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Evaluating Simple, Cost Effective Solutions for Reducing Stormwater and Urban Runoff Pollution

Santa Monica Bay Restoration Project

Characteristics

Santa Monica Bay's 414-square mile watershed includes a large part of the Los Angeles metropolitan area and is home to approximately three million people.

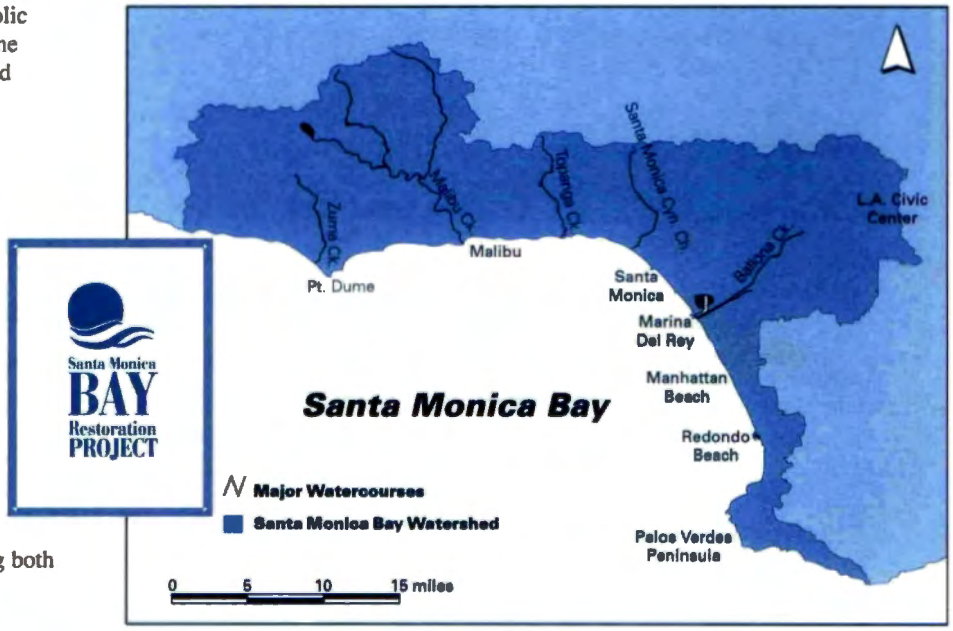
The bay is vital to the economic health of Los Angeles. Tourism ranks as the second largest industry in the region. Many of these visitors flock to the region's primary recreational resource — Santa Monica Bay. The 22 public beaches along the bay's 50 miles of shoreline attract over 45 million visitors each year and some are world renowned for providing spectacular surfing opportunities.

In addition, the bay supports a diversity of habitats and some 5,000 species, including biologically rich kelp forests the southernmost run of the endangered steelhead trout, submarine canyons and an extensive soft-bottom benthic community.

The Problem

Despite notable environmental improvements, the bay continues to face the challenges of health risks to recreational users and habitat degradation resulting from urban runoff pollution during both dry and wet weather.

Los Angeles County and the 21 cities in the watershed are grappling with implementing stormwater pollution reduction technologies, given limited financial resources and the lack of research on appropriate technologies for the climate and weather regime found in Southern California.



The National Estuary Program

Estuaries and other coastal and marine waters are national resources that are increasingly threatened by pollution, habitat loss, coastal development, and resource conflicts. Congress established the National Estuary Program (NEP) in 1987 to provide a greater focus for coastal protection and to demonstrate practical, innovative approaches for protecting estuaries and their living resources.

As part of the demonstration role, the NEP offers funding for member estuaries to design and implement Action Plan Demonstration Projects that demonstrate innovative approaches to address priority problem areas, show improvements that can be achieved on a small scale, and help determine the time and resources needed to apply similar approaches basin-wide.

