

1.2.1 Reducing Bacteria along Santa Monica Bay Beaches

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Santa Monica Bay Bacterial TMDL

For cities along Santa Monica Bay, having clean water for swimming, surfing, and other beach activities is a top priority. Unfortunately, beach water quality along Santa Monica Bay beaches has not always met the standards established by the United States Environmental Protection Agency (EPA). As a result, bacterial TMDLs have been established for all Santa Monica Bay beaches: Marina del Rey Harbor, Mother's Beach, and Back Basin; Malibu Creek; Ballona Creek and Estuary; and the Sepulveda Channel (SWRCB 2015). These TMDLs focus on reducing coliform bacteria, mainly through stormwater programs, and compliance is based on monitoring fecal indicator bacteria (FIB) in runoff and along beaches (for more on why FIB are a human health risk see [Sidebar 1.2.1a](#)).

Beach Contamination by Fecal Indicator Bacteria (FIB)

FIB serve as proxies for disease-causing microorganisms as the latter are difficult to measure and quantify. Elevated levels of FIB do not mean that pathogens are present; rather, a high FIB count implies that there is a greater chance of the presence of pathogens, and thus an increased risk to people swimming or surfing in the water (for more on advances in measuring FIB see Section 5.1).

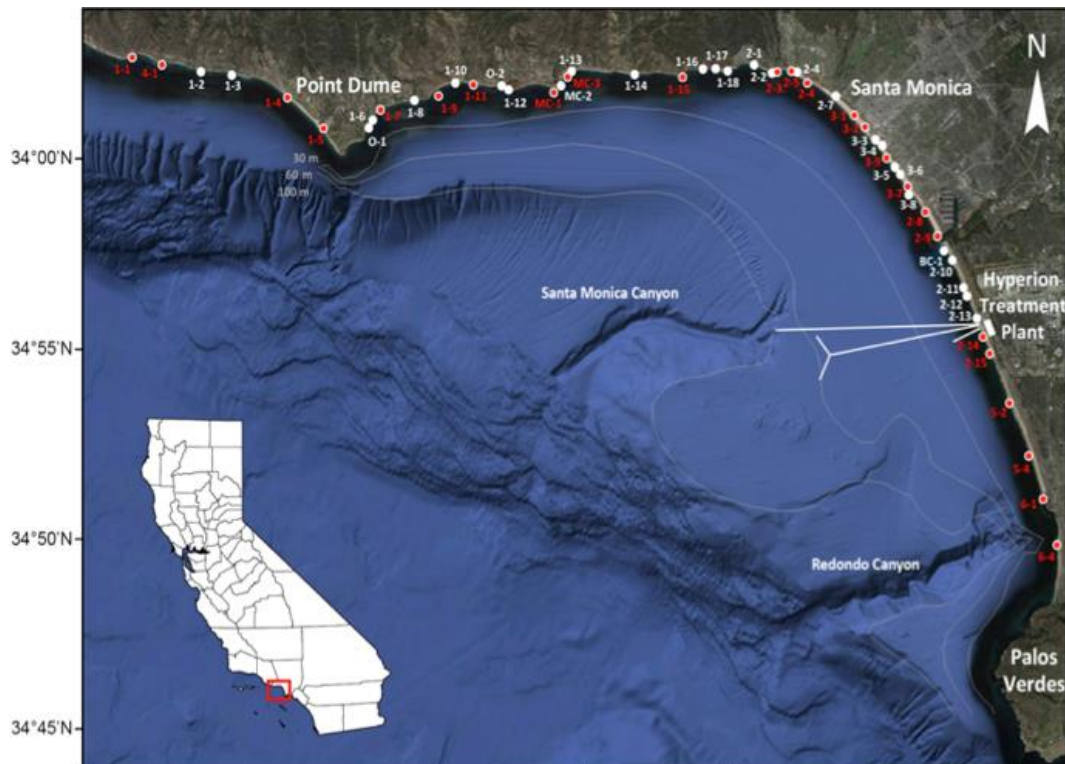
The cleanliness of a beach is determined through routine monitoring of FIB along a beach's shoreline, with results compared to water quality standards adopted by the EPA and individual states. In Santa Monica Bay, several agencies are responsible for collecting FIB samples daily or weekly. FIB are monitored daily by the City of Los Angeles' Environmental Monitoring Division, and weekly by the Los Angeles County Department of Health Services ([Figure 1.2.1-1](#)). The South Bay beach cities, Los Angeles County Sanitation District, and others monitor additional sites (City and County of Los Angeles 2004).

