and Inventory* may help to: 1) provide a comparative perspective of current sewage treatment practices; 2) show where reporting of treatment plant data could be improved; 3) help to direct future research into controlling and eliminating human sources of ocean pollution; and 4) assist efforts by various stakeholders, such as facility managers, policy makers, community leaders, and environmental groups to improve California's water quality and supply.

Heal the Ocean regards the online interactive mapping and our recommendations as two of the most important elements of this report. We note the increasing attention paid to the potential risks posed by CECs and how to address those risks. Our recommendations support the need for ongoing research but also call for immediate action–action that amounts to the adaptive management needed now to meet the challenges of wastewater treatment and water supply in the State of California.

5 The spatial analysis produced for Heal the Ocean by David Greenberg, Ph.D. supplements the *Report and Inventory.*

Wastewater Treatment and Ocean Discharges on the Coast of California

Every day, California coastal wastewater treatment plants discharge approximately 1.35 billion gallons of treated effluent into the Pacific Ocean (1.5 million acre feet per year (AFY)). This is about the amount of fresh water used every year by about two million average California households.[6] This is also the amount that California's Recycled Water Task Force estimates the State could potentially recycle in total (11), which shows that this estimate is feasible and possibly low. The effluent discharged includes approximately 270,000 pounds, or 135 short tons, of treated solid matter, all of it delivered daily to the Pacific Ocean off California. Annually, this amounts to 50,000 tons of treated solids dumped into the ocean – the equivalent of the weight of 16,000 Cadillac Hybrid Escalades.[7] The pollutants in treatment plant discharges have been drastically reduced since the introduction of the Clean Water Act (CWA) in 1972. Nevertheless, sewage treatment plants discharging off the coast of California remain a major source of ocean pollution from identifiable ("point") sources (12). The adaptation of treatment plants to new and future conditions could provide an opportunity to end the wasteful and polluting practice of ocean discharge and to decrease the climate impact of plants through increased energy efficiency and decreased emissions.

The treatment facilities included in this *Report and Inventory* receive wastewater collected from homes, businesses, and industrial premises, with pipelines used to transport the wastewater to and from the facilities. Household waste is generally not regulated at its source,

6 Based on Water Use Facts, U.S. Department of Agriculture website (accessed October 2009). "An average California household uses between one half-acre foot and one-acre foot of water each year."
http://www.fs.fed.us/r5/publications/water_resources/html/water_use_facts.html

7 Based on curb weight, manufacturer claim: 6,016 lb, 2009 Cadillac Escalade Hybrid 4WD Full Test. Edmunds InsideLine website (accessed September 2009).
http://www.insideline.com/cadillac/escalade-hybrid/2009/2009-cadillac-escalade-hybrid-4wd-full-test.html

California Ocean Discharging Wastewater Treatment Plants by Region

	California Ocean Discharging Wastewater Treatment Plants by Region			
	Wastewater treatment facility		**Location served**	**NPDES* Permit**
	Regional Board 1 – North Coast			
1	Crescent City Wastewater Treatment Facility		Crescent City	CA0022756
2	Arcata Municipal Wastewater Treatment Facility		Arcata	CA0022713
3	Greater Eureka Area / Elk River Wastewater Treatment Facility		Eureka	CA0024449
4	Humboldt County Resort Improvement District No. 1, Shelter Cove Wastewater Treatment Facility		Shelter Cove	CA0023027
5	Fort Bragg Municipal Improvement District No. 1 Wastewater Treatment Facility		Fort Bragg	CA0023078
6	Mendocino City Community Services District Wastewater Treatment Facility		Mendocino	CA0022870
7	Mendocino County Water Works District No. 2, Anchor Bay Wastewater Treatment & Disposal Facility		Anchor Bay (Gualala)	CA0024040
	Regional Board 2 – San Francisco Bay			
8	City & County of San Francisco Oceanside Water Pollution Control Plant *(sole combined plant in CA)*		San Francisco	CA0037681
9	Daly City (North San Mateo County Sanitation District) Wastewater Treatment Plant		Daly City	CA0037737
10	Half Moon Bay (Sewer Authority Mid-Coastline) Wastewater Treatment Plant		Half Moon Bay	CA0038598
	Regional Board 3 – Central Coast			
11	Santa Cruz Wastewater Treatment Plant		Santa Cruz	CA0048194
12	Watsonville Wastewater Treatment Facility		Watsonville	CA0048216
13	Monterey Regional Water Pollution Control Agency Regional Treatment Plant		Marina	CA0048551
14	Carmel Area Wastewater District WWTP & the Pebble Beach Community Services District		Carmel	CA0047996
15	Ragged Point Inn Wastewater Treatment Facility		Ragged Point	CA0049417
16	San Simeon Community Services District Wastewater Treatment Plant		San Simeon	CA0047961
17	Morro Bay and Cayucos Sanitary District Wastewater Treatment Plant		Morro Bay	CA0047881
18	Avila Beach Community Services District		Avila Beach	CA0047830
19	Pismo Beach Wastewater Treatment Facility		Pismo Beach	CA0048151
20	South San Luis Obispo County Sanitation District		Oceano	CA0048003
21	Goleta Sanitary District Wastewater Treatment Facility		Goleta	CA0048160
22	Santa Barbara (El Estero) Wastewater Treatment Facility		Santa Barbara	CA0048143
23	Montecito Sanitary District Wastewater Treatment Facility		Montecito (Santa Barbara)	CA0047899
24	Summerland Sanitary District Wastewater Treatment Plant		Summerland	CA0048054
25	Carpinteria Sanitary District Wastewater Treatment Facility		Carpinteria	CA0047364
	Regional Board 4 – Los Angeles			
26	Oxnard Wastewater Treatment Plant		Oxnard	CA0054097
27	City of Los Angeles (Hyperion Treatment Plant)		Los Angeles	CA0109991
28	County Sanitation Districts of Los Angeles County Joint Water Pollution Control Plant		Carson	CA0053813
29	Terminal Island Treatment Plant		San Pedro	CA0053856
30	Avalon Wastewater Treatment Facility		Avalon	CA0054372
31	US Naval Auxiliary Landing Field, San Clemente Island Wastewater Treatment Plant		San Clemente Island	CA0110175
	Regional Board 8 – Santa Ana			
32	Orange County Sanitation District, Reclamation Plant No. 1		Fountain Valley	CA0110604
	Orange County Sanitation District, Treatment Plant No. 2		Huntington Beach	CA0110604
	Regional Board 9 – San Diego			
33	SOCWA Joint Regional Treatment Plant**	*51 Permitted facility:* Aliso Creek Ocean Outfall	Laguna Niguel	CA0107611
34	SOCWA Coastal Treatment Plant**		Aliso Canyon, Laguna Niguel	
35	Irvine Ranch Water District Los Alisos Water Reclamation Plant**		Lake Forest	
36	El Toro Water District Water Recycling Plant**		Laguna Woods	
37	SOCWA JB Latham Treatment Plant**	*52 Permitted facility:* San Juan Creek Ocean Outfall	Dana Point	CA0107417
38	SOCWA Plant 3A**		Laguna Niguel	
39	Santa Margarita Water District Chiquita Water Reclamation Plant**		Rancho Santa Margarita	
40	San Clemente Reclamation Plant**		San Clemente	
41	Oceanside (San Luis Rey & La Salina Wastewater Treatment Plants)		Oceanside	CA0107433
42	Fallbrook Public Utility District WWTP No. 1		Fallbrook	CA0108031
43	US Marine Corps Base Camp Pendleton *(completely offline from March 2009)*		Camp Pendleton	CA0109347
44	Southern Region Tertiary Treatment Plant** *(replaced the Camp Pendleton plants)*			CA0109347
45	Encina Wastewater Authority Water Pollution Control Facility		Carlsbad	CA0107395
46	Escondido Hale Avenue Resource Recovery Facility		Escondido	CA0107981
47	San Elijo Powers Authority Water Reclamation Facility		Cardiff	CA0107999
48	E.W. Blom Point Loma Metropolitan Wastewater Treatment Plant		San Diego	CA0107409
49	South Bay Water Reclamation Plant		San Diego	CA0109045
50	International Boundary & Water Commission International Wastewater Treatment Plant		San Diego	CA0108928

**NPDES: National Pollutant Discharge Elimination System   **Indirect discharge via outfall facility; No effluent data collected for the Discharge Inventory*

Table 1.1 California Ocean Discharging Wastewater Treatment Plants by Region, indicating location served and National Pollutant Discharge Elimination System permit number. Direct to ocean discharge by 43 facilities.

Ocean Discharging Wastewater Treatment Plants in California

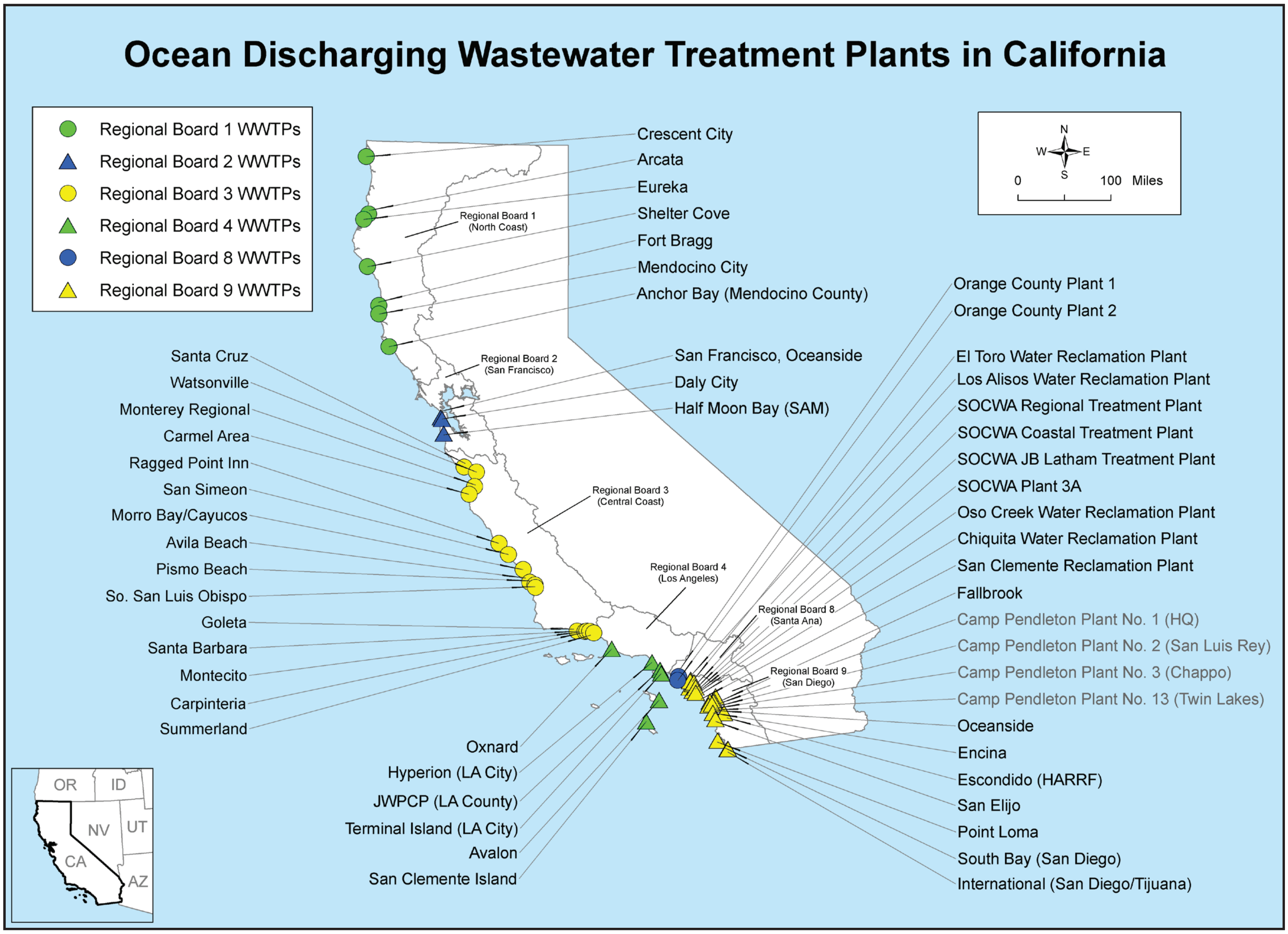

Figure 1.1. Location of Coastal Regional Water Quality Control Board Jurisdictions and Treatment Plants Discharging into the Pacific Ocean

but industrial and certain business waste must meet standards that may require pre-treatment (treatment before delivery to a wastewater treatment plant). Removal of fats and oils from restaurant waste is a typical example. With a few exceptions, source control requirements have been mainly to protect collection and treatment operations of the plant, not to improve overall quality of effluent.
In general, current sewage treatment technology and standard practices focus on removal of solid materials, elimination of pathogenic bacteria, and in some cases reduction of nutrients or other chemical constituents.

Wastewater treatment is typically described as occurring in three stages (13).

- **Primary – removal of solids: initial sedimentation and clarification to remove suspended material that settles or floats.**
- **Secondary – biological treatment: use of microorganisms to convert dissolved and suspended organic waste into stabilized compounds. Secondary processes decompose and/or transform the organic matter and kill off bacteria.**
- **Tertiary – treatment beyond secondary processes to increase the removal of dissolved pollutants like sodium and chloride, and nutrients: tertiary level treatment uses advanced processes that can at best remove 99% of known pollutants, and the nutrients nitrogen and phosphorous, which can contribute to algae blooms (13, p.600).**

Today's typical wastewater treatment involves primary and/or secondary treatment but is not 100% effective in removing pollutants. Since regulations anticipate less than 100% effectiveness, discharges of treated effluent contain solids, bacteria, and dissolved contaminants, but generally at a level below requirements. Requirements are established by balancing technical, environmental, and financial factors. Waste treatment byproducts include microorganisms, brine (containing nutrients and salts), methane gas and biosolids – the modern and more accurate term for treated sewage sludge. Following stabilization in "digesters" (a unit in which bacterial action is induced and accelerated in order to breakdown organic matter) and sometimes with chemicals, biosolids are commonly disposed of as soil amendment. However, fertilizing and composting with biosolids may be unwise practices if CECs are not properly removed. Some wastewater treatment plants use biosolids to generate energy for the running of the plant. Unused biosolids may also be delivered to landfills for burial or for use as daily cover.[8] As the salinity management plans for areas such as Calleguas and Santa Ana show, discharge of brine waste directly into the ocean from treatment plants remains a standard practice.

8 Daily cover is the compressed soil laid on top of a day's deposition of waste at a landfill site in order to reduce odors and help stabilize the waste.

Opportunities and Challenges for Wastewater Treatment on the Coast of California

Collection, treatment, and discharge of wastewater are regulated under both State and federal law. Within infrastructure and financial limits, plant operators carry out extensive monitoring of pollutants and apply typically sophisticated technology to ensure permit limitations are not exceeded. But the standards under which they operate need critical overhaul for the following reasons:

- **CECs–including pharmaceuticals, personal care products, estrogenic compounds, and genetic material from bacteria that have become resistant to antibiotics–are now of significant concern to researchers, particularly as some can escape standard treatment and most are not monitored in waste streams;**
- **Current monitoring techniques do not employ tests for viruses;**
- **The movement of discharged effluent is not usually tracked. Its ultimate fate is unclear, and when discharged in relatively shallow water, wastewater may migrate to shore with limited dilution;**
- **Relatively high salinity levels in treated wastewater can and often do prevent its most common use: irrigation.**
- **No composite picture exists of the total load of pollutants from different wastewater treatment plants that discharge into the same areas of the ocean. This means that cumulative impacts are unknown.**

Key areas of challenge and opportunity

Meeting the substantial institutional, technical, social, and financial challenges related to wastewater treatment will bring opportunities not only to expand the use of reclaimed water, but also to reduce demand on local and other imported water supplies in key areas of the State.

Bacteria/viruses/pathogens
Current treatment focuses on eliminating risk from pathogenic bacteria and, to some extent, viruses. Treatment systems are generally effective in meeting this objective. However, the proliferation and widespread use of chemicals has increased the load of chemicals entering the waste stream, and reaching the wastewater treatment plant. Current State approved wastewater treatment standards do not require monitoring of most of these chemicals. Therefore, the potential exists for these substances to be released untreated into groundwater, drinking water

supplies, and the ocean. Drugs passing through the human body or disposed of by toilet flushing, as well as antibiotics used to promote the growth of livestock have led to the development of MDRB (multi-drug resistant bacteria) and forms of antibiotic resistance, such as MRSA (methicillin-resistant staphylococcus aureus) (14) (15).

Contaminants of Emerging Concern

The term "CEC" has become increasingly accepted by scientists and researchers as their knowledge of the toxicity and sub-lethal effects of these substances has expanded and as the search has intensified for improved monitoring and ability to detect pollutants. National efforts to act on CECs are now underway, but guidelines and legislation are clearly lagging (16) (17). The quantity of such compounds in wastewater has been increasing while researchers have begun to understand the complexity of the interaction and degradation of CECs, and the dangers posed by new chemicals resulting from their degradation or exposure to ultra-violet treatment and/or sunlight. (18). As elsewhere, California wastewater treatment must address all aspects of CECs, particularly since water recycling has become a priority for the State.

Wasted nutrients

Wastewater typically contains nitrogen and phosphorous compounds. Although these soil nutrients and organic matter can serve as soil amendment, they are instead discharged. Because of the large overall quantity of wastewater discharge, the volume of these nutrients impacting the ocean is high. Nutrients at high levels can cause eutrophication – the over-stimulation of plant or algae growth that depletes the oxygen necessary to maintain other forms of life (19). As listed in the California National Pollution Discharge Elimination System (NPDES) Code of Regulations, nutrients are considered as non-priority pollutants (20). An SWRCB presentation[9] on "Water Quality Criteria: Nitrogen & Phosphorus Pollution" outlines how the U.S. Environmental Protection Agency (EPA) has concluded that "Nutrient Criteria cannot be developed as a single number for the Nation due to variability in background conditions and the role of other risk co-factors which affect nutrient processing within ecosystems" (21).

While a case-by-case pollutant assessment is needed for nutrients, the total quantities discharged off the coast of California need to be calculated. Nutrient loading of the total amount discharged would be prohibited if this amount were discharged from a single site. But situations of cumulative discharge by several plants into adjacent or overlapping ocean areas are escaping regulatory attention. No additional studies or monitoring programs would be needed to begin the reclamation of nitrogen and phosphorous for deliberate and controlled beneficial use. This would make more sense than nutrient discharge (frequently with water that could be reclaimed) in treated effluent. Advanced treatment could allow either capture of the nutrients or ensuring they are diverted specifically in water reclaimed for irrigation. In either case, the nutrients should not be discharged to the ocean with the attendant risk of ecosystem imbalance

Infrastructure investment

In 2002, the U.S. EPA concluded that if investment in water and wastewater systems remained flat, the United States would face a gap of $122 billion (the mid-range estimate) between the current funding available to the treatment plants and what is needed to bring them up to acceptable levels of treatment over the 2000-2019 period (10). The California and national budgets have been hit hard since this projection. But in 2009, the State Water Resources Control Board (SWRCB) began to take full advantage of national stimulus funds and other funding sources to kick-start treatment plant infrastructure projects, including water recycling facilities. The State Recycled Water Task Force concluded that, *"... recycled water could free up enough fresh water to meet the household water demands of 30 to 50 percent of… 17 million Californians. To achieve this potential, an investment of $11 billion would be needed"* (11).

Current financing methods based on population sizes, areas served, and the official requirements set for waste discharges lead to competition among wastewater treatment plants for State and national funding and loans. The regional and local district administrative system produces a case-by-case assessment of treatment plants, their needs, and pollution records. While such methods for evaluation provide a tight focus on day-to-day operations, pollution incidents, and performance goals, this narrow perspective bypasses opportunities for cooperation and information-sharing. Prioritization and research become more difficult, and awareness and communication among different stakeholders remains low (22).

Wasted water

When wastewater is treated to the highest possible level, producing essentially fresh water, and is then discharged into the ocean, the opportunity for reuse and conservation of water resources is lost. Sewage treatment plants discharge large volumes of such potentially re-usable water from areas that depend on imported supplies and that face shortages during drought. The San Diego region is an example: it discharges about 26 million gallons daily (MGD) (see Table 3.5) while simultaneously seeking new water sources. As water supplies diminish and demand increases, the production of high quality water through wastewater treatment presents a significant opportunity to decrease the use of drinking water for secondary uses such as irrigation and toilet flushing.

Demand for reclaimed water

The cost of recycled water is still higher than tap water, and there is a significant initial expense to install dual plumbing (a second pipe to convey recycled water for reuse). As a result, the use of reclaimed water has not kept pace with

9 Date unknown, but circa 2005.

recycled water supplies. The lack of demand acts as a disincentive to treatment plant upgrades and improvements necessary to meet standards for reclaimed water. Demand also falls for other reasons:

- Demand for direct reclaimed water use is less in wet-weather months and leads plants to discharge highly treated water.
- Low demand in general can stem from an unwillingness of potential consumers to pay the full price of reclaimed-water production.
- Lack of public acceptance poses an obstacle in some cases to the use of reclaimed water for indirect potable reuse.
- Lack of delivery and storage structure can lead to underutilization of highly treated water.
- Local regulation that unduly constrains or does not permit reuse can result in a waste of water that could be recycled. However, a delay in changes to regulations is necessary until new standards have been developed for CECs.

Taken together, these issues could appear to support delaying wastewater treatment plant upgrades until treatment technology improves and demand for water reuse increase. However, careful engineering design could allow facility modifications in a manner that would expedite subsequent upgrades that are sure to come. Given the known effects of pollutant discharges and existing constraints on State water supplies, there appears to be little benefit in delaying treatment plant upgrades that would increase reuse of water and/or address the known discharge of pollutants.

(See Part Two of this report for further details on key issues relating to reclaimed water.)

Ocean Wastewater Discharge Inventory Research Methods

The Inventory of wastewater discharge to the ocean and other aspects of wastewater treatment was completed in two phases. Phase 1 focused on collection of data and preparation of three data bases. Phase 2 comprised calculation of average flows, evaluation of compliance data, and selection of aspects for comparative presentation.

Phase 1 – Data Collection and Compilation

Data were compiled on outfall features, plant operation, and effluent characteristics for each of the California sewage treatment facilities that discharge into the Pacific Ocean. Information regarding regulatory compliance and water reclamation was also collected.

Database 1 – Wastewater treatment plant characteristics

Wastewater Discharge Requirement permits (WDRs) and other documents that provided data for the inventory were obtained from websites of the U.S. EPA, the SWRCB or from regional boards within California. Data came mainly from WDRs for 2005 and a few from slightly earlier or later years. From these reports, the following information was compiled:

- **Area receiving service and the size of the population receiving service;**
- **EPA classification of plants as a major or minor facilities;**
- **Treatment and disinfection process;**
- **Facility design and permit capacity;**
- **Longitude and latitude coordinates of the discharge and plant location;**
- **Depth below the water surface and distance from shoreline of ocean outfalls;**
- **Issuance and expiry dates of the WDR;**
- **Expected dilution ratio (seawater : effluent); and**
- **Type of wastewater (e.g., municipal or industrial).**

The WDR for each plant generally contained the data listed, but in some cases alternative sources had to be consulted. For example, census data, direct consultation with regional board staff and treatment plant managers, individual plant websites, U.S. EPA Facility Registry System, and Google Earth were all used to complete the data set. These alternative sources were necessary to provide missing information and coordinates or corrections to coordinates that are recorded in the WDRs for several treatment plants. Furthermore, the EPA online information about California wastewater treatment plants did not prove reliable in several cases. During completion of the *Report and Inventory*, more information has become available online, reflecting a trend toward greater access of data.

Database 1 Additions – Water reclamation and improvements made by wastewater treatment plants

After compilation of the two main databases, plant operators were surveyed in August 2009 by phone and email in order to collect current information and figures on water reclamation and on details of plant improvements made since 2005. Information was gathered from responses from 30 operators regarding 34 (79%) of the 43 facilities surveyed for the *Report and Inventory*.

Database 2 – Treated effluent

A second database was created to calculate the average amount and concentration of treated effluent that wastewater treatment facilities are discharging into the Pacific Ocean.

Data on specific pollutants were obtained from three sources:

- **the annual self monitoring reports (SMRs) compiled by each facility and submitted to the appropriate regional board;**
- **a few monthly SMRs provided by the treatment plants; and**
- **monthly SMR data collected and provided for the** *Inventory* **by the Southern California Coastal Water Research Project (SCCWRP).**

Annual SMRs were typically obtained directly from individual wastewater treatment plant managers, others were obtained by contacting regional board staff, and in a few cases a formal Public Records Act request was necessary. Data from the SCCWRP are for those plants within the Southern California Bight (the ocean area from Point Conception to the north to the US/Mexican border to the south). Parameters were chosen based on the existence of data for consistent comparison and based on parameters associated with 2006 303(d) listed impaired water bodies. This made it possible to identify any relationship between pollutants in effluent and the pollutants identified for beaches adjacent to water bodies on the CWA 303(d) list as impaired.

Database 3: Regulatory violations

The "Facility-at-a-Glance" online reports of the California Integrated Water Quality System (CIWQS) database provided a summary of the number of violations and enforcement actions. The CIWQS Interactive Violations Reports were also consulted to obtain detailed descriptions of the specific causes of violations and enforcement action taken. Large discrepancies were identified between the data reported on Facility-at-a-Glance and the data found on the Interactive Violations Reports. In addition, staff at some Regional Boards knew of certain cases involving court settlement proceedings but could not locate the enforcement documents. Heal the Ocean efforts to obtain the documents from the Superior Court were also unsuccessful. Difficult access and the inconsistencies in record keeping make it very difficult to track the regulatory compliance of the State's wastewater treatment plants. Heal the Ocean correspondence and conversation with plant operators confirmed that data recorded in the CIWQS were not always reliable.

Phase 2: Analysis & Calculations of Annual Discharge and Mass Emissions.

Annual average concentrations and mass emissions estimates were calculated based on the annual or monthly SMR results as available for a calendar year. Efficiency was calculated using effluent data and population served. The population served by each plant was used as a proxy for influent in calculations.[11] However, the lack of information about contributing factors such as historic storms renders unreliable any comparative assessment of a single year of treatment plant efficiency. Several plants, such as Morro Bay/Cayucos and Point Loma,[12] report their efficiency in percentage removal of total suspended solids (TSS), a practice that may be valuable to include as standard for treatment plant reporting as an indicator of overall plant efficiency. Without standardized, easily accessible presentation and uniform requirements for the inclusion of influent, effluent, and TSS figures in routine reporting, the tasks of identifying or calculating measures of efficiency are problematic.

Energy efficiency for wastewater treatment plants is reported in the CIWQS reporting system on a comparative basis, although it is possible that this information may be as unreliable as that for regulatory compliance, given the problems with the CIWQS reporting system at the time of research for the Report and Inventory. However, the inclusion of efficiency information in CIWQS shows how an online reporting system can accommodate various categories of information so that plant performance can be assesses in various ways.

The following equations represent the calculations used to determine the amount of treated water discharged annually by plants and their mass emissions as total suspended solids.

Annual Discharge (V) for each faculty

$$V = \sum_{i=1}^{12} a F_i D_i$$

F_i = Average Daily Flow for month i
D_i = # of days discharge occurred during month i
a = appropriate unit conversion factor for calculating volume in Gallons

Mass Emissions (ME) for each faculty

$$ME = \sum_{i=1}^{12} b F_i C_i D_i$$

F_i = average daily Flow for month i
D_i = # of Days discharge occurred during month i
C_i = constituent Concentration for month i
b = appropriate unit conversion factor for calculating ME in metric

Discharger Permits, Facility Information, Performance, and Reporting

Regulatory Framework

Wastewater treatment is regulated by the federal Clean Water Act (CWA) and California State law. The coastal facilities reviewed for this report each apply to their relevant regional board for an individual permit to discharge. Permits must be consistent with the federal National Pollution Discharge Elimination System (NPDES) and with the California Ocean Plan.[10]

The NPDES program rests on three major actions at the state level:

- **In California, ocean water quality standards are set by the California Ocean Plan in accordance with the CWA and the California Water Code.**
- **Under the CWA, states must make a list of water bodies that exceed pollutant limits designated in the Act.**
- **States must then list the Total Maximum Daily Load (TMDL) for pollutants in the water bodies identified as impaired. The resulting list is known as the 303(d) List of Impaired Waters.**

TMDLs are set at the level necessary to achieve the applicable water quality standards. NPDES permits must be consistent with the approved TMDLs and are issued to entities that discharge into an impaired body of water. Establishment of a TMDL may result in progressively stricter limitations of such discharges with time.

The U.S. EPA administers the NPDES and delegates regulatory authority to the California EPA. The California EPA in turn tasks the SWRCB with the administration of the nine regional water quality control boards that regulate water quality issues throughout the State. The regional boards under the SWRCB issue the individual WDRs to the plants.[11]

Wastewater treatment plants implement their permit requirements by meeting their WDR. WDRs set specific limits on the amount of various pollutants an individual plant is permitted to discharge. The plants are required to carry out periodic monitoring of these pollutants in their influent and treated effluent.

10 For NPDES Permit Program Basics, see: http://cfpub.epa.gov/npdes/home.cfm?program_id=45

11 For a brief history and description of the SWRCB see: http://www.waterboards.ca.gov/about_us/water_boards_structure/history.shtml

Discharger Information Sources

Information relating to permits, discharge requirements, and violations for all permitted sewage treatment facilities is made available to the public. The U.S. EPA operates the national Enforcement and Compliance History Online (ECHO) (23). At the State level, systematized and electronic reporting of compliance and monthly monitoring has long been adopted as a goal by the SWRCB. However, apart from all the treatment plants in Region Three, only a minority of wastewater treatment plants in other regions have adopted the present CIWQS. Technical, institutional, and financial problems have slowed the State's development of the System and have complicated electronic reporting. However, the CIWQS Review Panel believes the System can succeed under strong leadership and with a revised, narrower scope if it reflects user practices "down to the level of data entry," with constraints to ensure data integrity, and if subject to sufficient testing (24).

Work is underway through the CIWQS to develop the capacity to transfer needed data among dischargers and the federal NPDES system, and to make the data available to the public. As part of its recommendations, the CIWQS Review Panel recommends that: "… the State Water Board evaluate available alternatives for transferring needed data among dischargers, CIWQS, and the federal ICIS [Integrated Compliance Information System]-NPDES system. Because state and federal reporting and decision-making requirements differ, this interface should accommodate both state and federal needs and be developed in cooperation with the [U.S. EPA]."

Public reporting through ICIS-NPDES and ECHO, as well as the CIWQS, has emphasized access to permit violation information rather than to monitoring data itself. No interlinked comparative aspect has yet been included in these reporting systems. The move toward a much needed overview of wastewater treatment information for a region, or even California as a whole, has been encouraged by non-governmental organizations like Heal the Ocean and the SCCWRP.

Problems with existing information sources

During Heal the Ocean's data gathering and confirmation for compliance, it became clear that in addition to discrepancies in regulatory records, some violations had been recorded inaccurately. This *Report and Inventory* therefore leaves aside the regulatory information and uses the data collected only on the characteristics of each plant and outfall.[12]

12 California ocean dischargers include the San Francisco Oceanside plant, the only "combined' plant in the state that treats both sewage from the sanitary system and storm water runoff. It is the sole California plant that removes 100% of "first flush" storm water and treats the pollutants in this runoff. This major dual feature of the plant places it outside comparison

Thus, based on efforts associated with preparation of this report, Heal the Ocean has identified both a lack of integrated reporting and of significant data within the systems in place in the State of California. As a result, it is very difficult for any governing agency to assess the comparative operation, efficiency, and compliance of ocean-discharging treatment plants in California. The following problems arise:

1) Difficult access to information
Data is retrieved from waste discharge requirement documents, monthly monitoring reports, and annual reports. The lack of a complete and fully reliable online reporting system extends the time needed to gather the reports. Incomplete data also delay or prevent any measurement of plant efficiency.

- Electronic versions of reports have frequently been in a form that cannot be electronically searched (e.g., searching for key words), extending the time needed to find specific data.

2) Lack of consistency
While the unique characteristics in receiving waters produce a necessary and valuable variation in the standards set for each plant, unnecessary variation in reporting also occurs as follows:

- Reporting scope, style, format, depth, and occasionally units of measurement, vary considerably among regions and sometimes within regions. This raises obstacles of time and complexity to data gathering for any agency overseeing the comparative operations of wastewater treatment plants in California.

3) Data reliability
Heal the Ocean has learned from wastewater plant managers that on-line violation reports collected and administered by the SWRCB have also not always been accurate and therefore do not yet form a reliable basis for assessing compliance:

- Some violations have been incorrectly linked to plants where the violations did not occur;The online reporting database includes a number of violations resulting from errors or problems at contract analytical labs. The laboratory errors remain in the database and prevent a correct assessment of treatment plant operational errors;

- Multiple violations have been recorded for a single incident;

with other plants in the State.

- Some violations may be under appeal by treatment plants whose staff believes they can prove the violations occurred for reasons unrelated to the actual operation of the plant;

- Violations remain on record even after investigation and dismissal after a finding that the treatment plant was not responsible or that the violation did not occur (as distinguished from violations confirmed and corrected).

Opportunities to Improve Performance

The contribution to regional board financing from fines on plants for permit violations raises the issue of incentives vs. penalties and which costs should be borne by the consumer. At present, while the administrative emphasis appears to focus on violations rather than on achievement, incentives are provided through treatment facility award schemes. Professional associations offer competitive awards and the State has developed an exhaustive competition-based recognition system for both individual operators and plants as a whole.[13] These competitions are intended to recognize and reward excellence in individual and system operation.

Some operators, however, have reported that they cannot justify the time taken to enter their plant into competition even when the same operators feel their facility deserves recognition for standards achieved. Violations receive attention automatically, while rewards for improvements do not. It could be advantageous for both regional administration and plant operations to shift their focus from simply decreasing violations and to permanently improved performance that is aligned with statewide water resource policies and plans. The following two areas are suggested as starting points:

1) Redirection of fines toward more source control
Sanitary districts are typically fined for permit violations (25). Plants can request to apply a portion of a fine assessed for an administrative civil liability (ACL) complaint to a Supplemental Environmental Project (SEP) or a Regional Water Quality Improvement Project (RWQIP) as included on a SWRCB list. SEPs are designed to reverse "the negative impacts on the environment caused by illicit discharges, legacy pollutants or other factors." RWQIPs "address problems requiring cleanup and abatement actions and other significant unforeseen water pollution problems that may not be undertaken in the absence of financial assistance (e.g., wastewater treatment facility projects in disadvantaged communities)" (26). Given the issues of CECs, greater emphasis on projects centered on pollution prevention or reduction, i.e., source control (preventing

13 See Wastewater Treatment Awards: Table under Additional Online Resources (Additional References, Summaries, & Sources section).

contaminants from entering the waste stream), including public education toward this end, could prove worthwhile as part of a long term strategy to decrease the pollutant load in the waste stream.

2) Finding new significance for treatment plant awards
Wastewater treatment plants in California participate quite extensively in award programs that offer titles such as "Regional Plant of the Year." This reflects the pride taken in performance by plant managers and may improve the chances of success in applications for funding. But in addition to standards of permit compliance as well as operations and maintenance, awards could and should focus on new categories relative to current needs. For example, achievements relating to wastewater reclamation and the recycling of water could be one such focus. The State's water recycling policy involves extensive consultation with regional water board representatives to agree on targets, but the mandate has not yet extended to the treatment plant itself in the form of new standards, reporting requirements or award categories.

A number of awards that provide official vehicles for evaluation of wastewater treatment plants are considered prestigious within the wastewater industry. The National Association of Clean Water Agencies (NACWA's) Peak Performance Awards are an example of recognition based on individual plant performance. This invites a line of inquiry about the sources used for compliance data and the procedures applied by awarding organizations to ensure consistency.

NACWA also runs the Excellence in Management Program to honor "member agencies that have implemented and sustained, for a continuous three-year period, successful programs that address the range of management challenges faced by public clean water utilities in today's competitive environment" (27). The EPA has run the Clean Water Act Awards program from 1985 to 2009, when it suspended the awards for a year to consider a significant redesign in order to "align the program more closely with its Sustainable Infrastructure goals and to the water industry through broader applicability' (28). Integrating objectives regarding water reuse and control of CECs with operational performance measures in awards would align new monitoring and policy directions with the desire of plant managers to improve their facility and to win recognition for doing so.

The awards reviewed appear to involve stringent criteria, and engage wastewater treatment plants in reporting extensive information about their operations. Since plant participation in awards is widespread, it may be useful to model changes to the official reporting systems on entry formats used for the awards, which could in turn assist in improving records and the tracking of operational and compliance performance. Alternatively, it may also prove effective and time saving to offer more recognition based on mandatory State and regional reporting rather than requiring separate and formal entry into a competition. This would offer opportunities and incentives as well as potentially improved reporting and related systems.

3) Assessment of NPDES permit fees based on actual effluent instead of design capacity
The SWRCB assesses permit fees based on the 'Permitted Flow' or 'Designed Flow' specified in each waste discharge permit" (29). In this case, two facilities, each rated at a capacity of 10 MGD for ocean discharge, will be charged the same fee. This occurs even if the community that owns one of them also builds a companion water reclamation facility to process water for beneficial use. In addition, the regional board also levies a second permit fee on the recycled water facility. In this way, the community taking effective action to conserve water and decrease pollution pays more in permit fees than the facility that simply discharges all of its wastewater to the ocean. As suggested by plant operators, a sliding scale based instead on millions of gallons actually discharged would provide an incentive to improve efficiency and increase the amount of water reclaimed by plants.

