SAN FRANCISCO ESTUARY PROJECT

Pollution

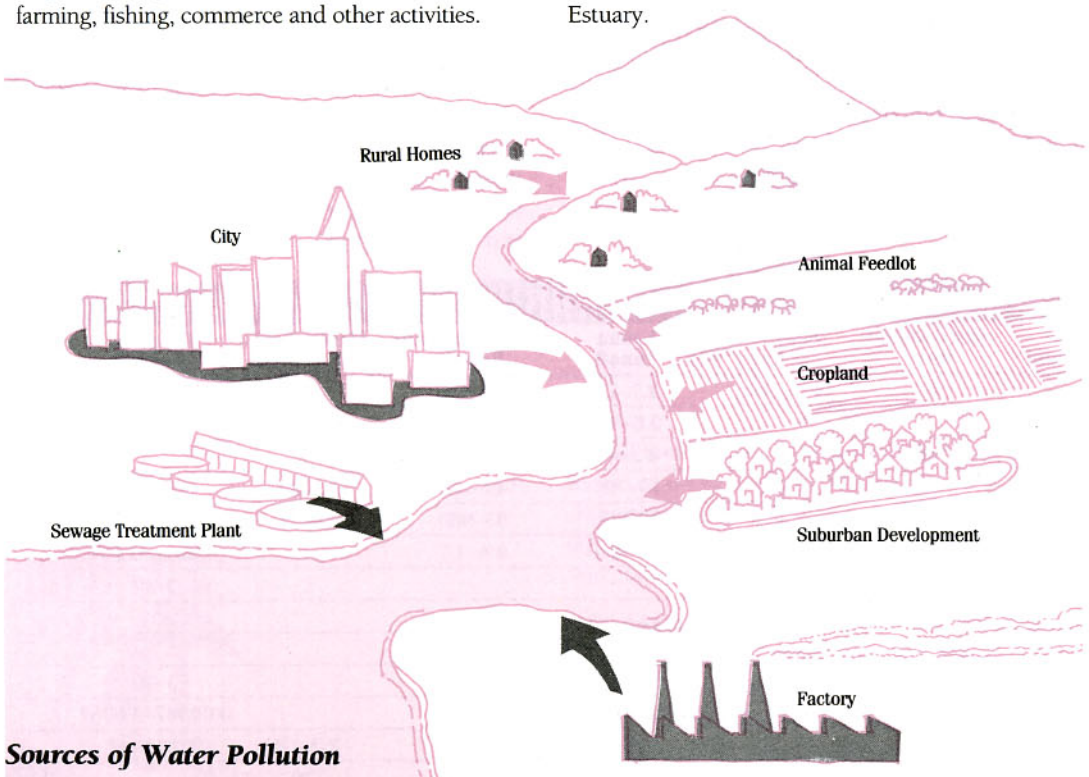
Pollution from the region's cities, farms and industries finds its way into San Francisco Bay and the Delta—stressing the Estuary's ecosystem and threatening its wildlife. To protect these natural resources, the San Francisco Estuary Project works with public interest groups, elected officials and government agencies to promote environmentally-sound management of the Bay and Delta.

The Estuary

San Francisco Bay and the Delta combine to form the West Coast's largest Estuary. The Estuary conveys the waters of the Sacramento and San Joaquin Rivers into the Pacific Ocean. The Estuary encompasses roughly 1,600 square miles, drains over 40% of the state, contains about 5 million acre feet of water at mean tide, and redistributes about 80–280 million cubic yards of sediment every year. The Estuary also hosts a rich diversity of aquatic life. Each year, two-thirds of the state's salmon pass through, as well as nearly half of the waterfowl and shorebirds migrating along the Pacific Flyway. Finally, Estuary waters enable the nation's fourth largest metropolitan region to pursue shipping, farming, fishing, commerce and other activities.

Pollution

As of 1991, the region discharged an estimated 5,000–40,000 metric tons of at least 65 pollutants (see glossary) into the Estuary each year. The quantity has most likely increased since then due to population growth and accompanying development. These pollutants come from many sources, including, urban and agricultural runoff, atomospheric fallout, municipal sewage treatment plants, industries, landfill seepage, natural and artificial erosion, illegal dumping, and spills. Some sources are diffuse, like runoff; some are focused, like the 50 publicly-owned sewage plants and 65 large industrial facilitites that discharge treated wastewater through a specific pipe or drain into the Estuary.