The NEP is managed by the U.S. Environmental Protection Agency (EPA). It currently includes 28 estuaries: Albemarle-Pamlico Sounds, NC; Barataria-Terrebonne Estuarine Complex, LA; Barnegat Bay, NJ; Buzzards Bay, MA; Casco Bay, ME; Charlotte Harbor, FL; Columbia River, OR and WA; Corpus Christi Bay, TX; Delaware Estuary, DE, NJ, and PA; Delaware Inland Bays, DE; Galveston Bay, TX; Indian River Lagoon, FL; Long Island Sound, CT and NY; Maryland Coastal Bays, MD; Massachusetts Bays, MA; Mobile Bay, AL; Morro Bay, CA; Narragansett Bay, RI; New Hampshire Estuaries, NH; New York-New Jersey Harbor, NY and NJ; Peconic Bay, NY; Puget Sound, WA; San Francisco Bay-Delta Estuary, CA; San Juan Bay, PR; Santa Monica Bay, CA; Sarasota Bay, FL; Tampa Bay, FL; and Tillamook Bay, OR.

The Project

The purpose of this project was to demonstrate and evaluate the effectiveness of catchbasin retrofit devices in reducing pollutant loads to the bay. The focus was on devices requiring only minor structural modifications to existing catchbasins, costing no more than $500 to $1,000 per catchbasin and needing maintenance, on average, only once per year. Commercially available and easily constructed devices were evaluated in both wet and dry weather.

Introduction to Santa Monica Bay

Santa Monica Bay is a priceless resource, as vital to its marine life, birds, and other forms of resident and transient wildlife as it is to the nine million people who live within an hour's drive of its shores. However, it has long been adversely affected by the ills associated with its proximity to the heavily urbanized Los Angeles basin. While tremendous improvements have been made, stormwater and urban runoff remain significant uncontrolled sources of pollution to the bay. Reducing pollution from these sources is one of the highest priorities in the Bay Restoration Plan.

Indicative of the problems associated with stormwater and urban runoff are the findings of the landmark epidemiological study conducted by the Santa Monica Bay Restoration Project (SMBRP), linking increased illness rates to swimming near flowing storm drain outlets and at beaches with high bacterial indicator densities. Stormwater also carries massive trash loads to the bay, costing Los Angeles County taxpayers roughly $4 million in beach clean-up costs in 1997. Sediment contaminants (e.g., metals) are elevated near stormwater discharges and urban runoff has been found to be toxic to portions of the bay's benthic community.

Overview of the Project

The Municipal Stormwater/Urban Runoff Pilot Project was initiated by the SMBRP, which awarded a $100,000 challenge grant to the City of Santa Monica. With this money, Santa Monica led the effort to organize a consortium of agencies, including Los Angeles County, 13 municipalities, one industry partner and the SMBRP, to collectively undertake a study to evaluate the feasibility and effectiveness of retrofitting catchbasins to reduce pollutant loads to the bay. Catchbasins in Southern California typically are not designed to allow the solids to fall out, allowing sediments and their associated contaminants to wash down the drain. The consortium hired two consulting firms and two researchers from the University of California at Los Angeles to conduct a series of applied research studies to meet the project's goal.

Project Objectives

The goal of this project was to evaluate the feasibility and benefits of using catchbasin retrofit devices as one element in local stormwater management programs. Three main objectives (or tasks) were undertaken to achieve this goal:

- characterizing local runoff and selecting target pollutants;
- evaluating catchbasin retrofits, and
- assessing the feasibility and potential environmental benefits of various inter-city catchbasin retrofit scenarios.

Implementing the Project

Characterize Local Runoff and Select Target Pollutants

Limited sampling was conducted at four sites to confirm the types and concentrations of pollutants in local urban runoff and differences between land uses. Target pollutants met the following criteria:

- present in local receiving waters in concentrations that threaten beneficial uses,
- discharged via municipal storm drains in significant quantities, and
- can be removed or reduced by some type of catchbasin insert.

Based on these criteria and the results of sampling conducted both prior to and as part of this project, the pollutants selected for study were total suspended solids, oil and grease, and trash and debris.