Suggestions for Improving Treatment Plant Reporting Protocol

Assessment of wastewater treatment plants in California would improve with full implementation of a standardized system of reporting. Improvements in reporting should shed clearer light on the treatment plant operations behind the reports and where changes could be made. To make the work of wastewater plants easier to comprehend, compare, and research, such a reporting system needs to include basic information related to plant technology, performance, and monitoring. Suggested improvements in reporting to increase the ease and value of evaluation are as follows:

- *Improved categorization of the size of treament plants:*
  This could be accomplished by using several more degrees of variation than the EPA classification of a plant as "major" or "minor," which is based on the number of gallons treated per day–over or under one million gallons respectively.

  The amount of treated wastewater discharged into the ocean by an individual sewage plant ranges from 0.01 million gallons daily (MGD) (Ragged Point Inn and Anchor Bay, Mendocino County) to 332.25

MGD (Hyperion). Out of a total of 43 wastewater facilities,[14] in 2005, 10 discharged under one; 18 facilities discharged between one and ten MGD; 11 discharged between 10 and 100 MDG; four plants discharged over 100 MGD (see Table 3.1). Basic information about a wastewater treatment plant needs to include: 1) its relative size based on how much it discharges; 2) its relative size also in terms of intake volume; and what proportion of influent wastewater ends up discharged. These figures would make it easier to compare treatment plant size, efficiency, and potential to reclaim water.

- *Characterization of community served:*
  A summary of community demographics and description of customer service classes would allow identification of source reduction opportunities and potential for water reuse.

- *Categorization by influent quantity and type, and by treatment processes used:*
  This would help to provide a quick reference for strategic assessment, for example, for the siting of pilot pre-treatment projects.

- *Standardization of monthly and annual reporting formats:*
  While the CIWQS remains under revision, an opportunity exists for improvements to reporting formats in order to bring greater consistency and provide more information about treatment plant operation and performance.

- *Standardized inclusion of performance goal reporting:*
  Besides plant regulatory standards, NPDES permits can also contain official performance goals that recognize the constraints on a particular plant in achieving certain water quality objectives. The 2008 NPDES permit for the new tertiary plant at Marine Corps Base Camp Pendleton provides an example and shows that individual plant reporting can provide more general information about effluent quality:

  > *The [reasonable potential analysis (RPA) procedure] results for [the Southern Region Tertiary Treatment Plant] discharge indicated that the effluent only has reasonable potential to cause exceedances of water quality objectives for chronic toxicity, copper, and total chlorine residual; therefore, water quality-based effluent limitations are included in the tentative order for these parameters. Performance goals, rather than effluent limitations, are included in the tentative order for all other toxic pollutant parameters of Table B of the Ocean Plan. Performance goals are not enforceable effluent discharge specifications or standards for the regulation of the discharge; however, inclusion of performance goals supports State and federal antidegradation policies and provides all interested parties with information regarding the expected levels of pollutants in the discharge that should not be exceeded to maintain the water quality objectives established in the Ocean Plan* (30).

  Performance goals of this kind show the extent to which the official system of assessment can be tailored and how it can be extended without entailing enforcement per se. Creation of a standard method to report on performance goals would simplify the gathering of related information from different treatment plants. Pilot projects designed to test methods of monitoring prioritized CECs could include performance goals in WDRs as a formal measure that encompasses, ensures, and tests reporting before the monitoring of CECs becomes mandatory.

- *Differentiation in regulatory reporting and recording between one incident or several as the cause of recurring ACLs:*
  This would avoid the mistake of over-counting violations.

- *Clearer distinction between violations linked to discharges vs. those related to sanitary sewer overflows (SSOs):*
  Treatment plant water quality violations are recorded as NPDES permit violations. These are separate from SSOs, which occur before wastewater reaches the treatment plant. However, a review of the record of these incidents requires knowledge of the specific terms and an understanding of the difference between the direct implications for water quality of NPDES violations and the typically indirect consequences for water quality of SSOs. The use of simple categories for different types of violations would make assessment of water quality violations easier.

- *Clear distinction between administrative/technical violations and violations affecting water quality:*
  Assessment of regulatory compliance affecting water quality could occur more easily if the water quality violations were listed separately from violations of a technical or administrative nature.

- *Clear and consistent identification and pairing of ACL complaints and orders:*

14 Individual facility figures include those collected for 1) the Aliso Creek Outfall as the permitted facility discharging treated effluent from SOCWA Regional, SOCWA Coastal, Los Alisos, and El Toro wastewater treatment plants; and 2) the San Juan Creek Outfall as the permitted facility for the JB Latham, 3A, Chiquita, and San Clemente wastewater treatment plants.

In some regions, the ACL order and complaint are assigned the same identification number. However, other regions use different numbers, and reference the complaint number deep in the body of the text of the order rather than in the heading. Consistent use of the same number for both a complaint and its related order, and inclusion of the number at the head of both documents would make it easier to research and evaluate compliance.

PART TWO

> Reclaimed water is water that, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur. In this way, reclaimed water (also referred to as recycled water) is considered a valuable resource. "The degree of treatment provided for recycled water depends on the quality of water needed for the specific beneficial use and for public health protection." Such water may include effluent from primary, secondary, or tertiary wastewater treatment, or "advanced treatment" (1, p.F-8).
>
> In 2003, when the Department of Water Resources (DWR) published Water Recycling 2030: Recommendations of California's Recycled Water Task Force, (WR 2030), the DWR task force estimated that by year 2030, "California has the potential to recycle up to 1.5 million acre feet (AF) [~1.3 billion gallons15] per year. This could free up freshwater supplies to meet approximately 30% of the household water needs associated with projected population growth" (1, p. xi). These figures may be modest given that California's ocean discharging plants alone release about 1.35 billion gallons daily. California's DWR task force calculated that $11 billion would be needed to build the infrastructure for the production and delivery of recycled water. This extrapolates to a unit cost of about $600 per AF (325,851 gallons) (1, p.48).

According to the *WR 2030* report, many of the recommendations made by the task force can be, "…implemented by State or local agencies without further legislative authorization or mandate and provide advice that can be used as a toolbox for communities to improve their planning for recycled water projects" (1, Letter of Transmittal).

In California, the State Water Code, together with the Health and Safety Code (in particular Title 22 on facilities and hazardous waste management), are the current statutes governing water reuse (2). The State Department of Public Health website summarizes these regulations and provides draft groundwater recharge reuse regulations, other related regulations, guidance documents and other reports.

The *WR 2030* report points out that, "…in terms of making the greatest impact on augmenting the State's water supply, emphasis should be placed on reusing recycled water that has no opportunity to be reused downstream" (1, p.10), and gives ocean discharges as an example of water that should be captured and recycled. In other words, ocean discharging wastewater treatment plants should be given priority over inland plants for water recycling.

Benefits of Reclaimed Water

In Florida, Seminole County has instituted advanced wastewater operations and has published a list of six advantages of reclaiming wastewater (3). As modified below, these advantages can provide the State of California with a cogent framework for a public education program as more reclaimed water projects are considered statewide.

1) **Environmental benefits**
   Environmental incentives are a strong motivation for recycling wastewater and should be a major basis for policy. In addition to avoiding the problems of salinity caused by over-pumping of groundwater, the diversion of wastewater discharges away from the ocean or freshwater bodies inhibits pollution by contaminants in effluent.

   Reclaimed water can also help to maintain the balance of natural water flows (the water budget) in a watershed, for example, by reducing the need to divert water for human use from trout streams. Many stream flows are now reliant on wastewater flow to maintain their function as habitat, and care is needed to avoid depleting such flows by ending the discharge of wastewater into them. Good examples of habitat protection by reclaimed water augmentation include saltwater marsh preservation around San Francisco Bay and around the South Bay close to the U.S./Mexico border (4).

2) **Financial advantages**
   As an August 2009 *Newsweek* online article states, "Climate models by the U.S. Global Change

15 1 million gallons per day = 1,120 acre feet per year. (Irvine Ranch Water District website: Water Equivalents http://www.irwd.com/MediaInfo/water_equivalents.php accessed October 2009.)

Research Program, the [California] state's water resources agency, and researchers at the University of California, Davis, all point to the same trend: the Sierra snowcaps that supply the state's water are disappearing" (5). If this forecast is accurate, the cost to import water from this source will increase and the available supply may not be capable of meeting established uses. The need to augment, or in some cases replace, this source (and others) may make reclaimed water a more attractive option.

3) **High-quality water**
Reclaimed water quality may be better for irrigation uses when the water contains nutrients such as nitrogen and phosphorus, as these elements are beneficial for agriculture, gardening, etc. As examples from Northern Virginia, Belgium, and the U.K. show, advanced secondary treatment alone can yield reclaimed water of a higher quality than that of standard water supplies (6). Tertiary treatment using reverse osmosis, as in Singapore, can produce very high quality water suitable even for specialized high-technology industrial processes (6, p.3). In California, the Orange County Groundwater Replenishment System was built on the premise that it would "produce water that is very similar to or better than bottled water quality" (6, p.3).

4) **Water conservation**
Conservation of potable water for human consumption occurs automatically when reclaimed water is used instead of potable water for irrigation and landscape watering, cooling or sanitary purposes (toilet flushing).

5) **Increased availability**
In times of drought, reclaimed water supplies will be steadier and more reliable than potable water and may be subject to fewer restrictions. This makes it possible for uses, particularly irrigation, to continue longer than when only potable supplies are available. Usage extended in this way forms the premise of the California Recycled Water Task Force's expectation that by 2030 recycled water could meet about 30% of the State's household water needs associated with projected population growth (7, p. xi). However, regional projections vary. The City of San Diego Water Department, which imports nearly 90% of its water from northern California and the Colorado River, concludes that, "…even the most optimistic projections" are that reclaimed water can meet only 20 to 25 percent of total demand (8).[16]

6) **Security of supply**
In September, 2008, this benefit of reclaimed water was summed up by David Nahai, CEO and General Manager of the Los Angeles Department of Water and Power, when he stated, "Moving forward with groundwater replenishment just makes sense. It provides a locally controlled source of water that is not at the mercy of drought, or court decisions, or politics" (9).

Two Key Water Reclamation Issues: Salinity and CECs

The degree to which reclaimed wastewater can be reused depends on a number of factors, including market demand, public acceptance, funding, local regulation, delivery and storage capacity, existing plant infrastructure, site size and location, background levels of pollutants, and the quality of the reclaimed water. But two key water quality issues, salinity and contaminants of emerging concern (CECs), must be addressed in any proposal to produce reclaimed water.

Before a wastewater treatment plant can begin to reclaim water, it has to ensure the final product will meet health criteria and not be so saline that it rules out many agricultural applications and/or causes salt stress in landscape plants or on golf courses and sports fields. The U.S. Environmental Protection Agency's (EPA) 2004 *Guidelines for Water Reuse* examine opportunities for, "substituting reclaimed water for potable water supplies where potable water quality is not required." Even this limited expectation for water reuse as a mechanism to conserve potable water supplies may need an improvement in reclaimed water quality. Water for indirect potable reuse in particular must meet health standards that increasingly need to take into account CECs. According to the *WR 2030* report, "…groundwater aquifers have been recharged with recycled water in California since the 1960s." For this long record to continue safely, the issues of salinity and CECs must be subject to careful scrutiny. Future regulation of CECs and the need to reduce salinity could require significant treatment improvements in order that recycled water will meet local beneficial use needs.

Water Reclamation Issue One: Salinity

Measured as total dissolved solids (TDS), salinity is the concentration of dissolved mineral salts in water. Typical salts include calcium, magnesium, sodium, sulfate and chloride (10).

16 North City Plant treatment capacity: 30 million gallons per day; South Bay Plant: 15 million gallons a day. San Diego's 2010 objectives include: a. Groundwater treatment program 10,000 acre-feet per year; b. Recycled water program 15,000 acre-feet per year; c. Groundwater storage program 20,000 acre-feet per year. d. Conservation program 32,000 acre-feet per year; e. Water transfer program 5,000 acre-feet per year. Also, by 2012: Develop and implement a desalination program (brackish groundwater and/or ocean water) (Source: City of San Diego Water Department web pages http://www.sandiego.gov/water/pdf/stratplan.pdf accessed December 2009).

The Southern California Salinity Coalition (SCSC), a ten-member coalition of water and wastewater agencies, lists the following consequences of excessive salinity:

- Detrimental effects on plant growth and crop yield
- Damage to wastewater and conveyance infrastructure
- Reduction of water quality
- Sedimentation problems
- Soil erosion

As pointed out on the City of Paso Robles website, "Water with salinity levels above 1,000 mg/l is of questionable use for irrigation and industrial customers" (11). Irrigation or watering with reclaimed water that is too saline can cause leaf burn, leaf drop, and plant death, which limits or rules out the use of such water for landscaping, agricultural, and sports field applications. Salt build-up negatively affects pipes and other infrastructure, thus limiting municipal, domestic, and industrial reuse. Without sufficient salt removal, reclaimed water used to recharge groundwater basins can cause a build-up of salt in the basins (12). The long list of negative effects of salt as a contaminant has led to the inclusion of TDS limits in wastewater.

Southwest Hydrology, a journal for consultants, regulators, researchers, water managers, lawyers, and policymakers working with water issues in semi-arid regions, has investigated the serious difficulties for wastewater treatment plants caused by brine discharges from industry and desalination plants in addition to the normal residential load. A March/April 2008 report in this journal states that, along with the loss of reclaimed water, other impacts of the combined saline influent "…can be significant, and include loss of hydraulic capacity of sewerage systems, infrastructure degradation of WWTPs from corrosion… lowering of the value of and ability to reuse biosolids, and mineral salt pollutants that adversely affect downstream reuse of the watershed supplies." The report quotes Walt Pettit, former executive director of the State Water Resources Control Board (SWRCB): "Salinity in Southern California is probably the biggest water problem that isn't being adequately addressed" (13).

Highly saline influent causes a serious obstacle to wastewater recycling because standard treatment processes remove very little salt. At present, reclaimed water is primarily used for irrigation, for example, spraying or drip feeding freeway plantings, parks, flower nurseries, agricultural fields, cemeteries, and golf courses. Reuse of this kind is highly desirable because irrigation and agriculture are the leading uses of water. Using recycled water for these purposes significantly reduces the demand for potable water and conserves its use for drinking. In some locations, however, reclaimed water must be mixed with equal volumes of potable water to reduce salinity to non-harmful levels.[17] Removing TDS from reclaimed water could greatly increase the amount of potable water available for drinking.

The financial cost of wastewater desalination is high. Nevertheless, a recent evaluation by the Rancho California Water District, in conjunction with Eastern and Western Municipal Water Districts of Riverside County, proposes that "…partially desalinated wastewater would be a cost-effective means to replace potable water currently used for irrigation" (14).

Salinity in wastewater has several causes: natural minerals dissolved in water flows; natural salt spring or seawater infiltration into freshwater flows; fertilizer runoff; byproducts of wastewater treatment chemicals such as chlorine, foods, and cleaning chemicals (15). A large influx of salt to the wastewater plant also comes from home water softeners.

Salt-based water softeners[18]

Water softeners offer real benefits to consumers. Hard water is abrasive to clothes, towels, etc., and can shorten the life of appliances such as washing machines and dishwashers. Hard water can also lead to mineral buildup and blockage in plumbing. The amount of energy needed to operate a water heater using hard water can increase by up to 30 percent (16). Where water softeners can be justified, the use of less salt is advised if an alternative is unavailable. The choice of alternatives to sodium salts is limited, however, particularly because the use of potassium chloride leads to the expensive problem of chloride removal (11).

Cutting the amount of salt entering the waste stream keeps salt removal costs down. In California, water softeners have come to be addressed as a major source of salinity in wastewater. In the Santa Clarita Valley Sanitation District, for example, water softeners are reported to be responsible for 20 per cent of chloride (17). Such sizeable contributions to the salinity problem have led local governments and water districts, such as Paso Robles, to emphasize the problems posed by water softeners in their public education programs.

In July 2008, California Governor Arnold Schwarzenegger vetoed AB 2270, a bill that would have made it easier for water districts to impose water softener bans.
The Governor's veto was predictably praised by the $500-million a year softener industry (18). But in October 2009, AB 1366 was signed into law, allowing the regional

17 Communication with plant operators revealed, however, that fifty-fifty mixing of overly saline water with potable water can be avoided by flushing fields that receive overly saline water at intervals typically of one month.

18 See basic description of water softener process: Wight, Chuck, How do water softeners work? Scientific American (2001) online, September 24, http://www.scientificamerican.com/article.cfm?id=how-do-water-softeners-wo.

water boards in certain hydrologic regions[19] to pass ordinances that would result in a reduction of the amount of sodium chloride released by water softeners, but only if those regional boards can prove such actions will "contribute to the achievement of water quality objectives" (17). According to the LA Times, the AB 1366 regulations allow the substitution of potassium chloride for sodium chloride (17), which proves just as problematic for water treatment plants because potassium chloride adds to the TDS load for chloride (11). The environmental problems associated with chloride are outlined on the website of the Madison (Wisconsin) Metropolitan Sewerage District, which states, "…high concentrations of chloride are harmful to aquatic plants and animals…Although it consists of potassium instead of sodium, [potassium chloride] still contains chloride…The technology to remove chloride is available, but it is very costly. It would involve microfiltration and reverse osmosis…One community determined that it would cost about twenty cents to add a pound of chloride at the water softener, and $5.00 to remove it at the treatment plant. Households can use up to 100 lbs of salt a month in their water softeners."

As residents face increased water rates to pay for augmented treatment to remove salt from wastewater, more bans on salt-based water softeners may succeed. Residents of the Santa Clarita Valley Sanitation District made their choice clear when they voted in 2008 to outlaw salt-discharging water softeners by 2009, with a six-month grace period (18). A comprehensive approach to reduce salinity by incorporating source control and treatment can be found in the 2004 recommendations of a Western Australia treatment plant. Recognizing a level of approximately 550 mg/l TDS as appropriate for sustainable use (with higher levels possibly acceptable for some uses), Melbourne Water and City West Water investigated the feasibility of: a) a reduction at source of influent salt loading by industry through cleaner practices; b) an education program with consumers and manufacturers to encourage a change to lower salinity domestic laundry detergents; and c) introduction of a desalination process to make up the shortfall in achieving the targeted salinity level (19). A similar set of measures could be effective for ocean discharging wastewater treatment plants in California.

Alternative water-softening devices are marketed, including some that use magnetic and electromagnetic softening methods, which reportedly alter the electrostatic properties of the ions instead of removing them from pipes and incoming water. But the effectiveness of these devices, especially on a small scale, is subject to debate (20). Other advertised softeners claim to use a "non-sacrificial catalytic alloy," but the process appears to be chemically impossible and one to be avoided. Some domestic systems based on reverse osmosis are available, but at a high price. In addition, energy use with reverse osmosis is high, and the process itself wastes water. A small Arizona community, the White Cliffs Mutual Domestic Water Users Association, decided the advantages of reverse osmosis outweigh its disadvantages and moved ahead with the installation of a reverse osmosis desalination system. Their action may serve as an example of a shared cost solution, which can be initiated inappropriate sites to achieve both source control and softened water, and to lessen the amount of salt reaching the wastewater treatment plant (21).

19 The regions stipulated in Assembly Bill 1366 are: South Coast, Central Coast, San Joaquin Valley, Tulare Lake and the lower half of the Sacramento Valley.

Brine Waste

Brine waste, which is wastewater high in salts, from industrial and wastewater treatment can contain a concentrated residual of CECs and poses a serious disposal problem. In the absence of CEC regulation, brine waste discharge to the ocean is included in long-term salinity management proposals. Water recycling that mixes brine waste in effluent possibly increases ocean pollution and cannot be considered a sensible solution, especially since future, revised standards could rule out ocean discharges of brine waste altogether.

The Water and Wastewater Salinity Management Project of the Eastern Municipal Water District of San Diego County is an example of salinity management that ultimately results in ocean discharge. The district serves an inland area and proposes to build as many as four brine-disposal pipelines to transfer non-recyclable brine waste from industry and the District's desalination program to existing brine management facilities. Waste from the Eastern Municipal Water District's brine management facilities is carried by the Santa Ana Regional Interceptor (SARI), to specially-equipped treatment plants operated by the Orange County Sanitation District (23), and from there to the Pacific Ocean (24). The stated aim of the project is to "…help protect existing groundwater supplies…and reduce the salinity of recycled water, both of which will reduce the need for additional imported water into Southern California" (22). Such discharge may meet current water quality standards, but the wastewater discharged to the ocean from the Salinity Management Pipeline (SMP) and San Diego County's SARI is highly treated and likely to contain CECs. The project fact sheets lists as a benefit that the SMP, "safely removes salts to the ocean where they cause no harm," but the issues surrounding CECs throw real doubt on this claim.

In Ventura County, the Calleguas Municipal Water District (CMWD) is bringing online a new Hueneme outfall and also an SMP (25). Like the Eastern Municipal District project in San Diego, Calleguas has a dual focus on wastewater desalination and recycling, and any ultimate discharge of unused treated wastewater to the ocean must also contain the chemical residue of desalination. The CMWD project fact sheet states that, "By providing a discharge mechanism, the SMP will enable local brackish groundwater resources to be demineralized and utilized for potable purposes, reducing dependence on imported water and improving local water supply reliability. The SMP will also deliver recycled water to areas where it can be used and export salts out of the watershed to help achieve compliance with total maximum daily loads (TMDLs) for salts." The questions around CECs, however, could bring the stated benefits only at the cost of environmental pollution caused by the ocean discharge of brine wastes.

On another front, the Calleguas project illustrates the need for storage infrastructure to ensure capacity and delivery to as many users as feasible, along with reuse regulations that can make way for dual plumbing–the installation of secondary piping to convey reclaimed water. These measures would have the potential to increase demand. Without the right balance of such measures in place, districts like the CMWD will continue to discharge usable reclaimed water to the ocean when demand is low. Increases in water reclamation need to be accompanied by expansion of markets and usages to ensure full reuse and prevention of the waste of recyclable water.

Wastewater Treatment Plant Desalination Processes

In areas around the world where fresh water is scarce, desalination of ocean water is increasing despite its expense. The market analyst company BCC Research issued an industry report in 2008 on the membrane and separation technology used in desalination processes. The company predicted an annual global growth rate for desalination plants of 13.7% by 2012. The technology used in desalination plants is also employed by wastewater treatment plants to remove salts for the production of high quality reclaimed water, maximizing its potential for reuse. Using 2005 data gathered from the largest water reusers in Florida, California, Texas, and Arizona, the BCC Research report includes a survey showing the 13 most prevalent water recycling and reuse technologies in the U.S. (26). For those treatment plants using demineralization technologies, approximately 82.4% used ion exchange, approximately 11.8% used electrodialysis reversal (EDR),[20] and approximately 5.9% used deionization. No plants surveyed used electrodialysis or electrodeionization. For treatment plants using membrane-based filtration technologies, 22.4% used microfiltration, 32.7% used ultrafiltration, 4.1% used nanofiltration, and 40.8% used reverse osmosis.

Membrane Separation of Salts

The following methods that use membranes of different types and in different ways are currently employed to remove salinity from wastewater:

Reverse Osmosis (RO)

This is a process by which a solvent such as water is purified of solutes by being forced through a semi-permeable membrane through which the solvent, but not the solutes, may pass (27). (See also Nanofiltration.) Reverse osmosis uses a membrane to separate water from dissolved salts. No heating is required, but energy is needed to power a pump that pressurizes the seawater fed into the treatment plant. As the salt water squeezes against the membrane, some water molecules are pushed through minute pores, with a diameter roughly 100,000 times smaller than a human hair. This creates a stream of fresh water on the opposite side of the membrane (28).
If enough pressure is applied to the solution with the higher concentration of dissolved solids (such as saline water), the natural osmotic pressure can be overcome (reversed), forcing the solution through the membrane towards the solution with less dissolved solids and removing the dissolved solids in the solution of higher concentration (29).

Microfiltration (MF)

Microfiltration is the physical retention of particles behind a filter medium while the liquid in which they were suspended passes through the filter. Particles are retained because they are larger than the pores in the filter. Other factors affecting retention are fluid viscosity and chemical interactions between the membrane and the particles in the solution. Microfiltration removes particles with a pore size of .05 and 5.0 µm, including bacteria and some viruses (13).

Ultrafiltration (UF)

Processes using ultrafiltration work in basically the same way as microfiltration, except that the pore sizes are considerably smaller. Solutes are retained behind the filter on the basis of molecular size while the bulk of the liquid and dissolved salts pass through. A pressure gradient across the membrane, known as transmembrane pressure, drives the filtration process. Ultrafiltration membranes are designed for the concentration and separation of complex protein mixtures (13).

Ion Exchange

Ion exchange is a reversible interchange of one kind of ion present in an insoluble solid with another of like charge present in a solution surrounding the solid with the reaction being used especially for softening or demineralizing water,

20 Electrodialysis reversal was investigated by the authors of a report to the Food & Agriculture Organization (FAO) of the UN that includes an overview of plants in southeast mainland Spain and the Canary Islands and Balearic Islands, including some using desalination processes in wastewater treatment and providing water for irrigation. The authors found that "the process is particularly suitable for brackish water with total dissolved solids (TDS) up to 3,000 mg/litre because the amount of energy required is directly proportional to the amount of salts to be removed" (ftp://ftp.fao.org/agl/aglw/docs/lwdp5_e.pdf).

or for purifying chemicals, or separating substances.[21] The process relies on "the selective permeability of ionized inorganic and ionized organic exchange membranes" (26). During ion exchange, the scale-forming ions of calcium and magnesium are replaced with an equivalent amount of sodium ions from a synthetic resin or a naturally occurring resin, typically from zeolite clays. This method is effective with only moderate levels of hardness because the exchange capacity of the resin is limited.

Water Reclamation Issue Two: Contaminants of Emerging Concern

Several variations of description and definition relate to the concept of CECs. The European Commission Network of Reference Laboratories for Monitoring of Emerging Pollutants (NORMAN), established in 2005, distinguishes between "emerging substances" versus "emerging pollutants" and does not appear to use the term CEC (1). While the topics under study through NORMAN are being reviewed by the U.S. EPA, the EPA's official definition of CEC has still to be finalized and different definitions are used by the U.S. Geological Survey, the California Department of Toxicology, and the EPA Office of Water (2).[22] The U.S. EPA's official definition of CEC has still to be finalized, but the following is under official consideration by the EPA Office of Water: "The term 'contaminant of emerging concern' is being used within the Office of Water to replace 'emerging contaminant,' a term that has been used loosely since the mid-1990s by EPA and others to identify chemicals and other substances that have no regulatory standard, have been recently 'discovered' in natural streams…and potentially cause deleterious effects in aquatic life at environmentally relevant concentrations" (3). While the EPA has not made its official designation, the term "CEC" appears to have become increasingly used in related literature.

CECs can be summarized as chemicals whose behavior, fate, and effects are uncertain but thought possibly to be harmful in the following ways: 1) they are toxic to aquatic life, persist in the environment, and accumulate in tissues (including human tissues); and/or 2) they interfere with hormone systems governing reproduction and growth. As chemicals become suspected of causing these kinds of harm, they raise concern about their possible impacts in the coastal and marine environment. Wastewater monitoring programs focus only on a small list of priority contaminants that were identified decades ago. Production of new contaminants and contaminants of emerging concern, however, is continuing and could increase in the future, making the update of monitoring programs a matter of urgency.[23]

Treatment plants began to battle significantly with CECs following the discovery in 1974 of trihalomethanes as a byproduct of chlorine disinfection (4), particularly when used to treat influent containing high levels of organic matter (5). The potential threat of these compounds to human health led to regular monitoring of their concentration in municipal water and treatment systems (6). Over three decades later, N-Nitrosodimethylamine (NDMA), also a chlorine disinfection byproduct, remains a subject of concern, and is a current example of a CEC that needs tertiary treatment for removal, adding to the costs of reclaiming water for potable use and of avoiding unintentional NDMA contamination through indirect potable reuse (7). NDMA is a "classic" CEC, like perchlorate, 1, 4-Dioxane (a manufacturing solvent), MTBE (methyl tertiary-butyl ether; a solvent and gasoline additive),[24] and TBA (tertiary-butyl alcohol; a paint remover ingredient and gasoline additive), and has long been considered a risk to environmental and human health. NMDA is in fact an example of a CEC under local discharge regulation (under public health legislation), where its removal is required for direct aquifer injection (subsurface application) under several water recycling permits issued to reclamation plants by the Los Angeles Regional Water Quality Control Board RWQCB.

Work is underway at national and state levels to ensure that guidelines and legislation address CECs. Meanwhile, wastewater contains increasing amounts of these substances, and not enough is known about their individual and combined fate. Wastewater engineers are finding that they have to tackle both the greater quantity and the increased complexity of CECs and their interaction. In 1998, a U.S. EPA study of chemical hazard data revealed the scale of the problem in its finding that of the 3,000 chemicals imported or produced by the U.S. at the rate of more than one million pounds per year, "…43% of these high production volume chemicals [had] no testing data on basic toxicity and only seven percent [had] a full set of basic test data" (8). In the years since this chemical hazard study, research has increased and policy has begun to shift. However, the *WR 2030* report states that lack of funding for research on CECs is a critical issue, as is the lack of funding for infrastructure and public health concerns. The U.S. EPA Office of Water guidelines for deriving ambient water quality criteria (AWQC) (established in 1985 pursuant to the Clean Water Act (CWA)) are now being revised to take account of the need "to help assess and manage the potential risk of some CECs in the aquatic environment" (3).

In the meantime, the 2008 report on "Green Chemistry" by the University of California's Centers for Occupational and

21 Source: Merriam-Webster.com
22 The U.S. Geological Survey and the California Department of Toxicology refer to "emerging contaminants" and "emerging chemicals of concern" ("ECC") respectively (2).
23 Adapted from Southern California Coastal Waters Research Project: http://www.sccwrp.org/view.php?id=53 (accessed January 2010).
24 MTBE is monitored by Point Loma WTP.

Environmental Health (CCOEH) finds that the amount of chemicals produced or imported in the U.S. has increased since the 1998 EPA tally of one million pounds per year.

The quantity has increased to, "42 billion pounds of chemical substances … produced or imported in the U.S. for commercial and industrial uses." The CCOEH report also points out that, "An additional 1,000 new chemicals are introduced into commerce each year" (9). EPA's recently appointed Administrator Lisa Jackson stated in September 2009 that, "Over the years, not only has [the Toxic Substances Control Act (TSCA) of 1976] fallen behind the industry it's supposed to regulate, it's been proven an inadequate tool for providing the protection against chemical risks that the public rightfully expects" (10). The EPA anticipates new legislation to strengthen TSCA and proposes six "Essential Principles for Reform of Chemicals Management Legislation" (11). These include a call for manufacturers and the EPA "to assess and act on priority chemicals, both existing and new, in a timely manner," for "green chemistry" to be encouraged, and for strengthened provisions assuring transparency and public access to information. Wastewater treatment is certain to be affected by new legislation and regulations that address CECs.

CEC Categories and Definitions

Several CECs are included in the EPA's 2009 Contaminant Candidate List 3 (CCL3),[25] which consists of 104 chemicals designated as "contaminants that are currently not subject to any proposed or promulgated national primary drinking water regulations that are known or anticipated to occur in public water systems." The list also includes 12 microbial contaminants, four of which cause mild gastrointestinal illness and two of which cause respiratory illness, as well as *Helicobacter pylori* (an uncommon bacterium that can colonize the human intestine and cause ulcers and cancer), hepatitis A (causing liver disease), *Escherichia coli* (a bacterium that can cause gastrointestinal illness and kidney failure), *Legionella pneumophila* (causing lung disease), *Mycobacterium avium* (causing lung disease in the severely immuno-compromised) and a parasite that can cause primary amoebic meningoencephalitis. The CCL3- listed microbes may become subject to regulation.

The field of CECs is becoming better defined due to research such as that of the U.S. EPA's 2005-2008 *Nine Publicly Owned Treatment Works* study, which investigated, "…the occurrence of Contaminants of Emerging Concern (CECs) in untreated and fully treated wastewater at POTWs [publicly owned treatment works]." The study lists five categories of CECs, with definitions, descriptions, and short summaries relating to each category (12). These categories are used below with some adapted and mainly additional content. The class of perfluorinated compounds (PFCs) is also summarized below, since the two CCL3-listed compounds perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) have recently received international attention and are being researched in relation to wastewater treatment (13). Additional chemicals being studied in relation to wastewater treatment include: the chlorinated organic compounds Dioxane (a manufacturing solvent) and the herbicides Acetochlor and diuron; and benzenes such as Dinitrobenzene and n-Propylbenzene (e.g., (14) (15)).

Pesticides

These are chemicals used to inhibit, repel, or kill pests that include compositions ranging from insecticidal soaps to formulations such as alachlor, malathion, carbaryl, and chlorhexidine. Many pesticides are persistent organic pollutants (POPs) and as such are "characterized by their long lifetime in the environment (persistence), their potential for long range transport and their capacity to build up to dangerous levels in predatory species"(16). Atrazine, DDT, lindane, and Carbofuran are among the most common pesticides found in water (17).

Between 1992 and 2001, an average of almost one billion pounds of conventional pesticides was used each year in the United States (18). Limits are already in place for many pesticide compounds, including organo-halides, but research continues into their individual, variant, and combined effects and their treatment in the wastewater process.

The U.S. EPA CCL3 list includes several pesticides such as Acrolein and Ethoprop. The older and well-known pesticide DDT presents a case of once-emerging and now ongoing concern at some ocean sites off California. Research on CECs should help to prevent a reoccurrence of the DDT story–an unsuspected, widely-used chemical that becomes a banned substance, but which continues to pollute.[26] DDT was banned in 1972 for most uses (19), but still contaminates the coastal waters of the Southern California Bight. Several harbor locations, including the Long Beach Outer Harbor, are listed as impaired due to contamination by DDT among other toxic chemicals (20). The Los Angeles RWQCB describes how, "The highest concentrations of DDT and PCB are in a layer of low density sewage-derived sediments around the main sewer outfalls at Whites Point on the Palos Verdes Shelf" (21). The DDT/PCB-contaminated area has been declared a

25 The US EPA's Contaminant Candidate List 3 is published every five years. The list is published on the U.S. EPA: website: http://www.epa.gov/ogwdw/ccl/ccl3.html

26 Chemicals that continue to pollute following an end to their use are known as "legacy" contaminants. Other CECs of this nature include the organochlorine (OCL) compounds dieldrin, chlordane, loxaphene, PCBs and dioxins (http://www.axysanalytical.com/services/organochlorine_legacy_compounds/)

Superfund Site by the U.S. EPA, which is investigating capping and other methods to remediate the sediments. The WDRs of most of the ocean-discharging wastewater treatment plants in the Southern California Bight (most of which provide secondary treatment) include monitoring for DDT. Methods including membrane filtration, solvent sublation, and activated carbon absorption remove DDT from wastewater by changing its chemical composition (18). To destroy DDT, a method known as the "Fenton Process" is used, but does not yield potable water. Research is ongoing into methods to improve the photodegradation of DDT (22).

Alkylphenols and Alkylphenol Ethoxylates (APEs)
These synthetic surfactants are used in some detergents, cleaning products, and paper. APEs can affect the reproductive systems of aquatic organisms. Nonylphenol ethoxylates (NPEs) are the most common form and are said to be removed at rates of 92% to 99% by wastewater treatment methods (23). However, new research presented at a SCCWRP/SWRCB 2010 meeting[27] suggests detrimental effects of nonylphenol buildup in marine life, with a wide range of sea animals exhibiting cancerous symptoms (tumors) over a wide area associated with septic system and wastewater discharge. As is the case with steroids, hormones and polybrominated diphenyl ethers (PBDEs)–which include flame retardants and plastics–APEs are hydrophobic, facilitating their removal through secondary treatment, but there is concern about the possibility of their buildup in the biosolids that are a byproduct of wastewater treatment (24).

Bisphenol A (BPA)
This is an organic, estrogenic compound used in the manufacture of polycarbonate plastic items such as eyeglass lenses, medical equipment, water bottles, CDs, DVDs, and many other consumer products, including paper. At least one study has shown that toilet paper is contaminated with BPA (and APEs) and is a source of this compound in wastewater (25).

The treatment of BPAs is the same as for APEs and PBDEs where the use of certain types of bacteria in secondary treatment has been found to biodegrade and remove BPA from wastewater (25).

Polybrominated Diphenyl Ethers (PBDEs)
These constituents of flame retardants are found in furniture foam, plastics for TV cabinets, consumer electronics, wire insulation, personal computers, small appliances, and clothes. PBDEs are related to PCBs and are a subcategory of brominated fire retardants (BFRs). Bromophenyl phenyl ether, manufactured as DecaPBDE, PentaPBDE, OctaPBDE, etc., is on the U.S. EPA's Priority Chemicals list (26).

The U.S. EPA's 2006 PBDE Project Plan notes that PBDEs are "…widely distributed in the environment and are present at increasing levels in people." The Project Plan also states that, "In recent years, scientists have measured PBDEs in human adipose tissues, serum and breast milk, fish, birds, marine mammals, sediments, sludge, house dust, indoor and outdoor air, and supermarket foods" and includes an account of the discovery of these compounds in San Francisco Bay area sewage effluent and sludge (27). A "Review of Available Scientific Research" by the Illinois EPA Toxicity Assessment Unit cites a study that found decaBDE "in glaucous gulls and polar bears from the Arctic" (28).[28] A 2008 study published in *Environmental Science & Technology* reports that, since the discovery of PBDEs in the environment in 1979, levels have soared, with the highest levels in the country of these chemicals now found in California residents (29) (30).

Two of the commercial forms of PBDEs, PentaBDE and OctaBDE, were withdrawn from the European market in 1998 (31). After the discovery of PBDEs in breast milk, the U.S. followed suit in 2004 (32). California became, in 2003, the first state to ban the two forms of PBDEs by 2008 (33). Production was scheduled to halt because PBDE has "…increased fortyfold in human breast milk since the 1970s" and holds the potential to contribute to low intelligence and learning disabilities (34). In 2008, the European Union restored Deca-BDE to its Registration, Evaluation, Authorisation and Restriction of Chemical substances (REACH) list[29] to be phased out, although it can be used without restriction in the meantime (31) (35). California began to phase out DecaPBDE in December 2009, with the use of DecaPBDE scheduled to end by 2013. Steve Owens, an assistant administrator at the U.S. EPA said that "studies have shown that DecaBDE persists in the environment, potentially causes cancer and may impact brain function…[and that] DecaBDE also can degrade to more toxic chemicals that are frequently found in the environment and are hazardous to wildlife" (36).