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Figure 1.2.1-1. Shoreline sampling of beach water quality. Shows locations sampled by the City of Los Angeles (white) and Los Angeles County Department of Health Services (red). *Data source: City of Los Angeles Environmental Monitoring Division.*



The main source of contamination by FIB in Santa Monica Bay is from polluted runoff occurring during both dry and wet weather. Runoff impacts beaches directly from storm drains discharging directly into the surf zone, or forming ponds in back-beach areas that eventually flow to the ocean. The largest source of runoff comes from Ballona Creek, where about 16 million gallons per day (MGD) of runoff flows into the Bay during dry weather, and 10 times higher or more during larger storms (LA Stormwater, n.d.). Runoff itself is contaminated by FIB from a variety of terrestrial sources, including rotting vegetation, sewer overflows, trash, and feces from domestic pets, wildlife, and humans. Illegal sewage discharges from boats also contribute to the contamination of water in marinas and the ocean. In addition, the feces of sea birds, bacteria associated with decomposing beach wrack, and populations living in damp beach sands can directly elevate FIB densities in the adjacent water.

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Reducing Bacterial Loads

Watershed-wide, a variety of actions have been implemented to reduce coliform bacteria in runoff, ranging from individual efforts by people and businesses to large-scale engineering projects. Most of the actions taken have focused on either preventing bacteria associated with fecal and other organic matter from coming into contact with runoff, or reducing the amount of runoff entering the storm drain system or surf zones. The following are some of the main measures being taken:

Municipal Operations: The County and City of Los Angeles, along with various local environmental organizations, wage campaigns educating the public on cleaning up after pets, capturing rain with rain barrels, and not placing organic matter, like lawn clippings, into the storm drains. The City of Los Angeles (Bureau of Sanitation) has improved its sewer collection system, implemented grease collection regulations for restaurants, and increased its response time to reported sewage blocks, all resulting in over 80% reduction in sewage spills from July 2000 to June 2014.

Clean Bay Restaurant Certification: Restaurants in many parts of the Bay's watershed are certified through The Bay Foundation (TBF) program by practicing good housekeeping to prevent storm drain contamination. More than 300 restaurants now are certified. [Learn More.](#)

Boater Education and Outreach: TBF staff work with the boating community in reducing ocean pollution vessel operations, with

Sidebar 1.2.1a: Epidemiology Studies at Malibu's Surfrider Beach

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Epidemiology studies quantify patterns of disease and illness in order to better understand risk factors. These studies have been used to link swimming in contaminated water to illnesses in swimmers, and are a key underpinning of federal and state regulations for beach water quality. More of these epidemiology studies have occurred in Southern California than anywhere else in the country. Five epidemiology studies have been conducted over the last two decades, two of which were conducted at Malibu's Surfrider Beach. The first was in the summer of 1995 and the second in the summer of 2009.

In 1995, highly credible gastrointestinal illnesses (i.e., combinations of cramps, diarrhea, nausea, or vomiting that are likely related to water contaminated with pathogenic viruses or bacteria) correlated with fecal indicator bacterial concentrations (such as *Enterococcus*), which also correlated with distance to the outflow from Malibu Creek and Lagoon, a large source of fecal indicator bacteria contamination (Haile et al. 1999). In 2009, gastrointestinal illnesses also correlated with swimming and the rates of illness rose with increased swimming exposure. However, overall incidence of illness was lower (857 swimmers were exposed to beach water quality exceeding state standards in 1995 compared with 30 swimmers in 2009) and there was little to no correlation with indicator bacterial contamination (Arnold et al. 2013).

The reason for this lies with changes in behavior. The results of the 1995 study provided the basis for issuing warnings not to swim within 100 yards of a flowing drain and helped form the California's present beach water quality standards. As a result, lifeguards prevent swimming near the Malibu Creek outlet to the beach. While this reduced the number of people exposed, it appears the underlying problem of contaminated water has not disappeared. The relative risk of contracting highly credible gastrointestinal illness for swimmers that immersed their heads was nearly double that of non-swimmers that went to Surfrider Beach during the summer of 2009 (Odds Ratio = 1.91, 95% confidence intervals 1.17-3.14). The City of Malibu has taken significant steps towards cleaning up some of the bacterial contamination at Surfrider Beach, including building a stormwater treatment facility at Legacy Park that opened in 2010, and planning for the construction of a sewage treatment facility (now in the permitting phase) to treat wastewater from properties in the low-lying areas in and around the civic center currently using septic systems.

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particular focus on establishing sewage pump-out facilities for boaters. See [Sidebar 1.2.1b](#) for more.