Sources of Water Pollution

History

The first significant pollutants added to the Estuary by humankind were the sediments and trace elements (see p. 2) that washed downstream from 19th century hydraulic gold mining. The Gold Rush sparked a population boom, which soon brought a second major pollutant to the Estuary—raw domestic sewage. Over the years, the region continued to grow. People built new cities and industries, converted Delta wetlands to farmfields, and produced more pollutants.

By the early 20th century, Bay waters smelled foul and clumps of unsightly sewage could be seen floating on the surface. Agricultural chemicals were finding their way into the Estuary via irrigation drainage. The first tests of Bay waters and bottom organisms showed evidence of pollutant impacts.

During the early 1950s, publicly-owned treatment plants began disinfecting and removing solids from municipal wastewater. The subsequent enactment of state and federal laws protecting the nation's waters, and resulting public and private investment in better wastewater treatment, led to major improvements in Estuary water quality—despite population growth. By 1985, treatment had brought conventional pollutants such as bacteria and suspended solids under control. Other pollutants, however, are not so easily controlled. The region and the nation remain far from achieving the pollution control goals established by the Clean Water Act in 1972.

Pollution Pathways

A Few Known Pollutants

DDT: *Dichlorodiphenyl-trichloroethane, a highly persistent pesticide used widely in the United States until banned in 1970.*

hydrocarbons: *Organic compounds, containing only carbon and hydrogen, such as petroleum–based fuels, oil, grease and other products.*

PAHs: *Polynuclear aromatic hydrocarbons, a group of petroleum–based organic pollutants, some of which are carcinogenic to mammals. PAHs are derived primarily from combustion processes (including automobile and truck exhaust) and oil refining.*

PCBs: *Polychlorinated biphenyls, a class of chlorinated aromatic organic compounds especially resistant to both chemical and biological degradation. PCBs were used in transformers for insulation, in gas pipelines as a lubricant, and in many other ways until banned in 1979.*

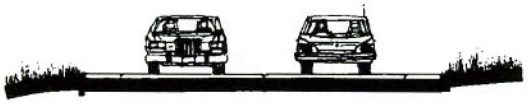
pesticides: *Pesticides of concern include organochlorines such as toxaphene and dicofol, organophosphates such as diazinon, chlorpyrifos, and methyl parathion, and carbamates such as cabaryl molinate, thiobencarb and carbufuran. The latter two groups are commonly used to kill weeds and pests in Delta ricefields.*

trace elements: *Elements such as silver, copper, selenium, mercury, cadmium, lead, zinc, chromium, nickel and tin. In low concentrations, many trace elements serve as essential nutrients to biota; higher concentrations, however, can be toxic.*

tributyl tin: *a toxic anti–fouling agent added to boat paint.*

Wastewater Discharges

The region's numerous publicly–owned treatment works (POTWS) and shoreline industries together discharge about 900 million gallons of treated wastewater into the Estuary each day. Though POTWs put all the wastewater through at least secondary treatment (see glossary), current treatment practices only remove biodegradable substances and fail to prevent more persistent pollutants from entering the Estuary. Numerous industrial facilities also discharge treated wastewater containing diverse pollutants—from the synthetic organic chemicals used in petroleum refining to the chromium used to galvanize steel.



Urban Runoff

Urban runoff occurs when rainfall, landscape irrigation and washdown practices flush pollutants off paved surfaces into the Estuary. When the ground is unable to absorb water, runoff washes street and yard pollutants into creeks and storm drains—most of which bypass treatment facilities and flow directly into the Estuary. Runoff pollutants derive largely from the automobile—crankcase oil, tires, combustion byproducts and batteries. However, other common pollutants include household and garden chemicals, sediments, and waste from commercial yards.

Nonurban Runoff

Runoff from crop, pasture, park, range and forest lands also contributes to the Estuary's pollutant load. Rainfall and irrigation water flush animal wastes, pesticides and other agricultural chemicals through farm drains and rivers into the Estuary. Pesticides that commonly find their way into the Delta include molinate, carbofuran and methyl parathion. Other components of nonurban runoff include trace elements leached (see glossary) from farmland by frequent irrigation, acid drainage from mine sites, and eroded sediment.