Studies reviewed by the EPA Unit in Illinois show that diet is the major route for human exposure to PBDEs, although a 2004 report by the Environmental Working Group, a non-profit research organization based in Washington, D.C., calculates that dust is a more potent route for children (37). Research reviewed by the Illinois Unit also found "high concentrations of decaBDE in municipal sewage sludge and [that] workers in sludge-related activities are potentially

27 Constituents of Emerging Concern Coastal & Marine Ecosystems Science Advisory Panel Meeting, January 12, 2010, Costa Mesa, California (www.sccwrp.org/view.php?id=574).

28 The Review also notes that PBDE levels have been found to be much higher in farm-raised salmon than in wild salmon. The difference is thought to stem from the diet of farmed salmon, which consists of concentrated feed high in fish oil and fishmeal from small open-ocean fish.

29 The EU REACH list was brought into law in 2007.

exposed to very high concentrations, primarily through inhalation" (28). Research at treatment plants in Tucson, Arizona, and Palo Alto, California, for example, shows that the resistance of PBDEs to wastewater treatment can lead to their accumulation in sediments where wastewater is discharged and in soils where biosolids are added (38) (39).

Steroids and Hormones

Steroids and hormones are naturally occurring and related synthetic copies of chemicals that serve as messengers between cells. "Many of the responses to hormone signals can be described as serving to regulate metabolic activity of an organ or tissue. Hormones also control the reproductive cycle of virtually all multicellular organisms" (40). Many hormones, body constituents, and drugs are steroids. Cholesterol is an example, the word "steroid" being derived from "sterol" (41). The category of steroids and hormones is included by many sources as a subset of Pharmaceuticals and Personal Care Products (PPCPs) since some originate in pharmaceutical products. Phthalates belong to this category and are included on the EPA's list of chemicals for priority review.

Several steroids and hormones come from sources such as dairy wastewater, aquaculture, and spawning fish (42). Endocrine disrupting compounds (EDCs) are substances that interfere with the normal functions of steroids and hormones. Steroids and hormones can themselves be EDCs. Studies have found that tiny amounts of biologically active natural and synthetic steroid estrogen hormones that survive sewage treatment, including the active ingredient of the contraceptive pill and naturally occurring female hormones, can disrupt the physiology of wild fish (43). The Office of Environmental Health Hazard Assessment of the California EPA has included butyl benzyl phthalate (BBP), di-n-butyl phthalate (DBP), and di-n-hexyl phthalate (DnHP) on the Proposition 65 list of chemicals known to cause reproductive toxicity (44). This listing, in compliance with the Safe Drinking Water and Toxic Enforcement Act of 1986, shows that phthalates fall into the category of endocrine disrupting compounds.

A British 2004-2005 study shows that conventional wastewater treatment does not completely remove EDCs; as a result these compounds can seep through river sediments and from there potentially into groundwater. This finding raises concern because, as pointed out by the authors of the study, it is less likely for these compounds to be neutralized by attaching to suspended solids (45).

Scientists from SCCWRP are investigating whether wastewater effluent or natural factors are the cause of unusual hormone levels in certain species of fish off the coast of California. A 2009 *Environmental Science & Technology* article summarizes: "With very few differences between the contaminated sites and the control site, [the] widespread pattern of odd endocrine levels could mean that the contamination is much more pervasive than scientists thought, or it could mean that these hormone levels are normal" (46). While the answer to this question is being determined, it is unknown whether regulatory changes affecting water reclamation will take a precautionary approach on suspect pollutants in order to avoid potential risk.

More research from the United Kingdom reviews how advanced technologies, such as activated carbon adsorption, ozonation, advanced oxidation processes, and nanofiltration/reverse osmosis, remove potential EDCs. However, the cost of these wastewater treatment methods and the scale of infrastructure and manpower needed to operate them, have led research engineers to experiment with supported biofilms in aeration tanks, taking note of by-product and additive issues (47). This alternative technology echoes the same approach of applying extended secondary treatment (longer holding times) to PBDEs and APEs for higher levels of removal, with the same cautions relating to byproducts and contaminant buildup in biosolids.

Pharmaceuticals and Personal Care Products (PPCPs)

PPCPs are a range of prescribed and over-the counter pharmaceuticals, and personal care products used for health or cosmetic purposes. The U.S. EPA considers "any product used by individuals for personal health or cosmetic reasons or used by agribusiness to enhance growth or health of livestock" to be a PPCP (48). Other examples include blood pressure, cholesterol and antidepressant medications, over-the-counter drugs, caffeine, detergents and soaps, lotions and cosmetics.

Excretion of medications from the body, the rinsing of cosmetics and soaps, and the disposal of prescription drugs through domestic plumbing are ways in which PPCPs enter sewage systems where a possibility may exist of onward transport to water bodies if they are not removed by treatment. Varying levels of PPCPs from point and non-point sources alike have been detected in measurable quantities in water bodies, both in the saline waters of oceans and the fresh waters of rivers, lakes, and groundwater aquifers (49) (50). It is unclear, though, at what levels these contaminants lead to manifested toxic events (51).

Among PPCPs, triclosan is a widely used nonprescription antibacterial/antimicrobial compound that illustrates how a single compound in the wastewater stream can have many sources. Triclosan is found in anti-gum disease toothpaste, deodorant soaps, deodorants, antiperspirants, body washes, detergents, dishwashing liquids, cosmetics, antimicrobial creams, lotions, and hand soaps, and is also used as an additive in plastics, polymers, and textiles to give these materials antibacterial properties (53). It also serves as an example of a PPCP coming under increasing scrutiny and monitoring by the EPA (54). The call in August 2009 by the Canadian Medical Association to the Canadian Government to ban all antibacterial household products (55) reflects the growing concern over the potential of such products to cause bacterial resistance.

Triclosan also serves as an example of a chemical of potential risk with many and varied fates. In 2002, a Swedish study published in *Chemosphere* found, "High levels of…Triclosan…in three out of five randomly selected human milk samples. It was also found in the bile of fish exposed to municipal wastewater and in wild living fish [exposed to] the receiving waters of the three wastewater treatment plants" (56). A 2003-2004 study for the U.S. Centers for Disease Control and Prevention detected triclosan in 74.6% of 2,517 urine samples. Exposure was thought to stem from use of consumer products that contain triclosan. The same study cites research showing that the chemical affects hormonal processes in frogs and rats but does not cause acute toxicity in humans (57). A risk assessment published in 2007 in Food and Chemical Toxicology concluded that, "… there is no evidence to indicate that the presence of a miniscule amount of triclosan in breast milk presents a risk to babies" (58). This range of findings shows the prevalence of triclosan in the environment, with known and unknown effects and risks for different species, but demonstrates the difficulty of determining if the substance should be regulated. The same problem applies to other PPCPs.

A study published in 2008 by the Washington Department of Ecology is an example of research into the fate and transport of PPCPs in relation to wastewater treatment. The researchers investigated "the potential for and status of PPCP contamination of area waters from application of tertiary treated wastewater via reuse programs and conventional land application" (50). The scientists conducted a screening analysis for 24 PPCPs in tertiary wastewater treatment plant effluents and nearby wells and creeks in the Sequim-Dungeness area of northwest Washington State. Sixteen compounds were detected in effluent: acetaminophen, caffeine, carbamazepine, cimetidine, codeine, cotinine, diltiazem, hydrocodone, ketoprofen, metformin, nicotine, paraxanthine, salbutamol, sulfamethoxazole, trimethoprim, and estrone. The study found that, "Only Caffeine, Nicotine, and the diabetes drug Metformin (tentatively identified) were consistently detected in the well and creek samples; concentrations were less than 25 ug/L."

The researchers concluded that, "These limited results give no indication that PPCPs represent a significant concern in the wells or creeks sampled." While the scientists considered additional monitoring for PPCPs to be a low priority for the two treatment plants involved, these results nevertheless show that tertiary-treated effluent can contain some PPCPs. However, the fact that most of the same PPCPs became undetectable in the downstream samples may provide evidence for the effectiveness of tertiary treatment in preventing PPCPs from reaching harmful levels in discharges.

The results of a national pilot study in the U.S. published in 2009 by the Society of Environmental Toxicology and Chemistry assessed "the accumulation of PPCPs in fish sampled from five effluent-dominated rivers that receive direct discharge from wastewater treatment facilities." The results show that better CEC-removal efficiency is achieved by advanced treatment. "Fish tissue analyses from the two sampling sites receiving more advanced treatment…showed lower overall concentrations of PPCPs, fewer compounds detected, and lower frequency of detection compared to the other three sampling sites… which employed less advanced treatment" (59). Modeling produced for the 2006 U.S. EPA's *Final Report on Occurrence and Fate in Drinking Water, Sewage Treatment Facilities, and Coastal Waters* by the National Center for Environmental Research (NCER) led to the conclusion that longer solids retention times should increase the removal of pharmaceuticals and antiseptics–a finding similar to those of studies investigating APEs as cited above (60).

The NCER findings on pharmaceuticals and antiseptics add to research that shows that removal and neutralization of PPCPs in influent is accomplished by biodegradation and biotransformation. A 2003-2004 British study of the removal specifically of triclosan by three different types of wastewater treatment works found that removal ranged from 58 to 96% using rotating biological contactors, 86 to 97% using trickling filters, and 95 to 98% through longer retention times in activated sludge (52). These results align with the U.S. EPA's review of studies of the fate and transport of triclosan, and its finding that, "the majority of published studies on the occurrence of triclosan in wastewater treatment plants, treatment plant efficiency, and open water measurements of triclosan suggest that aerobic biodegradation is one of the major and most efficient biodegradation pathways" (54). In 2009, the international journal *Environmental Pollution* published an assessment of removal efficiency indicating activated sludge with nitrogen treatment and membrane bioreactor achieves the most effective removal. Longer retention times during the activated sludge and membrane bioreactor phases of wastewater treatment allow for increased breakdown of PPCP organic compounds, resulting in large reductions in

PPCP concentrations in plant effluent (61) (62). Results of a Welsh study of the fate of PPCPs published in 2009 found that, "the [wastewater treatment plant] utilizing trickling filter beds resulted in, on average, less than 70% removal of all 55 PPCPs studied, while the WWTP utilizing activated sludge treatment gave a much higher removal efficiency of over 85%" (63).

Perfluorinated Compounds (PFCs)
A group of chemicals containing fluorine, PFCs are used to make household products and industrial materials stain resistant and non-stick. A 2009 review of PFCs by the Global Health & Safety Initiative (GH&SI), a collaboration of U.S. health care insurance providers, hospitals and non-governmental organizations, notes that PFCs are also used in food packaging, paints and lubricants. Products such as Teflon®, Stainmaster®, Scotchgard™, and NanoTex™ contain PFCs (13).

The GH&SI review summarizes how PFCs are highly persistent compounds that accumulate in the tissues of living organisms, including humans. The review found that PFC exposure is "nearly ubiquitous" and that PFCs can cross the placenta, "…directly exposing the developing fetus." According to the GH&SI, the existing data on toxicity of PFCs so far relates mainly to animal studies and tends to focus on two common PFC compounds–perfluorooctane sulfonate (PFOS), which is still used in fire-fighting foams and various surfactants because no alternatives are available, and perfluorooctanoic acid (PFOA), which is used in the manufacture of substances that provide non-stick surfaces on cookware as well as waterproof and breathable membranes for clothing. PFOS was added in May 2009 to the list of contaminants identified by the Stockholm Convention on Persistent Organic Pollutants (POPS) (16), and PFOS and PFOA are included on the U.S. EPA's CCL3 list.

A 2007 study by Stanford University researchers and the Santa Clara Valley Water District investigates perfluorochemicals in water reuse. The study focuses on PFOS and PFOA and their presence in wastewater effluent, particularly of three California treatment plants employing tertiary treatment, as well as their presence in ground and surface waters where the effluents are discharged (64). The study outlines the tertiary processes as follows: 1) dual media filtration and chlorination, followed by polymer treatment and repeated filtration for reclaimed wastewater; 2) dual media filtration and chloramination, followed by additional chloramination for reclaimed wastewater; 3) dual media filtration and chlorination; and 4) fixed growth reactor (ammonia removal), flocculation, dual media filtration, and chlorination, followed by additional flocculation, dual media filtration, and chlorination for reclaimed wastewater. PFCs were found "…to persist beyond the tertiary treatment steps…at concentrations [that] are consistent with reports for other municipal wastewaters which vary between plants."

Despite the persistence of these compounds beyond wastewater treatment, the researchers conclude, "Compared to the global perfluorochemical burden from sources such as wastewater discharge and rain, water recycling plays only a limited role." The authors indicate that nanofiltration and reverse osmosis tertiary treatment remove PFCs, although the filtered contaminants still remain intact in a post-treatment brine stream. To stop the flow of PFCs to the environment through the wastewater stream, the only apparent method is incorporation of disposal methods that completely avoid discharge into waters, including the ocean. Because, as the GH&SI review states, "Studies of the persistence of PFOS, for example, show that under *no conditions* does the chemical show any evidence of breaking down in the environment" (13), the logical precautionary approach would be a ban on the manufacture of PFOS.

Wastewater Treatment to Control CECs

Given the research available, improvements that optimize secondary biodegradation processes may prove to be the most cost-efficient and accessible way for wastewater treatment plants to increase the removal and neutralization of many CECs. Although research needs to continue on the subject of safe reuse of recycled water for agricultural irrigation, park facility application, public facility sanitation, industrial and commercial uses, several researchers find that extending secondary treatment can make a significant step towards this goal. The 2009 survey published in Environmental Pollution points out "activated sludge with nitrogen treatment and membrane bioreactors" as the most efficient process (61). Improvements to secondary treatment remove a high percentage of CECs, but thorough biological processing over long retention times is necessary to ensure that CECs do not accumulate in the resulting biosolids. Ternes et al find that many wastewater treatment plants in the U.S. and the EU do not operate with solid retention times long enough to achieve the necessary biological decomposition. Their report recommends that medium-sized and larger sewage plants upgrade to "a sludge age of 12–15 days by nitrification combined with denitrification" (62). Activated sludge operations and membrane bioreactors are relatively easy to incorporate and are compatible with the retrofitting of existing infrastructure. These methods do not create additional treatment side streams, and allow for the neutralization of many bioactive compounds without requiring including separate holding tanks and diversion infrastructure.

Advanced secondary treatment methods, optimized to treat influent content, also help to ensure the efficiency of tertiary treatment that follows, since the breakdown of CECs decreases the toxic load that goes on to more advanced processing (62). Higher levels of secondary treatment add the benefit also of a lesser amount of toxic residue after tertiary filtration.

However, these kinds of assessments of the effectiveness of treatment contrast with the findings of a wide-ranging review of treatment methods for pharmaceuticals. The review, published in 2009 in the Journal of Environmental Management, describes how advanced technologies all have shortcomings, which include: the effect on efficiency of the type of compound; undesirable changes to compounds caused by treatment; minimal improvement in elimination rates as a result of increased retention time; possible increase in antibiotic resistance as a result of treatment with bio-membrane reactors; high carbon dioxide emissions as a result of increased energy demands to operate advanced technologies; and unsustainability because they do not tackle the origin of the chemicals and are too expensive for many countries (65). The review describes how a life cycle assessment of three treatment processes to discover when the removal of micro-pollutants and reduction in toxicity would outweigh the increased resource- and energy consumption. The research found advanced treatment can induce more environmental impact than it removes. Unlike ozonization and membrane bioreactors, sand filtration was the only method found to have net benefits.

As a 2009 review for the journal Clean states, PPCPs and endocrine disrupting compounds, "are not completely removed in treatment plants" (66). The point that removal efficiencies depend on the chemistry of the compound being treated is also echoed. Nevertheless, the Clean review finds that, "Advanced posttreatment units (ozone, AOPs, activated carbon, membranes) may constitute reliable options for the removal of EDCs/PPCPs" However, techniques that are filtration-based *also generate a high-concentration pollution residual that is discarded in treated effluent if the pollutants are unregulated.* Such pollutants can remain in their raw form, and ideally should be subject to further biodeactivation treatment and careful disposal. Advanced treatment may maximize CEC removal, providing high-quality reclaimed water for agricultural irrigation, urban and industrial use, and even groundwater recharge, but its financial and energy costs are high. Many passes may be needed through the treatment process,[30] and typical disposal methods following treatment do not remove CECs from the waste stream.

30 Information from correspondence with treatment plant operators.

CECs and the Call for Analytical Methods, Research, and Water Quality Criteria

Wastewater treatment professionals face continual funding demands that only increase with new regulatory requirements and water recycling targets. These professionals will surely be the first to echo the U.S. EPA's Essential Principles for Reform of Chemicals Management Legislation. The U.S. EPA provides the principles in order to "help inform efforts underway in this Congress to reauthorize and significantly strengthen the effectiveness of the [Toxic Substances Control Act]. These Principles present Administration goals for updated legislation that will give U.S. EPA the mechanisms and authorities to expeditiously target chemicals of concern and promptly assess and regulate new and existing chemicals" (11). Action on the U.S. EPA's principles is needed to manage, or eliminate, the chemicals that flow daily into wastewater treatment plants and from there, into surface waters or the ocean. But action must be based on sound scientific research on substances whose rate of increase has so far greatly outstripped our understanding of their fate, transport, and consequences.

The need for the authors of the U.S. EPA's *Treatment Works* study to develop three analytical methods to detect the occurrence of CECs in wastewater illustrates the inadequacy of CEC analysis tools (12). The lack of CEC-analysis technologies as discussed in the study could alone justify a new U.S. EPA essential principle to set in place sustained funding for research to guide reform of chemicals management legislation. Changing environmental conditions, including ocean acidification, combined with an ever increasing chemical load, have raised the level of urgency for action on EPA's first new principle as set out under its pollution prevention strategy: "Chemicals should be reviewed against safety standards that are based on sound science and reflect risk-based criteria protective of human health and the environment" (11).

Hepatitis A is an example of a microbial CEC for which reliable and financially feasible monitoring methods are needed. A study published in 2006 in Water Science and Technology revealed that reclaimed water used to irrigate two golf courses in Spain and Portugal included somatic *E. coli* bacteriophages, enteric viruses (*entero*-, *hepatitis A* and *rota*-) and *Legionella pneumophila*. The study concluded that the wastewater treatment processes produced an adequate reduction in the number of indicator microorganisms. However, "…a significant correlation between pathogenic and indicator microorganisms tested was not found" (67). This lack of correlation between indicator and pathogenic microbes provides more evidence of the need for research to improve monitoring and testing protocols to ensure that wastewater treatment removes pathogens that may presently survive undetected through a range of processes.[31]

In July 2007, a Special Project of the State/EPA Water Quality Standards Workgroup began a survey on the issue of "emerging contaminants" (68). The survey was distributed to the Ambient Water Quality Standard (AWQS) contacts in all 52 states within the U.S. The results of the survey were published in 2008 and include a summary of responses elicited from 37 states as well as from interstate organizations in 27 states. Asked whether their state/organization defined "emerging chemicals," 13.5% responded "yes," 10.8% responded, "don't know, and 75.7% of the states answered, "no." Contacts were also asked about the level of interest of their state or organization in emerging chemicals, regulatory activities concerning these chemicals, and also about for near-term (1-year) and longer term (5-year) priorities to further develop a coherent "emerging chemicals program" in water quality regulation. Out of 37 responses, "only six indicated that their agencies already factored emerging chemicals into their programs." The proportion of agencies "interested enough to investigate ways to incorporate emerging chemicals into their agencies' programs" came to 62%. Another six agencies were "very interested, but not ready to implement" for the following reasons: "[1] Lack of national ambient water quality criteria; [2] Lack of state resources to develop and adopt standards; [3] Analytical methodologies are still in development; [4] [State] laboratories do not have necessary analytical capability; [5] Funds are insufficient to contract outside laboratories; [6] Toxicological research is still inadequate; [7] Acute and/or chronic aquatic life database still in development." Clearly, the need for research, new standards and for funding and administrative support regarding CECs and wastewater extends nationally.

The Water Quality Standards Workgroup survey also shows that considerable CEC research occurs in California and involves much collaboration, for instance, by the SWRCB with SCCWRP, and the Central Valley regional board with the University of California, Davis, and the U.S. EPA. Taking a lead role on the CEC issue, SCCWRP has convened two information-gathering panels at its headquarters in Costa Mesa, California: the SWRCB Advisory Panel on CECs in Recycled Water and the Advisory Panel for CECs in Coastal and Marine Ecosystems (69). The goal of these public sessions is to share and examine information about CECs for the purpose of developing a State policy for identifying the contaminants that should be monitored.

Increased monitoring and specialized treatment to remove CECs could help ensure reclaimed water quality reaches standards needed for safe reuse. However, present water shortages as seen, for instance, in Los Angeles and the San Joaquin Valley, combined with California's increasing population (70), could push water reclamation and recycling ahead of science, technology, and the establishment of new standards. Maximizing the potential to reclaim water from wastewater treatment plants is fast becoming a necessity. More action on the call made by the State's Recycled Water Task Force in 2003 for funding of research on recycled water issues has become urgent.

Four Advanced Treatment Offset Approaches

The cost of producing recycled or reclaimed water has in many cases inhibited wastewater treatment plants from moving forward with new technologies. One of the biggest problems in meeting technology improvement costs has been the resistance of ratepayers to rate increases, even though wastewater treatment rates are very low relative to fees for other household utilities (e.g., gas, electricity, cable). Researchers continue to investigate ways to reduce the cost of treatment plant processes both for desalination and the removal of CECs, processes that are expensive in terms of both equipment and energy costs. Related research on desalination covers topics such as membrane types, energy efficiency, and pretreatment, including methods such as enzyme enhancement (1). Factors affecting the cost of treatment to reduce or eliminate salinity include the type of technology used, the salinity level of feed water, the salinity level of product water, available energy sources, and the short and medium term demand for recycled water (2).[32] Whichever technology is used, desalination is a costly process.

Cogeneration

Many wastewater treatment plants use processes that allow for cogeneration–the simultaneous production of power/electricity, hot water, and/or steam from one fuel (3). Methane, a "biogas," is a typical plant biomass fuel, one produced in wastewater treatment facilities with anaerobic digesters. Bacteria in the digesters break down biosolids in sewage. Combustion of the resulting methane creates energy and also cuts emissions of this powerful greenhouse gas, which some plants flare off (4). Combined cycle power plants can be energy self-sufficient, as demonstrated by

31 Studies, however, such as Occupational Medicine's 2009 short report, "*Wastewater workers and hepatitis A virus infection*," provide some reassurance, for the research contributing to the report found that "…working in a wastewater treatment plant does not seem to be related to a greater prevalence of antibodies to hepatitis A. Moreover, the relative risk of HAV infection among (wastewater workers) seems to be correlated with low anti-HAV(+) prevalence in the general population" (16).

32 According to the above mentioned experts' report to the FAO, various recovery devices "can reduce energy requirements by as much as 50%." In addition, "Larger plant size… contributes to the economy of scale that is significant between a plant producing 1,000 m3/d and that producing 40,000 m3/d, where the capital cost per cubic metre of water can decrease by a factor of 2.5. However, RO plant sizes larger than 40 000 m3/d will not have any further considerable effect on cost reduction" (ftp://ftp.fao.org/agl/aglw/docs/lwdp5_e.pdf)

the Joint Water Pollution Control Plant in Los Angeles (JWPCP). JWPCP uses digester gas (mainly methane), to generate electricity and produce surplus energy that is sold back to a utility company. Installation of co-generation systems that are simultaneous with upgrades to achieve desalination may help, over time, to offset the costs of the upgrades.

Alternative Energy Generation

New site construction and, potentially, upgrades and improvements can provide opportunities not only for cogeneration, but also for use of plant facilities and/or space for the installation of energy-generating technologies such as solar power. Two wastewater treatment plants in California have installed solar photovoltaic (PV) systems: the Las Gallinas Valley wastewater treatment facility in the San Rafael, California area, and the San Joaquin water treatment plant, inland from Monterey, California (6).

The San Joaquin wastewater treatment plant formed an electricity-producing facility in 2005. With electricity costing about $400,000 annually, the District installed a solar project on property adjacent to the plant, in order to generate electricity for itself and to sell the excess into the Pacific Gas and Electric (PG&E) system. With incentives worth $6 million from the California Solar Initiative Program, it has been estimated that it will take 15 years for the long-term payback on the capital expenditure for the solar project.

The California Solar Initiative Program also contributed incentives in relation to the installation at the Las Gallinas Valley wastewater treatment plant. Near the shores of San Pablo Bay, the Las Gallinas plant sited a solar PV system in 2006 on a foundation of manmade bay-fill. The wastewater plant reports power production of over 1 GWh annually, "…meeting and exceeding the contract's levels" and saving $156,000 in its first year of operation. By November 2008, this wastewater treatment plant was meeting 100% of the facility's power needs.

Energy Efficiency

Both the San Joaquin and Las Gallinas districts contracted expert energy usage analysis with the aim of designing "…the smallest [PV] system with the largest rate of return." Several proposals were submitted to the districts for systems that would have supplied 100% of both plants' power needs. The Las Gallinas energy audit revealed, however, that the plants' energy use could be reduced by applying certain efficiency measures. A proposal was accepted that incorporated these measures and, as a result, required a smaller PV system than specified in proposals based on the plant's original energy needs. Following installation, the plants achieved a fifty percent cut in electricity use and a net savings on the project of $175,000. Energy audits of treatment plants throughout California would show where savings could be achieved, savings that could be applied to plant improvements and upgrades.

Public-Private Partnerships

In some cases, public-private partnerships can make plant improvements feasible. Since 1994 the privately-owned Pebble Beach Company (PBC) in California's Central Coast region has been the fiscal sponsor of modifications to the Carmel Area Wastewater Treatment Plant, working in partnership with the Carmel Area Wastewater District (CAWD), Pebble Beach Community Services District (PBCSD), and the Monterey Peninsula Water Management District (7). CAWD and the PBCSD own and operate the wastewater plant while PBC guarantees repayment of "certificates of participation" and pays annual operating expenses over and above the revenues derived from reclaimed water sales.

The Carmel plant produces about 800 AF of reclaimed wastewater annually [0.7 million gallons daily], "…which is used to irrigate the Pebble Beach golf courses and other recreational areas. This supply is replacing an equivalent quantity of potable water that was previously applied to these grassy areas." The other important result of using the high-quality effluent in this way is that "about 700,000 gallons of secondary effluent does not get discharged to Carmel Bay every day."

The Pebble Beach model may be applicable at other locations in California and serves as an example of a financial means to reduce CEC pollution in California as well as help realize the State's reclaimed water potential. The *Sacramento Bee* newspaper reported on a more recent example of a successful public-private partnership, with the March 2009 adoption by the Sacramento Regional County Sanitation District of, "a strategy to partner with buyers to recycle wastewater from the State Capitol's 1.4 million residents into a new municipal water source" (8). Similar opportunities may exist elsewhere in the State of California.

Water Reclamation: Conclusion

While the Water Recycling 2030 report summarizes key issues identified by the California Recycled Water Task Force and makes recommendations to increase water recycling (9), environmental and scientific findings in the years since the Task Force's report have led the National Water Research Institute (NWRI) to call in June 2009 for a re-prioritization of the report's recommendations. NWRI recommends an emphasis on communication with the public, followed by state leadership and advocacy, regulatory consistency, funding, and public support (10).

Heal the Ocean concurs based on its research for the *Report and Inventory,* and makes specific recommendations that fall under the following

- Public education and promotion of water reuse
- Research and technology development
- Updated and streamlined regulations
- Improved water quality treatment
- Financing

A concerted, concentrated effort is needed to address the problems of salinity and CECs in reclaimed water. Both issues present serious challenges to water reclamation and its benefits. While work is underway to find solutions, and while the health and environmental effects of CECs remain uncertain, the most cost-effective and immediately accessible wastewater treatment processes should be applied as soon as possible in order to reclaim water for basic uses such as irrigation and habitat preservation. New plans for treatment to remove salt and other contaminants for water reuse must include plans for the disposal of residual contaminants and should not include the method of ocean discharge. Contaminants that cannot be removed at reasonable cost by wastewater treatment need to be eliminated at source to prevent them entering the wastewater stream. Bans should be considered for CECs that are found to pose high risks.

Given that efforts to reclaim treated wastewater are increasing worldwide, opportunities exist for international exchange of both research and information emerging from cutting edge pilot projects that use potentially cheaper technologies and engineering. Ongoing collaborative efforts to examine and improve the control of toxic pollutants in California waters include those of the Bay Delta Conservation Plan, the Recycled Water Policy Science Advisory Panel, and the Advisory Panel for CECs in Coastal and Marine Ecosystems (11). In addition, many integrated regional water management plans now in process around the State are already proving to be effective in promoting pilot projects, research partnerships, and stakeholder involvement.

The reclamation of wastewater necessitates the building of appropriate infrastructure, including dual plumbing, to maximize wastewater capture, storage, and delivery. While implementation costs may be high, public-private partnerships, and energy efficiency, co-generation, and generation schemes can offer solutions for overcoming financial difficulties.

Source control needs to take priority as the most effective and economic method of preventing water pollution. Funding should be provided for sustained public education and pre-treatment. Wastewater treatment plants are nder siege from an ever-growing list of chemicals that plants are not typically designed to treat. Strong pre-treatment measures would help to combat the high costs of wastewater treatment by lessening the contaminant load in influent.

Publicly owned treatment works are designed mainly to process domestic wastewater. However, many facilities also receive wastewater from industrial or commercial sources. Regulations, and monitoring and inspection regimes for industrial wastewater are implemented by the local sanitary districts. Industrial wastewater is defined by the sanitation districts of Los Angeles County as, "all wastewater from any manufacturing, processing, institutional, commercial, or agricultural operation, or any operation where the wastewater discharged includes significant quantities of waste of non-human origin."[33] Sources employing particular industrial processes and/or discharging high volumes of wastewater are required to obtain a permit to discharge to the municipal sewer system, but local limits on discharge constituents apply to all industrial discharges. Recognizing the positive effects of source control, some districts such as the Montecito Sanitary District in Santa Barbara County, already provide pre-treatment assistance beyond any official program. Greatly expanded funding for source control programs could help districts and treatment plants significantly reduce the pollutant load reaching wastewater facilities and therefore increase the potential to reclaim water.

Water reclamation is currently undermined by outdated water quality standards, lack of demand, and outdated regulations for reuse. Public education is crucial to increase conservation, demand for reclaimed water, and to support relevant government action. All public education programs should focus on:

- the crucial role of the wastewater treatment plant in maintaining public and environmental health
- the urgent need for water conservation and the potential for safe water reclamation by wastewater treatment plants
- the need to support regulatory changes to facilitate reclamation
- the need for funding from sources, such as environmentally sustainable State bond measures and ratepayer increases, to pay for the increasingly demanding tasks of the wastewater treatment plant

Coordinated public education statewide would support the work of individual authorities to increase water

33 See 1) U.S. EPA web page: Pretreatment of Wastewater (Industrial Users) Compliance Monitoring http://www.epa.gov/compliance/monitoring/programs/cwa/wastewater.html
2) SWRCB NPDES Pretreatment Program: http://www.waterboards.ca.gov/water_issues/programs/npdes/pretreat.shtml
3) Sanitation Districts of Los Angeles County website: About the Industrial Waste Section http://www.lacsd.org/info/industrial_waste/default.asp

reclamation, enabling the replication of effective local campaigns such as the citywide program begun in 2008 by the Los Angeles Department of Water and Power (LADWP) that presents a dialogue with the public through its website. The LADWP cites this program as the start "of a multi-year outreach campaign to inform the public and raise awareness about the need for recycled water and groundwater replenishment to create a locally sustainable water supply in Los Angeles." A statewide campaign tailored to local needs and circumstances could ensure consistency of information and presentation, and add greater weight and urgency to local public education efforts.

A concerted effort should be made to bring consistency to the State regulations for reuse of reclaimed water. The State's Recycled Water Policy, effective from May 2009, and the proposal for a statewide dual plumbing code, indicate that California is beginning to move in the direction of achieving a more unified policy for water reclamation.

The case for reclaimed water in California is clear. The U.S. Geological Survey figures for water use in the year 2000 revealed that California accounted for "almost 11 percent of all freshwater used in the United States." California also consumes 22% of all the water used for irrigation in the U.S., making it the largest user in this category.(see Table 2.1) Replacement of potable flows with reclaimed water for irrigation alone could provide a considerable boost to the public drinking water supply in California. It

Irrigation	Thermo-electric power	Public supply	Industry	Domestic (self-supplied)	Mining	Livestock, aquaculture
40 %	39 %	13 %	5 %	1 %	1%	less than 1 %

Table 2.1. Water uses in California in 2000 by percentage. Source: U.S. Geological Survey

may not be long before the environmental stresses on California's water supply make reclaimed water an unquestioned, everyday reality for the general population, but an effective, coordinated communications campaign is needed. Meanwhile, it is a hopeful sign that the State has begun to invest in policy, research, and public funding of infrastructure and treatment upgrades to tackle the challenges of salinity and CECs. Contaminant removal and desalination, along with more storage capacity and delivery infrastructure, will increase water reclamation in California. Together with comprehensive new water quality standards, updated reuse regulation, and consistent, statewide public education, the statewide investment in wastewater treatment and water reclamation will help California combat its present and predicted water shortage. The most welcome side benefit of a concerted drive for reclaimed water in California will be a significantly reduced pollutant load on the Pacific Ocean.

Summary of Heal the Ocean Recommendations on Water Reclamation and Reuse

Public education and promotion of water reuse: The public should be engaged in an active dialogue in developing new regulations and planning water recycling projects. Curricula need to be developed for public schools and institutions of higher education addressing water reuse issues. Public service announcements and relevant agency media bulletins and websites should highlight water recycling.

Research and technology development: The State should expand funding sources to include increased and sustained funding for research on the full range of recycled water issues.
Updated and streamlined regulations: State government should take a leadership role in improving consistency of policy within branches of State government. This should extend to regulations for indirect potable reuse to ensure adequate health and safety assurance for California residents. Regulation must be able to accommodate revised ambient water quality standards as research findings on CECs become clearer. A framework is also necessary for uniform regulations and revisions to be made to building and plumbing codes at local levels. Additionally, less burdensome regulatory mechanisms affecting incidental runoff of recycled water from use sites need to be implemented.

Improved water quality treatment and pollution prevention: Source control programs should be expanded and implemented in a wide-reaching campaign targeting and quickly engaging industrial wastewater dischargers and the general public for the long term. Local governments should have the ability to impose bans on, or require more stringent standards for, residential water softeners. Wastewater treatment plant improvements and upgrades should be at the most advanced level feasible and designed to efficiently accommodate enhanced treatment and increased water reuse in the future.

Financing: State funding for water reuse/recycling facilities and infrastructure should be increased beyond Propositions 50 and 84, and other current sources. A reliable and predictable funding procedure should be developed to provide local agencies with assistance through State and federal funding opportunities. State funding agencies should make better use of existing regional planning studies to determine the funding priority of projects. Funding sources should be expanded to include sustainable State funding for technical assistance and research, including flexibility to work on local and regional planning, emerging issues, and new technology.

Reclaimed Water – a Worldwide Effort

The need for increased water supplies worldwide has spurred a global campaign for recycled water, a campaign that is motivating improved wastewater treatment in many countries. A Queensland (Australia) Water Commission publication, *Fact Sheet* on *Purified Recycled Water*, states that the Commission's process for indirect re-use "…will be the world's best practice, underpinned by state-of-the-art technology, similar to that used in Singapore and Orange County." The *Fact Sheet* provides a useful guide to many technologies and operations in use by various wastewater plants around the world. The examples also show that California boasts at least one treatment plant known internationally for its water reclamation achievements (12).

Groundwater Reclamation Plant (GWR), Orange County (California). This facility is one of three U.S. examples of six summarized in the Queensland *Fact Sheet*. Treatment involves a dual membrane microfiltration process, reverse osmosis and advanced oxidation, yielding 70 million gallons daily of reclaimed, "near-distilled quality" water. The GWR website explains how the system received approval in 2008 "…to inject about half of the purified sewer water from the GWR System into OCWD's [Orange County Water District's] seawater intrusion barrier." On January 18, 2008, OCWD won final approval to allow for the release of the other half of the water to OCWD's groundwater spreading basins in Anaheim, and from there to be conveyed for indirect potable re-use.

Upper Occoquan, Northern Virginia. This treatment plant uses no membrane processes, but instead, incorporates aerobic treatment using activated sludge, high pH lime treatment, recarbonation, sand filtration, upflow carbon adsorption and chlorination. In 1998, this Northern Virginia plant reclaimed 87 million liters/23 million gallons of water, which was used to augment the Occoquan Reservoir. Monitoring results show the reclaimed water is "far cleaner" than other surface inflows.

Montebello Forebay Groundwater Recharge Project, Los Angeles County. The facility in this project uses sedimentation and activated sludge treatment, sand filtration and disinfection with chlorine before recharge of the aquifer. Influent is mainly domestic. Reclamation began in 1969 and contributes up to 38% of drinking water supplies, meeting "…drinking water standards for pesticides, heavy metals, minerals, trace organic compounds, microorganisms and radionuclides." The Queensland *Fact Sheet* states that, "studies examining health have found no negative impacts from drinking recycled water in this community." Further information from a technical bulletin of the Water Replenishment District of Southern California provides details of the of the recharge sources: "Since 1962/63, over 5.6 million acre feet (AF) of water has been recharged at the spreading grounds, including 2.23 million AF (40%) of storm water, 1.45 million AF (26%) of recycled water, and 1.92 million AF (34%) of imported water. Over time, recycled water amounts increased while imported water amounts decreased as the safety and reliability of the recycled water was proven through intensive sampling, monitoring, and research efforts. Currently, about 40% of the replenishment water is storm water, 40% is recycled water, and 20% is imported water" (13).