Evaluate Catchbasin Retrofits

Before conducting field and laboratory tests, a set of objectives for evaluating retrofits was established. The objectives addressed the cost of the devices and their ability to control the designated target pollutants, function as operationally practical components of the municipal stormwater collection system, and be used in certain municipal applications (i.e., with specific types of catchbasins and/or for specific types of land use).

Based on previous research and limited modeling, a variety of catchbasin "inserts" was selected for further evaluation. Inserts are devices that attach to the catchbasin entrance or mount inside and thus are relatively easy and inexpensive to install. Inserts are designed to improve stormwater quality by either preventing debris and pollutants from entering the basin or by detaining and treating the water in the basin. Field-testing was conducted in two areas — one having residential land use and the other commercial. Laboratory testing included shake tests, bench-scale column tests, and a full-scale simulation in a fabricated, aboveground catchbasin. Table 1 summarizes the results of the field and full-scale laboratory tests for the candidate devices.

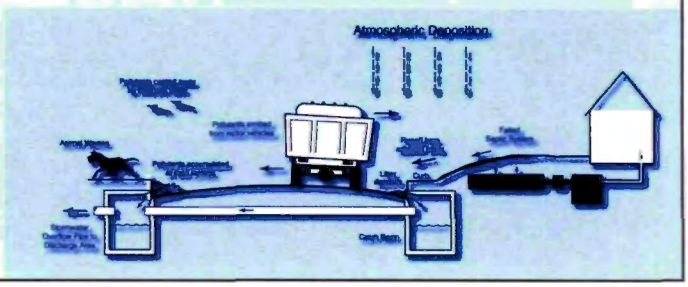


Table 1: Comparative Pollutant Removal Effectiveness*

Retrofit Device	Dry Weather			Wet Weather		
	TSS	Oil & Grease	Debris	TSS	Oil & Grease	Debris
Commercial Device**	none	mod.	high	none	low	high
Boardover	none	none	high	NR***	NR	NR
Debris Basket	none	none	high	none	none	high
Inlet Screen	none	none	high	NR	NR	NR
Sedimentation Baffle	high	low	high	mod.	low	mod. - high

**Full report includes a similar comparison for all evaluation objectives.*

***Commercial device consisting of an inlet screen panel, debris basket and oil sorbing columns.*

****"NR" indicates that the device is not recommended.*

Assess Inter-city Implementation Scenarios

Several inter-city implementation scenarios were considered, including citywide implementation, implementation at high opportunity sites, land-use specific implementation, and implementation in catchments discharging to sensitive or targeted receiving waters.

For example, for the land-use specific scenarios, the expected reduction in the target pollutant load was estimated using data on the number of catchbasins associated with the particular land use(s): the predicted pollutant removal efficiency for retrofitted catchbasins and the estimated pollutant load for the area under that land use. These calculations are illustrated for free oil and grease removal in Table 2. Calculations were also made for removal of trash and debris and total suspended solids under various scenarios.

Table 2: Estimated Results of Sedimentation Baffle Retrofit for Free Oil and Grease Removal

Land Use-Based Retrofit Alternative	% of Catchbasins Retrofitted (approx. number)	Estimated Removal for Sedimentation Baffle	Total Watershed Reduction	Reduction in Actual Pollutant Load (in metric tons)
Baywide	80%(12,320)	80%	64%	434
Commercial, Multi-Family Industrial	80%(6,966)	80%	43.2%	293

Based on this pilot project, a decision framework for evaluating retrofit options was developed to help municipalities select catchbasin retrofit devices taking into account local conditions and priorities. The first "decision tree" includes four steps:

1. Determine which pollutants are of concern (e.g., which impair or threaten beneficial uses),
2. Identify the catchbasins to be controlled (e.g., those discharging to sensitive water bodies),
3. Decide whether to focus on dry-weather or wet-weather discharges or both, and
4. Select appropriate devices (e.g., boardovers or screens to control dry-weather pollutants).

Another decision tree with supporting information helps planners evaluate different devices based on their technical feasibility, pollutant removal effectiveness, cost, and operation and maintenance considerations.

