Reclamation of Bay Wetlands and Disposal of Dredge Spoils: Meeting Two Goals Simultaneously

US Geological Survey
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FACT SHEET—MARCH 1997

MAJOR CONCERNS IN THE MANAGEMENT OF SAN FRANCISCO BAY

Loss of Tidal Wetland

San Francisco Bay is one of the world's largest urbanized estuarine systems with a watershed that drains about 40 percent of the State of California. Its freshwater and saltwater marshes comprise approximately 125 square kilometers (48 square miles), compared to 2,200 square kilometers (850 square miles) before California began rapid development in 1850. This staggering reduction in tidal wetlands of approximately 95 percent has resulted in significant loss of habitat for many species of fish and wildlife. The need for wetlands is well documented—healthy and adequate wetlands are critical to the proper functioning of an estuarine ecosystem like San Francisco Bay.

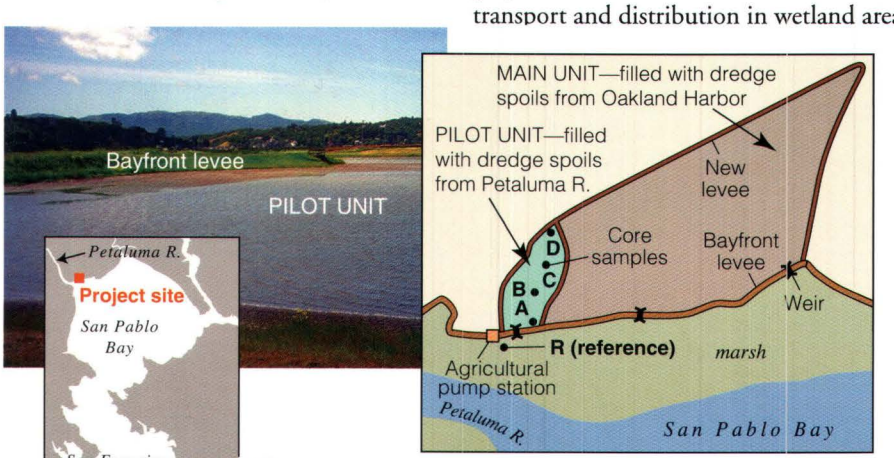
Ninety five percent of the wetlands have been lost to anthropogenic activities such as hydraulic mining in the mid to late 1880s, and urban, industrial, and agricultural encroachment in the 1900s.

Finding Sites for Dredge Disposal

One of the key resource management issues in the Bay is identification of sites suitable for disposal of dredge material. Maritime commerce has become increasingly dependent on larger ships and, therefore, even deeper channels and harbors. Consequently, San Francisco Bay managers are required to find new solutions for the problem of disposal of the large amounts of dredge material regularly excavated to keep the shipping channels open and the harbors operable. Options for areas into which to dump these dredge spoils are becoming severely limited because of the filling up of formerly used sites, the expense of spoils transport, and potential environmental impacts. Any new disposal sites would be a very important economic resource. In order to address this dredge spoils problem and to develop a strategy to reclaim some of the historic wetland habitat, the U.S. Army Corps of Engineers, California Department of Fish and Game, the Environmental Protection Agency, the San Francisco Bay Conservation and Development Commission, and other groups are currently investigating the use of dredge spoils at carefully chosen sites in the Bay to restore lost fish and wildlife habitat. One such site is the Sonoma Baylands.

RESTORING WETLANDS UTILIZING DREDGE SPOILS

Sonoma Baylands has been chosen as a demonstration site both for reclamation and for utilization of dredge spoils as fill material. U.S. Geological Survey (USGS) scientists, working in cooperation with State and Federal Agencies, are aiding in this effort. They have initiated long-term projects which include studies of sediment transport and distribution in wetland areas and are monitoring pollutant and natural organic compounds in the sediments at the Sonoma Baylands site as the site is reclaimed and developed. These studies are intended to yield information that will improve the planning and construction of future wetland restoration projects using dredged material throughout the Bay.



Core samples were collected from the pilot and main unit sites shown above, as well as from the existing marsh for reference. Sampling is in progress in the main unit.

The Sonoma Baylands Wetland Demonstration Project site, located on the northwest shoreline of San Pablo Bay, is an area of former tidelands that had been diked, plowed to slightly below sea level, and used for oat-hay farming. In 1995, a pilot unit was filled with about 0.26 million cubic yards of maintenance-dredged material from the Petaluma River, and the main unit was filled with about 2.5 million cubic yards of Oakland Harbor Deepening Project sediments. The purpose of the filling was to partially restore the ground

elevation to historical tidal marsh elevation. This filling should accelerate the restoration of vegetated tidal wetlands by an estimated 15-45 years. After the dredged material had consolidated, the site was opened to tidal action by breaching an existing bay-front levee. In order to define baseline conditions of the sediments, the USGS has collected sediment core samples from the pilot site and the main unit prior to exposure to tidal action, as well as from the adjacent established wetland. The USGS will continue to collect cores over several years in order to evaluate the geochemical changes that occur in the sediment as the site reverts to its wetland condition.