Torreele Reclamation Plant, Veurne-Ambacht, Flemish Coast, Belgium. In this tourist region, the local water supply comes from groundwater, which is under threat of seawater intrusion due to over-pumping of the groundwater. The Torreele plant treats wastewater from a nearby sewage plant to produce 660 million gallons annually of recycled water. Treatment consists of ultrafiltration, reverse osmosis, and ultraviolet disinfection. Following discharge into an infiltration basin, the water filters through sand dunes into the groundwater. A study published in January 2008 in the international (Elsevier) journal *Desalination* looked at the effectiveness of this case of indirect potable reuse. The study states that, "…due to the sensitive environmental nature of the dune area, the quality of the infiltration water is subject to stringent standards. The combination of membrane filtration techniques proved capable of producing this quality and enabled a sustainable groundwater management of both dune water catchments owned by the IWVA [Intermunicipal Water Company of the Veurne region]" (14).

Essex & Suffolk Water. Water reclamation in the County of Essex (United Kingdom) began in 1997. Using wastewater from a local sewage treatment plant, 128 million liters/134 million gallons per day of treated and UV-disinfected wastewater was mixed with river water and then sent into a reservoir. Extracted reservoir water was then treated with pre-ozonation, coagulation, settling, lime softening, rapid sand filtration, ozonation, granular activated carbon filtration and chlorination. Since 2003, a permanent system using these technologies now processes 40 million liters/40.5 million gallons per day. Wastewater receives advanced treatment at a reclamation plant before release to the river, which actually improves the river water quality. Downstream, all the water receives drinking water treatment before distribution to consumers, all of which augments the local drinking water supply by about 10 percent. The utility website states that the area served is one of the driest regions in the UK, "…with less water available for use than in many parts of Spain, Portugal and Italy (15).

Singapore. According to a *U.S. Water* news article, Singapore has been pumping reclaimed water into its water system since 2003. Today, with its new Changi plant producing up to 50 million gallons of per day, the government of Singapore has branded reclaimed water as "NEWater." Official promotion of NEWater by the State included the Prime Minister and his cabinet ministers drinking NEWater in public, along with the distribution of free, brightly labeled bottles of the reclaimed water at public functions. Although most of the reclaimed water supplies industrial uses, the quality achieved is so high that, "The water fabrication plant operators who require water quality more stringent than for drinking have reported savings of some 20 to 30%." The aim in Singapore is to produce 250 million liters per day for industry and 2.5% of drinking water by 2011. Treatment involves "membrane pre-treatment, reverse osmosis, UV disinfection and chlorination for control of bio-fouling and residual chlorine in NEWater. Unlike Water Factory 21 [Orange County's original 1976 reclamation plant], advanced oxidation is not required, (because) the level of n-nitrosodimethylamine (NDMA) in NEWater is low, at less than 10 parts per trillion. This could be attributed to wastewater mainly from domestic sources and to full secondary wastewater treatment" (12).

The Changi plant came on line in June 2009 and has a treatment capacity of 176 million gallons daily. The latest component of the country's deep tunnel sewage system, which was designed to treat and reclaim wastewater for 100 years, the system was named "Water Project of the Year" at the 2009 Global Water Awards held in Zurich (16) (17).

Moving beyond its long-established water conservation policy, the Singapore government plans to use nonconventional sources, including water reclamation and seawater desalination, to meet one third of the country's total water demand. Unused effluent is discharged through a five-mile ocean outfall (18).

Hong Kong. In 2001, the collection of sewage from five major areas around Victoria Harbour in Hong Kong received only chemically-enhanced primary treatment, and in 2005, disinfection was added (19). Improvements have accelerated since 2005 under the Hong Kong Government's Total Water Management program. Two pilot schemes promote the use of reclaimed water. Ngong Ping Sewage Treatment Works on Lantau Island has been operational since 2006 and is the first tertiary treatment works in Hong Kong to produce reclaimed water. The plant uses a sequencing batch reactor, dual media filter, and disinfection process to reduce organic pollutants, suspended solids, nutrients, and pathogens. The reclaimed water is used for local toilets, the Ngong Ping Cable Car Terminal, to raise aquarium fish, and for use in controlled irrigation within the sewage treatment works. The Shek Wu Hui Sewage Treatment Works also opened in 2006 and supplies reclaimed water to select nearby users, such as schools, senior citizen housing, decorative streams and fountains. The water is also used for domestic toilet flushing and unrestricted irrigation.

The Kingdom of Saudi. Reclaimed water is big business in Saudi Arabia. The Queensland Commission information states that, in 2009, "…the National Water Company described plans to set up joint-venture reclaimed water marketing companies in Riyadh and Jeddah that will be in charge of promotion and distribution of the TSE [treated sewage effluent], with the reclaimed water to be supplied by the new generation of advanced wastewater treatment plants being built in the Kingdom."

For California, like many of the above locations, leadership in wastewater treatment has become a necessity rather than a choice. The present push for more research and strong trend toward wide collaboration are signs of the progress toward new water quality standards and improved monitoring and reporting. The resulting new requirements will necessitate improvements in wastewater administration, infrastructure, and technology. But these improvements are already badly needed. The technology to remove or reduce CECs and salinity already exists. Water supplies are already growing scarce. Meanwhile, huge quantities of water that could be reclaimed are being wasted in ocean discharges that pollute the ocean. Support for improved wastewater treatment from State and federal funds, energy schemes, and public-private partnerships directed first to plants on the coast would represent a wise and overdue investment. In present times of uncertain supply and risk, investment now would help secure more than future water supplies. By acting together to reclaim high quality water, we would take a sensible and necessary step toward a sustainable, future for both the environment and the people of California.

PART THREE

INVENTORY

Introductory Notes

Data Sources
Data used in the depth/distance figure and inventoried in tables were compiled from: 1) waste discharge requirements for individual plants for 2005 or most recent year available; 2) annual reports by individual plants for 2005 or most recent year available; 3) August 2009 phone/email survey of plant operators on information and figures for water reclamation and plant improvements made since 2005; 4) census data; 5) regional board staff; 6) individual plant websites; 7) U.S. EPA Facility Registry System; and 8) Google Earth.

Relative Plant Size
(as calculated by Heal the Ocean)

very small	-	up to 0.1 MGD
small	-	0.1 to 1 MGD
medium	-	1 to 10 MGD
large	-	10 to 100 MGD
very large	-	100 MGD and over

U.S. EPA plant classification

minor	-	up to 1 MGD
major	-	1 MGD and over

Seasonal Average Flow *(effluent)*
wet months: December – May / dry months: June – November

Influent: data on influent were not collected.

Types of Facilities:
Outfalls: Aliso Creek and San Juan: the 52 facilities in the *Inventory* include two outfalls – supplied by eight separate plants for which it serves as the permitted facility. Individual plants served required to meet periodic monitoring requirements since 2006.

Combined plant: San Francisco Oceanside: only one of its kind in the State that treats both sewage from sanitary system and storm water runoff, and which removes 100% of "first flush" storm water, treating pollutants in this runoff. This feature of the plant places it strictly outside comparison with other plants in the State

Treatment plant (TP) / facility (TF); **reclamation plant (RP) / facility (RF)**; **Water pollution control plant (WPCP) / facility (WPCF):** These terms all describe sewage wastewater treatment plants.

Outfalls and Diffusers
Figures provided in most cases refer to the terminus of the pipe. However, some waste discharge requirements use measurements that include the length of diffusers, which can add several feet in depth and up to 200 feet in length. In the case of shared outfalls such as San Elijo, discharge points for different plants are located at different points along the pipe where diffusers are also added.

Water Quantity Context
An average California household uses between about 445 and 890 gallons per day (one half to about 4/5 of an acre foot per year). US Department of Agriculture: http://www.fs.fed.us/r5/publications/water_resources/html/water_use_facts.html.

Interactive Online Site for Researchers
Ocean Discharging Treatment Plants and Outfalls: Interactive GIS mapping by David Greenberg, Ph.D.
We invite researchers to use this prototype site constructed with multiple layers and search and results functions that draw on a database of the material provided in the *Inventory.* (Please note: software constraints limit simultaneous users to 20.) http://maps8.msi.ucsb.edu/HTO/

California Treated Wastewater Ocean Discharge Characteristics

Distance and Depth of Ocean Discharges from Wastewater Treatment Facilities in California

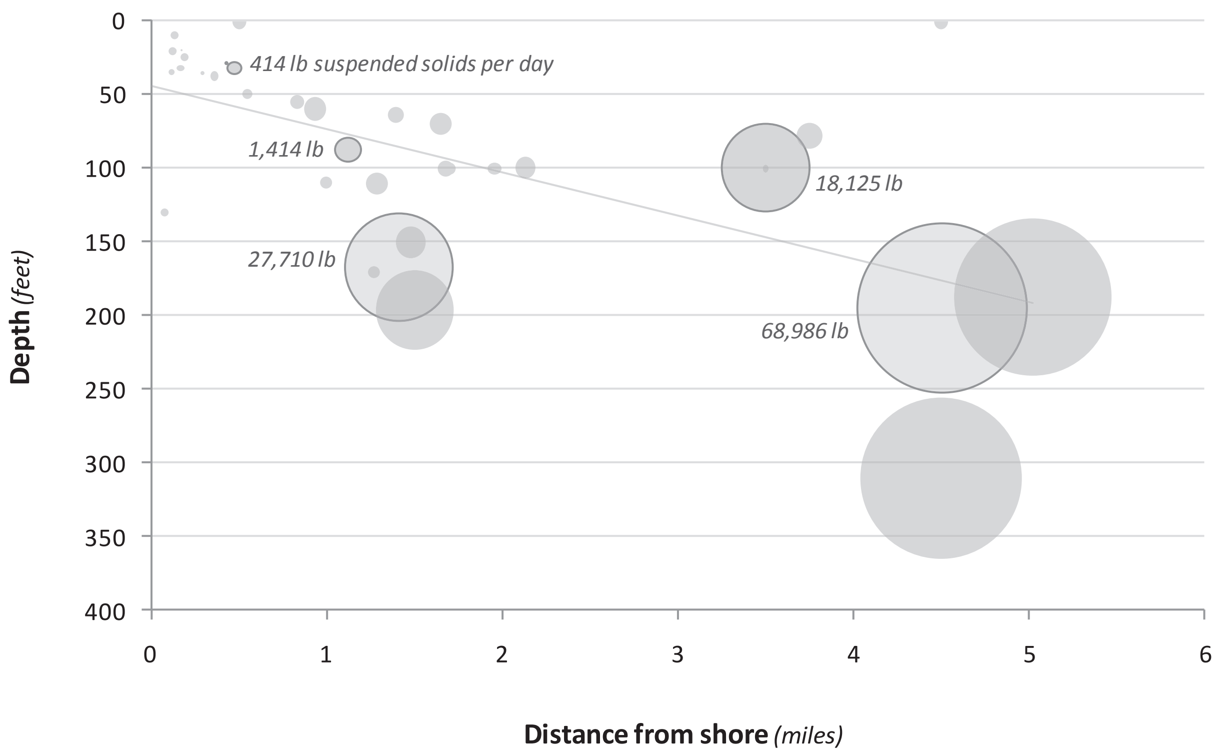

Figure 3.1. Distance and depth of discharges from wastewater treatment facilities in California discharging into the Pacific Ocean in or close to 2005. Circles indicate amount in lb/day of total solids suspended in discharged effluent, sample values provided. Trend line for depth included. (See Table 3.2 for measurements for each plant.)

Relative Size of Ocean Discharging Wastewater Treatment Plants in California

Wastewater Treatment Facility	Average Flow Millions of Gallons daily	Population Served	Relative Plant Size *(by Average Flow)*
Anchor Bay (Mendocino County)	0.01	86	very small
Ragged Point Inn	0.01	12	very small
San Clemente Island	0.02	500	very small
Avila Beach	0.04	500	very small
San Simeon	0.07	429	very small
Mendocino City	0.08	1,000	very small
Shelter Cove	0.15	973	small
Summerland	0.21	2,500	small
Avalon	0.51	3,500	small
Fort Bragg	0.97	6,500	small
Montecito	1.13	10,000	medium
Pismo	1.18	9,500	medium
Morro Bay	1.25	13,293	medium
Carpinteria	1.58	16,500	medium
Fallbrook	1.59	25,000	medium
Crescent City	1.63	14,387	medium
Carmel	1.95	17,600	medium
Camp Pendleton#1*	2.10	49,000	medium
Half Moon Bay	2.19	20,500	medium
Arcata	2.72	17,000	medium
So. San Luis Obispo County	2.81	37,000	medium
San Elijo	3.12	35,000	medium
South Bay	3.95	150,000	medium
Goleta	4.51	74,000	medium
Eureka	6.50	45,000	medium
Daly City (North San Mateo)	6.75	120,000	medium
Watsonville	7.63	61,000	medium

**Table 3.1. Ocean discharging wastewater treatment plants in California by size. U.S. EPA classifies a plant as "major" if it discharges one million or more gallons daily, and "minor" if it discharges less than this amount. Relative size calculated by Heal the Ocean on the following basis: up to one tenth of a million gallons daily (MGD) – very small; one tenth to one MGD – small; one to 10 MDG – medium; 10 to 100 MGD – large; 100 MGD and over – very large. Based mainly on 2005 average flows – largely unchanging over time. ****Camp Pendleton plants offline March 2009.*

Quantities by California Water Quality Control Board Region of Treated Wastewater Effluent and Suspended Solids Discharged Daily into the Pacific Ocean off the Coast of California

Wastewater treatment plant	Total suspended solids *(average lb/day)*	Percentage of total for all plants	*Ratio: lb total suspended solid per day /millions of gallons daily*	Treated effluent discharged *(millions of gallons daily)*	Percentage of total for all plants
REGION 1 North Coast	1,413.94	0.52	*0.009*	12.06	0.89
REGION 2 San Francisco Bay	2,256.83	0.83	*0.011*	25.90	1.92
REGION 3 Central Coast	5,876.17	2.18	*0.009*	52.71	3.90
REGION 4 Los Angeles	102,977.72	38.18	*0.007*	696.19	51.57
REGION 8 Santa Ana	68,986.59	25.58	*0.004*	245.92	18.22
REGION 9 San Diego	88,227.57	32.71	*0.004*	317.19	23.49
			Average ratio **0.007**		
Total suspended solids DAILY TOTAL *lb/day*	**269,738.82**		**Treated effluent discharged DAILY TOTAL** *millions of gallons daily*	**1,349.97**	
short tons/day	**134.87**				
ANNUAL TOTAL *lb/year*	**98,454,669.07**				
short tons/year	**49,227.33**		**ANNUAL TOTAL** *millions of acre feet/year*	**1.52**	

Table 3.2. Total suspended solids and treated effluent discharged daily and annually in 2005, or year close, by wastewater treatment facilities – summed for each coastal California water quality control board region. Ratio calculated of total suspended solids (lb) in treated effluent per day to millions of gallons discharged daily.

Treatment Level and Quantities of Wastewater Effluent and Suspended Solids Discharged Daily by Wastewater Treatment Facilities into the Pacific Ocean off California

	Wastewater treatment plant	Total suspended solids *(average lb/day)*		Average dry weather discharge *(millions of gallons daily)*		Average discharge *(millions of gallons daily)*	2005 Level of treatment of discharge	Distance from shore *(miles)*	Depth *(ft)*
		Original inventory figure	2005	Original inventory figure	2005	2005			
1	**Anchor Bay**	not included	**0.40**	not included	0.01	0.01	secondary with chlorination and dechlorination	0	0
2	**Ragged Point Inn**	(2003) **1.21**	**0.61**	(2003) 0.013	0.01	0.01	secondary with disinfection	0	0
3	**Mendocino City**	(2003) **6.04**	**2.20**	(2003) 0.05	0.07	0.08	tertiary	0.19	60
4	**San Clemente Island**	(2000) **0.91**	**2.69**	(2000) 0.02	0.02	0.02	secondary with chlorination and dechlorination	0	0
5	**Shelter Cove**	(2003) **24.16**	**4.16**	(2003) 0.17	0.11	0.15	secondary with chlorination and dechlorination	0	0
6	**Summerland**	(2003) **18.12**	**4.29**	(2003) 0.15	0.16	0.21	tertiary	0.14	20
7	**San Simeon**	(2002) **9.66**	**6.11**	(2002) 0.075	0.07	0.07	secondary with chlorination and dechlorination	0.17	20
8	**Avila Beach**	(2003) **3.02**	**9.09**	(2003) 0.03	0.04	0.04	secondary with chlorination and dechlorination	0.42	29
9	**Fallbrook**	—	**44.38**	—	1.29	1.59	tertiary	1.68	100
10	**Montecito**	(2001) **126.84**	**54.31**	(2001) 1	0.94	1.13	secondary with chlorination and dechlorination	0.29	35
11	**Carmel Area**	(2001) **144.96**	**58.07**	(2001) 1.60	1.67	1.95	secondary	0.11	35
12	**Avalon**	(2000) **66.44**	**109.16**	(2000) 0.60	0.55	0.51	secondary with some chlorination	0.08	130
13	**South Bay** (San Diego)	(2003) **15,534.78**	**124.99***	(2003) 4.10	3.95	3.95*	secondary w/ disinfection	3.50	100
14	**Terminal Island**	(2000) **132.88**	**133.25**	(2000) 30	15.68	15.97	tertiary	0.17	32
15	**Carpinteria**	(2000) **211.40**	**150.41**	(2000) 1.70	1.44	1.58	secondary with chlorination and dechlorination	0.19	25
16	**Pismo Beach**	not included	**153.87**	not included	1.16	1.18	secondary with chlorination and dechlorination	0.83	55
17	**Fort Bragg**	(2003) **163.08**	**162.11**	(2003) 1.30	0.71	0.97	secondary with chlorination and dechlorination	0.12	20
18	**Crescent City**	(2003) **235.56**	**180.57**	(2003) 1.9	1.47	1.63	secondary with chlorination and dechlorination	0.13	10
19	**Half Moon Bay**	(2003) **199.32**	**201.67**	(2003) 2.20	1.79	2.19	secondary with chlorination and dechlorination	0.36	37
20	**Morro Bay/Cayucos**	(2002) **126.84**	**257.61**	(2002) 1.40	1.18	1.25	blended primary and secondary with chlorination and dechlorination	0.55	50
21	**Camp Pendleton 1**	—	**309.23**	—	1.93	2.10	secondary with some chlorination	1.68	100
22 23 24 25	**SOCWA Regional** **SOCWA Coastal** **Los Alisos** **El Toro**	**Aliso Creek Outfall** (2000) **1,207.99**	**1,346.59**	(2000) 17.60	13.78	16.87	disinfected secondary	1.27	170

	Wastewater treatment plant	Total suspended solids (average lb/day) Original inventory figure	Total suspended solids (average lb/day) 2005	Average dry weather discharge (millions of gallons daily) Original inventory figure	Average dry weather discharge (millions of gallons daily) 2005	Average discharge (millions of gallons daily) 2005	2005 Level of treatment of discharge	Distance from shore (miles)	Depth (ft)
26	Santa Cruz	(2002) 742.92	371.03	(2002) 9.10	9	11.38	secondary with ultraviolet disinfection	1	110
27	San Elijo	—	411.51	—	3.03	3.12	undisinfected secondary	1.50	150 -160
28	Daly City	(2003) 616.08	414.38	(2003) 6.80	6.25	6.75	secondary with chlorination and dechlorination	0.47	32
29 30 31 32	JB Latham 3A Chiquita San Clemente	San Juan Creek Outfall (2000) 1,721.39	2,134.68	(2000) 18.70	21.77	23.17	undisinfected and disinfected secondary, some tertiary	1.96	100
33	So. San Luis Obispo	not included	504.92	not included	2.74	2.81	secondary with chlorination	0.83	55
34	Arcata	(2003) 211.40	522.05	(2003) 1.70	2.02	2.72*	secondary with chlorination, dechlor. and marshland secondary treatment equivalent	0 to bay, 9 to ocean	0
35	Watsonville	(2002) 682.52	529.36	(2002) 7.50	7.34	7.63	secondary with chlorination and dechlorination	1.39	64
36	Eureka	(2003) 652.32	542.45	(2003) 5.20	5.33	5.45	secondary with chlorination and dechlorination	0 to bay, 1 to ocean	0
37	Oceanside	—	640.37	—	16.02	15.04	undisinfected secondary	1.68	100
38	Escondido	—	1,082.96	—	14.33	13	undisinfected secondary	1.29	110
39	Monterey	(2001) 1,292.55	1,114.53	(2001) 29.60	5.18	10.71	undisinfected secondary	2.13	100
40	Santa Barbara	(2003) 1,063.03	1,247.88	(2003) 8.50	7.39	8.23	secondary with chlorination and dechlor., some tertiary	1.65	70
41	Oxnard	(2000) 1,352.95	1,321.22	(2000) 21	23.83	24.49	secondary with chlorination and dechlorination	0.93	60
42	Goleta	(2001) 1,703.27	1,414.10	(2001) 4.80	3.65	4.51	blended primary and secondary	1.12	87
43	San Francisco, Oceanside	(2002) 1,640.78		(2002) 18	16.57	16.97*	secondary - up to 43 MGD, primary 44 - 175 MGD	3.50	78
44	Encina	(2000) 1,715.35	2,199.15	(2000) 22.90	26.95	29.08	undisinfected secondary	1.48	150
45	International	(2003) 133.48	18,125.85	(2003) 25	24.54	24.05	advanced primary	3.50	100
46	JWPCP	(2003) 44,635.31	outfall 1 27,709.86 outfall 2 14,920.69	(2003) 320	317.88	outfall 1 216.42 outfall 2 116.53	secondary with chlorination	1.51 1.41	196-210 167-190
47	Hyperion	(2002) 44,695.71	58,780.86	425	318.83	332.25	disinfected secondary	5.02	~187
48	Point Loma	(2003) 59,493.61	61,807.87	170	172.35	183.16	advanced primary, some tertiary	4.50	310
49	Orange Cty. Plants 1&2	(2002) 8,455.94	68,986.59	(2002) 320	236.33	245.92	primary/secondary with chlorination and some dechlor.	4.50	195

Table 3.3. Treatment level and quantities of effluent and total suspended solids discharged into the ocean by individual wastewater facilities daily (data from original Heal the Ocean *Inventory* and for 2005). Note: For method of calculation of total suspended solids (TSS), see this report, *Part 1, Methods, Phase 2: Analysis and Calculations*; JWPCP 42,630.55 total TSS; Camp Pendleton plants offline March 2009. * *See individual plant summary page for exception to compiled or calculated data.*

Quantities and Treatment Levels of Wastewater Effluent Discharged into the Pacific Ocean off the Coast of California at a Range of Depths

Wastewater treatment plants	Up to 2,500 ft from shore		Depth 50 – 100 ft		Depth 101 – 150 ft		Depth 151 ft plus		Total			
	Avg. lb/day	*% of total*	Avg. lb/day	*% of total*	Avg. lb/day	*% of total*	Avg. lb/day	*% of total*	Avg. lb/day	MGD	Avg. short tons/day	*% of Total TSS*
San Francisco, Oceanside International Point Loma	**0**	*0*	**19,766.62**	*7.33*	**61,807.87**	*22.91*	**0**	*0*	**81,574.50**	*224.18*	**40.79**	*30.24*
Treatment level of discharged effluent: *Blended primary and secondary, no disinfection; Advanced primary; Advanced primary, some tertiary*												
San Elijo Monterey Regional Escondido Oceanside Encina Hyperion	**0**	*0*	**1,754.90**	*0.65*	**3,693.61**	*1.37*	**58,780.86**	*21.79*	**64,229.37**	*405.19*	**32.12**	*23.81*
Treatment level of discharged effluent: *Secondary without disinfection; Secondary without disinfection and some tertiary; Secondary with and without disinfection*												
Goleta Morro Bay/Cayucos Camp Pendleton No.1 Orange County Plants 1 & 2	**0**	*0*	**1,980.94**	*0.73*	**0**	*0*	**68,986.59**	*25.58*	**70,967.53**	*253.78*	**35.48**	*26.31*
Treatment level of discharged effluent: *Primary and secondary with chlorination; Secondary with chlorination and dechlorination; Secondary with some chlorination, some no dechlorination; Blended primary and secondary with chlorination, some dechlorination and some tertiary*												
Ragged Point Inn Avalon So. San Luis Obispo South Bay *(San Diego)* Santa Cruz Joint Water Pollution Control Plant *(LA County)*	**109.77**	*0.04*	**629.90**	*0.23*	**371.03**	*0.14*	**42,630.55**	*15.80*	**43,741.25**	*341.60*	**21.87**	*16.22*
Treatment level of discharged effluent: *Secondary with disinfection/chlorination/ultraviolet*												
SOCWA Regional SOCWA Coastal Los Alisos El Toro Water SOCWA JB Latham Chiquita San Clemente SOCWA Plant 3A	**2,308.47**	*0.86*	**3,252.32**	*1.21*	**0**	*0*	**0**	*0*	**3,481.27**	*40.03*	**1.74**	*1.29*
Treatment level of discharged effluent: *Secondary with disinfection, some tertiary*												

Wastewater treatment plants	Up to 2,500 ft from shore		Depth 50 – 100 ft		Depth 101 – 150 ft		Depth 151 ft plus		Total	
	Avg. lb/day	% of total	Avg. lb/day	% of total	Avg. lb/day	% of total	Avg. lb/day	% of total		
Anchor Bay San Clemente Island Avila Beach San Simeon Shelter Cove Fort Bragg Montecito Pismo Beach Carpinteria Crescent City Half Moon Bay Arcata Eureka Daly City Watsonville Oxnard Carmel Area Santa Barbara	**25.72**	*1.91*	**41.53**	*3.08*	**0**	*0*	**0**	*0*	Avg. lb/day **5,560.79**	**MGD** *67.26*
	Treatment level of discharged effluent *Secondary w/ chlorination and dechlorination;* *Secondary w/ chlorination and dechlorination, some tertiary*								Avg. short tons/day **2.78**	*% of Total TSS* *2.06*
Mendocino City Summerland Fallbrook Terminal Island	**139.74**	*0.05*	**44.38**	*0.02*	**0**	*0*	**0**	*0*	Avg. lb/day **184.12**	**MGD** *17.85*
	Treatment level of discharged effluent *Tertiary*								Avg. short tons/day **0.09**	*% of Total TSS* *0.07*
AVERAGE DAILY TOTALS	**Up to 2,500 ft from shore**		**Depth 50 – 100 ft**		**Depth 101 – 150 ft**		**Depth 151 ft plus**		**MGD** ***1,349.89***	
	Avg. lb/day	*% of total*	Avg. lb/day	*% of total*	Avg. lb/day	*% of total*	Avg. lb/day	*% of total*	Avg. lb/day	Avg. short tons/day
Total Suspended Solids	**2,557.98**	*0.95*	**29,563.74**	*10.96*	**4,064.64**	*1.51*	**233,552.46**	*86.58*	***269,738.82***	***134.87***

Table 3.4. Quantities and treatment levels of effluent discharged by wastewater treatment facilities in 2005, or year close, into the Pacific Ocean off the coast of California at a range of depths.

Partial Summary Information on Water Reclamation by California Ocean Discharging Wastewater Treatment Facilities

Average Water Reclaimed Daily by California Water Quality Control Board Region

Wastewater treatment plant	2005 Treated effluent discharged *(average millions of gallons daily)*	2008 Water reclaimed *(average millions of gallons daily)*	2008 Secondary treated reclaimed water *(average millions of gallons daily)*	2008 Tertiary treated reclaimed water *(average millions of gallons daily)*
REGION 1 North Coast	12.06	>0.01	-	>0.01
REGION 2 San Francisco Bay	25.90	>4.27	>1.5	>2.77
REGION 3 Central Coast	52.71	>20.11	>0.19	>19.9
REGION 4 Los Angeles	696.19	>206.81	>133.31	>73.5
REGION 8 Santa Ana	245.92	>44	-	>44
REGION 9 San Diego	317.19	>36.65	>4	>26.65
Average millions of gallons daily TOTAL	**1,349.97**	**>311.85**	**>139**	**>166.83**
Total average acre feet/year	1,511,966.40	>349,272	>155,680	>186,849.60

Table 3.5. Approximate average quantity of water reclaimed daily in 2008 by ocean discharging wastewater treatment plants in California coastal water quality control board regions. Recycled water amounts provided by individual wastewater treatment plants. Based on these incomplete figures, Region 8 and Region 9 accounted for about 42% (80.86 MGD) of the total effluent discharged in 2005, and about 46% of the total water reclaimed in 2008 (4.21 MGD secondary and 70.65 MGD tertiary).

Average Quantity and Treatment Level of Water Reclaimed Daily by California Ocean Discharging Wastewater Treatment Plants

	Wastewater treatment plant	2005 average discharge *(millions of gallons daily)*	2008 approximate average reclaimed water *(millions of gallons daily)*	2008 approximate % reclaimed water	Level of treatment of reclaimed water
1	**Anchor Bay**	0.01	**	**	disinfected secondary
2	**Ragged Point Inn**	0.01	< 0.02	**	disinfected tertiary, some disinfected secondary
3	**Mendocino City**	0.08	~0.01	6	disinfection tertiary
4	**San Clemente Island**	0.02	~0.21	**	disinfected secondary
5	**Shelter Cove**	0.15	**	**	tertiary, some disinfected secondary
6	**Summerland**	0.21	none	0	none
7	**San Simeon**	0.07	none	0	none
8	**Avila Beach**	0.04	none	0	none
9	**Fallbrook**	1.59	~1.60	100	disinfected tertiary
10	**Montecito**	1.13	none	0	none
11	**Carmel Area**	1.95	1.10	**	tertiary
12	**Avalon**	0.51	none	0	none
13	**South Bay** (San Diego)	3.95*	6.49	75-100	tertiary
14	**Terminal Island**	15.97	~3.50	20	undisinfected tertiary
15	**Carpinteria**	1.58	none	0	none
16	**Pismo Beach**	1.18	none	0	none
17	**Fort Bragg**	0.97	none	0	none
18	**Crescent City**	1.63	none	0	none
19	**Half Moon Bay**	2.19	none	0	none
20	**Morro Bay/Cayucos**	1.25	none	0	none
21	**Camp Pendleton 1**	2.1	offline	2009	replaced by Southern Region Tertiary Treatment Plant
	Southern Region Tertiary Treatment Plant (SRTTP)		**	**	disinfected tertiary
22	**SOCWA Regional**		6.22	62	disinfected tertiary
23	**SOCWA Coastal**	**Aliso Creek Outfall**	0.78	20	disinfected tertiary
24	**Los Alisos**	16.87	3	65	disinfected tertiary
25	**El Toro**		> 4	**	disinfected secondary

	Wastewater treatment plant	2005 average discharge *(millions of gallons daily)*	2008 approximate average reclaimed water *(millions of gallons daily)*	2008 approximate % reclaimed water	Level of treatment of reclaimed water
26	**Santa Cruz**	11.38	~0.19	2	disinfected secondary
27	**San Elijo**	3.12	1	33	disinfected tertiary
28	**Daly City**	6.75	2.77	<25	disinfected tertiary
29	**JB Latham**	**San Juan Creek Outfall** 23.16	none	0	none
30	**3A**		0.62	28	disinfected tertiary
31	**Chiquita**		2.14	32	tertiary
32	**San Clemente**		1	15	disinfected tertiary
33	**So. San Luis Obispo**	2.81	none	0	none
34	**Arcata**	2.72*	*	*	disinfected secondary flows equivalent to re-use in marsh habitat maintenance
35	**Watsonville**	7.63	**	>50	disinfected tertiary
36	**Eureka**	6.5	none	0	insubstantial amount of disinfected secondary
37	**Oceanside**	15.04	0.30	3	tertiary
38	**Escondido**	14.99	~3.50	12-13	disinfected tertiary
39	**Monterey**	10.71	~12.50	60	disinfected tertiary
40	**Santa Barbara**	8.23	4.30	**	disinfected tertiary
41	**Oxnard**	24.49	in plant only	0	unsubstantial amount of 3W final effluent water (disinfected secondary)
42	**Goleta**	4.51	~2	40-50	tertiary
43	**S. Francisco, Oceanside**	16.97*	<1.50	<10	undisinfected secondary
44	**Encina**	29.08	~6 to reclamation plant	18-36 to reclamation plant	disinfected secondary and tertiary
45	**International**	24.05	none	0	none
46	**JWPCP**	**outfall 1** 209.92 **outfall 2** 113.03	133.10	31	disinfected secondary
47	**Hyperion**	332.25	70 to reclamation plant	**	tertiary
48	**Point Loma**	183.16	none	0	none
49	**Orange County 1&2**	245.92	44 to reclamation plant	20.9	disinfected secondary to reclamation plant becomes tertiary
	Average reclaimed water daily APPROXIMATE TOTAL (using range averages) *(millions of gallons daily)*	**1,349.88**	**>311.85**		

Table 3.6. Approximate average quantity and treatment level of water reclaimed daily in 2005 and 2008 by ocean discharging wastewater treatment plants in California. ** See individual plant summary page for exception to compiled or calculated data. **Figures not available or not provided.*

Summary Information – by Water Quality Control Board Region

2005 Discharge Summary /**2008** Water Reclamation Information
REGION 1 – North Coast - California Sewage Wastewater Treatment Plants Discharging to the Ocean
http://www.waterboards.ca.gov/northcoast

	TREATMENT PLANT	# of people served	2005 average total suspended solids (average lb/day)	2005 average discharge (millions of gallons daily)	Level of treatment of discharge	Distance from shore (miles)	Depth (ft)	2008 average reclaimed water amount (millions of gallons daily)	2008 approximate % reclaimed water
1	Anchor Bay (Mendocino County)	86	0.40	0.01	secondary w/ chlorination and dechlorination	0.00	0		
2	Mendocino City	1,000	2.20	0.08	tertiary	0.19	60	0.0055	6
3	Shelter Cove	937	4.16	0.15	secondary w/ chlorination and dechlorination	0.00	0		
4	Fort Bragg	6,500	162.11	0.97	secondary w/ chlorination and dechlorination	0.12	20	none	0
5	Crescent City	14,387	180.57	1.63	secondary w/ chlorination and dechlorination	0.13	10	none	0
6	Eureka	45,000	542.45	6.50	secondary w/ chlorination and dechlorination	0 to bay, 1 to sea	0	none	0
7	Arcata	17,000	522.05	2.72*	secondary w/ chlorination and dechlorination; marshland tertiary	0 to bay, 9 to sea	0	*	*
	REGIONAL TOTAL	84,910	1,413.94 lb/day; 0.71 short tons/day 516,088.10 lb/year; 258.04 short tons/year	12.06 millions of gallons daily 13,507.2 acre feet per year				>0.0055 millions of gallons daily >6.15 acre feet per year	

http://www.healtheocean.org/images/_pages/research/wdi/REGION1.jpg

2005 Discharge Summary /**2008** Water Reclamation Information
REGION 2 – San Francisco Bay - California Sewage Wastewater Treatment Plants Discharging to the Ocean
http://www.waterboards.ca.gov/sanfranciscobay

	TREATMENT PLANT	# of people served	2005 average total suspended solids (average lb/day)	2005 average discharge (millions of gallons daily)	Level of treatment of discharge	Distance from shore (miles)	Depth (ft)	2008 average reclaimed water amount (millions of gallons daily)	2008 approximate % reclaimed water
1	Half Moon Bay (SAM)	20,500	201.67	2.19	secondary w/ chlorination and dechlorination	0.36	37	none	0
2	Daly City	120,000	414.38	6.75	secondary w/ chlorination and dechlorination	0.47	32	2.77	<25
3	San Francisco, Oceanside*	250,000	1,640.78	16.97	secondary	3.75	78	<1.5	<10
	REGIONAL TOTAL	390,500	2,256.83 lb/day; 1.13 short tons/day 823,742.95 lb/year; 823,742.95 short tons/year	25.91 millions of gallons daily 29,019.2 acre feet per year				<4.27 millions of gallons daily <4,782.4 acre feet per year	

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2005 Discharge Summary /2008 Water Reclamation Information
REGION 3 – Central Coast – California Sewage Wastewater Treatment Plants Discharging to the Ocean
http://www.waterboards.ca.gov/centralcoast

	TREATMENT PLANT	*# of people served*	*2005 average total suspended solids* (average lb/day)	*2005 average discharge* (millions of gallons daily)	Level of treatment of discharge	Distance from shore (miles)	Depth (ft)	*2008 average reclaimed water amount* (millions of gallons daily)	*2008 approximate % reclaimed water*
1	**Ragged Point Inn**	12	0.61	0.01	secondary w/ disinfection	0.00	0	<0.015	
2	**Summerland**	2,500	4.29	0.21	tertiary	0.14	20	none	0
3	**San Simeon**	429	6.11	0.07	secondary w/ chlorination and dechlorination	0.17	20	none	0
4	**Avila Beach**	500	9.09	0.04	secondary w/ chlorination and dechlorination	0.42	29	none	0
5	**Montecito**	10,000	54.31	1.13	secondary w/ chlorination and dechlorination	0.29	35	none	0
6	**Carmel Area**	17,600	58.07	1.95	secondary	0.11	35	1.1	
7	**Carpinteria**	16,500	150.41	1.58	secondary w/ chlorination and dechlorination	0.19	25	none	0
8	**Pismo Beach**	9,500	153.87	1.18	secondary w/ chlorination and dechlorination	0.83	55	none	0
9	**Morro Bay/Cayucos**	13,293	257.61	1.25	blended primary and secondary w/ cholorination and dechlorination	0.55	50	none	0
10	**Santa Cruz**	150,000	371.03	11.38	secondary w/ ultraviolet disinfection	1.00	110	~0.185	2

http://www.healtheocean.org/images/_pages/research/wdi/REGION3(p.1).jpg

2005 Discharge Summary /2008 Water Reclamation Information
REGION 3 – Central Coast - California Sewage Wastewater Treatment Plants Discharging to the Ocean
http://www.waterboards.ca.gov/centralcoast

