



SF Bay Mercury TMDL Air Deposition Challenges and Opportunities



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San Francisco Bay Does Not Fully Support Beneficial Uses



Sport Fishing

–Fish consumption advisory



Wildlife Habitat

–Bird egg hatch failures



Preservation of Rare and Endangered Species

–California least tern



striped bass



California least tern

San Francisco Bay Mercury Loads and Allocations

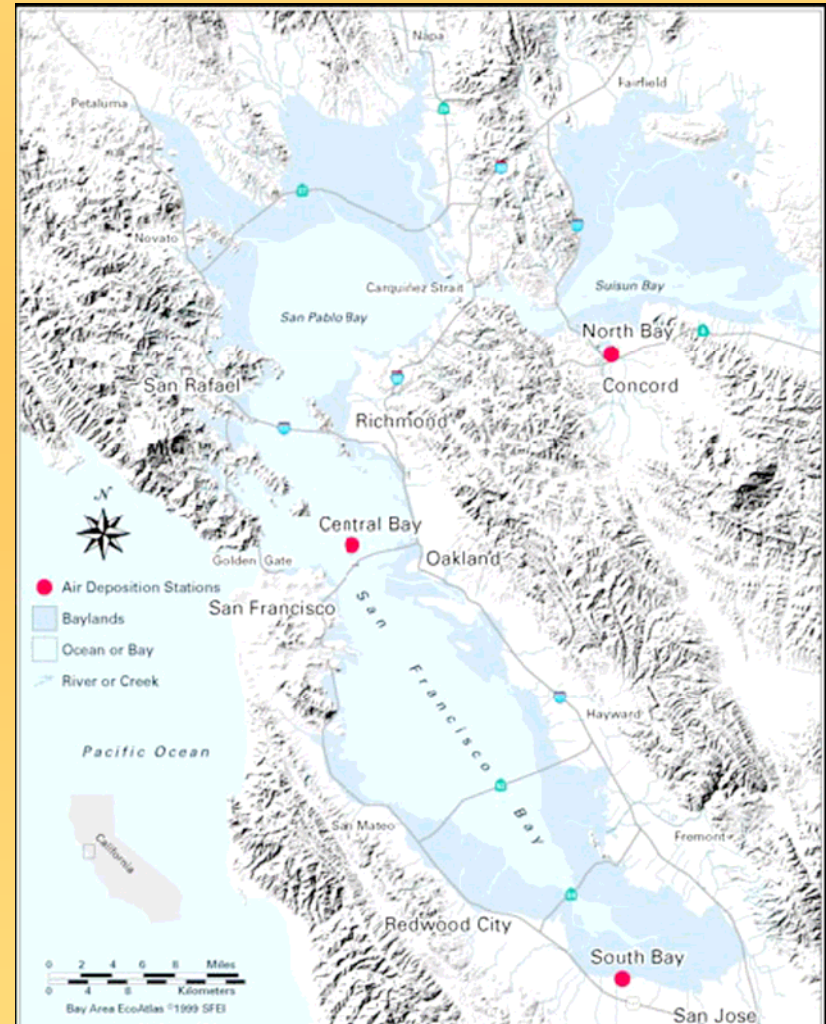
SOURCE	EXISTING LOAD (kg/yr)	ALLOCATION (kg/yr)
Bed Erosion	460	220
Central Valley Watershed	440	330
Urban Runoff	160	82
Guadalupe River Mining Legacy	92	2
Atmospheric Deposition	27	27
Rural Runoff	25	25
Wastewater	20	20
Dredging and Disposal	net loss	0 ≤ ambient concentration
TOTAL	1,220	706

San Francisco Bay Regional Monitoring Program Study

- 🐟 Three stations
- 🐟 Wet and dry deposition

Mercury Loading

- 🐟 Direct deposition to Bay = 27 kg/yr
- 🐟 Indirect (via runoff) = 55 kg/yr



Big Picture Mass Budget

~ 20,000 kg/yr Hg
Moves thru Air Shed (1 km top)



Outputs ~ 1700 kg/yr: 

Inputs ~ 1200 kg/yr: 