Low-Flow Diversions (LFDs): Low-flow diversions are large underground structures that prevent contaminated runoff from ponding or flowing across beaches to the ocean waters. These structures intercept runoff in the storm drain, pass it through a screen to separate the trash from the water, and pump the runoff into the adjacent sewer system, where it mixes with raw sewage for treatment at a wastewater treatment facility. 29 LFDs are located along the coast of Santa Monica Bay: 17 are operated by the City and County of Los Angeles, and four by the City of Santa Monica ([Figure 1.2.1-2](#)). Those operated by the City of Los Angeles flow throughout the year, but are automatically shut down during rain events to prevent flooding of the sewers. Once the storm has passed and flows in the sewers are back to normal, the diversions are reactivated. This system helps provide good shoreline water quality for swimmers and surfers year around, except during and right after rain events.

Figure 1.2.1-2. Location of 21 low-flow diversions (LFDs) operated by the City and County of Los Angeles, and the City of Santa Monica. Two LFDs are located at Imperial Highway. Not shown on the map are two LFDs in Marina Del Rey, operated by the County of Los Angeles, as well as nine others in the Cities of El Segundo, Manhattan Beach and Redondo Beach. *Data Source: Wing Tam, City of Los Angeles Stormwater Program.*



Santa Monica Urban Runoff Recycling Facility (SMURRF): The SMURRF, owned and operated by the City of Santa Monica, is located close to the foot of Santa Monica Pier, intercepting 500,000 gal/day of highly contaminated runoff from the Pico-Kenter

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catchment area. Runoff is cleaned to the level where it can be recycled for landscape irrigation and other uses.

Biofiltration systems: Stormwater biofiltration systems capture urban runoff and allow it to percolate into the ground. Through this process, plants take up nutrients, soil microorganisms decontaminate pollutants, and groundwater supplies are enhanced. Using native vegetation enhances biodiversity, boosts aesthetics, and provides other ecosystem services needed in urban settings. These decentralized systems, including rain gardens, bioswales, and retention basins ([Figure 1.2.1-3](#)), can significantly reduce runoff entering receiving waters, thus improving water quality, water supply, and extending the life of the existing storm drain infrastructure (Ambrose and Winfrey 2015). Because of their multiple benefits, biofilters form the backbone of the Low-Impact Development (LID) stormwater management strategy now being implemented throughout the Bay's watersheds. To learn more about LID go to Section 1.1.

Figure 1.2.1-3. The newly planted Culver City rain garden located along the Ballona Creek. This 1000-ft rain garden intercepts runoff from commercial buildings and parking lots located along Jefferson Blvd. *Photo: Ivan Medel, The Bay Foundation*

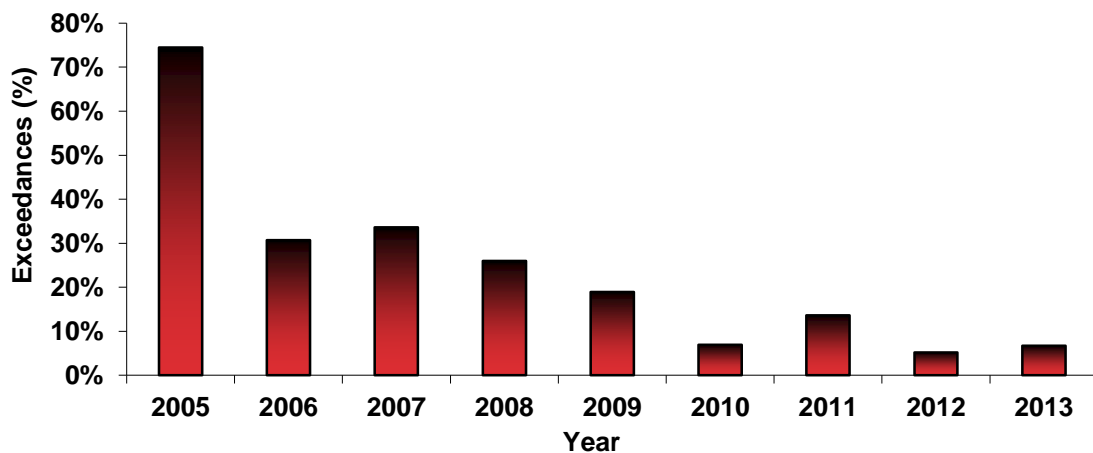


Natural Wetlands: The Ballona Wetlands Ecological Reserve (BWER), degraded by decades of human activities and development, still provides valuable water purification services for contaminated runoff from Ballona Creek that enters this salt marsh system via the adjacent estuary. Of its 577 acres, only approximately 15 (> 3%)

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receive tidal water. Studies have shown that as water flows into the wetlands from flood tides occurring during daylight hours, densities of FIB are significantly reduced by up to two orders of magnitude (Dorsey et al. 2010), especially in the uppermost layers of the water (Johnston et al. 2015). Although some FIB load is released back into the estuary during the lowest ebb flows, overall loads are diminished, thus improving the quality of water that flows past adjacent beaches. Enabling more water to enter the wetlands will provide additional natural water cleansing services, boost other ecosystem services that provide enhanced biodiversity and cleaner water, and create recreational, educational, and spiritual opportunities for the residents of the region and its visitors. Various restoration scenarios that would increase tidal flows into the Ballona Wetlands are being considered by the California Department of Fish and Wildlife and the Army Corps of Engineers (www.ballonarestoration.org).