Success Stories

- This pilot project is the first to systematically test stormwater treatment devices under the climate and weather regime found in Southern California (i.e., arid climate, clearly defined wet and dry seasons, and high-intensity winter storms).
- The project's findings are transferable to coastal Southern California and other arid regions of the U.S. and, in addition, the implementation scenarios can be easily updated with new information.
- The project's findings are providing a timely impact on disbursement of county bond funds for capital improvements to reduce stormwater pollution — and should prove valuable to municipalities as they formulate capital project proposals.
- Inlet screen panels and boardovers are a very effective and inexpensive way to prevent nearly all debris from entering catchbasins during dry weather. In addition, they do not interfere with street sweeping; in fact, tests showed that the street sweeper picked up 95% of the accumulated debris in front of the catchbasin.
- Debris baskets are equally effective in both dry and wet weather; they did not impede flow in field tests, require no catchbasin modifications and can be easily cleaned out. Furthermore, they can hold oil sorbents to control oil and grease. These are probably used most effectively in commercial areas, which typically generate about three times the trash as other areas.

Prototype box-shaped debris basket

Lessons Learned

When evaluating stormwater treatment devices, planners should make sure that devices have been tested based on pollutant concentrations typically found in urban runoff. Many sorbers, for example, had been tested based on oil and grease concentrations in the thousands of milligrams per liter rather than the more appropriate 10 to 35 mg/l range typical of urban runoff.

Catchbasins should be evaluated in the context of all of the elements of a watershed-based stormwater management program. When considering the use of catchbasin inserts, it is important to recognize that there are practical limits on which pollutants can be controlled, what degree of control is possible, and what is truly "practicable" given that catchbasins must still perform their function of flood control.

For oil and grease removal, the most cost-effective land use-based approach is to target commercial, multi-family and industrial areas. Reducing the number of retrofits by 44%, but focusing on the land uses that generate more oil and grease, still affords a pollutant load reduction of 67% of the baywide scenario (see Table 2).

The volume of most Southern California catchbasins is large enough to allow significant capture of total suspended solids and fine particulate-related pollutants. The most cost-effective scenario for controlling total suspended solids is to focus on catchbasins where pollutant removal would be highest (e.g., those with larger volume to tributary area and imperviousness ratios).

For Further Information

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A "boardover" used to physically block the curb inlet of the catchbasin

Santa Monica BAY Restoration PROJECT

Previous Publications in the Demonstration Projects Series

Report Title	National Estuary Program	Date	Publication #
Biological Nutrients Removal Project	Long Island Sound, CT/NY	1995	EPA842-F-95-001A
Buttermilk Bay Coliform Control Project	Buzzards Bay, MA	1995	EPA842-F-95-001B
Georgetown Stormwater Management Project	Delaware Inland Bays, DE	1995	EPA842-F-95-001C
Texas Coastal Preserves Project	Galveston Bays, TX	1995	EPA842-F-95-001D
Shell Creek Stormwater Diversion Project	Puget Sound, WA	1995	EPA842-F-95-001E
City Island Habitat Restoration Project	Sarasota Bay, FL	1995	EPA842-F-95-001F
Buzzards Bay "Sep Track" Initiative	Buzzards Bay, MA	1997	EPA842-F-97-002G
New Options for Dredging in Barataria-Terrebonne	Barataria-Terrebonne Basin, LA	1997	EPA842-F-97-002H
Coquina Bay Walk at Leffis Key	Sarasota Bay, FL	1997	EPA842-F-97-002I
"Pilot Project Goes Airborne"	Narragansett Bay, RI	1997	EPA842-F-97-002J
The National Estuary Program: A Ten-Year Perspective	General NEP Discussion	1998	EPA842-F-98-003K
Rock Barbs In Oregon's Tillamook Bay Watershed	Tillamook Bay, Oregon	1998	EPA842-F-98-003L
The Weeks Bay Shoreline & Habitat Restoration Project	Mobile Bay, AL	1998	EPA842-F-98-003M
Evaluation of Shrimp Bycatch Reduction Devices in Texas Coastal Bend Waters	Corpus Christi, TX	1998	EPA842-F-99-003N

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