Dredging

About 7 million cubic yards of sediment are dredged from the Estuary each year and dumped at various aquatic or upland disposal sites. Dredging activities may dislodge pollutants deposited earlier in the Estuary, exposing biota (see glossary) to these pollutants.

Rivers

As the San Joaquin and Sacramento Rivers flow from the Central Valley into the Estuary, they bring along large amounts of pollutants. The rivers act as conveyances of pollutants that originate from sources along their banks.

Other Sources

Additional loads of pollutants enter the Estuary through atmospheric deposition (airborne pollutants reach the water through winds and precipitation), marine vessel discharges, accidental spills, and landfill seepage.

Estimated Pollutant Loads in Metric Tons

Pollutant	Municipal and Industrial Effluent	San Joaquin River	Sacramento River	Urban Runoff	Total Nonurban Runoff	Atmospheric Deposition	Dredged Material	Spills
Arsenic	1.5–5.5	12	.	2.7–25	27–330	.	.	.
Cadmium	1.8–4.0	.	.	0.8–8.2	1.4–16	0.4–1.0	0.02–0.2	
Chromium	12–13	66	.	8.2–41	370–4200	.	.	.
Copper	19–30	80	.	19–160	140–1600	5.2–8.5	1–10	.
Lead	11–16	51–55	.	82–680	85–980	16–57	1–10	.
Mercury	0.2–0.7	.	0.2	0.1–0.4	0.4–4.7	.	0.01–0.1	.
Nickel	19–27	51	.	.	.	.	2-20	.
Selenium	2.1	4.2	1.1	.	.	.	.	.
Silver	2.7–7.2	.	.	.	.	.	.	.
Zinc	77–80	164–175	.	93–730	350–4000	.	3–30	.
PCBs	.	.	.	0.02–1.1	.	.	0.00067–0.0067	.
PAHs	.	.	.	1.4–14	.	2.2–13	0.05–0.47	.
Hydrocarbons	(a)	.	.	3100–30000	.	120	.	26

a) oil and grease from point sources are probably comparable to loads shown for urban runoff.

Fate of Pollutants

Pollutants enter the Estuary in different chemical forms, change forms within the ecosystem, and move throughout the system in response to tides, freshwater inflows, and winds. Many pollutants bind to particles of sand and silt. Contaminated sediments, mainly from old industrial sites, have accumulated in certain areas of the Estuary, creating "toxic hot spots."

Shrimp, clams, fish and other estuarine organisms can accumulate pollutants both directly from the water or from the ingestion of contaminated food. The feeding habits, physiology and habitat of each organism determine the degree to which it absorbs and tolerates pollutants. Whereas many organisms can adjust to low concentrations of pollutants, even low doses can adversely affect species already stressed by other chemicals, temperature changes and environmental factors. As aquatic organisms accumulate pollutants in their tissues and organs, they pass them on through the food chain—eventually endangering the health of birds, marine mammals and humans.

Current Pollutant Levels

While the Bay and Delta exhibit moderate pollution compared to some other estuaries in the nation, high levels of certain pollutants in certain areas are cause for concern. Pollutant concentrations in sediments and biota are genereally highest in harbors, marinas, and industrial waterways. Currently, pollutants of particular concern to plant and animal life in the Estuary include the trace metals cadmium, copper, mercury, nickel, selenium, silver, and TBT; organochlorines and other pesticides, especially diazinon, chlorpyrifos, and DDT; PCBs and dioxin; and petroleum hydrocarbons.

Ecosystem Impacts

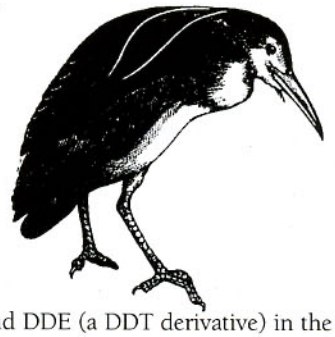
In an ecosystem as complex as the San Francisco Bay–Delta Estuary, it's difficult to separate the effects of pollutants from those of other environmental changes such as freshwater diversion and habitat destruction. In recent years, however, scientists have identified an array of specific signs that pollutants may have a negative impact on the ecosystem.