Figure 1.2.1-4. Dry-weather exceedances of state water quality standards at the Santa Monica Canyon station SMB 2-7 during the period 2005-2013. Starting November 1, 2009 the LFDs were in operation year-round during dry weather (LAC-EMD 2014). Percent exceedances were significantly lower from 2010-2013 relative to 2006-2009 (Mann-Whitney U-Test, $p=0.008$); data from 2005 were not included in the analysis as the total rainfall for that year was 27.32", or 180% of normal. *Data source: City of Los Angeles-Environmental Monitoring Division.*



All of the strategies mentioned above have led to cleaner beaches along the Bay's shoreline. This achievement is best demonstrated by the decline in the percentage of samples that exceeded state water quality standards during dry weather at what was one of the more polluted beach sites in the Bay, Will Rogers State Beach at Santa Monica Canyon. Here, exceedances were significantly reduced after year-round operation of a LFD began in 2009 ([Figure 1.2.1-4](#)). Throughout the Bay, improved beach water quality most likely resulted from the automated LFDs, but certainly reflects the combined effects of water conservation efforts from local residents, and natural treatments from vegetation, wetlands, bioswales and infiltration areas. Continued work by municipalities and the public to implement these strategies will further reduce the volume of runoff reaching the Bay, and begin to tackle the next big challenge: reducing bacteria and other pollutants in wet weather runoff.

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Sidebar 1.2.1b. Preventing Boat Sewage Discharges

Author: Victoria Gambale, The Bay Foundation

In Southern California, over half of all boaters have a toilet or port-a-potty on their boat (Godard & Browning 2011). With over 5,000 boaters based in Marina del Rey and a total of 6,000 boaters who call Santa Monica Bay home, the collective water quality impacts associated with boating activities pose a considerable risk to coastal waters if these waste disposal systems are not properly used or maintained.

A variety of services are available for boaters to properly dispose of sewage: public pump-outs, private pump-outs, in-slip pump-out systems, and mobile pump-out services. Using Clean Vessel Act Grant funding from the California State Parks Division of Boating and Waterways, The Bay Foundation has conducted a Boater Education Program since 1996, which provides several tools and resources to promote environmental boating practices throughout Santa Monica Bay. Efforts include:

- **Honey Pot Day-** This program educates boaters about the adverse effects of sewage and offers them a free mobile sewage pump-out to demonstrate the ease of proper disposal. This program has reached approximately 800 boaters and properly disposed of 20,000 gallons of sewage.
- **Dockwalker Volunteers-** This program educates boaters on how to conduct outreach to their peers about environmental boating practices, including the prevention of sewage discharges. Statewide, it reaches 7,000 boaters annually.
- **Southern California Boater's Guide-** Available as an interactive e-book since February 2014, it conveniently features environmental boating practices. The Boater's Guide has reached approximately 8,000 people and is used by marina operators, yacht brokers, marina industry representatives, and boaters throughout Southern California.
- **Southern California Tidebook-** This free resource features environmental boating services and the locations of all public sewage pump-out stations in southern California. This resource reaches over 4,000 boaters annually.

The operability and location of these pump-outs are an important part of preventing waste from entering the Bay. Boater program monitoring in Marina del Rey indicates a decline in public pump-out usage. This could be due to a number of factors, such as malfunctioning or difficult to use pump-outs, increasing use of private pump-outs, declining boat usage, and increasing utilization of landside facilities, but data on such factors in Santa Monica Bay are limited. However, statewide boater surveys indicate that while mobile pump-out services are declining, pump-out use at facilities where boats are berthed or stored is increasing. In addition, awareness of environmental issues seems to be on the rise. According to boater surveys, recognition of the sewage pump-out logo has increased from 2007/2008 to 2009 (Godard & Browning 2011). Due to the overall increased awareness of environmental issues and the installation of new in-slip pump-outs in Marina del Rey, it is reasonable to believe boaters in Marina del Rey are also exchanging one type of pump-out for another.



Staff monitoring a public pump-out unit to ensure it works properly and at peak efficiency. Photo: Michelle Staffield, The Bay Foundation

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