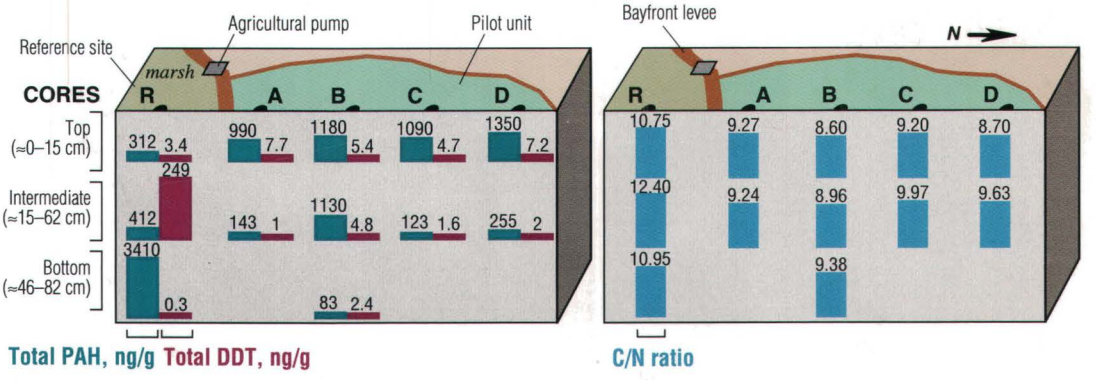
ORGANIC COMPOUND ANALYSIS OF THE SEDIMENTS

Using organic compounds as indicators

The purpose of this study of organic compounds in the sediment is to determine if specific anthropogenic and biogenic indicator compounds can be used as environmental probes in monitoring the developing wetland system. The compounds analyzed include: aliphatic hydrocarbons (indicators of input from terrestrial plants) and biomarkers ("fossil" organics that are indicators of input from weathered petroleum); contaminants from human activities, especially chlorinated pesticides and pollutants such as DDTs and PCBs, and polycyclic aromatic hydrocarbons (PAHs); and natural plant constituents, such as sterols and fatty acids, which are expected to show geochemical changes, specifically increasing amounts and complexity, as the wetland develops. Ratios of atomic carbon to nitrogen (C/N) also can give an indication of how the wetland is changing, since the increasing levels of vegetation in the developing wetland will probably result in higher levels of carbon relative to nitrogen in the sediment. All of these parameters will help assess the rate at which the wetland is developing and if any environmental problems are occurring.

Establishing baseline conditions

Preliminary analyses provide baseline conditions in the pilot site and the adjacent wetland. Analyses of the aliphatic hydrocarbons indicate that sediments in the pilot unit are somewhat stratified. Whereas concentrations of terrestrial alkanes (hydrocarbons which originate from plant waxes) are about the same at all depths, biomarker profiles and other hydrocarbon data indicate the presence of slightly higher levels of weathered and biodegraded petroleum in the top horizon of the cores. Sediments from both the pilot unit and a reference site in a nearby established wetland area contain low concentrations of PAHs (with a distribution which suggests they are probably from combustion sources) and the chlorinated pesticide DDT and its degradation products DDE and DDD, with DDE being the major compound. In the pilot site cores, total PAHs range from 83 to 1350 parts per billion (ppb), and total DDTs from 1 to 7.7 ppb. In general, the highest concentrations of these compounds are found near the top of the cores. These distributions probably indicate heterogeneity in the fill material, or a difference in settling of the particles from the fill sediment, with finer particles, known to adsorb contaminants more efficiently, settling toward the top.



In the reference core, by contrast, the intermediate horizon is contaminated with significantly higher levels of DDTs, especially DDE (249 ppb), and the bottom horizon with higher levels of PAHs (3410 ppb). This contamination is likely from a nearby agricultural pump and drain. That the higher levels of DDTs appear in the mid-cores may reflect the historical usage of this pesticide, since DDT has been banned since 1972. The C/N ratios are higher in the reference core (10.8 to 12.8) than in the pilot unit (8.6 to 10.0). Analysis for classes of natural plant constituents indicate that polar molecules such as sterols and fatty acids do indeed show significant differences between the established wetland reference site and the pilot site.

Preliminary conclusions

The baseline analyses of the Sonoma Baylands sediment from the pilot and adjacent wetland sites indicate:

- Petaluma River dredge spoils probably contribute only trace levels of contaminants to the wetland site.
- The surrounding established wetlands may contain higher levels of contaminants than the pilot unit, and therefore will be included in the study
- Naturally-occurring plant organic compounds, like sterols and fatty acids, show substantial differences between the pilot and reference site sediment.

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