• Bioassay (see glossary) tests of certain creeks and rivers in the Bay–Delta drainage basin, as well as some Bay sediments, have shown toxicity.

• Stormwater runoff from the City of Sacramento produced acute toxicity in invertebrates (see glossary). Invertebrates also had an acute response to San Joaquin River water, which exhibited high concentrations of agricultural pesticides.

• Current PCB levels appear to have reduced the reproductive success of starry flounder, and may be causing similar sub lethal effects in other organisms.

• Exposure to metals in water and sediments have affected the condition and reproductive status of North Bay clams—organisms in the middle of the food web.



• PCBs and DDE (a DDT derivative) in the eggs of Black–crowned Night Herons have reduced embryo size and shell thickness. PCBs in Bay cormorant eggs may also cause developmental malformations and reduced breeding success.

• Six contaminants were found in Bay fish at levels exceeding Environmental Protection Agency (EPA) screening values for safe human consumption. The California Office of Health Hazard Assessment has issued an interim Health Advisory concerning the consumption of fish tissue from the Bay.

Glossary

beneficial use: *Uses of the waters of the state that may be protected against quality degradation include domestic, municipal, agricultural and industrial supply; recreation and navigation; and the preservation of fish and wildlife.*

bioassay: *A laboratory test using live organisms to measure biological effects of a substance, factor or condition.*

bioavailability: *The extent to which a compound is obtainable for biological use by organisms.*

biota: *All living organisms that exist in a region.*

effluent: *Wastewater discharged into the Estuary from point sources.*

invertebrates: *Organisms like clams and worms that lack a spinal column. Many of these filter bottom sediments and water for food.*

leach: *To pass out or through soil by water percolation.*

pollutant: *A harmful chemical or waste material discharged into the environment. Persistent pollutants are those that don't degrade, causing potential long-term chronic toxicity to biota.*

pollution: *Impairment of land, air or water quality by agricultural, domestic or industrial waste to a degree having an adverse effect on beneficial uses (see above).*

treatment: *Wastewater treatment is divided into three steps, primary, secondary and tertiary. Primary treatment uses screens and sedimentation tanks to remove most materials likely to float on the water or settle on the bottom. Secondary treatment uses a biological process to consume organic materials in the waste, and disinfects the effluent. Tertiary treatment removes additional nutrients, suspended solids and other pollutants.*

Current Issues

Resources

San Francisco Estuary Project 1990–1998

Comprehensive Conservation and Management Plan

Estuarywise
100 tips on how you can prevent pollution of our Bay and Delta.

Information Sheets
The Estuary, The Delta, Wetlands, Dredging, Water Usage, Aquatic Organisms and Wildlife, Land Use, Research and Monitoring, Agricultural Drainage

Status and Trends Reports
Pollutants, Wetlands, Dredgind and Waterway Modification, Wildlife, Aquatic Resources, Land Use and Population

State of the Estuary, 1992–1997: Vital Statistics, New Science, Environmental Management

An Introduction to the Ecology of the San Francisco Estuary

Toxic Hot Spots in San Francisco Bay, *Citizens for a Better Environment, 1987*

Pollutant Policy Document, *State Water Resources Control Board, June 1990*

Regional Monitoring Program for Trace Substances, 1996 Annual Report, *San Francisco Estuary Institute*

Contacts

Bay Area Dischargers Association, *P.O. Box 24055, MS 702, Oakland, CA 94623, (510)287-1408*

Bay Area League of Industrial Associations, *155 Jackson Street, #305, San Francisco, CA 94111 (415)788-2739*

Central Valley Regional Water Quality Control Board, *3443 Routier Road, Sacramento, CA 95827-3098 (916)255-3000*

Communities for a Better Environment, *500 Howard Street, #506, San Francisco, CA 94105 (415)243-8373*

S.F. Bay Conservation and Development Commission, *30 Van Ness Avenue, #2011, San Francisco, CA 94102 (415)557-3686*

San Francisco Estuary Institute, *1325 South 46th Street, Richmond, CA 94804 (510)231-9539*

S.F. Bay Regional Water Quality Control Board, *1515 Clay Street, Suite 1400, Oakland CA, 94612, (510)622-2300*

San Francisco Estuary Project, *c/o RWQCB, 1515 Clay Street, Suite 1400, Oakland CA, 94612, (510)622-2465*

