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**PAST, PRESENT AND FUTURE:  
Persistent Bioaccumulative Toxins in San Francisco Bay**

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**EXECUTIVE SUMMARY**

San Francisco Bay is located in a highly urbanized environment and receives waste from the activities of more than seven million people and myriad industries. As of the December 2002 draft 303(d) list of California waterbodies, San Francisco Bay is officially impaired by no less than ten toxic pollutants, which does not take into account other water quality stressors like sediment and exotic species. The purpose of this report is to focus on the continued impairment of San Francisco by persistent, bioaccumulative toxins. Toxic substances are those that have adverse acute (e.g., death) or chronic (e.g., reproductive or neurotoxic) effects on living organisms. Bioaccumulative substances increase in concentration in living tissues as one goes up the food chain. Since humans, especially developing fetuses and young children, are at the top of the global food chain, the health effects of bio-accumulative toxics are of extreme importance in the public health context. Persistent bio-accumulative toxics are of even greater concern since they degrade slowly, if at all, over time. Individuals are primarily exposed to persistent, bioaccumulative substances through food consumption, particularly fish from contaminated waters. Those most at risk are communities of color, emerging ethnic majorities, and cultural minorities - economically disadvantaged, and socially marginalized groups already experience disproportionate impacts from a range of toxic exposures.

We selected the three chemical groups featured in this report to illustrate the extent to which the Bay is currently contaminated, the direct impact of these pollutants on human health, the cost of this contamination, and the need for a policy and regulatory transition to preventative action. These three chemical groups are polychlorinated biphenyls, dioxins, and polybrominated diphenyl ethers. This report will be used as a primer to educate decision-makers about the significance of these issues in order to inspire precautionary action.

Despite the decades old ban on the manufacture, distribution and processing of PCBs, they continue to be emitted into San Francisco Bay to this day. About 90% of the fish samples from San Francisco Bay tested by the Regional Monitoring Program in 2000 contained PCBs at a level that warrants concern for human health. PCBs from atmospheric deposition, surface waters, municipal wastewater, industrial wastewater, urban runoff and Bay sediment sources exist in the San Francisco Bay water column. According to estimates provided by San Francisco Estuary Institute, even small PCB input to the Bay would significantly delay declines in concentrations. The SFRWQCB is currently in the process of developing a Total Maximum Daily Load for PCBs in San Francisco Bay. The TMDL program was created as part of the federal Clean Water Act as a means of cleaning up pollution that is derived from diffuse, nonpoint sources. The TMDL process, which aims to ratchet down PCB concentration in Bay sediments, water column and in fish tissue, is a lengthy, expensive and challenging process. Because of the extent of PCB pollution and their persistent nature, we are currently far away from health or even ecosystem protective levels and clean up is expected to take decades at best. It should be noted that TMDLs are inherently a retroactive means of improving water quality.

Structurally and chemically related to PCBs, dioxins are one of the most toxic chemical groups known. Dioxins are created when chlorine-containing substances are burned in the presence of hydrocarbons.

They are the unintentional yet extremely potent byproducts of a variety of industrial and manufacturing processes. What makes dioxins particularly problematic, both from regulatory and policy perspectives, is that the majority of dioxins are released at least originally, to air rather than water. As dioxins reach the ground, they are picked up by water flowing on the surface and to reach the Bay along with such storm water flows. Thus, non-point sources to water are likely to be the most significant to San Francisco Bay. In 1994, the SF Regional Water Quality Control Board, in cooperation with the Bay Protection and Toxic Cleanup Program (BPTCP), performed a pilot study to measure concentrations of contaminants in fish in San Francisco Bay and found dioxins to be among the chemicals in San Francisco Bay fish that exceed levels of concern. This prompted US EPA Region 9 to add dioxin-like compounds to the 303(d) list of pollutants in San Francisco Bay, thus triggering opportunity for regulatory action. Unfortunately, four years have passed and no dioxin TMDL is planned at this time and some regulatory agency staff question whether the TMDL is even the right approach for cleanup of dioxin from San Francisco Bay because air sources dominate direct water releases. This scenario speaks to the need for interagency coordination in order to solve the dioxin problem in the future.

Polybrominated diphenyl ethers, commonly known as PBDEs, are a class of brominated flame retardants that have similar properties to the other two chemical groups discussed in this report - namely, they are persistent, bioaccumulative and toxic. In fact, PBDEs exhibit many of the same characteristics that compelled Congress into banning PCBs in 1976. Scientific concern is growing as PBDEs widely used as flame retardants in consumer goods continue to spread and accumulate in humans, fish and other wildlife. PBDEs are the latest addition to the list of chemical toxins detected at alarming levels in San Francisco Bay. More and more studies are showing that these substances, previously considered safe, can have an adverse effect on animals reproduction and health and can affect human health, especially that of pregnant women, children and low-income families earning their living fishing in San Francisco Bay. The human fat levels were significantly higher than any levels previously reported anywhere in the world. The average level in San Francisco Bay Area women was ten times higher than the average level reported in Germany and Canada, three times higher than levels reported in Sweden, and twenty-five times higher than levels reported in human tissue in Spain. Levels of PBDEs tended to be higher in younger (premenopausal) women, implying that the exposures are likely to be a fairly recent phenomenon.

This year, the San Francisco Bay Regional Water Quality Control Board this year added PBDE to its watch list of chemicals monitored for environmental accumulation as part of its Regional Monitoring Program. However, despite growing level of pollution in the Bay, and despite PBDEs' similarity to dioxin and other pollutants imposing such health risks as cancer, diabetes, endometriosis and problems with the immune system and neurodevelopmental disabilities – there is lack of precaution in dealing with the substance in San Francisco Bay. Despite concerted efforts of a number of environmental organizations, including Clean Water Fund and Clean Water Action, the State Water Resources Control Board has decided against listing San Francisco Bay as impaired by PBDEs, a decision which essentially delays any potential regulatory action from that avenue for another four years. Precautionary action will most likely be proposed in the state legislature, but no guarantee of success exists. Because of the heavy use of PBDE-treated products in various industries, environmental concentrations of PBDEs are increasing logarithmically and will soon reach alarming levels if their prevalent use continues. Today, 28 years after being banned, PCBs are still in the sediment of San Francisco Bay, they can still be measured in human blood and they still have adverse effects on human health. Cleanup of PCBs alone is likely to take decades if not longer, and the majority of the financial burden will fall on public entities. Without precaution, this can become the case with PBDEs in the future.

Persistent bio-accumulative toxic substances, by their very nature, have economic implications for human health. Nonetheless, surprisingly little research exists that links concentration of PBTs with the economic losses that result from poor health. Financial impacts from lost work days or reduced productivity, or the costs of medical treatment, are relatively easy to evaluate when sufficient data exist. Unfortunately, most data-intensive scientific efforts related to PBTs have focused on the link between exposure and health, not the link between health and earnings or expenses. A summary of economic studies in this area, as well as illustrations of the potential economic impacts in the San Francisco Bay Delta, are presented in this report to illustrate the potential size of economic impacts if the San Francisco Bay-Delta, its fishing and consumption patterns, demographic and business patterns, and levels of pollution were similar to the areas studied.

One of the most important areas of future economic research on health impacts of pollution is the productivity and health expenditure impacts of chronic diseases and conditions other than cancer. What the literature does is show us that the total damages from pollution (benefits of totally eliminating

pollution) in the San Francisco Bay-Delta are significant (e.g., \$2 to \$300 billion). When industry or publicly owned treatment works say "We can't afford to clean up pollution type X," it is fair to reply "Can we afford to continue to pollute?"