	TREATMENT PLANT	*# of people served*	*2005 average total suspended solids* (average lb/day)	*2005 average discharge* (millions of gallons daily)	Level of treatment of discharge	Distance from shore (miles)	Depth (ft)	*2008 average reclaimed water amount* (millions of gallons daily)	*2008 approximate % reclaimed water*
11	**So. San Luis Obispo**	37,500	504.92	2.81	secondary w/ chlorination	0.83	55	none	0
12	**Watsonville**	61,000	529.36	7.63	secondary w/ chlorination and dechlorination	1.39	64		>50
13	**Monterey Regional**	252,000	1,114.53	10.71	secondary	2.13	100	~12.5	60
14	**Santa Barbara**	96,000	1,247.88	8.23	secondary w/ chlor. and dechlor., some tertiary	1.65	70	4.3	
15	**Goleta**	74,000	1,414.10	4.51	blended primary and secondary	1.12	87	~2	40-50
	REGIONAL TOTAL	**740,834**	**5,876.19** lb/day; **2.94** short tons/day; ***2,144,809.35*** lb/year; ***1,072.41*** short tons/year	**52.688** millions of gallons daily; **59,010.56** acre feet per year				**~20.1** millions of gallons daily; **~22,512** acre feet per year	

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2005 Discharge Summary /2008 Water Reclamation Information
REGION 4 – Los Angeles – California Sewage Wastewater Treatment Plants Discharging to the Ocean
http://www.waterboards.ca.gov/losangeles

	TREATMENT PLANT	*# of people served*	*2005 average total suspended solids* *(average lb/day)*	*2005 average discharge* *(millions of gallons daily)*	Level of treatment of discharge	Distance from shore *(miles)*	Depth *(ft)*	*2008 average reclaimed water amount* *(millions of gallons daily)*	*2008 approximate % reclaimed water*
1	**San Clemente Island**	500	2.69	0.02	secondary w/chlorination and dechlorination	0	0	0.21	
2	**Avalon**	3,500	109.16	0.51	secondary w/ some chlorination, no dechlorination	0.08	130	none	0
3	**Terminal Island**	130,000	133.25	15.97	tertiary	0.17	32	3.5	20
4	**Oxnard**	225,000	1,321.22	24.49	secondary w/ chlorination and dechlorination	0.93	60	in plant only	0
5	**JWPCP (LA County)**	3,500,000	42,630.55	322.95	secondary w/ disinfection	OO1: 1.41 OO2: 1.51	OO1: 167 to 190 OO2: 196 to 210	133.1	31
6	**Hyperion (LA City)**	4,000,000	58,780.86	332.25	secondary w/out disinfection	5.02	187	70	*
	REGIONAL TOTAL	**7,859,000**	**102,977.73** *lb/day*; **51.49** *short tons/day* **37586860.50** *lb/year*; **18793.43** *short tons/year*	**696.19** *millions of gallons daily* **779,732.8** *acre feet per year*				**206.81** *millions of gallons daily* **231,627.2** *acre feet per year*	

http://www.healtheocean.org/images/_pages/research/wdi/REGION4.jpg

2005 Discharge Summary /2008 Water Reclamation Information
REGION 8 – Santa Ana – California Sewage Wastewater Treatment Plants Discharging to the Ocean
http://www.waterboards.ca.gov/santaana

	TREATMENT PLANT	*# of people served*	*2005 average total suspended solids* *(average lb/day)*	*2005 average discharge* *(millions of gallons daily)*	Level of treatment of discharge	Distance from shore *(miles)*	Depth *(ft)*	*2008 average reclaimed water amount* *(millions of gallons daily)*	*2008 approximate % reclaimed water*
1	**Orange County Plant 1**	2,500,000	54,552	211	Blended treated primary and secondary effluent	4.50	195	*.	20.90
2	**Orange County Plant 2**								
	REGIONAL TOTAL	**2,500,000**	**54,552** *lb/day*; **27.28** *short tons/day* **19,911,480** *lb/year*; **9,955.74** *short tons/year*	**211** *millions of gallons daily* **247,520** *acre feet per year*					

http://www.healtheocean.org/images/_pages/research/wdi/REGION8.jpg

2005 Discharge Summary /2008 Water Reclamation Information

REGION 9 – San Diego – California Sewage Wastewater Treatment Plants Discharging to the Ocean

http://www.waterboards.ca.gov/sandiego

	TREATMENT PLANT		# of people served	2005 average total suspended solids (average lb/day)	2005 average discharge (millions of gallons daily)	Level of treatment of discharge	Distance from shore (miles)	Depth (ft)	2008 average reclaimed water amount (millions of gallons daily)	2008 approximate % reclaimed water
1	Fallbrook		25,000	44.38	1.59	tertiary	1.68	100	~1.6	100
2	South Bay (San Diego)		150,000	124.99*	3.95*	secondary w/ disinfection	3.50	100	6.49	75-100
3	Camp Pendleton		49,000	309.23	2.10	secondary w/ some chlorination	1.68	100	offline	2009
4	San Elijo		35,000	411.51	3.12	undisinfected secondary	1.50	150 - 160	1	33
5	Ocean -side	San Luis Rey Treatment Plant La Salina Treatment Plant	184,000	640.37	15.04	undisinfected secondary	1.68	100	0.3	3
6	Escondido (HARRF)		173,300	1,082.96	13	undisinfected secondary	1.29	110	~3.5	12-13
7	Aliso Creek Outfall	SOCWA Regional Treatment Plant							6.22	62
8		SOCWA Coastal Treatment Plant							0.78	20
9		Los Alisos Water Reclamation Plant							3	65
10		El Toro Water Reclamation Plant	232,000	1,346.59	16.87	disinfected secondary, some tertiary	1.27	170	>4	

http://www.healtheocean.org/images/_pages/research/wdi/REGION9(p.1).jpg

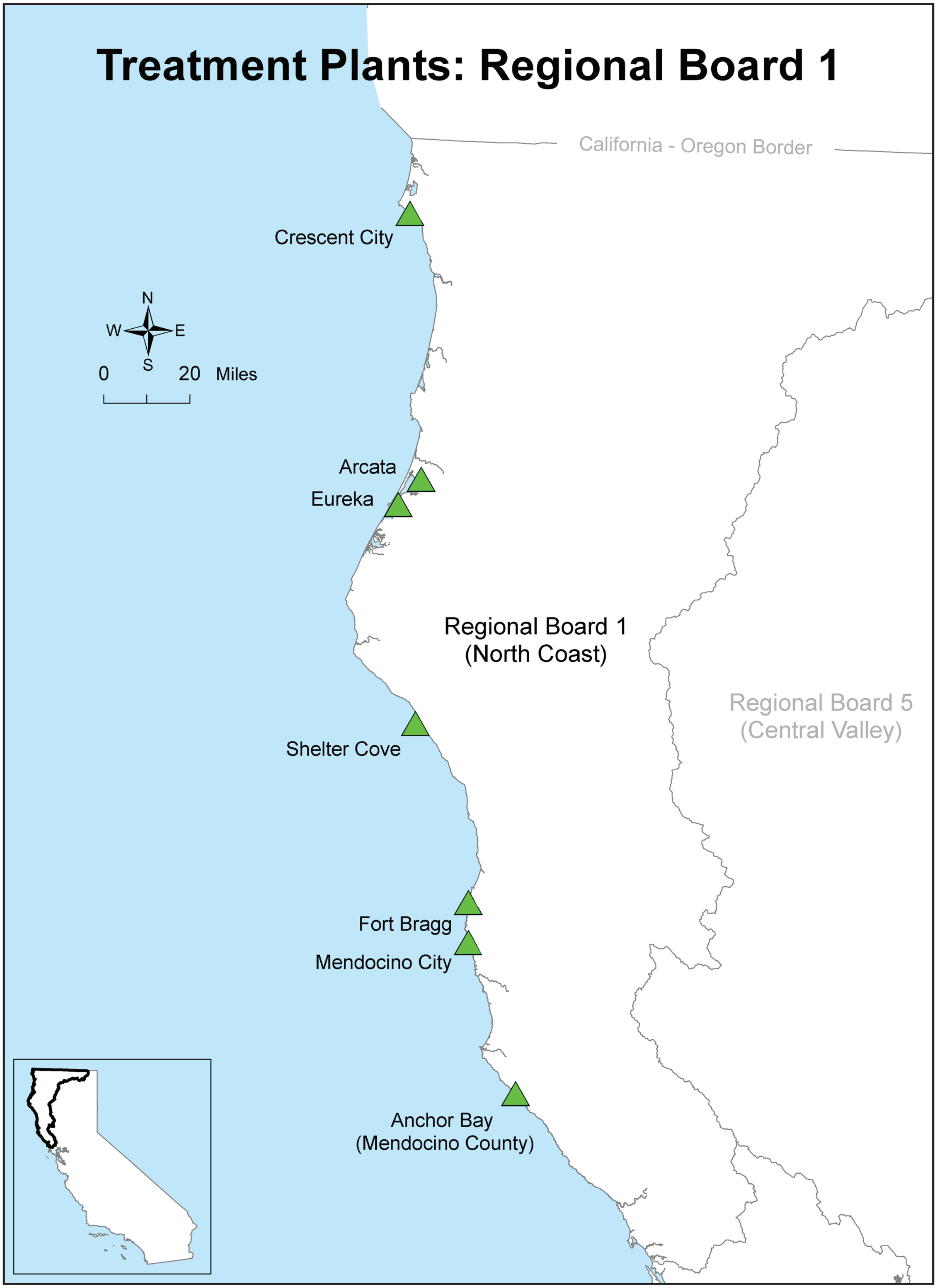
2005 Discharge Summary /2008 Water Reclamation Information
REGION 9 – San Diego – California Sewage Wastewater Treatment Plants Discharging to the Ocean
http://www.waterboards.ca.gov/sandiego

	TREATMENT PLANT		# of people served	2005 average total suspended solids (average lb/day)	2005 average discharge (millions of gallons daily)	Level of treatment of discharge	Distance from shore (miles)	Depth (ft)	2008 average reclaimed water amount (millions of gallons daily)	2008 approximate % reclaimed water
11	San Juan Creek Outfall	SOCWA JB Latham Tmt. Plant							none	0
12		SOCWA Plant 3A							0.62	28
13		Chiquita Water Reclamation Plant							2.14	32
14		San Clemente Reclamation Plant	253,578	2,134.68	23.17	undisinfected & disinfected secondary, some tertiary	1.96	100	1	15
15	Encina Water Authority (EWA)		281,000	2,199.15	29.08	undisinfected secondary	1.48	150	~6 to RP	18-36 to RP
16	International (San Diego/Tijuana)		730,000	18,125.85	24.05	advanced primary	3.50	100	none	0
17	Point Loma		2,200,000	61,807.87	183.16	advanced primary, some tertiary	4.50	310	none	0
	REGIONAL TOTAL		4,312,878	88,227.58 lb/day; 44.11 short tons/day 32,203,006.70 lb/year; 16,100.15 short tons/year	317.12 millions of gallons daily 355,174.4 acre feet per year				>38.25 millions of gallons daily >42,840 acre feet per year	

http://www.healtheocean.org/images/_pages/research/wdi/REGION9(p.2).jpg

California Ocean Discharging Wastewater Treatment Plants
Summary Information

Individual treatment plant operations, discharge, water reclamation, etc.
(Alphabetical sequence for print version; alphabetical and regional sequences online)



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Crescent City Wastewater Treatment Facility – Regional Board 1 – North Coast					
Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Crescent City and surrounding areas of Del Norte County	14,387	small	major	686 ft 0.13 miles	10 ft

Treatment process
SECONDARY W/ CHLORINATION AND DECHLORINATION: Primary treatment in two parallel 1200-square-foot clarifiers. Secondary treatment in three parallel four stage rotating biological contactors followed by three parallel secondary clarifiers. Treated wastewater disinfected by sodium hypochlorite prior to dechlorination with sodium bisulfate. Treated wastewater seasonally mixed with up to 0.8 MGD from fish processing plant.

Improvements since 2005
none

Results of improvements
n/a

Improvements planned
New influent pump station, upgrades to solids handling, various piping upgrades, rehabilitation of headworks, new membrane bioreactor, new operations building, new dewatering building, UV disinfection system, odor control upgrades, digester improvements, three new rotating biological contactors, and new grit removal system (to be partially financed by seafood processing company). Upgrades to meet North Coast Water Board's WDR. Will expand average dry weather flow treatment to 3.5 MGD and peak wet weather flow treatment to 8 MGD.

2008 average reclaimed water amount: none

approx. % of annual plant flow	0

2008 reclaimed water use(s)
none

Notes
Facility discharges in "rocky slot in the surf zone" adjacent to Battery Point lighthouse on Battery Point Island. Facility operating under Cease and Desist Orders since 1997. Historical violations attributed to peak flow events and difficulties maintaining reliable secondary treatment. Violations attributable to peak loadings reduced by an infiltration and inflow correction program.

2005 average flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions lb/day*	*2005 effluent dilution*	*NPDES Permit #* CA0022756	
Avg.	*Weather* – *Wet months*	*Weather* – *Dry months*				*Permit adopted* (1) *effective* (2)	*Permit expiry*
1.63	1.80	1.47	municipal	180.57	29:1	(1) Sept. 22, 2000? (2) Feb. 24, 2006	Sept. 22, 2005 Jan. 25, 2011

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Crescent City http://www.healtheocean.org/images/_pages/research/wdi/1.CrescentCity.jpg

Arcata Municipal Wastewater Treatment Facility – Regional Board 1 – North Coast					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
Arcata and Glendale area. (Glendale Fieldbrook Community Services District discharges to Arcata under a sewer agreement as a permitted Municipal User.)	17,000	small	major	To bay: 0 ft/miles To ocean: 47,520 ft 9 miles	0 ft

Treatment process
SECONDARY W/ CHLORINATION AND DECHLORINATION: Primary plant - mechanical bar screens, grit removal, two clarifiers, anaerobic digester. Secondary treatment -three oxidation ponds, followed by three 2-acre treatment marshes. Secondary treatment approx. 39 days detention time. Effluent disinfection - chlorine and dechlorination: sulfur dioxide before release into Humboldt Bay (tidal waters). Marshland tertiary treatment. Some water chlorinated and dechlorinated before release to enhancement marshes. Discharges with ebb tide into Humboldt Bay equivalent to surf zone discharge. Wastewater discharge requirements in line with ocean discharge standards.

Improvements since 2005
Replaced single speed pumps, improved treatment marshes 1, 2, 3, & 4; installed variable speed pump; operational review system.

Results of improvements
Improved water quality, energy efficiency, flow regulation, and compliance. Reduced chlorine/sulfur dioxide use and improved permit compliance.

2008 average reclaimed water amount: (see notes)

approx. % of annual plant flow (see notes)

2008 reclaimed water use(s)
Supplies flows to constructed wetland as part of treatment process. Equivalent to re-use in resulting bird and marsh plant habitat maintenance. No substantial amount of process water reclaimed per se. Expensive to pump water back to city, no local delivery capacity, little local business. Local river provides excess water for community.

Improvements planned
New, 2009 permits with more appropriate conditions. Collection system I/I controls. Funding from Environmental Enhancement and Mitigation Program and Wildlife Conservation Board to purchase 75 acres of agricultural. Plans underway for restoration and enhancement of up to 250 acres of former tidelands.

Notes: Plant known internationally for its successful use of natural processes. Also site of Arcata Marsh & Wildlife Sanctuary. Plant uses natural processes to maintain effluent concentrations within limits. Large volume of infiltration causes occasional exceedance of BOD/TSS mass limits; distorts efficiency score. Plant compliance under legal appeal, 2009. Wastewater treated in constructed 31 acres of freshwater wetlands enhances biological productivity of each wetland. Pre-empted cost of ocean outfall, provides effective, largely self-sustaining, energy conserving treatment alternative. Major recreational and ecological benefits. Ongoing research partnership w/ Humboldt State University.

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0022713	
Avg.	***Weather*** ***Wet months***	***Dry months***				***Permit adopted ✓ effective***	***Permit expires***
2.41	3.42	1.40	municipal	522.05	1:1	Jun. 22, 2004	Jun. 22, 2009

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Arcata http://www.healtheocean.org/images/_pages/research/wdi/2.Arcata.jpg

Greater Eureka Area / Elk River Wastewater Treatment Facility – Regional Board 1 – North Coast					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
Eureka and surrounding unincorporated areas within Humboldt Community Services District (HCSD)	45,000	small	major	To bay: 0 ft/miles To ocean: 5280 ft 1 mile	0 ft

Treatment process
SECONDARY W/ CHLORINATION AND DECHLORINATION: Grit removal, primary clarification, trickling filters, secondary clarification, chlorination and dechlorination. Treated wastewater retained in effluent holding pond until ebb tide in Bay. Disinfection and dechlorination provided for all flows up to 12 MGD. Flows between 12 and 32 MGD resulting from inflow and infiltration during winter rainy season receive primary treatment and are blended with secondary treated wastewater before discharge.

Improvements since 2005
Solid handling facility

Results of improvements
Removes solids to point of stabilization.

Improvements planned
Financing has been unavailable, but plant to be assessed Fall 2009 for future upgrades.

2008 average reclaimed water amount: none

approx. % of annual plant flow	0

2008 reclaimed water use(s)
No substantial amount. Expensive to pump water back to city. Plant only reclaims water for plant operations.

Notes
Discharge with ebb tide into Humboldt Bay equivalent to surf zone discharge. Plant's wastewater discharge requirements in line with Ocean Plan standards. Plant focus on critical problem of increasing river flow to sustain fish habitat (salmon, steelhead, plus). (Flows diverted south for some time for development and wine growing.)

2008 average effluent flow (MGD)			***Type of wastewater***	***2008 average total suspended solids*** lb/day	***2005 effluent dilution***	***NPDES Permit #*** CA0024449	
	Weather						
Avg.	***Wet months***	***Dry months***				***Permit adopted ✓ effective***	***Permit expires***
5.45	6.49	4.40	municipal	435.10	30:1	Mar. 24, 2004 Jun. 24, 2009	Mar. 24, 2009 Jun. 24, 2014

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Eureka http://www.healtheocean.org/images/_pages/research/wdi/3.Eureka.jpg

Humboldt County Resort Improvement District No. 1, Shelter Cove Wastewater Treatment Facility
Regional Board 1 – North Coast

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Residential units within Shelter Cove, commercial and public facilities within district	973	very small	minor	0 ft 0 miles	0 ft

Treatment process
SECONDARY W/ CHLORINATION AND DECHLORINATION AND TERTIARY: Coarse screening, two oxidation ditches, two clarifiers, and chlorination and dechlorination facilities. Recycled effluent is also filtered and chlorinated again before reaching storage pond. During winter period, all secondary treated effluent discharged into ocean.

Improvements since 2005

Results of improvements

Improvements planned

Notes
Discharges into an ASBS (King Range Natural Conservation Area).

2008 average reclaimed water amount:

approx. % of annual plant flow

2008 reclaimed water use(s)
During spring and summer months, some or all treated water stored in pond for spray irrigation of golf course.

2005 average effluent flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0023027	
Avg.	*Weather* – *Wet months*	*Weather* – *Dry months*				*Permit adopted ✓ effective*	*Permit expires*
0.15	0.19	0.11	municipal	4.16	50:1	May 15, 2003	May 15, 2008

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Shelter Cove http://www.healtheocean.org/images/_pages/research/wdi/4.ShelterCove.jpg

Fort Bragg Municipal Improvement District No. 1 Wastewater Treatment Facility
Regional Board 1 – North Coast

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Fort Bragg and adjacent unincorporated areas	6,500	very small	major	650 ft 0.12 miles	20 ft

Treatment process
SECONDARY w/ CHLORINATION AND DECHLORINATION: Grit removal, comminution, primary clarification, biological secondary treatment utilizing two-stage biofiltration, chemical coagulation, secondary clarification, and disinfection. Treated wastewater disinfected using chlorine gas; dechlorinated with sulfur dioxide.

Improvements since 2005
Solids removal equipment at headworks, vacuum operated chlorine and sulfur dioxide injection systems, leak detection, new alarm auto-dialer and 1,000 square foot laboratory.

Results of improvements
All untreatable solids removed from waste stream preventing pump plugging and erosion. Increased operational reliability and safety. Small and large leak detection improved.

Improvements planned
Plant extension master plan: renovation of existing treatment processes, adding filtration, UV disinfection, biosolids tower, additional clarifier, and storm water collection system. Clean and rehabilitate primary digester, construct secondary digester, drain and clean two sludge lagoons for addition of soil liners. Purchase property to expand plant.

2008 average reclaimed water amount: none

approx. % of annual plant flow 0

2008 reclaimed water use(s)
none

Notes
No reclaimed water due to lack of commercial or industrial demand.

2005 average effluent flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0023078	
Avg.	*Weather*					*Permit adopted ✓ effective*	*Permit expires*
	Wet months	*Dry months*					
0.97	1.24	0.71	municipal	162.11	50:1	Mar. 24, 2004 Oct. 12, 2005	Mar. 24, 2009 Oct. 12, 2010

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Fort Bragg http://www.healtheocean.org/images/_pages/research/wdi/5.FortBragg.jpg

Mendocino City Community Services District Wastewater Treatment Facility – Regional Board 1 – North Coast					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
Mendocino Community Services District	1,000	very small	minor	996 ft 0.19 miles	60 ft

Treatment process
TERTIARY: Extended aeration activated sludge system followed by secondary clarification, filtration, chlorination and dechlorination. Full tertiary treatment for approx. 0.3 MGD.

2008 average reclaimed water amount: ~0.0055 MGD (2 MGY)

approx. % of annual plant flow approx. 6

2008 reclaimed water use(s)
High school fields or discharged into ocean.

Improvements since 2005
Sludge dryer, effluent dechlorination.

Results of improvements
Class-A exceptional quality biosolids and chlorine now removed from effluent discharged to outfall.

Improvements planned
Headworks auto-screen, headworks Auger Monster and emergency generator installation. Screen will remove all synthetic material from wastewater influent flow.

Notes
During dry weather season (generally May through October) and other periods as needed, tertiary treated effluent sent to water recycling system. Reclaimed water discharged through ocean outfall in wet weather months.

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0022870	
Avg.	***Weather***						
	Wet months	***Dry months***				***Permit adopted ✓ effective***	***Permit expires***
0.08	0.09	0.07	municipal	2.20	100:1	Aug. 25, 2004	Aug. 24, 2009

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Mendocino City http://www.healtheocean.org/images/_pages/research/wdi/6.MendocinoCity.jpg

Fort Bragg Municipal Improvement District No. 1 Wastewater Treatment Facility
Regional Board 1 – North Coast

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Fort Bragg and adjacent unincorporated areas	6,500	very small	major	650 ft 0.12 miles	20 ft

Treatment process
SECONDARY w/ CHLORINATION AND DECHLORINATION: Grit removal, comminution, primary clarification, biological secondary treatment utilizing two-stage biofiltration, chemical coagulation, secondary clarification, and disinfection. Treated wastewater disinfected using chlorine gas; dechlorinated with sulfur dioxide.

Improvements since 2005
Solids removal equipment at headworks, vacuum operated chlorine and sulfur dioxide injection systems, leak detection, new alarm auto-dialer and 1,000 square foot laboratory.

Results of improvements
All untreatable solids removed from waste stream preventing pump plugging and erosion. Increased operational reliability and safety. Small and large leak detection improved.

Improvements planned
Plant extension master plan: renovation of existing treatment processes, adding filtration, UV disinfection, biosolids tower, additional clarifier, and storm water collection system. Clean and rehabilitate primary digester, construct secondary digester, drain and clean two sludge lagoons for addition of soil liners. Purchase property to expand plant.

2008 average reclaimed water amount: none

approx. % of annual plant flow	0

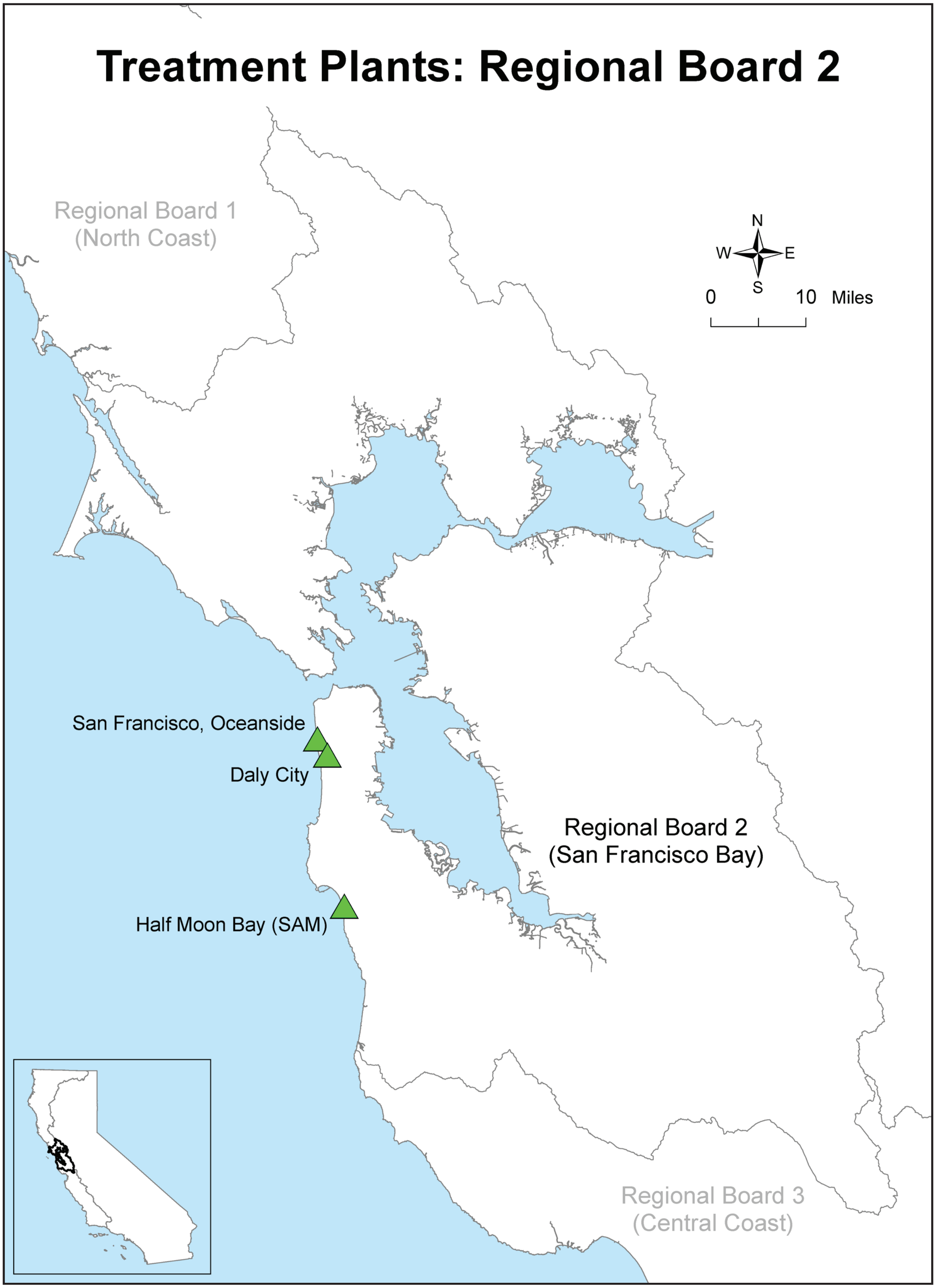
2008 reclaimed water use(s)
none

Notes
No reclaimed water due to lack of commercial or industrial demand.

2005 average effluent flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0023078	
Avg.	*Weather* – *Wet months*	*Weather* – *Dry months*				*Permit adopted ✓ effective*	*Permit expires*
0.97	1.24	0.71	municipal	162.11	50:1	Mar. 24, 2004 Oct. 12, 2005	Mar. 24, 2009 Oct. 12, 2010

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

AnchorBay http://www.healtheocean.org/images/_pages/research/wdi/7.AnchorBay.jpg



http://www.healtheocean.org/images/_pages/research/wdi/WWTPs_RegBoard2.jpg

City & County of San Francisco Oceanside Water Pollution Control Plant – Regional Board 2 – San Francisco					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
West side of SF and small portions of North San Mateo County Sanitation District	250,000	medium	major	approx. 17,952 ft approx. 3.50 miles	approx. 78 ft *(mean lower low water)*

Treatment process

COMBINED PRIMARY AND UNDISINFECTED SECONDARY (Oceanside WPCP); PRIMARY (Westside CSS):
During dry weather, all wastewater receives secondary level of treatment via pre-oxygen activated sludge process. Secondary treatment capacity maximized at 43 MGD. During wet weather, Oceanside WPCP provides primary treatment for up to additional 22 MGD of mixed stormwater and sewage. Maximum primary treatment capacity 65 MGD. No disinfection requirements. Westside CSS - flows above 65 MGD and up to 175 MGD receive flow-through treatment within combined sewer overflow structures and discharged to South Western Ocean Outfall (SWOO). "Decanted" effluent receives flow-through treatment equivalent to primary. Flows exceeding discharge capacity of SWOO (175 MGD) discharged to shoreline via seven overflow structures.

2008 average reclaimed water amount: <1.5 MGD

approx. % of annual plant flow	<10

2008 reclaimed water use(s)

Oceanside Plant activities, including plant wash down and cleanings, cooling systems and water seals of plant equipments.

Improvements since 2005

none

Results of improvements

none

Improvements planned

Construction of recycled water facility to take another 4 MGD of flow for irrigation of city's parks and open space (under environmental review 2009).

Notes

Combined sewer system - domestic sewage, industrial wastewater, and stormwater runoff collected in same pipes.

SWOO is in federal waters - beyond 3 mile limit of State's territorial sea. Wet weather combined sewer discharge points in state waters – at shoreline.

Effluent flows from 2002 WDR – figures left unrevised for 2005 data.

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2008 effluent dilution***	***NPDES Permit #*** CA0037737	
Avg.	***Weather***					***Permit adopted effective ✓***	***Permit expires***
	Wet months	***Dry months***					
16.97	18.37	15.57	combined sewer (domestic, industrial and stormwater)	1,640.78	150: 1	Oct.1, 2003 Oct. 1, 2009	Aug. 20, 2008 ext. - Sept. 30 Sept. 30, 2014

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

San Francisco http://www.healtheocean.org/images/_pages/research/wdi/8.SanFrancisco.jpg

Daly City (North San Mateo County Sanitation District) Wastewater Treatment Plant Regional Board 2 – San Francisco					
Area served	***# of people serve*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
Daly City, portions of San Mateo County, Colma, San Francisco County Jail, and Westborough Water District within South San Francisco	120,000	small	major	2,500 ft 0.47 miles	32 ft

Treatment process
SECONDARY W/ CHLORINATION AND DECHLORINATION AND TERTIARY: Bar screens, micro screen and compactor, primary clarifiers, equalization basins, aeration tanks, secondary clarifiers, and chlorine contact chamber. System uses sodium hypochlorite for chlorination and sodium bisulfite for dechlorination. Tertiary treatment system includes alum injection followed by dual media filtration, disinfection, gypsum injection, and 1.4 million gallon storage basin.

2008 average reclaimed water amount: 2.77 MGD

approx. % of annual plant flow	Up to 25

2008 reclaimed water use(s)
Three golf courses, city parks and highway medians. Another golf course to be added Summer 2010.

Improvements since 2005
none

Results of improvements
none

Improvements planned
Retrofitting secondary clarifiers, microturbines to use digester biomethane gas, replace 2 500KW generators with one 1000KW generator to increase hydrological loading and energy efficiency.

Notes
No significant industrial users.

Golf courses are under contract with WWTP and supplement costs.

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** lb/day	***2005 effluent dilution***	***NPDES Permit #*** CA0037737	
Avg.	***Weather*** — ***Wet months***	***Dry months***				***Permit adopted effective*** ✓	***Permit expires***
6.75	7.25	6.25	domestic (mostly residential, but some commercial)	414.38	76:1	Dec. 1, 2006	Nov. 30, 2011

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Daly City http://www.healtheocean.org/images/_pages/research/wdi/9.DalyCity.jpg

Half Moon Bay (Sewer Authority Mid-Coastline) Wastewater Treatment Plant – Regional Board 2 – San Francisco					
Area served	***# of people serve*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
Half Moon Bay, Montara Sanitary District, and Granada Sanitary District	20,500	small	major	1,900 ft 0.36 miles	37 ft

Treatment process
SECONDARY w/ CHLORINATION AND DECHLORINATION: Influent screening, grit removal, primary clarification, activated sludge, secondary clarification, chlorination and dechlorination.

Improvements since 2005
none

Results of improvements
none

Improvements planned
Recycled water facility and tertiary treatment to reduce discharge to ocean and provide community with alternate water supply.

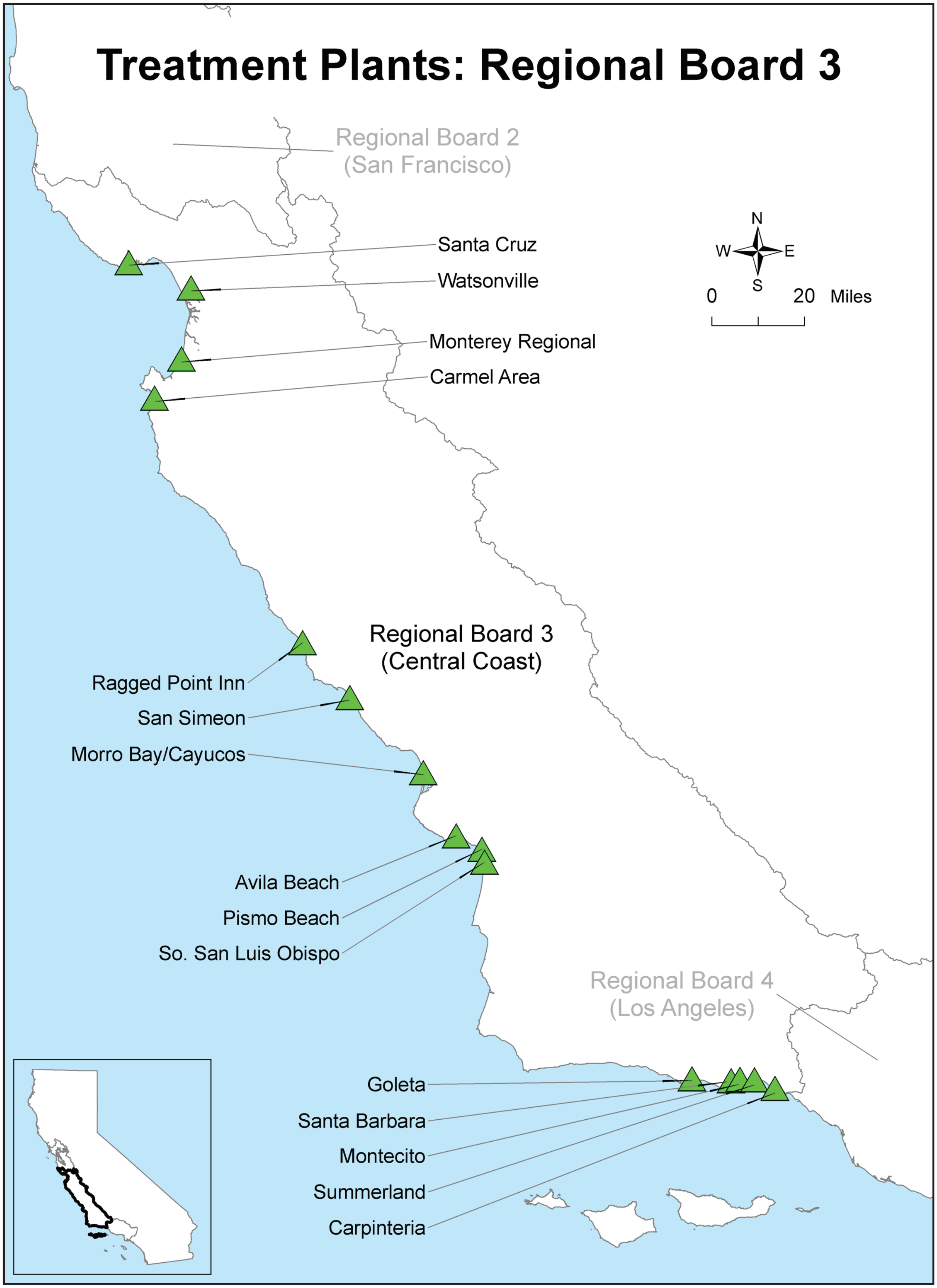
Notes
Discharges into Monterey Bay Marine Sanctuary - into an area not considered to be an ASBS.

2008 average reclaimed water amount: none		***2008 reclaimed water use(s)***
approx. % of annual plant flow	0	none

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0038598	
	Weather						
Avg.	***Wet months***	***Dry months***				***Permit adopted effective ✓***	***Permit expires***
2.19	2.60	1.79	domestic and commercial	201.67	119:1	Mar. 1, 2007	Feb. 28, 2012

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Half Moon Bay http://www.healtheocean.org/images/_pages/research/wdi/10.HalfMoonBay.jpg



http://www.healtheocean.org/images/_pages/research/wdi/WWTPs_RegBoard3.jpg

Santa Cruz Wastewater Treatment Plant – Regional Board 3 – Central Coast

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Santa Cruz and Capitola, Live Oak, Soquel and Aptos areas, University of California at Santa Cruz	150,000	medium	major	5,280 ft 1 mile	110 ft

Treatment process

SECONDARY W/ ULTRAVIOLET DISINFECTION:
Screening, aerated grit removal, primary sedimentation, trickling filters, solids contact, secondary clarification, and disinfection with ultraviolet light.

Improvements since 2005

Piping changed to allow for various additional processes to use reclaimed water instead of non-potable water.

Results of improvements

none

Improvements planned

none

Notes

Reclaimed water production and usage up from 2005 low of 46,303,200 to 52,475,200 gallons total in 2007 and near 100% reclamation capacity in 2008.
Discharges into Monterey Bay National Marine Sanctuary.