State Department of Fish & Game,

1416 9th Street, 12th floor, Sacramento, CA 95814 (916)653-7664

State Department of Water Resources, *1416 9th Street, Sacramento, CA 95814-5515 (916)653-5791*

State Water Resources Control Board, *901 P Street, Sacramento, CA 95814 (916)657-2390*

United States Environmental Protection Agency, Region 9, *75 Hawthorne Street, San Francisco, CA 94105 (415)744-2125*

Persistent Pollutants

Now that bacteria and other biodegradable pollutants are largely under control, concern has shifted to more persistent pollutants and their impact on the beneficial uses of the Estuary. While substantial information is now available for trace element pollutants such as copper, cadmium and silver, there's only limited information on the abundance of organic chemicals such as volatile compounds, organochlorine pesticides, PCBs and PAHs. What little is known about the distribution and actual toxicity of these pollutants, however, suggests the need to prevent their discharge into the Estuary while new and more sophisticated research is underway.

Pollution Prevention

Recent years have seen a move toward better pollution prevention at the source. Such strategies employ recycling, technological improvements, good housekeeping and raw material substitution (the replacement of a toxic raw material with something more benign) to eliminate the discharge of persistent pollutants at the source and reduce the volume and toxicity of industrial wastes as a whole. One local petroleum refinery, for example, recently eliminated 70-90% of the chromium and lead in its waste effluent by changing one of the chemicals used in its cooling towers and improving the efficiency of a catalyst manufacturing site. The challenge today is to encourage industries regionwide to undertake pollution prevention programs.

Runoff

Planners have projected a 25% increase in urbanization for the Bay-Delta and a 50% increase for the Central Valley between 1985 and 2005. Without appropriate countermeasures, this continuing urbanization of open land will increase runoff pollution. Urban and non urban runoff may contribute the most significant loads of pollutants to the Estuary, but their sources are the hardest to document and control. While scientists struggle to find more accurate ways to measure pollutants in runoff, regulators face the extraordinary task of developing incentives, laws and enforcement measures that will encourage homeowners, mechanics and business executives alike to minimize toxic runoff from their own backyards.

Need for Comprehensive Research

Today's understanding of how the Estuary works is in its infancy, due to the extreme complexity of the system, the limitations of certain techniques of discerning biological impacts of pollutants, and the high costs associated with monitoring. Scientists face enormous challenges in their effort to go beyond the basic measurement of pollutant levels in water, sediments and biota. Undertaking more "cause and effect" oriented research is expensive and often inconclusive.

What Can You Do?

- Recycle used oil, paint and other products. Many Bay Area cities and counties offer household waste disposal and recycling centers, but more are needed. To learn more about household waste disposal options, contact your local health department.
- Don't dump anything on the street, in a drain or down the toilet you wouldn't like to end up in Estuary waters.
- Encourage source reduction and pollution prevention strategies in your workplace.
- Educate yourself and your children. Remember, as consumers we demand the gas, food and other everyday products whose manufacture and use produces many pollutants.
- Inform your elected representatives at local, state and federal levels of your concerns and opinions about Estuary pollution.
- Stencil your storm drain. Call the Estuary Project for a "Don't Dump, Flows to the Bay/Delta," stencil kit.
- Get yourself a copy of *Estuarywise*—100 tips on how you can prevent pollution of our Bay and Delta. Call (510)622-2465.

Estuary Project Goals

The Estuary Project's primary goal is to restore and maintain water quality and natural resources while promoting effective management of Bay and Delta waters. The Project's Comprehensive Conservation Management Plan (CCMP) sets the following goals for pollution prevention in the 12-county Estuary region:

- *Promote mechanisms to prevent pollution at its source.*
- *Where pollution prevention is not possible, control and reduce pollutants entering the Estuary.*
- *Clean up toxic pollution throughout the Estuary.*
- *Protect against toxic effects including bioaccumulation and toxic sediment accumulation.*

The CCMP Action Plan's pollution section recommends 16 specific actions to achieve these goals. the actions range from pursuing a mass emissions strategy for the Estuary to developing environmental audit procedures for all significant users of toxic substances. The Estuary Project is now working cooperatively with other agencies, business and the public to develop implementation programs for the CCMP. For more information, call (510)622-2465.

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