~ 100 kg Hg in Water

**~ 60,000 kg Hg in
Active Sediment**

15 cm

**Active
Sediment**

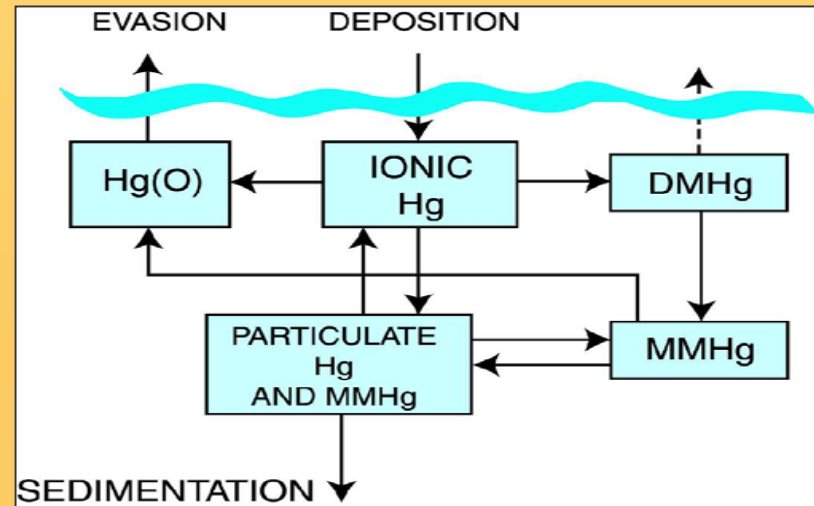
100 cm

**HUGE mass of Buried mercury
from historical loads (> 500,000 kg)**

Hg chemical form is important

🐸 Elemental mercury (Hg^0) is volatile

- Mercury loss from bay to air is mainly Hg^0



🐸 Hg^0 can be oxidized (by air pollutants) to ionic form (Hg^{+2})

- Mercury in atmospheric deposition is Hg^{+2}
- Hg^{+2} is more water soluble

🐸 Controls on "conventional" air pollutants probably have a significant benefit

Local air sources of mercury

Air Board estimated 500 kg/yr (1996)

Cement kilns

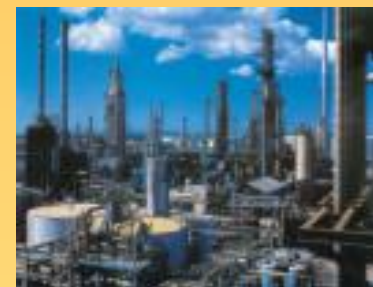
- Existing controls = cool exhaust gases
- Do not readily control mercury

Crematoria (from dental fillings)

- No controls

Petroleum Refineries

- There's mercury in crude oil
- Our TMDL requires air emissions / deposition study



Global air sources of mercury

🐟 Combustion of fossil fuels

- Coal in China
- Studies suggest Asia air emissions dominate mercury concentrations in CA



🐟 Evidence of impairment in local reservoirs where main (only?) source is atmospheric deposition

Reservoirs have high levels of mercury (and PCBs) in fish

- 303(d) list of impaired waters
- Atmospheric deposition is main source
- 303(d) list of impaired waters → TMDL
- TMDL → ?

Quicksilver Caucus



Recap

- ➡ Direct air deposition (27 kg/yr) > wastewater load (20 kg/yr)
- ➡ Indirect air deposition load to Bay (55 kg/yr)
 - > 2 X rural runoff load (25 kg/yr)
 - ~ 1/3 urban runoff load (160 kg/yr)
- ➡ Air controls have direct (mercury) and indirect (oxidants) benefit

Information needs (mercury)

Two key questions



🐟 How much of air deposition is from local versus long-range sources?

- Needed to evaluate control options for direct and indirect pathways to Bay




🐟 What is relative bioavailability of sources?

- Newly-air deposited Hg may be more bioavailability



Partnership opportunities

State Air \Leftrightarrow State Water \Leftrightarrow Local Gov

-  Transport and chemistry models exist to assess air quality and planning
 - Add water quality inputs and endpoints to existing
-  Some modeling/monitoring scenarios exist \rightarrow apply / extrapolate / expand
-  Establish protocols/forums for needs and info/data exchange and access
 - Ask /tell

Regulatory Actions



- Require air emissions monitoring of water pollutants (Water Code)
 - 13267 Water Boards require dischargers?
 - 13225 Waters Boards ask Air Board/Districts
- Water Quality based using Air Code?
 - Point source monitoring / control
 - Land use / transportation (nonpoint) planning / monitoring / control