2008 average effluent reclaimed water amount:	*approx. % of annual plant flow*	*2008 reclaimed water use(s)*
~0.185 MGD (67,443,500 gallons/year)	~2	plant operations

2005 average flow (MGD) Avg.	Weather: Wet months	Weather: Dry months	*Type of wastewater*	*2005 average TSS mass emissions* lb/day	*2005 effluent dilution*	NPDES Permit # CA0048194: Permit adopted✓ & effective ✓	NPDES Permit # CA0048194: Permit expires
11.38	13.76	9.00	municipal (industrial and domestic)	371.03	139:1	May 13, 2005	May 13, 2010

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Santa Cruz http://www.healtheocean.org/images/_pages/research/wdi/11.SantaCruz.jpg

Watsonville Wastewater Treatment Facility – Regional Board 3 – Central Coast

Area served	*# of people served* (source: 2003 permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Watsonville, Santa Cruz County Freedom Sanitation District, Santa Cruz County, Salsipuedes Sanitary District, and Monterey County Pajaro Sanitation District	61,000	small	major	7,350 ft 1.39 miles	64 ft

Treatment process

SECONDARY W/ CHLORINATION AND DECHLORINATION AND TERTIARY: Screening, pre-aeration/grit removal, primary sedimentation, biological filtration (trickling filters), odor control, solids contact stabilization (activated sludge), secondary clarification, disinfection and dechlorination facilities. Facility accepts less than 10,000 gallons per month of hauled brine wastes.

Improvements since 2005

Coagulation, flocculation, sedimentation, cloth media filtration, UV disinfection.

Results of improvements

Met new standard for crop irrigation, Title 22.

Improvements planned

none

Notes

Discharges into Monterey Bay National Marine Sanctuary.
According to plant manager influent flows are equivalent to effluent flows for 2008.

2008 average reclaimed water amount:		***2009 reclaimed water use(s)***
approx. % of annual plant flow	> 50 (up to 100)	Water recycling commenced March 2009. Food crop irrigation (7.5 – 8 months of year)

2008 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0048216	
Avg.	***Weather*** ***Wet months***	***Dry months***				***Permit adopted*** (1)? ***effective*** (2)	***Permit expires***
~6.5	7.5	~5.5	municipal (industrial and domestic)	529.36	84:1	(1) May 16, 2003 (2) May 9, 2008	May 16, 2008; May 9, 2013(?)

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Watsonville http://www.healtheocean.org/images/_pages/research/wdi/12.Watsonville.jpg

Monterey Regional Water Pollution Control Agency Regional Treatment Plant – Regional Board 3 – Central Coast

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Monterey, Pacific Grove, Seaside, Del Rey Oaks, Sand City, Marina, Salinas, Seaside Sanitation District, Castroville, Moss Landing, Boronda Community Services Districts, former Fort Ord	252,000	medium	major	11,260 ft 2.13 miles	100 ft

Treatment process

UNDISINFECTED SECONDARY AND TERTIARY:
Aerated grit removal, primary clarifiers, trickling filters, secondary clarifiers, filtration, and chlorination/dechlorination. Undisinfected secondary clarifier effluent discharged to ocean. Facility currently accepts 30,000 - 50,000 gallons per day of brine wastes. Brine wastes discharged directly or blended with secondary treated wastewater before being discharged to ocean.

Tertiary treatment using filtration through 6-foot bed of coal, sand and gravel, and chlorination. Maintains specific chlorine level in water for two hours.

Improvements since 2005

Chemical tank project to enhance removal of solids during primary treatment (complete May '09), Coral Pump Station generator update (began May 09), Reeside Pump Station generator replacement project, flapper gate replacement at 4 Pump Stations. Wet well trolley system replacement at 3 pump stations, replacement of sluice gates at Monterey and Seaside Pump Stations with manually operated ones. Replacement of headworks bar screen (complete Sept. '09).

Results of improvements

Meeting emission standards.

Improvements planned

Study to incorporate existing and planned SCADA needs into comprehensive plan for implementation over several years.

2008 average reclaimed water amount:

11.61-13.39 MGD
(13,000-15,000 acre ft/year)

approx. % of annual plant flow	60 (100 in summer)

2008 reclaimed water use(s)

In summer months, treated wastewater reclaimed to contribute to irrigation of 12,000 acres of farmland in northern Salinas Valley. Held in 80 acre-foot storage pond before distribution by Salinas Valley Reclamation Project. Plan to additionally supply recycled water to city parks, roadway landscape and golf courses.

Notes

Discharges to MBNMS. Diffuser used only in Winter. Methane gas (treatment process byproduct) blended with natural gas to fuel all electricity requirements for plant. Reclaimed water provided by Salinas Valley Reclamation Project - distributed by Castroville Seawater Intrusion Project. Largest water recycling facility designed for raw food crop irrigation. June 09 signatory to Regional Urban Water Augmentation Project (RUWAP) - initial component: recycled water to meet non-potable water demand at former Fort Ord. Extensive five-year Monterey Wastewater Reclamation for Agriculture Study (1980-85) proved recycled water safe for irrigation of crops consumed without cooking.

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0048551	
Avg.	***Weather*** ***Wet months***	***Dry months***				***Permit adopted ✓ effective***	***Permit expires***
10.71	16.23	5.18	municipal (industrial and domestic)	1,114.53	145:1	Nov. 1, 2002 Apr. 30, 2008 (?)	Nov. 1, 2007 Apr. 30, 2013 (?)

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Monterey http://www.healtheocean.org/images/_pages/research/wdi/13.Monterey.jpg

Carmel Area Wastewater District Wastewater Treatment Plant & the Pebble Beach Community Services District
Regional Board 3 – Central Coast

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Carmel-by-the-Sea Wastewater Services District, Pebble Beach Community District and outlying County Areas	17,600	small	major	600 ft 0.11 miles	35 ft

Treatment process
SECONDARY w/ CHLORINATION AND DECHLORINATION AND TERTIARY: Bar screens, comminutors, aerated grit tank, primary settling basins, four secondary aeration basins, and secondary clarifiers. Secondary treated wastewater chlorinated and dechlorinated before discharge into the ocean. Tertiary treatment in 2005 accomplished by eight up flow, continuous backwash sand filters. Up to 1.8 MGD can be diverted to a water recycling plant.

2008 average reclaimed water amount: 1.1 MGD

approx. % of annual plant flow

2008 reclaimed water use(s)
Irrigation of golf courses, athletic fields, and driving range. Also, construction dust mitigation, soil compaction, street cleaning, city parking, and stairway cleaning.

Improvements since 2005
Reverse osmosis and microfiltration upgrade completed 2008.

Results of improvements
Improved water quality.

Improvements planned
none

Notes
Discharges into Monterey Bay National Marine Sanctuary and Carmel Bay ASBS with waiver adopted in 1984. 2007 permit renewal change to allow for tertiary treated water to be discharged into the Carmel River Estuary.

Since 1994, improved tertiary train process funded by Pebble Beach Company has yielded 260,680,800 gallons of reclaimed wastewater per year for irrigation of golf courses and other recreational areas. Supply replaces equivalent quantity of potable water previously applied to these areas. Saves ~700,000 gallons of secondary effluent from daily discharge to Carmel Bay.

2005 average effluent flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0047996	
	Weather						
Avg.	*Wet months*	*Dry months*				*Permit adopted✓ effective*	*Permit expires*
1.95	2.23	1.67	municipal	58.07	121:1	(1) Mar. 22, 2002 (2) Apr. 30, 2008	May 9, 2008 (?) April 30, 2013

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Carmel http://www.healtheocean.org/images/_pages/research/wdi/14.Carmel.jpg

<table>
<tr><th colspan="9">Ragged Point Inn Wastewater Treatment Facility – Regional Board 3 – Central Coast</th></tr>
<tr><th colspan="3">Area served</th><th># of people served (source: permit)</th><th>Relative size</th><th>EPA facility class</th><th colspan="2">Outfall distance from shore</th><th>Outfall depth</th></tr>
<tr><td colspan="3">Serves the inn and 5-6 residences only</td><td>12</td><td>very small</td><td>minor</td><td colspan="2">0 ft
0 miles</td><td>0 ft</td></tr>
<tr><td colspan="4">Treatment process
UNDISINFECTED SECONDARY AND DISINFECTED TERTIARY: Comminutor (grinder/macerator), flow equalization tank. Extended aeration package treatment plant with secondary clarification; tertiary treatment - filtration followed by ozone disinfection. Design flow capacities of package plant and tertiary treatment system: 0.01 5 MGD. Disinfected tertiary effluent discharged to Pacific Ocean via discharge to cliff face (Discharge Point 001) and to land via surface drip irrigation system (Discharge Point 002). Discharge of undisinfected secondary treated wastewater to land via surface drip irrigation system also allowable under permit.</td><td colspan="5">Improvements since 2005
Upgrade to tertiary treatment. Drip irrigation system.

Results of improvements
End to discharge of undisinfected effluent into Monterey Bay National Marine Sanctuary. High percentage of water now reclaimed.

Improvements planned</td></tr>
<tr><td colspan="2">2008 average reclaimed water amount:
up to 0.015 MGD</td><td colspan="2" rowspan="2">2008 reclaimed water use(s)
irrigation</td><td colspan="5" rowspan="2">Notes
Disinfected tertiary treated water discharged into Monterey Bay National Marine Sanctuary.</td></tr>
<tr><td>approx. % of annual plant flow</td><td></td></tr>
<tr><th colspan="3">2005 average effluent flow (MGD)</th><th>Type of wastewater</th><th rowspan="3">2005 average TSS mass emissions lb/day</th><th rowspan="3">2005 effluent dilution</th><th colspan="3">NPDES Permit #
CA0047961</th></tr>
<tr><th rowspan="2">Avg.</th><th colspan="2">Weather</th><td rowspan="3">domestic</td><th colspan="2" rowspan="2">Permit adopted (1) effective (2)</th><th rowspan="2">Permit expires</th></tr>
<tr><th>Wet months</th><th>Dry months</th></tr>
<tr><td>0.008</td><td>0.007</td><td>0.009</td><td>0.61</td><td>115:1</td><td colspan="2">(1) Oct. 24, 2003
(2) June 1, 2009</td><td>Oct. 24, 2008
June 1, 2014</td></tr>
<tr><td colspan="9">EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet</td></tr>
</table>

Ragged Point Inn http://www.healtheocean.org/images/_pages/research/wdi/15.RaggedPointInn.jpg

San Simeon Community Services District Wastewater Treatment Plant – Regional Board 3 – Central Coast					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
San Simeon and Hearst San Simeon State Historical Monument	429	very small	minor	900 ft 0.17 miles	20 ft

Treatment process

SECONDARY w/ CHLORINATION AND DECHLORINATION: Secondary treatment achieved by extended aeration activated sludge process. Four aeration basins with integral clarifiers can be operated in parallel, following initial treatment with in-stream grinder. During peak flow periods, at least three aeration basin/clarifier units operated, with fourth unit maintained for reserve capacity. During low flow periods, one unit may be used for aerobic sludge digestion. Facility includes chlorination/dechlorination capability and 90,000 gallon equalization tank, which allows flow equalization during peak summer flow periods and during rainfall events.

Improvements since 2005

Improved aeration basins, tiny bubble diffusers, valves changed/replaced, upgrades in final clarifiers, changed scrapers. Added squeegees, skimmers to remove floatable material, flow monitoring systems, and chlorine analyzer to help disinfect water.

Results of improvements

Improvements planned

Tertiary treatment, gravity sand filters.

Notes

Discharges into MBNMS.

2008 average reclaimed water amount: none

approx. % of annual plant flow 0

2008 reclaimed water use(s)

none

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0047961	
Avg.	***Weather*** ***Wet months***	***Dry months***				***Permit Adopted*** (1) ***effective*** (2)	***Permit expires***
0.07	0.07	0.07	domestic	6.11	115:1	(1) May 31, 2002(?) (2) May 30, 2007	May 31, 2007(?) May 30, 2012

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

San Simeon http://www.healtheocean.org/images/_pages/research/wdi/16.SanSimeon.jpg

Morro Bay and Cayucos Sanitary District Wastewater Treatment Plant – Regional Board 3 – Central Coast					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
Morro Bay and Cayucos Sanitary District	13,293	small	major	2,900 ft 0.55 miles	50 ft

Treatment process

BLENDED PRIMARY AND SECONDARY w/ CHLORINATION AND DECHLORINATION: Modified secondary treatment. Split stream process of physical and biological treatment. All wastewater flows through primary sedimentation basins. Approx. 1 MGD flows through secondary treatment including trickling filters, solids contact, and secondary clarification. Secondary treated effluent then blended with primary treated wastewater and disinfected by chlorination, and then dechlorinated prior to discharge to ocean.

Improvements since 2005

Continued extensive O&M program, including some equipment replacement projects.

Results of improvements

Increased operational efficiency.

Improvements planned

Facility Master Plan under review to replace existing facility with new building implementing tertiary treatment using oxidation ditch with cloth media filters. Project completion scheduled for 2014. Design treatment from advanced primary to tertiary treatment prior to ocean discharge.

Notes

Operates under 301(h) waiver. Dischargers have agreed to upgrade the facility to at least full secondary treatment standards by 2014 pursuant to Settlement Agreement with the Central Coast Water Board.

2008 average reclaimed water amount: none		***2008 reclaimed water use(s)***
approx. % of annual plant flow	0	none

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0047881	
Avg.	***Weather*** ***Wet months***	***Dry months***				***Permit adopted effective ✓***	***Permit expires***
1.25	1.33	1.18	municipal	257.61	133:1	Mar. 8, 2006	Mar. 8, 2011

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Morro Bay http://www.healtheocean.org/images/_pages/research/wdi/17.MorroBay.jpg

Avila Beach Community Services District – Regional Board 3 – Central Coast

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Community of Avila Beach and Port San Luis Harbor District	500	very small	minor	2,240 ft 0.42 miles	29 ft

Treatment process

SECONDARY w/ CHLORINATION AND DECHLORINATION: When filters effective - primary clarifier, trickling filter, secondary clarifiers, disinfection with chlorine, and dechlorination. "Equivalent to Secondary Standards" applies to facilities with certain types of biological treatment processes that cannot consistently meet secondary treatment limitations, including trickling filters. Discharger utilizes trickling filters and cannot consistently meet secondary treatment standards.

Improvements since 2005

Outfall extension (500ft) and upgrade of both clarifier and headworks. Replaced influent station pumps with better reliability, new drive on primary clarifier, complete SCADA (Supervisory Control And Data Acquisition), remote monitoring and alarm systems, upgraded and improved gas scrubbing equipment, improved chemical addition equipment to reduce the amount of chlorine and sodium bisulfite.

Results of improvements

SCADA gives notice of equipment failure quickly and effectively and logs information in graphical format for trouble shooting and energy conservation.

Improvements planned

Capital improvement to clean and inspect primary digester, replace primary clarifier rake arm, coat primary clarifier, replace all variable frequency drives, new pumps, GIS mapping of maintenance.

2008 average reclaimed water amount: none

approx. % of annual plant flow	0

2008 reclaimed water use(s)

none

Notes

Discharge is approx. 540 ft beyond Avila Pier. Provisions of permit included replacement of outfall diffuser system by June 30, 2005 and feasibility study of water recycling by May 15, 2005.

2005 average effluent flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0047830	
Avg.	*Weather* – *Wet months*	*Weather* – *Dry months*				*Permit adopted ✓ effective*	*Permit expires*
0.04	0.04	0.04	domestic	9.09	10:1	Sept. 10, 2004	Sept. 10, 2009

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Avila http://www.healtheocean.org/images/_pages/research/wdi/18.Avila.jpg

Pismo Beach Wastewater Treatment Facility – Regional Board 3 – Central Coast

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Pismo Beach	9,500	small	major	4,400 ft 0.83 miles	55 ft

Treatment process
SECONDARY w/ CHLORINATION AND DECHLORINATION: Primary sedimentation, activated sludge, secondary sedimentation, disinfection using chlorine and dechlorination. Single mechanical bar screen with a 0.625-in. (16-mm) bar spacing and a 6-mgd (23,000-m3/d) capacity. Influent splitter box divides flow between two oxidation ditches, each with side water depth of 12 ft and volume of 0.89 million gal. Aeration provided by mechanical aerators; about 12% (0.11 million gal of each tank is anoxic, and 88% is aerobic (0.78 million gal). Oxidation process promotes removal of nitrogen from wastewater without chemical treatment, making future wastewater reuse achievable. Flow from splitter box evenly distributed between plant's two 65-ft-diameter secondary clarifiers with side water depth of 14 ft and volume of 0.35 million gal.

Improvements since 2005
Plant upgrade in 2006 to increase daily flow, new control building, lab, headworks, oxidation ditches, secondary clarifiers, and an ocean outfall pump system.

Results of improvements
Resolution of overflow problems.

Improvements planned

Notes
Wastewater discharged to outfall jointly owned by Pismo Beach and South San Luis Obispo County Sanitation District. Discharge occurs under separate permit.

2008 average reclaimed water amount: none

approx. % of annual plant flow	0

2008 reclaimed water use(s)
none

2005 average effluent flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0048151	
Avg.	*Weather* – *Wet months*	*Weather* – *Dry months*				*Permit adopted effective* ✓	*Permit expires*
1.18	1.20	1.16	municipal	153.87	165:1	Oct. 13, 2004	Sept. 10, 2009

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Pismo Beach http://www.healtheocean.org/images/_pages/research/wdi/19.PismoBeach.jpg

South San Luis Obispo County Sanitation District – Regional Board 3 – Central Coast					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
Arroyo Grande and Grover Beach, and Oceano Community Services District	37,500	small	major	4,400 ft 0.83 miles	55 ft

Treatment process	***Improvements since 2005***
SECONDARY w/ CHLORINATION: Primary clarification, trickling filters, secondary clarification and chlorination.	***Results of improvements***
	Improvements planned
2008 average reclaimed water amount: none ***approx. % of annual plant flow*** 0 ***2008 reclaimed water use(s)*** none	***Notes*** Wastewater discharged to outfall jointly owned by Pismo Beach and South San Luis Obispo County Sanitation District. Discharge occurs under separate permit.

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0048003	
Avg.	***Weather*** ***Wet months***	***Dry months***				***Permit adopted effective ✓***	***Permit expires***
2.81	2.88	2.74	municipal	504.92	165:1	Oct. 13, 2004	Sept. 10, 2009

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

San Luis Obispo http://www.healtheocean.org/images/_pages/research/wdi/20.So.SanLuisObispo.jpg

Goleta Sanitary District Wastewater Treatment Facility – Regional Board 3 – Central Coast

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Goleta including: Goleta Sanitary District, Goleta West Sanitary District, University of California at Santa Barbara (UCSB), Santa Barbara Airport, and facilities of Santa Barbara County	74,000	small	major	5,912 ft 1.12 miles	87 ft

Treatment process

BLENDED PRIMARY AND SECONDARY w/ CHLORINATION AND DECHLORINATION AND TERTIARY: All wastewater flows up to 4.4 MGD flow through primary sedimentation basins and secondary treatment facilities, including biofiltration, solids contact, and secondary clarification. Wastewater flows greater than 4.4 MGD receive primary treatment only, and are blended with the secondary-treated wastewater and disinfected by chlorination/dechlorination prior to ocean discharge. Tertiary capacity of 3.3 MGD reclaimed water.

2008 average reclaimed water amount: 1.5 - 2.5 MGD

approx. % of annual plant flow 40-50

2008 reclaimed water use(s)

Landscape irrigation in Goleta area and surrounding areas of Santa Barbara County, Goleta Beach Park, golf courses, UCSB, incidental uses at facility.

Improvements since 2005

Replaced equipment, capital improvements.

Results of improvements

No improvement to water quality, only plant maintenance.

Improvements planned

Upgrading facility to full secondary treatment over 10 years; completion in 2014.

Notes

Goleta Water District is responsible for distribution of reclaimed water. After production, reclaimed water stored in reservoir prior to distribution.

2005 average effluent flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0048160	
	Weather						
Avg.	*Wet months*	*Dry months*				*Permit adopted effective* ✓	*Permit expires*
4.51	5.38	3.65	municipal (domestic, commercial, & light industrial)	1,414.10	111:1	Dec. 31, 2004	Dec. 31, 2009

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Goleta http://www.healtheocean.org/images/_pages/research/wdi/21.Goleta.jpg

Santa Barbara (El Estero) Wastewater Treatment Facility – Regional Board 3 – Central Coast

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Santa Barbara and portions of Santa Barbara County	96,000	small	major	8,720 ft 1.65 miles	70 ft

Treatment process
SECONDARY w/ CHLORINATION AND DECHLORINATION AND TERTIARY: Screening and grinding, aerated grit removal, primary sedimentation, activated sludge stabilization, secondary clarification, disinfection by chlorination, and dechlorination facilities. Tertiary wastewater treatment by coagulation, flocculation, filtration and additional disinfection process.

Improvements since 2005
New influent pump, upgrade of primary clarifiers, new thickened sludge pump station, redesigned aeration basins, rehabilitated secondary clarifiers, replacement of anaerobic digester mixing system.

Results of improvements
Allow plant to treat wastewater and protect environment for next decade or more; upgraded equipment to more energy-efficient models.

Improvements planned
New sludge presses.

Notes
City owns deactivated desalination plant; utilizes 800 acre ft/yr recycled water.

Fuel cell project generates electricity from methane-byproduct of treatment process.

2008 average reclaimed water amount: 4.3 MGD

approx. % of annual plant flow

2008 reclaimed water use(s)
Irrigation and toilets in city park restrooms. Not all reclamation capacity can be used.

2005 average effluent flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0048143	
Avg.	*Weather: Wet months*	*Weather: Dry months*				*Permit adopted ✓ effective*	*Permit expires*
8.23	9.07	7.39	municipal (domestic and industrial)	1,247.88	120:1	Oct. 22, 2004	Oct. 22, 2009

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Santa Barbara http://www.healtheocean.org/images/_pages/research/wdi/22.SantaBarbara.jpg

Montecito Sanitary District Wastewater Treatment Facility – Regional Board 3 – Central Coast					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
Montecito	10,000	small	major	1,550 ft 0.29 miles	35 ft

Treatment process

SECONDARY W/ CHLORINATION AND DECHLORINATION: Comminution, extended aeration treatment, secondary clarification, chlorination and dechlorination. Other processes include: dissolved air floatation (DAF) thickener, aerobic digester, belt filter press and biosolids sent to compositing facility.

Improvements planned *(2009-2011)*

Retrofit existing electrical main control circuit (MCC) panels for MCC-1, MCC-1a, and new MCC-panel.
Replace existing 250KW emergency generator with new 450KW generator - 2011 (CARB) emission compliant.
Update and add to existing SCADA system.
New laboratory building for more onsite process analyses and quicker results than contract lab.
COLLECTIONS SYSTEM: goal to repair, replace or slip-line up to 5 miles of the sewer collections system per year.
Replacement of pumps at Lift Station #1.
Connection of areas not currently serviced by Montecito Sanitary District and possibly on septic tanks.
Implement Resident Sewer Lateral Replacement Program

Notes

El Nino weather pattern in 2005: plant measured 22.2" of rain Jan 1 to May 31; total 2005 rainfall 25.86". Normal annual rain typically 8-12 inches and less than 8" in drought years.

2008 average reclaimed water amount: none

approx. % of annual plant flow 0

2008 reclaimed water use(s)
none

Improvements & results *(2004-2009)*

WWTP influent pump station retrofitted to increase raw sewage flow pumping capacity from 3.5 MGD to 6.6 MGD with SCADA control.
Two new influent channel grinders (replaced 10+ year old units) to increase flow through capability from 1.7 MGD each to 4.0 MGD each.
Effluent disinfection system retrofitted with new "state of the art" sodium hypochlorite (bleach) pumps and sodium bisulfite pumps. New pumps capable of disinfecting higher effluent flows possibly caused by storm inflow and infiltration.
Effluent multi-parameter meter installed for sampling treated water before discharge to ocean. Dissolved oxygen, PH, conductivity, temperature and turbidity measured.
Post chlorine analyzer added to record adequate chlorine residual maintained for pathogen kill prior to chlorine removal and discharge to ocean.
New maintenance building to keep plant equipment working at optimal energy performance and decrease maintenance costs.
COLLECTIONS SYSTEM: Lift Station #4 retrofitted with three new high capacity output pumps, variable frequency drives, alarm system, SCADA control, and new force mains. Emergency back-up generators for three of four lift stations. Additional mobile emergency generator.
Approx. 14 miles of collections system repaired, replaced, and or slip lined (ongoing).
Installation and continuous monitoring of 20 Smart Covers strategically placed throughout collections system to alert staff 24/7 of potential system blockage before development of sanitary sewer overflow. Smart Cover website used to monitor and manage data.

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average total suspended solids** lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0047899	
	Weather						
Avg.	***Wet months***	***Dry months***				***Permit adopted** (1)* ***effective** (2)*	***Permit expires***
1.13	1.27	0.94	municipal	50.17	89:1	(1) Dec. 7, 2001 (2) Jan. 20, 2007	Dec. 7, 2006 Dec. 1, 2011

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Montecito http://www.healtheocean.org/images/_pages/research/wdi/23.Montecito.jpg

<table>
<tr><th colspan="10">Summerland Sanitary District Wastewater Treatment Plant – Regional Board 3 – Central Coast</th></tr>
<tr><th colspan="4">Area served</th><th># of people served (source: permit)</th><th>Relative size</th><th>EPA facility class</th><th colspan="2">Outfall distance from shore</th><th>Outfall depth</th></tr>
<tr><td colspan="4">Unincorporated Community of Summerland</td><td>2,500</td><td>very small</td><td>minor</td><td colspan="2">740 ft
0.14 miles</td><td>20 ft</td></tr>
<tr><td colspan="5">Treatment process
TERTIARY:
Primary clarifier, activated sludge aeration basin, secondary clarifier, chlorination contact chamber (hypochlorite), tertiary sand filter and dechlorination basin (sodium bisulfate). All wastewater treated to tertiary level (except when filters are being changed) before discharge to ocean.</td><td colspan="5">Improvements since 2005
none
Results of improvements
none
Improvements planned
none</td></tr>
<tr><td colspan="2">2008 average reclaimed water amount: none</td><td colspan="3" rowspan="2">2008 reclaimed water use(s)
none</td><td colspan="5" rowspan="2">Notes
Undertaking initial plan to supply recycled water for local landscape use.</td></tr>
<tr><td>approx. % of annual plant flow</td><td>0</td></tr>
<tr><th colspan="3">2005 average effluent flow (MGD)</th><th rowspan="3">Type of wastewater</th><th rowspan="3">2005 average TSS mass emissions lb/day</th><th rowspan="3">2005 effluent dilution</th><th colspan="4">NPDES Permit #
CA0048054</th></tr>
<tr><th rowspan="2">Avg.</th><th colspan="2">Weather</th><th colspan="2" rowspan="2">Permit adopted effective ✓</th><th colspan="2" rowspan="2">Permit expires</th></tr>
<tr><th>Wet months</th><th>Dry months</th></tr>
<tr><td>0.21</td><td>0.27</td><td>0.16</td><td>domestic</td><td>4.29</td><td>60:1</td><td colspan="2">Mar. 21, 2003
May 9, 2008</td><td colspan="2">Jun. 9, 2008
May 9, 2013</td></tr>
<tr><td colspan="10">EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet</td></tr>
</table>

Summerland http://www.healtheocean.org/images/_pages/research/wdi/24.Summerland.jpg

Carpinteria Sanitary District Wastewater Treatment Facility – Regional Board 3 – Central Coast

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Carpinteria and portions of Santa Barbara County	16,500	small	major	1,000 ft 0.19 miles	25 ft

Treatment process
SECONDARY w/ CHLORINATION AND DECHLORINATION: Pretreatment, screening, grit removal, primary sedimentation, aerated activated sludge tanks, secondary sedimentation, chlorination, and dechlorination.

Improvements since 2005
Critical pump station replacement and improvements in Mar. 2009.

Results of improvements

Improvements planned
none

Notes

2008 average reclaimed water amount: none

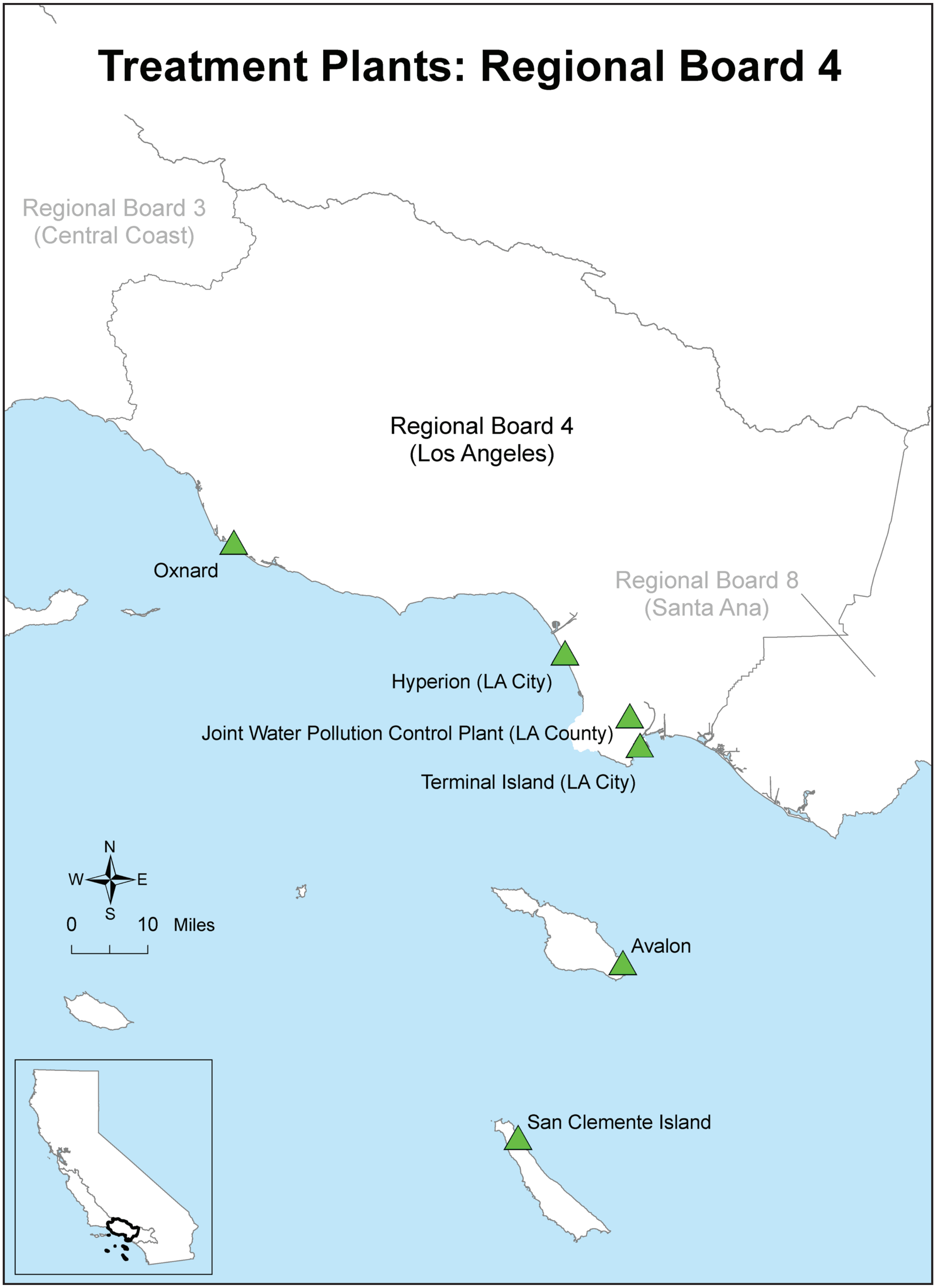
approx. % of annual plant flow: 0

2008 reclaimed water use(s)
none

2005 average effluent flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0047364	
	Weather						
Avg.	*Wet months*	*Dry months*				*Permit Adopted* (1) *effective* (2)	*Permit expires*
1.58	1.72	1.44	municipal	150.41	93:1	(1) Oct. 21, 2005 (2) Jan 20, 2007	(effect. delay) Oct. 21, 2010

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Carpinteria http://www.healtheocean.org/images/_pages/research/wdi/25.Carpinteria.jpg



http://www.healtheocean.org/images/_pages/research/wdi/WWTPs_RegBoard4.jpg

Oxnard Wastewater Treatment Plant – Regional Board 4 – Los Angeles					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
Oxnard, Port Hueneme, U.S. Naval Base, Ventura County, and some unincorporated areas of Ventura County	225,000	medium	major	4,934 ft 0.93 miles	60 ft

Treatment process
SECONDARY w/ CHLORINATION AND DECHLORINATION:
Bar screening, aerated grit removal, primary clarification, biofiltration, activated sludge, secondary clarification, flow equalization, chlorine disinfection, dechlorination.

Improvements since 2005
New influent screening, grit removal and new influent pumps.

Results of improvements

Improvements planned
none

Notes
Discharge off Ormond Beach.

2008 average reclaimed water amount: none

approx. % of annual plant flow: 0

2008 reclaimed water use(s)
Final effluent water ("3W" water) may be used to wash down equipment and grounds, and feed pump packing glands. All 3W water recycled back into plant and eventually discharged. No uses outside of plant.

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0054097	
Avg.	***Weather*** – ***Wet months***	***Weather*** – ***Dry months***				***Permit Adopted*** (1) ***effective*** (2)	***Permit expires***
24.49	25.15	23.83	domestic, commercial, and industrial	1,321.22	98:1	(1) Jul. 11, 2002 (2) Jun. 20, 2008	Jul. 10, 2007; Apr. 10, 2013

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Oxnard http://www.healtheocean.org/images/_pages/research/wdi/26.Oxnard.jpg

City of Los Angeles (Hyperion Treatment Plant) – Regional Board 4 – Los Angeles					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
City of Los Angeles	4,000,000	large	major	26,525 ft 5.02 miles	~187 ft

Treatment process

DISINFECTED & UNDISINFECTED SECONDARY: Preliminary and primary treatment consists of screening, grit removal, and primary sedimentation with coagulation and flocculation. In secondary treatment, primary effluent biologically treated in high purity oxygen activated sludge process comprised of cryogenic oxygen plant, 9 secondary reactor modules, and 36 secondary clarifiers. After clarification, undisinfected secondary effluent discharged into Santa Monica Bay.

Improvements since 2005

Installation of six KSP 50V (HD)XL Cake Pumps with SD 500 Screw Feeders (Aug. 2009).

Results of improvement

Each conveys 100 GPM of biosolids.

Improvements planned

2008 average reclaimed water amount: none, however up to 70 MGD from West Basin Water Recycling Facility (WBWRF)

approx. % of annual plant flow

2008 reclaimed water use(s)

From WBWRF: irrigation, industrial applications including cooling water and boiler feed water, and other purposes. Reverse osmosis treated water primarily injected into West Coast Basin Barrier Project to control seawater intrusion.

Notes

City of Los Angeles' largest and oldest wastewater treatment plant. Hyperion has 3 ocean outfalls. Discharge 001 permitted for emergency discharge of disinfected (chlorinated) secondary effluent during extremely high flows. Discharge 002 only outfall permitted for routine discharge of undisinfected secondary treated effluent. Discharge 003 historically used for discharge of sludge, but discharge from this outfall now prohibited.

From plant website: 1980 Sludge-out to full secondary treatment resulted in 95% reduction in amount of wastewater solids going into Santa Monica Bay; elimination of Bay's ecological dead-zone near mouth of sludge outfall; vast improvements in biological integrity of bottom-dwelling marine community; remarkable increases in relative abundance of many indicator-species; and partnerships among public, regulatory agencies, government and dischargers.

West Basin Water Recycling Facility can receive secondary effluent from Hyperion Treatment Plant for advanced treatment.

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0109991	
	Weather						
Avg.	***Wet months***	***Dry months***				***Permit adopted effective*** ✓	***Permit expires***
332.25	345.67	318.83	municipal	58,780.86	84:1	May 9, 2005	May 14, 2010

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Hyperion http://www.healtheocean.org/images/_pages/research/wdi/27.Hyperion.jpg

County Sanitation Districts of Los Angeles County Joint Water Pollution Control Plant
Regional Board 4 – Los Angeles

Area served	*# of people served* (source: plant website)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
JWPCP is part of an interconnected system serving main portion of Los Angeles basin, excluding areas served by City of Los Angeles and several other cities. Interconnected system, known as Joint Outfall System (JOS), includes six water reclamation plants designed to produce high quality recycled water.	3,500,000	large	major	OO1: 7,440 ft 1.41 miles OO2: 7,982 ft 1.51 miles	OO1: 167 to 190 OO2: 196 to 210

Treatment process
SECONDARY W/ CHLORINATION: Screening, grit removal, primary sedimentation, pure oxygen activated sludge reactors, secondary clarification, and chlorination. Waste brine generated by West Basin Municipal Water District's Carson Regional Water Recycling Plant discharged to ocean through JWPCP outfalls OO1 & OO2 via waste brine line connected to JWPCP's effluent tunnel.

Improvements since 2005
Additional odor control systems, including biotrickling filters and carbon scrubbers.

Results of improvements
Since attaining full secondary treatment in October 2002, final effluent levels of BOD and suspended solids dropped below 30-day average of 30 mg/L. No violations since full secondary treatment became operational.

Improvements planned
Construction of high-speed centrifuges underway Aug. 2009. Results of evaluation of high-speed centrifuges to be used to determine long-term digested sludge dewatering strategy.

Notes
One of largest wastewater treatment plants in world and largest of Los Angeles County Sanitation District. Facility provides treatment for approximately 300 MGD. Combined cycle power plant utilizes digester gas (approx. 65% methane) to generate 22MW electricity - JWPCP essentially energy self-sufficient. Surplus energy sold back to utility company. OO1: discharges approx. 65% of effluent from JWPCP. Discharges south of shoreline off Whites Point, San Pedro. 120" width; diffuser length 4,440 ft. OO2: discharges approx. 35% of effluent from JWPCP. Discharges south o shoreline off Whites Point, San Pedro. Outfalls. 90" width; diffuser length 2,416 ft. OO3 and OO4 used only under hig flow conditions. Bixby Marshland restored and enhanced by JWPCP related sanitation districts, improving hydrologic conditions to maintain and enhance freshwater marsh and riparian habitats.

2008 average reclaimed water amount:
For entire JOS system:
(428.7 MGD treated)
133.1 MGD reclaimed;
54.2 MGD beneficially reused.

2008 reclaimed water use(s) No water produced at JWPCP directly reused because routing of high-salt content wastewater t JWPCP instead of water reclamation plants (WRP) results in JWPCP wastewater exceeding salinity limits for direct reuse.

approx. % of annual plant flow	31 (12.6 re-used)	***Type of wastewater***: municipal (1,100 significant industrial users)		***2005 average total suspended solids*** lb/day	***2005 effluent dilution***	***NPDES Permit #*** CA0053813	
2008 average effluent flow *(MGD)*		***Weather (flow)***				***Permit adopted effective ✓***	***Permit expires***
Average	*OO1:* 192 *OO2:* 103 Total: 295	***Wet months***	*001:* 194 *002:* 104 Total: 298	*OO1:* 27,709.86 *OO2:* 14,920.69 Total: 42,630.55	166:1	April 6, 2006	May 24, 2011
		Dry months	*001:* 191 *002:* 102 Total: 293				

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

JWPCP http://www.healtheocean.org/images/_pages/research/wdi/28.JWPCP.jpg

Terminal Island Treatment Plant – Regional Board 4 – Los Angeles					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
San Pedro, Wilmington and Harbor City Areas	130,000	medium	major	900 ft 0.17 miles	32 ft

Treatment process
UNDISINFECTED TERTIARY:
Preliminary treatment - bar screening and aerated grit removal. Primary treatment - primary sedimentation.
Secondary treatment - secondary clarification and activated sludge biological treatment.
Tertiary treatment without disinfection – microfiltration and reverse osmosis. Under normal operating conditions, discharge of tertiary-treated effluent to harbor not chlorinated.

Improvements since 2005
Terminal Island Renewable Energy Project: deep well injection of biosolids.

Results of improvements
none

Improvements planned
Centrifuge replacement

2008 average reclaimed water amount: 2-5 MGD

approx. % of annual plant flow	20

2008 reclaimed water use(s)
Harbor Water Recycling Project: Non-potable Reuse Project (1/20/03) permits irrigation, industrial, and recreational uses.

Dominguez Gap Barrier Project: (10/2/03) permits injection of 5 MGD into Dominguez Gap to prevent seawater intrusion.

Notes
Industrial Wastewater 60% of total flow to plant.

Discharge of treated municipal wastewater to harbor prohibited by 2020, including discharge of reclaimed, tertiary treated water.

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0053856	
	Weather						
Avg.	***Wet months***	***Dry months***				***Permit adopted effective ✓***	***Permit expires***
15.97	16.25	15.68	domestic, commercial and industrial	133.25	61:1	May 27, 2005	Mar. 10, 2010

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Terminal Island http://www.healtheocean.org/images/_pages/research/wdi/29.TerminalIsland.jpg

Avalon Wastewater Treatment Facility – Regional Board 4 – Los Angeles

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
City of Avalon on Catalina Island	3,500	very small	minor	400 ft 0.08 miles	130 ft

Treatment process SECONDARY W/ PARTIAL CHLORINATION, NO DECHLORINATION: Rotating screens, trickling filter, and activated sludge reactors for removal of organics, clarifiers for separation of solids, and chlorination system. Effluent partially chlorinated with addition of sodium hypochlorite solution to maintain consistent compliance with receiving waters bacterial standards. Chlorine concentration up to 2 mg/L in effluent at entrance of chlorine contact chamber. Trickling filter used only in summer, when portion of influent is passed through trickling filter to increase dissolved oxygen content of wastewater.	***Improvements since 2005*** Replaced aeration systems, added secondary clarifier. ***Results of improvements*** Maintained quality with increased flow due to increased tourism. ***Improvements planned*** Emergency generators, renovated decanters, and reverse osmosis water reclamation. Due to fiscal crisis, many improvements planned but not yet in works.

2008 average reclaimed water amount: none		***2008 reclaimed water use(s)*** none	***Notes*** Discharge 1.5 miles outside of ASBS (Binnacle Rock to Jewfish Point on Santa Catalina Island).
approx. % of annual plant flow	0		

2005 average effluent flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0054372	
Avg.	*Weather* — *Wet months*	*Weather* — *Dry months*				***Permit adopted*** (1) ***effective*** (2)	***Permit expires***
0.51	0.47	0.55	municipal wastewater from domestic and commercial sources	109.16	60:1	Apr. 25, 2002; June 20, 2008	Apr. 10, 2007; Apr. 10, 2013

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Avalon http://www.healtheocean.org/images/_pages/research/wdi/30.Avalon.jpg

San Clemente Reclamation Plant – Regional Board 9 – San Diego

Area served	# of people served by shared outfall (source: permit)	Relative size	EPA facility class	Outfall distance from shore	Outfall depth
San Juan Capistrano, Mission Viejo, San Clemente, Rancho Santa Margarita, Capistrano Beach, Dana Point	253,578	medium	major	10,334 ft 1.96 miles	100 ft

Treatment process

UNDISINFECTED SECONDARY AND TERTIARY:
Screening, grit removal, primary clarification and secondary treatment using activated sludge process consisting of aeration and clarification. Plant has chlorination facilities, but only effluent intended for irrigation is chlorinated. Secondary effluent not directed for reclamation is discharged through ocean outfall.

Improvements since 2005

Headworks and aeration basins.

Results improvements

Replacement of outdated equipment.

Improvements planned

2007 Master Plan updated and now includes expansion to serve future customers with recycled water. Replacement of solids handling dewatering equipment.

Notes

San Clemente Reclamation Plant served by San Juan Creek Outfall. NPDES permit and waste discharge monitoring and principal reporting requirements applied to outfall. Since 2006, individual plants served by outfall required to meet periodic monitoring requirements factored into combined reporting for outfall. Additional plants served by San Juan Creek Outfall: JB Latham Treatment Plant (South Orange County Water Authority (SOCWA)); 3A Reclamation Plant (Moulton Niguel Water District (MNWD)); Chiquit Water Reclamation Plant (Santa Margarita Water District (SMWD)); San Clemente Reclamation Plant; and Oso Creek Water Reclamation Plant (Santa Margarita Water District).

*2005 data applied across all plants served respectively by the individual outfalls.

2008 average reclaimed water amount: *1 MGD*

approx. % of annual plant flow	15 (40 in summer)

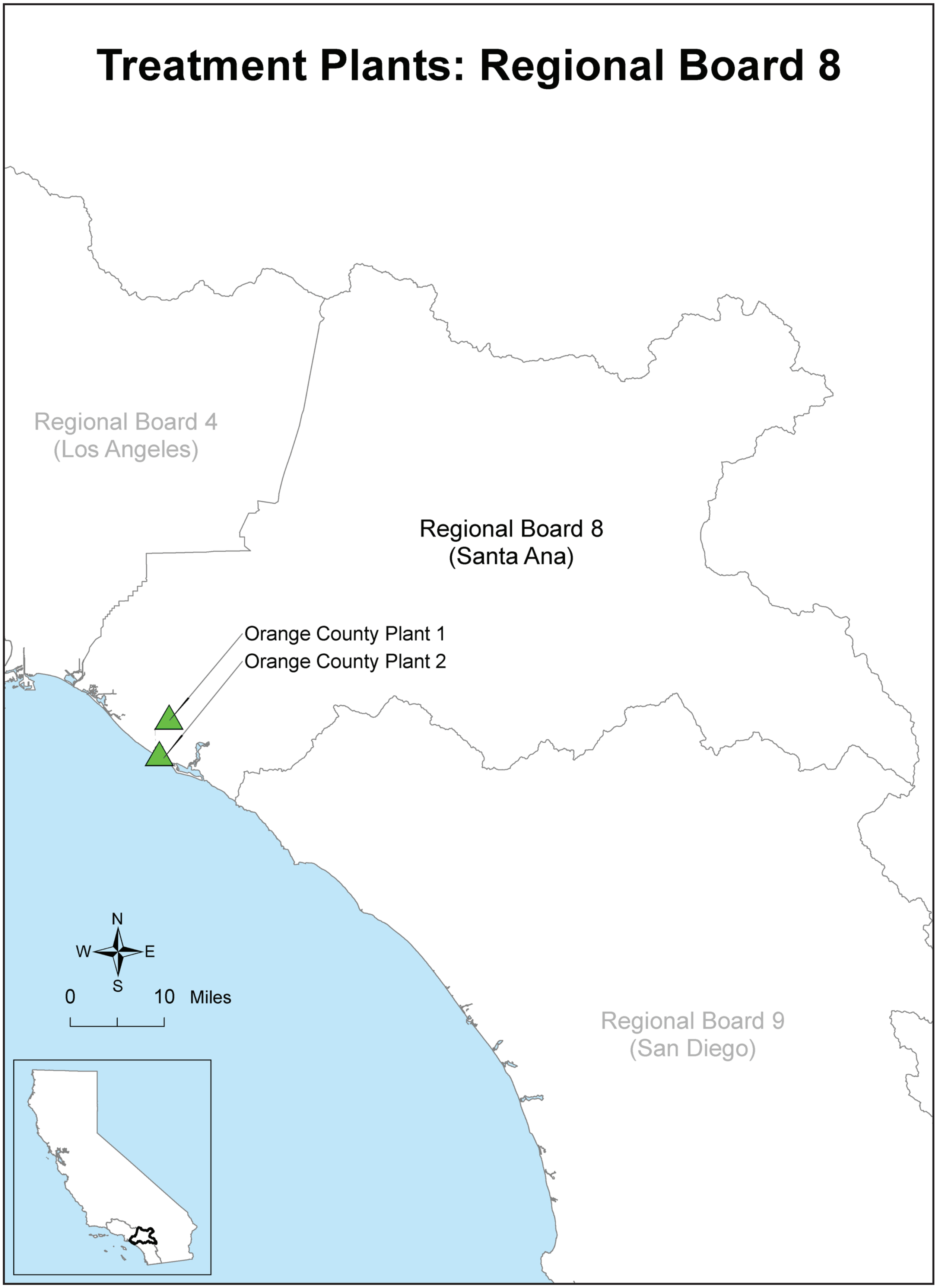
2008 reclaimed water use(s)

Irrigation of municipal golf course, Bella Colina Golf Club and reclamation plant for plant processes to treat sewage.

2005 average effluent flow (MGD) (total for shared outfall)*			Type of wastewater	shared outfall* 2005 avg. TSS mass emissions lb/day	2005 effluent dilution	NPDES Permit # CA0107417	
	Weather						
Avg.	Wet months	Dry months				Permit adopted effective ✓	Permit expires
23.17	24.57	21.77	municipal, waste brine from desalination facilities and dry weather nuisance flows	2,134.68	100:1	Oct. 31, 2004(?)	Oct. 1, 2009

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

San Clemente http://www.healtheocean.org/images/_pages/research/wdi/31.SanClemente.jpg



http://www.healtheocean.org/images/_pages/research/wdi/WWTPs_RegBoard8.jpg

Orange County Sanitation District, Reclamation Plant No. 1 & Treatment Plant No. 2
Regional Board 8 – Santa Ana

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Extends from the San Bernardino and San Gabriel mountains in the north and east to Newport Bay along the coast.	2,500,000	large	major	23,760 ft 4.5 mile	195 ft

Treatment process

Plant 1: BLENDED PRIMARY AND SECONDARY W/ CHLORINATION, NO DECHLORINATION: Plant designed to treat 208 MGD primary treated wastewater and 122 MGD secondary treated effluent - 30 MGD trickling filter plant, 92 MGD conventional air activated sludge plant. Ferric chloride and polymer added upstream of primary sedimentation basins. Effluent chlorination with sodium hypochlorite (bleach). Plant designed to convey highly treated secondary effluent to OCWD for reclamation of 70 MGD of water through the Ground Water Replenishment System (GWRS). Additionally, 9 MGD of secondary effluent can be conveyed to the Green Acres Project (GAP) process.

Plant 2: BLENDED PRIMARY AND SECONDARY WITH CHLORINATION AND DECHLORINATION: Raw sewage not treated at Plant 1 conveyed to Plant 2. Plant 2 designed to treat 168 MGD primary treated wastewater and 90 MGD secondary treated effluent (pure oxygen activated sludge). Primary treatment chemically enhanced. Disinfection with sodium hypochlorite, dechlorination with sodium bisulfite. Blended treated primary and secondary effluent from Plants 1 and 2 discharged through the ocean outfall.

2008-09 average reclaimed water amount: none, 44 MGD secondary effluent diverted to Orange County Water District to be reclaimed

approx. % of annual plant flow	20.9 from OCWD

2008 reclaimed water use(s)
Orange County Ground Water Replenishment System provided water for groundwater replenishment and for seawater intrusion barrier. Orange County Water District's Green Acres Project water used for greenways and industrial uses.

Improvements since 2005
Construction Capital Improvement Program (2002-2020): major rehabilitation of existing headworks, primary treatment, secondary treatment, ocean pipeline pumping, and biosolids handling facilities at both plants.

Results of improvements
Plants to transition to full secondary treatment from a blend of primary/secondary water to meet consent decree requirements (December 31, 2012). Disinfection of ocean discharge to reduce bacteria levels. Replacement of facilities beyond their useful life. Solids handling system capacity increased to address projected solids loadings.

Improvements planned
Ability to reclaim an additional 30 MGD of Orange County Sanitary District's highly treated effluent.

Notes
Dec. 2002, Discharger's 301(h) waiver withdrawn. Full compliance with secondary treatment requirements not anticipated to occur until 2013. Under average flow conditions, Plant No. 1 is currently operating at full secondary treatment.

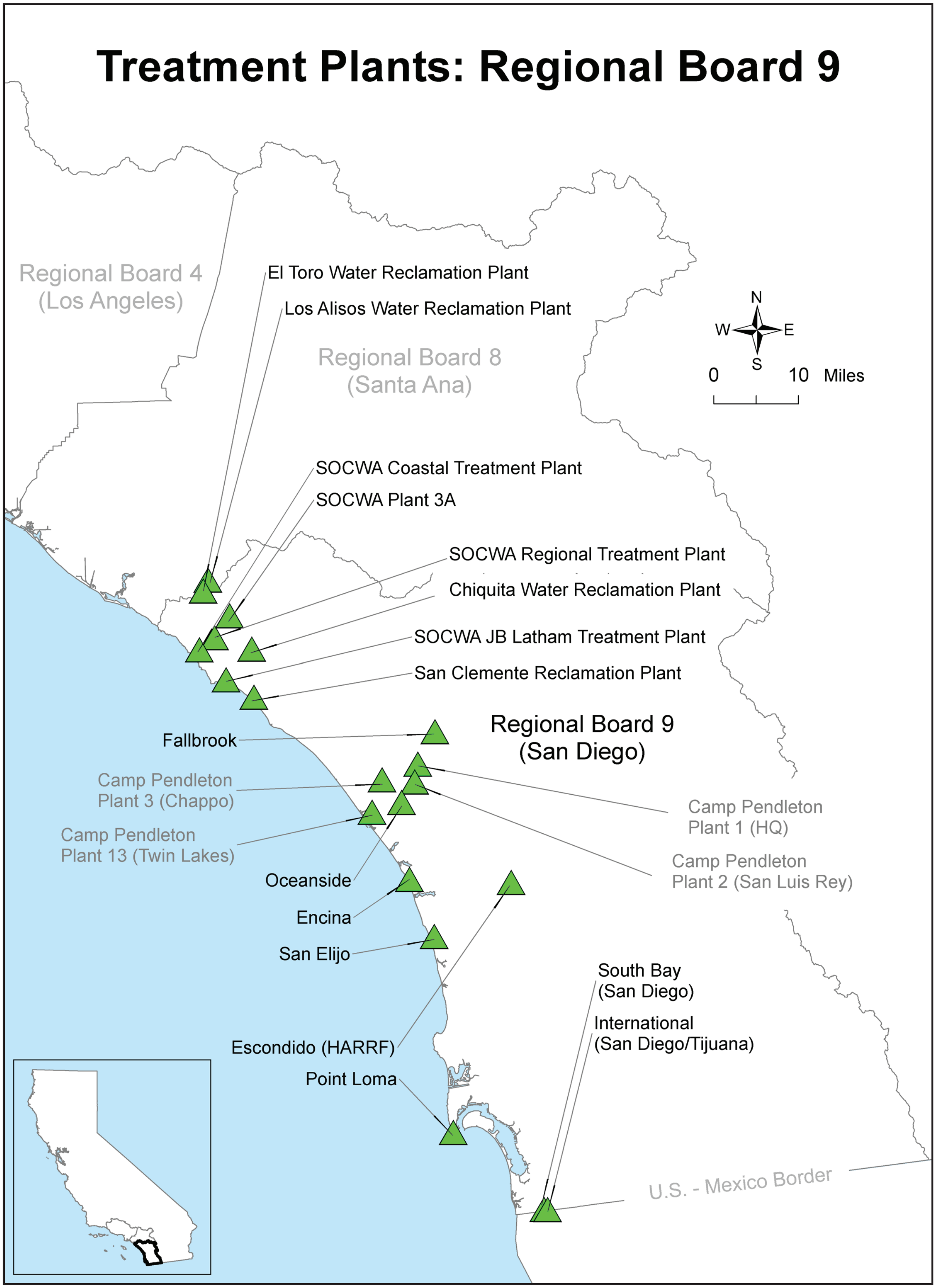
Orange County Plants 1 & 2 considered a single plant under NPDES permit and waste discharge requirements.

Flow in wet months from Nov. to Mar. less than flow in dry months due to recent water conservation efforts.

2008 average effluent flow (MGD)			*Type of wastewater*	*2008 average TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0110604	
Avg.	*Weather* *Wet months*	*Dry months*				*Permit adopted effective* ✓	*Permit expiry*
211	210 (*see notes on flow*)	211	domestic, commercial, and industrial	54,552	180:1	Oct. 31, 2004	Oct. 31, 2009

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Orange County http://www.healtheocean.org/images/_pages/research/wdi/32.OrangeCounty.jpg



http://www.healtheocean.org/images/_pages/research/wdi/WWTPs_RegBoard9.jpg

SOCWA Joint Regional Treatment Plant – Regional Board 9 – San Diego					
Area served	***# of people served*** *by shared outfall* (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
Laguna Beach, San Clemente, San Juan Capistrano, El Toro Water District, Emerald Bay Service District, Irvine Ranch Water District, Moulton Niguel Water District, San Margarita Water District, South Coast Water District, and Trabuco Canyon Water District	232,000	medium	major	6,700 ft 1.27 miles	170 ft

Treatment process
UNDISINFECTED SECONDARY AND DISINFECTED TERTIARY:
Screening, aerated grit removal, primary sedimentation, activated sludge aeration, and secondary sedimentation. Portion of wastewater receives tertiary treatment by chemical addition, coagulation, filtration, and chlorine disinfection. Wastewater not reclaimed is discharged to ocean.
Tertiary capacity: 11.4 MGD

2008 average reclaimed water amount: 6.22 MGD

approx. % of annual plant flow 62

2008 reclaimed water use(s)
Pumped into Moulton Niguel Water District reclaimed water system for distribution for irrigation.

Improvements since 2005

Results of improvements

Improvements planned
Installation of natural gas burning boiler by 2010 with subsequent retrofit of cogeneration engines with Nox Tech technology by 2012. Siloxane Treatment system. Natural gas burning boiler needed in future to meet demands of South Coast Air Quality Management District Rule 1110.2, which significantly lowers limits on carbon monoxide, nitrogen oxides, and volatile organic emissions from internal combustion engines using biogas.

Notes
Joint Regional Plant (South Orange County Water Authority (SOCWA)) served by Aliso Creek Outfall. NPDES permit and waste discharge monitoring and principal reporting requirements applied to outfall. Since 2006, individual plants served by outfall required to meet periodic monitoring requirements factored into combined reporting for outfall. Additional plants served by Aliso Creek Outfall: SOCWA Coastal Regional Plant; Los Alisos Water Reclamation Plant; and El Toro Water Recycling Plant.

*2005 data applied across all plants served by outfall.

2005 average effluent flow (MGD) *(total for **shared outfall**)**			***Type of wastewater***	***shared outfall* 2005 avg. TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0107611	
Avg.	***Weather*** ***Wet months***	***Dry months***				***Permit issued***	***Permit expires***
16.87	19.95	13.78	municipal	1,346.59	260:1	Aug. 1, 2006	Aug. 1, 2011

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

SOCWA Regional http://www.healtheocean.org/images/_pages/research/wdi/33.SOCWARegional.jpg

SOCWA Coastal Treatment Plant – Regional Board 9 – San Diego

Area served	*# of people served* *by shared outfall* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Laguna Beach, San Clemente, San Juan Capistrano, El Toro Water District, Emerald Bay Service District, Irvine Ranch Water District, Moulton Niguel Water District, San Margarita Water District, South Coast Water District, Trabuco Canyon Water District	232,000	medium	major	6,700 ft 1.27 miles	170 ft

Treatment process

UNDISINFECTED SECONDARY AND DISINFECTED TERTIARY: Screening, aerated grit removal, primary clarification, activated sludge aeration, and secondary clarification. Portion of wastewater receives tertiary treatment by chemical addition, coagulation, filtration, and chlorine disinfection. Wastewater not reclaimed discharged to ocean. Tertiary capacity: 4.2 MGD.

Improvements since 2005

Upgrade of tertiary filters completed. Construction of first phase of primary treatment upgrade nearing completion in Aug. 2009. Project includes replacement of primary sludge collectors in East Primary Sedimentation basins.

Results of improvements

Improvements planned

Installation of new sludge storage/equalization basin with truck unloading facility. Based on sludge equalization tank at El Toro Water Reclamation Facility. Provisions for more storage of export sludge will provide increased reliability and flexibility to deal with potential outages of export sludge force main.

2008 average reclaimed water amount: 0.78 MGD

2008 reclaimed water use(s)

Irrigation

approx. % of annual plant flow 20

Notes

Coastal Regional Plant (South Orange County Water Authority (SOCWA)) served by Aliso Creek Outfall. NPDES permit, and waste discharge monitoring and principal reporting requirements applied to outfall. Since 2006, individual plants served by outfall required to meet periodic monitoring requirements factored into combined reporting for the outfall. Additional plants served by Aliso Creek Outfall: Joint Regional Plant (South Orange County Water Authority (SOCWA); SOCWA Joint Regional Plant; Los Alisos Water Reclamation Plant; and El Toro Water Recycling Plant.

*2005 data applied across all plants served by outfall.

2005 average effluent flow (MGD) (total for ***shared outfall****)**			*Type of wastewater*	*shared outfall** *2005 avg. TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0107611	
Avg.	*Weather* *Wet months*	*Dry months*				*Permit issued*	*Permit expires*
16.87	19.95	13.78	municipal	1,346.59	260:1	Aug. 1, 2006	Aug. 1, 2011

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

SOCWA Coastal http://www.healtheocean.org/images/_pages/research/wdi/34.SOCWACoastal.jpg

Irvine Ranch Water District Los Alisos Water Reclamation Plant – Regional Board 9 – San Diego					
Area served	***# of people served*** ***by shared outfall*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall dep***
Laguna Beach, San Clemente, San Juan Capistrano, El Toro Water District, Emerald Bay Service District, Irvine Ranch Water District, Moulton Niguel Water District, San Margarita Water District, South Coast Water District, and Trabuco Canyon Water District	232,000	medium	major	6,700 ft 1.27 miles	170 ft

Treatment process
UNDISINFECTED SECONDARY AND DISINFECTED TERTIARY: Screening and aerated lagoons. Portion of secondary effluent receives tertiary treatment by chemical addition, flash mixing, coagulation, flocculation, sedimentation, filtration, and chlorine disinfection. Effluent not reclaimed is discharged through ocean outfall. Tertiary treatment capacity - 5.5 MGD.

Improvements since 2005
none
Results of improvements
none

Improvements planned
none

2008 average reclaimed water amount: 3 MGD		***2008 reclaimed water use(s)***
approx. % of annual plant flow	65	irrigation

Notes
Los Alisos Water Reclamation Plant served by Aliso Creek Outfall. NPDES permit and waste discharge monitoring and principal reporting requirements applied to outfall. Since 2006, individual plants served by outfall required t meet periodic monitoring requirements factored into combined reporting for outfall. Additional plants served Aliso Creek Outfall: SOCWA Joint Regional Plant; SOCWA Coastal Regional Plant; and El Toro Water Recycling Plan

*2005 data applied across all plants served by outfall.

2005 average effluent flow (MGD) *(total for* ***shared outfall****)**			***Type of wastewater***	***shared outfall**** ***2005 avg. TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0107611	
Avg.	***Weather*** ***Wet months***	***Dry months***				***Permit issued***	***Permit expire***
16.87	19.95	13.78	municipal	1,346.59	260:1	Aug. 1, 2006	Aug. 1, 2011

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Los Alisos http://www.healtheocean.org/images/_pages/research/wdi/35.LosAlisos.jpg

El Toro Water District Water Recycling Plant – Regional Board 9 – San Diego					
Area served	***# of people served*** *by shared outfall* (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
Laguna Beach, San Clemente, San Juan Capistrano, El Toro Water District, Emerald Bay Service District, Irvine Ranch Water District, Moulton Niguel Water District, San Margarita Water District, South Coast Water District, and Trabuco Canyon Water District	232,000	medium	major	6,700 ft 1.27 miles	170 ft

Treatment process
UNDISINFECTED AND CHLORINATED SECONDARY: Coarse screening, aerated grit removal, fine screening, activated sludge aeration, and secondary clarification. Portion of secondary effluent reclaimed - receives filtering and chlorine disinfection. Effluent not reclaimed discharged through ocean outfall.

Improvements since 2005
Major reconstruction and upgrade project of plant process components.

Results of improvements
Achieved objectives of compliance with short and long term regulatory requirements, while providing higher effluent and recycled water quality.

Improvements planned
Position district to expand use of recycled water locally and regionally. Tertiary treatment.

2008 average reclaimed water amount: > 4 MGD

approx. % of annual plant flow

2008 reclaimed water use(s)
Portion of secondary effluent reclaimed for irrigation of golf course, nursery, and tennis center.

Notes
El Toro Water Recycling Plant served by Aliso Creek Outfall. NPDES permit and waste discharge monitoring and principal reporting requirements applied to outfall. Since 2006, individual plants served by outfall required to meet periodic monitoring requirements factored into combined reporting for outfall. Additional plants served by Aliso Creek Outfall: SOCWA Joint Regional Plant; SOCWA Coastal Regional Plant; and Los Alisos Water Reclamation Plant.

*2005 data applied across all plants served by outfall.

2005 effluent average flow (MGD) *(total for **shared outfall**)**			***Type of wastewater***	***shared outfall* 2005 avg. TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0107433	
Avg.	***Weather*** – ***Wet months***	***Weather*** – ***Dry months***				***Permit issued***	***Permit expires***
16.87	19.95	13.78	municipal	1,346.59	260:1	Aug. 1, 2006	Aug. 1, 2011

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

El Toro http://www.healtheocean.org/images/_pages/research/wdi/36.ElToro.jpg

SOCWA JB Latham Treatment Plant – Regional Board 9 – San Diego					
Area served	***# of people served*** *by shared outfall* (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
San Juan Capistrano, Mission Viejo, San Clemente, Rancho Santa Margarita, Capistrano Beach, Dana Point	253,578	medium	major	10,334 ft 1.96 miles	100 ft

Treatment process
UNDISINFECTED SECONDARY: Screening, grit removal, primary clarification and secondary treatment using an activated sludge process consisting of aeration and clarification. Plant has unused chlorination facilities.

Improvements since 2005
In 2006, rehabilitation of Digesters No. 1 and No.2 completed, including conversion from gas mix systems to pump mixing systems. Gaseous chlorine system replaced by sodium hypochlorite system in 2008.

Results of improvements

Improvements planned
Construction of advanced water treatment (AWT) facility (including chemical addition, coagulation, filtration and ultraviolet light disinfection). Aug 2009, in design stage of possible construction of 7 MGD recycled water treatment facility.

Notes
JB Latham Regional Treatment Plant (South Orange County Water Authority (SOCWA)) served by San Juan Creek Outfall. NPDES permit and waste discharge monitoring and principal reporting requirements applied to outfall. Since 2006, individual plants served by outfall required to meet periodic monitoring requirements factored into combined reporting for outfall. Additional plants served by San Juan Creek Outfall: Chiquita Water Reclamation Plant (Santa Margarita Water District (SMWD); 3A Reclamation Plant (Moulton Niguel Water District (MNWD)); San Clemente Reclamation Plant; and Oso Creek Water Reclamation Plant (Santa Margarita Water District).

*2005 data applied across all plants served by outfall.

2008 average reclaimed water amount:	none
approx. % of annual plant flow	0
2008 reclaimed water use(s)	

2005 effluent average flow (MGD) *(total for **shared outfall**)**			***Type of wastewater***	***shared outfall* 2005 avg. TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0107417	
Avg.	***Weather*** – ***Wet months***	***Weather*** – ***Dry months***				***Permit issued***	***Permit expires***
23.17	24.57	21.77	municipal, waste brine from desalination facilities and dry weather nuisance flows	2,134.68	100:1	Oct. 1, 2006	Oct. 1, 2011

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily

SOCWA J.B. Latham http://www.healtheocean.org/images/_pages/research/wdi/37.SOCWAJ.B.Latham.jpg

SOCWA Plant 3A – Regional Board 9 – San Diego

Area served	*# of people served* *by shared outfall* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
San Juan Capistrano, Mission Viejo, San Clemente, Rancho Santa Margarita, Capistrano Beach, Dana Point	253,578	medium	major	10,334 ft 1.96 miles	100 ft

Treatment process

UNDISINFECTED SECONDARY AND TERTIARY: Screening, grit removal, primary sedimentation, and secondary treatment using an activated sludge process consisting of aeration and clarification. Plant has chlorination facilities, but only effluent intended for irrigation is chlorinated. Effluent not sent for advanced treatment is discharged through ocean outfall.

Improvements since 2005

2008: rehabilitation of tertiary filters.

Results of improvements

Improvements planned

Only SOCWA facility w/ anaerobic digestion but w/out some form of co-generation. Digester gas at Plant 3A either burned in boiler to generate heat for digestion process or flared. Gas Management Project to review potential installation of either microturbines or fuel cells to generate electricity from digester gas. Separate element of project currently under study is development of fats, oils and grease (FOG) receiving station. Preliminary analysis indicates handling of local FOG could approximately double available digester gas and increase economic viability of co-generation.

2008 average reclaimed water amount: 0.62 MGD

approx. % of annual plant flow	28

2008 reclaimed water use(s)

Portion of secondary treated effluent reclaimed through onsite reclamation facility. Pumped into Moulton Niguel Water District (MNWD) reclaimed water system. MNWD can also pump the reclaimed water into Upper Oso Reservoir.

Notes 3A Reclamation Plant served by San Juan Creek Outfall (Moulton Niguel Water District (MNWD)). NPDES permit and waste discharge monitoring and principal reporting requirements applied to outfall. Since 2006, individual plants served by outfall required to meet periodic monitoring requirements factored into combined reporting for outfall. Additional plants served by San Juan Creek Outfall: JB Latham Treatment Plant (South Orange County Water Authority (SOCWA); San Clemente Reclamation Plant; and Oso Creek Water Reclamation Plant (Santa Margarita Water District)

*2005 scores applied across all plants served by outfall.

2005 effluent average flow (MGD) *(total for **shared outfall**)**			*Type of wastewater*	*shared outfall** *2005 avg. TSS mass emissions* *lb/day*	*2005 effluent dilution*	***NPDES Permit #*** CA0107417	
Avg.	*Weather*					*Permit issued*	*Permit expires*
	Wet months	*Dry months*					
23.17	24.57	21.77		2,134.68	100:1	Oct. 1, 2006	Oct. 1, 2011

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

SOCWA Plant 3A http://www.healtheocean.org/images/_pages/research/wdi/38.SOCWAPlant3A.jpg

Santa Margarita Water District Chiquita Water Reclamation Plant – Regional Board 9 – San Diego

Area served	# of people served by shared outfall (source: permit)	Relative size	EPA facility class	Outfall distance from shore	Outfall depth
San Juan Capistrano, Mission Viejo, San Clemente, Rancho Santa Margarita, Capistrano Beach, Dana Point	253,578	medium	major	10,334 ft 1.96 miles	100 ft

Treatment process

UNDISINFECTED SECONDARY AND TERTIARY: Screening, grit removal, primary clarification and secondary treatment using combination of high-rate trickling filtration, recirculation, solids contact, and secondary clarification. Plant has unused chlorination facilities. Effluent not sent for advanced treatment is discharged through ocean outfall.

Improvements since 2005

Results of improvements

Improvements planned

Notes

Chiquita Water Reclamation Plant (Santa Margarita Water District (SMWD)) served by San Juan Creek Outfall. NPDES permit and waste discharge monitoring and principal reporting requirements applied to outfall. Since 2006, individual plants served by outfall required to meet periodic monitoring requirements factored into combined reporting for outfall. Additional plants served by San Juan Creek Outfall: JB Latham Treatment Plant (South Orange County Water Authority (SOCWA); 3A Reclamation Plant (Moulton Niguel Water District (MNWD); San Clemente Reclamation Plant; and Oso Creek Water Reclamation Plant (Santa Margarita Water District).

*2005 data applied across all plants served by outfall.

2008 average reclaimed water amount: 2.14 MGD	***2008 reclaimed water use(s)***
approx. % of annual plant flow: 32	irrigation

2005 average effluent flow (MGD) *(total for **shared outfall**)**			***Type of wastewater***	***shared outfall* 2005 avg. TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0107417	
Avg.	***Weather – Wet months***	***Weather – Dry months***				***Permit issued***	***Permit expires***
23.17	24.57	21.77	municipal, waste brine from desalination facilities and dry weather nuisance flows	2,134.68	100:1	Oct. 1, 2006	Oct. 1, 2011

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Chiquita http://www.healtheocean.org/images/_pages/research/wdi/39.Chiquita.jpg

San Clemente Island – Regional Board 9 – San Diego

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Wilson Cove area on San Clemente Island and some domestic waste pumped from septic tanks or temporary portable facilities in the outlying areas of the island	500	very small	minor	0 ft 0 miles	0 ft

Treatment process
SECONDARY w/ DISINFECTION:
Communition, equalization, aeration, clarification, chlorination, and dechlorination. Beyond chlorine contact tank, Navy has installed recycled water splitter box housing two submersible pumps to pump recycled water to storage tank. Since recycling system operates on side stream from SCI Plant, all effluent from chlorine contact tank not meeting recycled water limitations is diverted to dechlorination tank and discharged through plant's ocean outfall.

Improvements since 2005
none

Results of improvements
n/a

Improvements planned
Projects to build sand filter, chlorination, and lay down more pipe for reclaimed water.
Reclamation of 4.4 MGD by Summer '10 with no discharge to ocean.

2008 average reclaimed water amount: ~0.2085 MGD (0.834 MGD between May 1 and July 31)

approx. % of annual plant flow

2008 reclaimed water use(s)
In-plant uses, all irrigation around plant, multiple golf courses, soil compaction, mixing concrete, backfill consolidation around non-potable piping, dust control on roads and streets, and flushing sanitary sewers.

Notes
Outfall located in rocky shoreline; discharge above ocean surface. Discharges into an ASBS. Regional board cannot issue new permit until State Board allows SCI to discharge storm water into ASBS. Availability of recycled water for non-potable uses is crucial for conservation of limited potable water for use on island. Potable water shipped to island once a week from San Diego, approx. 80 miles distant.

2005 average effluent flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0110175	
	Weather						
Avg.	*Wet months*	*Dry months*				*Permit adopted effective ✓*	*Permit expires*
0.02	0.023	0.018	domestic	2.69	0:1	Jun. 29, 2000	Jul. 10, 2005 ext.

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

San Clemente http://www.healtheocean.org/images/_pages/research/wdi/40.SanClemente.jpg

Oceanside (San Luis Rey & La Salina Wastewater Treatment Plants) – Regional Board 9 – San Diego					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
Oceanside, Vista, Rainbow Municipal Water District	184,000	medium	major	8,850 ft 1.68 miles	100 ft

Treatment process

UNDISINFECTED SECONDARY:
Waste discharge requirements (WDR) cover treatment at both San Luis Rey Wastewater Treatment Plant (SLRWTP) and La Salina Wastewater Treatment Plant (LSWTP); process uses screening and grit removal, primary sedimentation, activated sludge treatment followed by secondary clarification.

TERTIARY: SLRWTP produces up to 0.7 MGD of tertiary treated recycled water - discharge covered under separate WDR. Discharger also operates Brackish Groundwater Desalination Facility (BGDF), which produces up to 6 MGD of final potable water and 2 MGD waste brine (tertiary capacity 4.0 MGD).

Improvements since 2005

none

Results of improvements

none

Improvements planned

Improvement to tertiary water, sand filter, improvements to chlorination system, construction of emergency holding pond at Buccaneer Beach.

2008 reclaimed water amount:	***2008 reclaimed water use(s)***
0.3 MGD	Bird sanctuary and golf course; WWTP infrastructure limits reclaimed water use.
approx. % of annual plant flow 3	

Notes

Under waste discharge requirements on or before 2005, discharge goes to Fallbrook Public Utility District's land outfall pipeline that conveys effluent approximately 14 miles from Fallbrook to Oceanside Ocean Outfall (OOO). Effluent comingles with discharges from Fallbrook Public Utility District, US Marine Corps Base Camp Pendleton and Biogen IDEC Pharmaceuticals Corporation. Oceanside Artificial Fishing Reef No. 1 located approx. 6,000 feet north of inshore end of OOO diffuser.

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0107433	
	Weather						
Avg.	***Wet months***	***Dry months***				***Permit adopted effective ✓***	***Permit expires***
15.04	14.07	16.02	municipal	640.37	87:1	Aug. 10, 2005	Aug. 10, 2010

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily
GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Oceanside http://www.healtheocean.org/images/_pages/research/wdi/41.Oceanside.jpg

Fallbrook Public Utility District Wastewater Treatment Plant No. 1 – Regional Board 9 – San Diego

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Fallbrook	25,000	small	major	8,850 ft 1.68 miles	100 ft

Treatment process
TERTIARY W/ DISINFECTION:
Preliminary treatment by screening and grit removal, primary sedimentation and scum removal, biological treatment using activated sludge followed by secondary clarification. Tertiary treatment by coagulation and flocculation followed by sand filtration, and chlorine disinfection. Treated wastewater not distributed as recycled water is discharged from ocean outfall.

Improvements since 2005
Addition of Fenton Heat Dryer for production of Class A biosolids.

Results of improvements
none

Improvements planned
Upgrade of tertiary filter system, Duperon Flex Rake. Flex rake will reduce amount of rags entering system.

2008 average reclaimed water amount: ~ 1.6MGD

approx. % of annual plant flow	100%

2008 reclaimed water use(s)
~ 10 recycled water use sites supplied directly from WTP1, including nurseries, roadway medians; 15-32% of tertiary effluent reused.

Notes
Effluent commingles with discharges from City of Oceanside, US Marine Corps Base Camp Pendleton, and Biogen IDEC Pharmaceuticals Corporation.

Discharge through shared Oceanside Ocean Outfall (OOO). Oceanside Artificial Fishing Reef No. 1 located approximately 6,000 feet north of inshore end of OOO diffuser.

2005 average effluent flow (MGD)			*Type of wastewater*	*shared outfall* *2005 avg. TSS mass emissions* lb/day	*2005 effluent dilution*	*NPDES Permit #* CA0108031	
Avg.	*Weather* – *Wet months*	*Weather* – *Dry months*				*Permit adopted effective ✓*	*Permit expires*
1.59	1.90	1.29	municipal with no industrial users	44.38	87:1	Feb. 9, 2000(?) Jun. 1, 2006	Jun. 1, 2005 (ext?) Jun. 1, 2011

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Fallbrook http://www.healtheocean.org/images/_pages/research/wdi/42.Fallbrook.jpg

Southern Region Tertiary Treatment Plant – Regional Board 9 – San Diego

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
US Marine Corps Base – Camp Pendleton	49,000	small	major	8,850 ft 1.68 miles	100 ft

Treatment process

SECONDARY & TERTIARY: Mechanical bar screen (one manual backup), two grit vortexes, alum injection, five sequencing batch reactors (SBRs), two equalization basins for SBRs, three disk filters, two chlorine contact basins. Chlorination only of effluent for reclaimed water. 5 MGD capacity.

Improvements since 2005

$40+ million tertiary plant located less than 1 mile from beach - opened Aug. 2006. Fully online Mar. 2009, completely replacing Camp Pendleton ocean discharging plants. Replaced plants converted to lift stations. Summer 2008, wastewater conveyance pipelines completed to divert sewage from Treatment Plant Nos. 1 (Headquarters Plant), 2 (San Luis Rey Plant), and 3 (Chappo Plant) to Southern Regional Tertiary Treatment Plant (SRTTP).

Results of improvements

Improvements planned

2008 average reclaimed water amount:		***2008 reclaimed water use(s)***
approx. % of annual plant flow	100	Marine memorial Golf Course or reused on Base. Excess water stored in Lemon Grove Pond or sent to Oceanside Ocean Outfall (OOO).

Notes

Effluent comingles with discharges from Fallbrook Public Utility District, Oceanside WWTF and Biogen IDEC Pharmaceuticals Corporation, and enters the Pacific Ocean from the Oceanside Ocean Outfall (OOO).
Oceanside Artificial Fishing Reef No. 1 located approx. 6,000 feet north of inshore end of OOO diffuser.

2005 average effluent flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions lb/day*	*2005 effluent dilution*	*NPDES Permit #* CA0109347	
Avg.	*Weather* – *Wet months*	*Weather* – *Dry months*				*Permit adopted effective* ✓	*Permit expires*
3.6 permitted			municipal		87:1	Nov. 1, 2008	Nov. 1, 2013

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

SRTTP http://www.healtheocean.org/images/_pages/research/wdi/44.SRTTP.jpg

Encina Wastewater Authority Water Pollution Control Facility – Regional Board 9 – San Diego					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
Vista, Carlsbad, Buena Sanitation District, Vallecitos Water District, Leucadia Wastewater District, Encinitas	281,000	medium	major	7,800 ft 1.48 miles	150 ft

Treatment process

Main plant Encina Water Pollution Control Facility (EWPCF): UNDISINFECTED SECONDARY: Bar screening, aerated grit removal, primary sedimentation, biological treatment using activated sludge, and secondary clarification. Facility also has disinfection (chlorination) capabilities with enough capacity only to disinfect secondary effluent currently used on site. Secondary capacity 36 MGD.

For more advanced treatment, wastewater which would have gone to EWPCF is diverted to Vallecitos Meadowlark Water Reclamation Plant (VMWRP) for secondary and tertiary treatment or Carlsbad Water Reclamation Facility (CWRF) for tertiary and reverse osmosis brine.

Improvements since 2005

Additional secondary clarifier, upgraded aeration tank diffusers, installed additional flow equalization capacity, new co-generation facility, centrifuges/sludge heat dryer process, new aeration blowers.

Results of improvements

Increased efficiency, increased capacity.

Improvements planned

none

2008 average reclaimed water amount: none (However, associated plants produce 8 MGD in summer, 4 MGD in winter)

approx. % of annual plant flow 0 (However associated plants produce 36% in Summer and 18% in Winter)

2008 reclaimed water use(s)

Plant irrigation, odor reduction facility, co-generation cooling, pump seals, facility hose down, chemical make-up. Exportation of water to Carlsbad and Leucadia for additional treatment and reclamation use.

Notes

All wastewater generated within service areas of Encina Water Authority member agencies, except for VMWRP, is treated at EWPCF. All flows that are not recycled are discharged from the ocean outfall. Other plants associated with Encina: Vallecitos Meadowlark Water Reclamation Plant (VMWRP) diverts raw wastewater from EWPCF; utilizes rotating screens, biological treatment using rotating biological contactors, secondary clarification, filtration, and chlorine disinfection (tertiary capacity 2.25 MGD); CWRF diverts portion of secondary effluent from Encina Water Pollution Control Facility (EWPCF) for recycling using process of continuous backwash granulated media filtration, microfiltration or ultrafiltration, reverse osmosis membrane filtration, chlorine disinfection, and solids thickening (tertiary capacity 4.0 MGD).

2005 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 effluent dilution***	***NPDES Permit #*** CA0107395	
	Weather						
Avg.	***Wet months***	***Dry months***				***Permit Adopted*** (1) ***effective*** (2)	***Permit expires***
29.08	31.20	26.95	municipal	2199.15	144:1	(1)Apr. 12, 2000 (2) Jan. 1, 2006	Apr. 12, 2005 Jan. 1, 2011

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

Encina http://www.healtheocean.org/images/_pages/research/wdi/45.Encina.jpg

Escondido Hale Avenue Resource Recovery Facility – Regional Board 9 – San Diego					
Area served	***# of people served*** (source: permit)	***Relative size***	***EPA facility class***	***Outfall distance from shore***	***Outfall depth***
City of Escondido and Rancho Bernardo community of San Diego	173,300	medium	major	6,800 ft 1.3 miles	110 ft

Treatment process

UNDISINFECTED SECONDARY AND TERTIARY: Secondary treatment - bar screens and grit removal, primary sedimentation, secondary aeration basins and clarifiers, lined basin used to equalize flow before discharge. Wastewater discharged to ocean or receives tertiary treatment. Tertiary treatment - pre-filtration chemical addition and chlorination, flocculation and filtration, UV disinfection, flow equalization. Tertiary capacity 9 MGD.

Improvements since 2005

Chemically enhanced primary treatment system finished Sept. '09, testing in Oct. Complete retrofit of aeration basins; rebuild of digester heating system; working on recommission of UV system at higher capacity; addition of 3 million gallons of storage capacity; working with identified businesses to stop inflow.

Results of improvements

Rated capacity of tertiary system will return to 9 MGD as result of UV system upgrade. Digester heating system more reliable; aeration basins more efficient with higher treatment capacity; increased storage capacity to help with peak flow management; over 1 MG reduction in inflow during peak rain events.

Improvements planned

Inflow & Infiltration program, pilot soft filters to replace dynasand filters. Pilot system for reverse osmosis and microfiltration to bring total nitrogen and phosphorous levels "below 1."
More efficient and effective filtering for water reclamation, which will also improve UV system and chlorination effectiveness. Investigating potential sale of reclaimed water to customers and other agencies.

2008-09 average reclaimed water amount:	3 - 4 MGD	***2008-09 reclaimed water use(s)***	***Notes***
approx. % of annual plant flow	12-13	cooling towers, irrigation, energy producers, plant process	Tertiary treated wastewater typically discharged to City's recycled water distribution system; however, excess tertiary treated wastewater may be discharged with secondary treated wastewater into Pacific Ocean or under certain conditions into Escondido Creek (separate permit).

2008-09 average effluent flow (MGD)			***Type of wastewater***	***2005 average TSS mass emissions*** *lb/day*	***2005 affluent dilution***	***NPDES Permit #*** CA0107981	
	Weather						
Avg.	***Wet months***	***Dry months***				***Permit adopted effective ✓***	***Permit expires***
13	13.25	12.75	municipal	1,082.96	237:1	Jan. 1, 2006	Jan 1, 2011

Escondito http://www.healtheocean.org/images/_pages/research/wdi/46.Escondito.jpg

San Elijo Powers Authority Water Reclamation Facility – Regional Board 9 – San Diego

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
Solana Beach, Rancho Santa Fe Community Services District, and Cardiff Sanitation District	35,000	small	major	8,000 ft 1.50 miles	150-160 ft

Treatment process

UNDISINFECTED SECONDARY AND TERTIARY:
Screening and aerated grit removal, primary sedimentation, activated sludge treatment followed by secondary clarification. Secondary treated effluent either discharged to San Elijo Ocean Outfall or receives tertiary treatment.
Tertiary treatment - coagulation, flocculation, filtration, disinfection by sodium hypochlorite. Up to 2.48 MGD of tertiary treated recycled water produced for reuse.

Improvements since 2005

Performance optimization of activated sludge system, plant lighting and ballast upgrade.

Results of Improvements

Energy efficiency, water quality improvement.

Improvements planned

Master plan outlines future upgrade projects including those for: headworks improvement, hydraulic management, Class-A biosolids, improved energy independence, fats oils and grease acceptance, solids transfer station, groundwater brine disposal, building improvements, advanced water treatment, demineralization facilities.

2008 average reclaimed water amount: 1 MGD

approx. % of annual plant flow 33

2008 reclaimed water use(s)

Irrigation, dual plumbed buildings.

Notes

Emissions much improved since Jan. 2006 to TSS average of 254 lb/day. Effluent comingles with discharges from City of Escondido.

2005 average effluent flow (MGD)			*Type of wastewater*	*2006-09 average TSS mass emissions* lbs/day	*2005 effluent dilution*	***NPDES Permit #*** CA0107999	
	Weather						
Avg.	*Wet months*	*Dry months*				*Permit adopted effective* ✓	*Permit expires*
3.12	3.21	3.03	residential and commercial	254	237:1	Jun. 8, 2005	Jun. 8, 2010

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

San Elijo http://www.healtheocean.org/images/_pages/research/wdi/47.SanElijo.jpg

E.W. Blom Point Loma Metropolitan Wastewater Treatment Plant – Regional Board 9 – San Diego

Area served	*# of people served* (source: permit)	*Relative size*	*EPA facility class*	*Outfall distance from shore*	*Outfall depth*
All portions of San Diego and Chula Vista, Coronado, Del Mar, El Cajon, Imperial Beach, La Mesa, National City, Poway, Lakeside-Alpine Sanitation District, Lemon Grove Sanitation District, East Otay Mesa Sewer Maintenance District, Otay Water District, Spring Valley Sanitation District, Padre Dam Municipal Water District, Winter Gardens Sewer Maintenance District	2,200,000	large	major	23,760 ft 4.50 miles	310 ft

Improvements since 2005
Various – not specified.
Increased treatment of flows diverted to South Bay Water Reclamation Plant.

Results of improvements
Removal 90% of total suspended solids in 2009 – improvement on 88% removal in 2008.
Mass emission of total suspended solids down from 50,000 lb/day in 2006 to 46,000 lb/day in 2007
Decreased average daily flow from 170 MGD in 2006 to 161 MGD in 2007.
BOD removals up to 70% in 2009 from 65% in 2008.

Treatment process
ADVANCED PRIMARY: Preliminary screening at Pump Station No. 2 (course screens) and at treatment plant (fine screens). Wastewater distributed to six aerated grit removal chambers. Ferric chloride added prior to entering grit chamber to enhance solids removal. Wastewater exiting grit chamber treated with anionic polymers to aid coagulation of solids and distribution to 12 sedimentation tanks. Relies on North City Water Reclamation Plant (NCWRP) for dilution of raw sewage intake.

Improvements planned
Grit aeration system project to replace existing leaking grit air piping and existing grit air blowers. Wastewater recycling likely to form major part of plan to address waiver discontinuation. Waiver was to remain in place while City studies issue.

Notes
Largest wastewater facility in nation not meeting federal threshold for secondary treatment.

Oct. 7, 2009, overturning its Aug. decision, California Coastal Commission permitted plant operation to continue below minimum pollution standards.

Upgrade would cost City of San Diego $1.5 billion.

2008 average reclaimed water amount:	none
approx. % of annual plant flow	0
2008 reclaimed water use(s)	none

2005 average effluent flow (MGD)			*Type of wastewater*	*2005 average TSS mass emissions lb/day*	*2005 effluent dilution*	*NPDES Permit #* CA0107409	
Avg.	*Weather*						
	Wet months	*Dry months*				*Permit adopted effective* ✓	*Permit expires*
183.16	193.97	172.35	municipal	61,807.87	204:1	Aug. 1, 2003	Aug. 1, 2008 ext.

Point Loma http://www.healtheocean.org/images/_pages/research/wdi/48.PointLoma.jpg

South Bay Water Reclamation Plant – Regional Board 9 – San Diego

Area served	# of people served (source: permit)	Relative size	EPA facility class	Outfall distance from shore	Outfall depth
Southern San Diego, Chula Vista, and un-incorporated portions of South and East Counties	150,000	small	major	18,480 ft 3.50 miles	100 ft

Treatment process
TERTIARY: Wastewater passes through bar screens, aerated grit chambers, primary sedimentation basins, anoxic zone chambers, aeration basins, secondary clarifiers, anthracite coal beds, and ultraviolet light chambers where fully disinfected.

Reclaimed water capacity – all tertiary treated: 15 MGD. Excess secondary treated effluent discharged through South Bay Ocean Outfall shared with International Wastewater Treatment Plant.

Improvements since 2005
2006: Began distribution of reclaimed water.
2008: Applied technical correction treatment to monitoring data to accurately represent effluent quality and plant performance
2009: redesigned sampling system for effluent monitoring. Chlorine added at UV influent to control algae growth.

Results of improvements
During warm weather months, virtually no wastewater discharged into ocean.

Improvements planned
Completion of manhole rehabilitation, installation of reclaimed Water Pump No. 3.

2008 average reclaimed water amount: 6.49 MGD (4.46 MGD distributed)

approx. % of annual plant flow	75-100

2008 reclaimed water use(s)
Plant processes (0.68 MGD), CALTRANS, irrigation, freeway landscaping, wholesalers (e.g., Otay Water District – 69%).

Notes
Quantity of flows directed to tertiary filtration depends on anticipated reclaimed water demands. Completed negotiations over drainage plan for slope south of operations building.

2006 average effluent flow (MGD)			Type of wastewater	2006 average TSS mass emissions lb/day	2006 effluent dilution	NPDES Permit # CA0109045	
	Weather						
Avg.	Wet months	Dry months				Permit adopted effective ✓	Permit expires
3.95	3.94	3.95	municipal	124.99	94.6:1	Jan. 1, 2007	Jan 1, 2012

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

South Bay http://www.healtheocean.org/images/_pages/research/wdi/49.SouthBay.jpg

International Boundary & Water Commission International Wastewater Treatment Plant
Regional Board 9 – San Diego

Area served	# of people served (source: permit)	Relative size	EPA facility class	Outfall distance from shore	Outfall depth
Parts of Tijuana, Mexico	730,000	medium	major	18,480 ft 3.50 miles	100 ft

Treatment process
ADVANCED PRIMARY:
Screening, grit removal, chemically assisted sedimentation, activated sludge aeration, secondary sedimentation.

Improvements since 2005
Starting Dec. 2008, major construction underway to upgrade to secondary treatment.

Results of improvements

Improvements planned

2008 average reclaimed water amount: none

approx. % of annual plant flow: 0

2008 reclaimed water use(s)
none

Notes
Plant treats sewage originating in Tijuana, Mexico, and discharges it to the Pacific Ocean through the South Bay Ocean Outfall (outfall construction completed 1999).

U.S. Section of International Boundary and Water Commission (USIBWC) has considered variety of alternatives to bring plant wastewater into Clean Water Act (CWA) compliance. Plant faced federal court order to achieve CWA compliance by September 30, 2008. USIBWC announced, November 2008, $88 million construction contract award for upgrade of plant.

Research from Scripps Institute of Oceanography has found that during certain oceanographic conditions the plant's effluent has reached beaches off Tijuana, Imperial Beach and Coronado. (http://www.sdcoos.org/about.documents.php)

2005 average effluent flow (MGD)			Type of wastewater	2005 average TSS mass emissions lb/day	2005 effluent dilution	NPDES Permit # CA0108928	
Avg.	Weather: Wet months	Weather: Dry months				Permit adopted✓ effective	Permit expires
24.05	23.56	24.54	domestic and industrial	18,125.85	100:1	Nov. 14, 1996	Nov. 14, 2000 ext.

EPA: Environmental Protection Agency NPDES: National Pollution Discharge Elimination System MGD: millions of gallons daily GPD: gallons per day TSS: total suspended solids BOD: biological oxygen demand ASBS: area of special biological significance UV: ultra-violet

International http://www.healtheocean.org/images/_pages/research/wdi/50.International.jpg

GLOSSARY

Note: Further wastewater related definitions can be found in glossaries provided by a number of organizations, including those listed below.

Terms of Environment: Glossary, Abbreviations, and Acronyms

(U.S. EPA)
http://www.epa.gov/OCEPAterms/aterms.html

Definition of Terms and Descriptions of Wastewater Systems.

(U.S. EPA Wastewater Management)
http://www.epa.gov/owm/mab/smcomm/rtc/mast3.pdf

California Integrated Water Quality System
http://www.swrcb.ca.gov/ciwqs/glossary.shtml

Impaired Waters and Total Maximum Daily Loads
(U.S. EPA Office of Water)
http://www.epa.gov/owow/tmdl/glossary.html

Clean Watersheds Needs Survey
(U.S. EPA)
http://www.epa.gov/cwns/1996rtc/glossary.htm

Understanding Units of Measurement
(California State Water Resources Control Board)
http://www.epa.gov/Region7/citizens/amoco/units_measurement.htm

Iowa Administrative Code
http://www.epa.gov/waterscience/standards/wqslibrary/ia/ia_7_chapter60.pdf

303(d) listed impaired water body

Under Section 303(d) of the 1972 Clean Water Act, states, territories and authorized tribes are required to develop a list of areas of water that do not meet water quality standards, even after identifiable (point) sources of pollution have installed the minimum required levels of pollution control technology. The law requires the governing jurisdictions to establish priority rankings for the areas of water on the lists and to develop action plans. The plans are known as Total Maximum Daily Loads (TMDL) and set the maximum quantity of individual pollutants permitted in order to improve the quality of the water. *(Adapted from State Water Resources Board Website: http://www.swrcb.ca.gov/water_issues/programs/tmdl/303d_lists.shtml)*

acre foot
The volume of water needed to cover one acre to a depth of one foot.

activated sludge
Wastewater treatment where suspended microorganisms digest organic matter in the wastewater.

advanced treatment technologies
"…the methods and processes that remove more contaminants (suspended and dissolved substances) than are taken out by conventional biological treatment…the application of a process or system that follows secondary treatment or that includes phosphorous removal or nitrification in conventional secondary treatment" *(Spellman, Frank R., Handbook of water and wastewater treatment plant operations. Lewis Publishers, CRC Press, Boca Raton, Florida, 2003, pp 545-600).*

areas of special biological significance (ASBS)
"These include marine life refuges, ecological reserves, and designated areas where the preservation and enhancement of natural resources requires special protection. In these areas, alteration of natural water quality is undesirable" *(State Water Resources Control Board http://www.swrcb.ca.gov/rwqcb2/water_issues/programs/planningtmdls/basinplan/web/bp_ch2.shtml).*

administrative civil liability (ACL)

A complaint issued by a regional water quality board against a discharger for a violation of permitted discharge requirements. A civil liability indicates potential responsibility for payment of damages or other court-enforcement in a lawsuit, as distinguished from criminal liability, which means open to punishment for a crime. An ACL carries a mandatory penalty. If findings determine that the ACL was merited, an ACL order is issued, detailing the minimum mandatory penalty that applies.

biodegradation

The chemical breakdown of a substance in a biologically active environment. Biodegradation can occur in the presence of oxygen (aerobic ally) or without oxygen (anaerobically). In wastewater treatment, biodegradation occurs in secondary treatment when microorganisms (bacteria) are used to break down organic matter in the wastewater. The biodegradation occurs as the bacteria consume the organic matter.

bio-fouling

An unwanted accumulation of microorganisms such as bacteria and algae on wet surfaces. Bio-fouling can impair the function of membranes used in wastewater treatment. Bio-fouling can build up, for example, on membranes within bioreactors used to accelerate biodegradation during secondary treatment. Membrane processes such as reverse osmosis, used in tertiary treatment to remove dissolved pollutants, can also be harmed by bio-fouling.

biosolids

Modern term for treated sewage sludge.

blended primary (process/effluent)

Primary treatment removes solids from wastewater by facilitating the flotation or settling of material suspended in the wastewater. In blended primary treatment, a portion of the primary treated wastewater is sent on for secondary treatment where microorganisms break down the organic matter in the wastewater. The wastewater that results from the primary and secondary treatment is mixed together. Many plants then disinfect the blended wastewater before discharging it as blended primary effluent.

biological oxygen demand (BOD)

The determination of the rate of uptake of dissolved oxygen by biological organisms in a body of water. BOD provides an indication of the quality of the water.

brine wastes / brine wastewater

Water with high salt(s) content resulting from industrial processes or from wastewater treatment.

California Integrated Water Quality System (CIWQS)
"The California Integrated Water Quality System (CIWQS) is a computer system used by the State and Regional Water Quality Control Boards to track information about places of environmental interest, manage permits and other orders, track inspections, and manage violations and enforcement activities. CIWQS also allows online submittal of information by Permittees within certain programs and makes data available to the public through reports." (*State Water Resources Control Board:*

http://www.swrcb.ca.gov/ciwqs/).

California Ocean Plan
A plan required under the California Water Code and developed by the State Water Resources Control Board in order to protect the quality of the ocean waters "for use and enjoyment by the people of the State" by controlling the ocean discharge of waste. The plan is reviewed "at least every three years to guarantee that the current standards are adequate and are not allowing degradation to marine species or posing a threat to public health"
(California Ocean Plan: http://www.swrcb.ca.gov/water_issues/programs/ocean/docs/oplans/oceanplan2005.pdf).

California Recycled Water Task Force
"The State Legislature established the Task Force in 2001. The mission of the Task Force was to examine the current framework of State and local rules, regulations, ordinances, and permits to identify opportunities for and obstacles to the safe use of recycled water in California. The task Force consisted of 40 members representing State and local regulatory agencies, water and wastewater utilities, environmental groups, and federal resource agencies. The Chairman of the Task Force was Richard Katz, who is also a State Board member" *(State Water Resources Board email memorandum from Board Chair to Regional Board Executive Officers, Feb 24, 2004: http://cccwonline.com/SWRCB.pdf).*

clarification
The process of removing solids suspended in wastewater. Gravity and centrifuge cause solids to settle out. Filtration traps particles over a certain size. The result is a clearer liquid of improved quality.

contaminants of emerging concern (CECs)
CECs can be summarized as chemicals whose behavior, fate, and effects are uncertain but thought possibly to be harmful in the following ways: 1) they are toxic to aquatic life, persist in the environment, and accumulate in tissues (including human tissues); and/or 2) they interfere with hormone systems governing reproduction and growth. As chemicals become suspected of causing these kinds of harm, they raise concern about their possible impacts in the coastal and marine environment. Wastewater monitoring programs focus only on a small list of priority contaminants that were identified decades ago. Production of new contaminants and contaminants of emerging concern, however, is continuing and could increase in the future, making the update of monitoring programs a matter of urgency *(Adapted from Southern California Coastal Waters Research Project: http://www.sccwrp.org/view.php?id=53 (accessed January 2010)).*

degradation products
Substances that result from the decomposition of material found in wastewater. Some degradation products can be toxic. In addition, the environmental consequences and fate of some degradation products, including toxic ones, are unknown (see, for example, Beauchesne, I.; Barnabé, S., Cooper, D.; Nicell, J., *Plasticizers and related toxic degradation products in wastewater sludges.* Water Science and Technology (2008) 57(3):367-74.)

diffuser
A device used in wastewater treatment plants for aeration and to achieve dilution of effluent in water. Diffusers are typically fitted on the end of outfall pipes and can add many feet in depth and/or distance to the discharge. "Multiport" diffusers can discharge effluent over a wide area though numerous ports.

digester
A unit in which bacterial action is induced and accelerated in order to breakdown organic matter.

dilution ratio
The ratio of the flow of receiving waters to the flow of effluent discharged. For example, a dilution ratio of 4:1 indicates four parts of receiving water flow to one part effluent flow.

disinfection
Treatment of wastewater effluent designed to destroy pathogens. Disinfection of wastewater does not achieve sterilization (the destruction of all microorganisms), but does lead to a substantial reduction in the number of microbes to a level considered safe. Wastewater disinfection methods include chlorination, ultraviolet exposure, ozone contact, and ultrasonic exposure. "Chlorination is

by far the most common method of wastewater disinfection and is used worldwide for the disinfection of pathogens before release into receiving streams, rivers or oceans. Chlorine is effective in destroying a variety of bacteria, viruses and protozoa, including Salmonella, Shigella and Vibrio cholera. A majority of the 36 billion gallons of treated wastewater released into waterways throughout the United States each day is disinfected via chlorination." *(Orange County Sanitation District website: http://www.ocsd.com/civica/inc/displayblobpdf2.asp?BlobID=1653)*

dual plumbing

Plumbing that includes separate piping for potable vs. recycled/reclaimed water. The systems are kept separate to avoid mixing the two water supplies. "Dual plumbing" often refers particularly to the system installed for recycled water. Piping for recycled water is frequently purple in color.

Department of Water Resources (DWR) (California)

"The mission of the Department of Water Resources (DWR) is to manage the water resources of California, in cooperation with other agencies, to benefit the State's people and to protect, restore, and enhance the natural and human environment."
(http://www.water.ca.gov/deltainit/docs/organization.pdf http://wwwdwr.water.ca.gov/)

ecosystem

The living organisms and their physical environment in an area, and the way they function together as a unit. An ecosystem on Earth comprises animals, plants, microorganisms, rocks, minerals, soil, water and (above ground) the local atmosphere, and the interaction between all these components.

effluent

Wastewater that results from treatment at a wastewater treatment plant. Effluent is piped out of the treatment plant and typically is disinfected before being discharged.

endocrine disrupting compounds (EDCs)

Substances that interfere with the normal functions of steroids and hormones, which are chemicals that serve as messengers between cells delivering signals that, for example, the reproductive cycles of multicellular organisms and the metabolic activity of an organ. Many sources include EDCs as a subset of Pharmaceuticals and Personal Care Products (PPCPs) since some originate in pharmaceutical products.

Enforcement and Compliance History Online (ECHO)

http://www.epa-echo.gov/echo/#

The U.S. Environmental Protection Agency's online system that allows searches of EPA and state data for EPA regulated facilities. The system provides inspection, violation, and enforcement data on facility activities stemming from the Clean Water Act, Clean Air Act, and hazardous waste laws. Data is retrieved from the Toxics Release Inventory, National Emissions Inventory, and Water Quality data sources.

EPA

Environmental Protection Agency - U.S. EPA / California EPA

GIS

Geographic information system (GIS). A GIS "integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information."
(GIS.com The guide to Geographic Information Systems: http://www.gis.com/content/what-gis)

GPD

gallons per day

groundwater recharge

The process where water is artificially routed or moves naturally from surface locations to groundwater, which is water naturally stored underground in soil or spaces and porous deposits within formations. Water moving or routed in this way can be natural flows, such as rainfall and river water, or it can be highly treated reclaimed water. Using reclaimed water returns it to the natural recycling process, where the replenished groundwater is subject to purification through, for instance, filtration, as the water moves deeper into the groundwater basin.

indirect potable reuse

Recycling water to levels safe for drinking where the recycled water is not provided directly, but through groundwater recharge or reservoir augmentation.

influent

Wastewater piped into a treatment plant from local sources such as residences and commercial outlets.

major / minor facilities

EPA classification of a plant as "major" or "minor" based on the number of gallons treated per day–over or under one million gallons respectively.

mass emissions

The total of all substances or all monitored substances discharged in treated wastewater.

MGD

Millions of gallons daily: the standard unit of measurement for the amount of wastewater flowing into or out of a wastewater treatment plant.

National Marine Sanctuary (NMS)

Discrete areas of the marine environment with special conservation, recreational, ecological, historical, research, educational, or aesthetic resources that are under comprehensive management. National Marine Sanctuaries are designated under the 1972 Marine Protection, Research and Sanctuaries Act, and can be authorized by the Secretary of the Department of Commerce, the U.S. Congress and (with the authority of the Antiquities Act) the President.

National Pollution Discharge elimination System (NPDES)

"The NPDES controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized state/tribe contain industry-specific, technology-based and/or water-quality-based limits, and establish pollutant monitoring and reporting requirements." California is one of 40 states authorized to administer the NPDES program. "A facility that intends to discharge into the nation's waters must obtain a permit before initiating a discharge" *(U.S. EPA website http://www.epa.gov/oecaagct/lcwa.html#National%20Pollutant)*.

non-waste fuel alternative energy generation

Wastewater treatment plant processes result in products like methane that can be used as fuel to generate energy for the facility. Some of the same and other treatment plants are located at sites suitable for installations, such as solar panels and wind turbines that do not use waste fuels. These installations can generate energy for use by the treatment plants or for re-sale back to the electricity grid.

ocean waters

"…the territorial marine waters of the State as defined by California law to the extent these waters are outside of enclosed bays, estuaries, and coastal lagoons. If a discharge outside the territorial waters of the State could affect the quality of the waters of the State, the discharge may be regulated to assure no violation of the Ocean Plan will occur in ocean waters" *(Water Quality Control Plan: Ocean Waters of California, California Ocean Plan: http://www.epa.gov/waterscience/standards/wqslibrary/ca/ca_9_wqcp_waters.pdf)*.

on-site wastewater treatment technology

A septic tank or alternative system installed at a site to treat and dispose of wastewater generated at that site. The wastewater in this case is mainly of human origin.

outfall

A pipe or other outlet used to carry wastewater, treated or untreated, to a final point of discharge.

potable water

Water considered safe for drinking.

pretreatment

The removal of contaminants from wastewater before the wastewater receives treatment at a treatment plant.

primary treatment

The removal of solids from wastewater: initial sedimentation and clarification to remove suspended material that settles or floats.

publicly owned treatment works (POTW)

"A wastewater treatment facility owned by a public entity, such as a city, a county, or a special sanitary district" *(U.S. EPA Clean Watersheds Needs Survey Glossary: http://www.epa.gov/cwns/1996rtc/glossary.htm)*.

reclaimed water

Also used as a synonym for recycled water (see below), reclaimed water is produced by treating wastewater to the point that it is no longer considered wastewater and is suitable for a direct beneficial use or for a controlled use that would not otherwise occur.

recycled water

Also used as a synonym for reclaimed water (see above), recycled water is water that results from wastewater treatment and is used for a direct beneficial use or for a controlled use that would not otherwise occur.

regional water quality control board (RWQCB)

The regional boards are the administrative bodies charged with developing and enforcing "water quality objectives and implementation plans that will best protect the State's waters, recognizing local differences in climate, topography, geology and hydrology...Regional boards develop "basin plans" for their hydrologic areas, issue waste discharge requirements, take enforcement action against violators, and monitor water quality.
(http://www.waterboards.ca.gov/about_us/water_boards_structure/mission.shtml)

regional water quality improvement project (RWQIP)

Project within a water quality board region that involves activities designed to correct water quality problems.

sanitary sewer overflow (SSO)

The leakage of untreated sewage into the environment before the sewage reaches a treatment plant.

seawater intrusion barrier

(For examples see: Johnson, T., Saltwater Intrusion in Los Angeles County - Current & Future Challenges: http://www.lib.berkeley.edu/WRCA/WRC/pdfs/GW26thJohnson.pdf))

secondary treatment

Biological treatment: the use of microorganisms to convert dissolved and suspended organic waste into stabilized compounds. Secondary processes decompose and/or transform the organic matter and kill off bacteria in wastewater.

self-monitoring report (SMR)

Under the NPDES system, individual wastewater treatment plants are required to monitor various aspects of their operation in order to document compliance. Compliance is with waste discharge requirements and prohibitions established by the respective regional boards. SMRs also facilitate self-policing by the waste discharger in the prevention and abatement of pollution arising from waste discharge and can be used to prepare water and wastewater quality inventories.

source control

Preventing contaminants from entering the waste stream, e.g., the use of filters to keep fats, oils, and grease from being discharged into a sanitary sewer system.

State Water Resources Control Board (SWRCB)
"The State Water Resources Control Board (State Water Board) was created by the Legislature in 1967. The joint authority of water allocation and water quality protection enables the State Water Board to provide comprehensive protection for California's waters." *(http://www.waterboards.ca.gov/about_us/water_boards_structure/mission.shtml)*

Supplemental Environmental Project (SEP)
"SEPs are projects that enhance the beneficial uses of the waters of the State, that provide a benefit to the public at large and that, at the time they are included in the resolution of an ACL [administrative civil liability] action, are not otherwise required of the discharger" *(California State Water Resources Control Board, Policy on Supplemental Environmental Projects: http://www.swrcb.ca.gov/water_issues/programs/enforcement/docs/rs2009_0013_sep_finalpolicy.pdf)*.

RF

reclamation facility

(See wastewater treatment plant.)

RP

reclamation plant

(See wastewater treatment plant.)

total dissolved solids (TDS)

The measure used to indicate the salinity of wastewater, which is the amount of salt compounds, such as sodium chloride and potassium chloride that are contained in the wastewater. The material measured is the residue remaining after filtration through a particular industry standard filter.

tertiary treatment

Treatment beyond secondary processes to increase the removal of dissolved pollutants like sodium and chloride, and nutrients: advanced tertiary treatment can remove 99% of known pollutants and the nutrients nitrogen and phosphorous, which can contribute to algae blooms.

TF
treatment facility
(See wastewater treatment plant.)

total maximum daily load (TMDL)
"Calculation of the highest amount of a pollutant that a [body of water] can receive and safely meet water quality standards set by the state, territory, or authorized tribe. TMDLs must…account for seasonal variations in water quality, and include a margin of safety to account for uncertainty in predicting how well pollutant reductions will result in meeting water quality standards" *(U.S. EPA Impaired Waters and Total Maximum Daily Loads. http://www.epa.gov/owow/tmdl/overviewoftmdl.html)*.

TP

treatment plant

(See wastewater treatment plant.)

TSS

Total suspended solids in wastewater (as distinct from total dissolved salts). TSS is measured using standardized methods to weigh the amount of material retained as a residue on and behind the filter when wastewater is filtered.

Waste stream

The total flow of waste from creation to disposal. Human waste flow sources include, for instance homes, schools, businesses, and manufacturing plants. The waste stream begins with the generation of unwanted material, continues with the transport and storage of that material, and ends with, for example, recycling, burning, wastewater treatment, or disposal in landfills.

wastewater discharge requirement (WDRs)

The official document issued by the relevant regional water quality control board to a wastewater treatment plant that sets out the conditions with which the plant and its discharge must comply. The WDR sets out discharge prohibitions, effluent limitations, discharge specifications, receiving water limitations, and many other specifications.

wastewater treatment plant (WWTP)

"A structure designed to treat wastewater, storm water, or combined sewer overflows prior to discharging to the environment. Treatment is accomplished by subjecting the wastewater to a combination of physical, chemical, and/or biological processes that reduce the concentration of contaminants" *(U.S. EPA, Clean Watersheds Needs Survey. http://www.epa.gov/cwns/1996rtc/glossary.htm).*

Terms used to describe sewage wastewater treatment plants:
reclamation plant (RP); reclamation facility (RF); treatment plant (TP); treatment facility (TF); water pollution control plant (WPCP); water pollution control facility (WPCF); treatment works (TW).

water budget

The relationship between the input and output of water in a region. Natural input can be precipitation, such as rain and snow. Artificial inputs can include, for example, wastewater discharges into rivers. Examples of natural outputs include evaporation and transpiration from soils and plants. Wastewater discharges into the ocean are an example of an artificial output. A water budget is the direct comparison of water inputs and outputs.

watershed

"A watershed is the area of land where all of the water that is under it or drains off of it goes into the same place. John Wesley Powell, scientist geographer, put it best when he said that a watershed is: 'that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community'" *(U.S. EPA, Watersheds: http://www.epa.gov/owow/watershed/whatis.html).*

WPCP/F

water pollution control plant/facility

(See wastewater treatment plant.)

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Part Two
Benefits of Reclaimed Water, Two Key Water Reclamation Issues: Salinity and CECs, Water Reclamation Issue One: Salinity

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