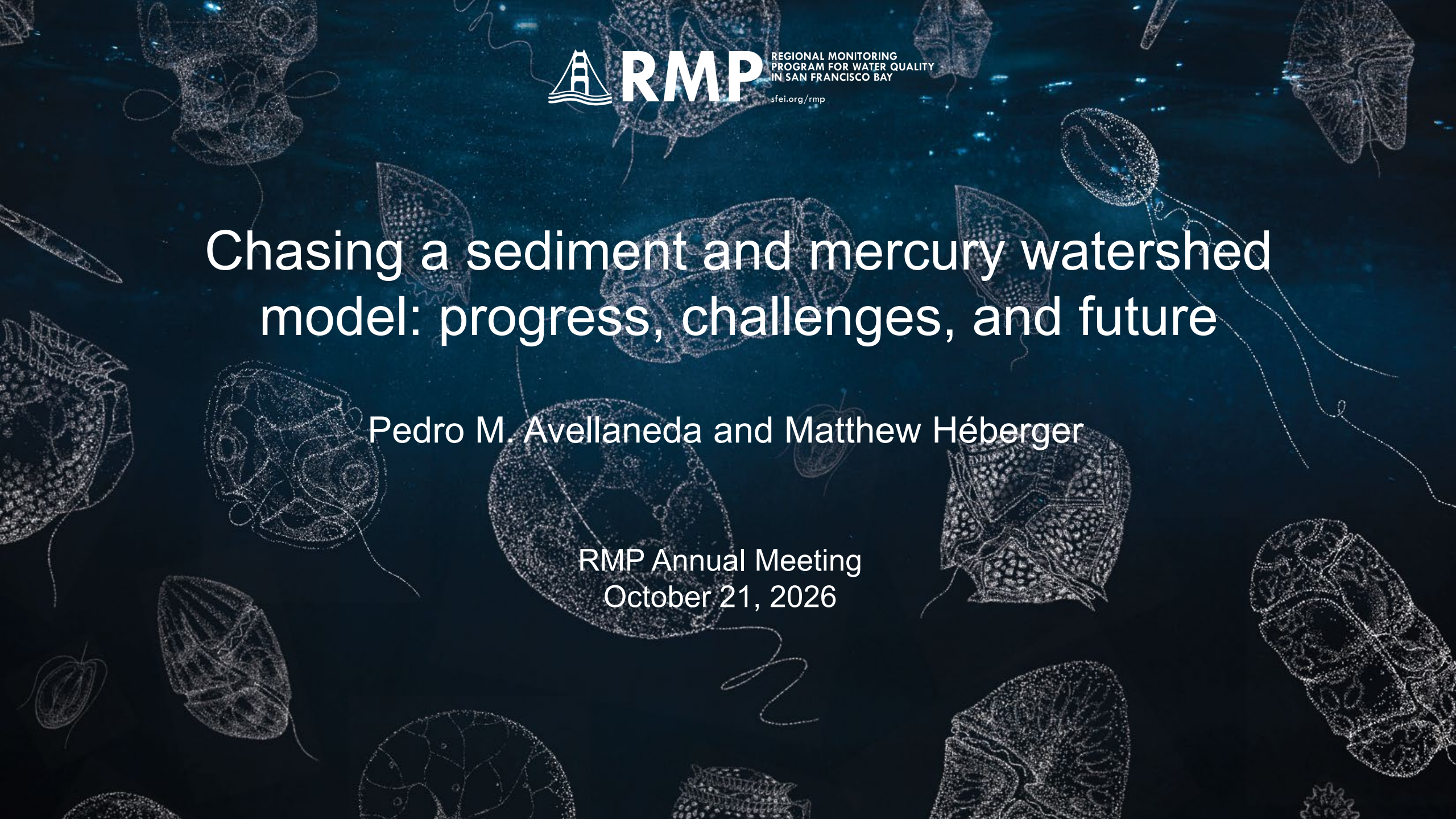


Chasing a sediment and mercury watershed model: progress, challenges, and future

Pedro M. Avellaneda and Matthew Héberger

RMP Annual Meeting
October 21, 2026

We have an extraordinary and dedicated team

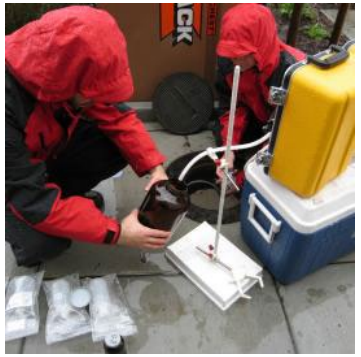












RMP

…and a fantastic group of advisors

Dr. Jon Butcher
Tetra Tech



Tom Jobes
Independent





Dr. James Limbrunner
Tufts University

Dr. Robert Budd,
California Department
of Pesticide Regulation

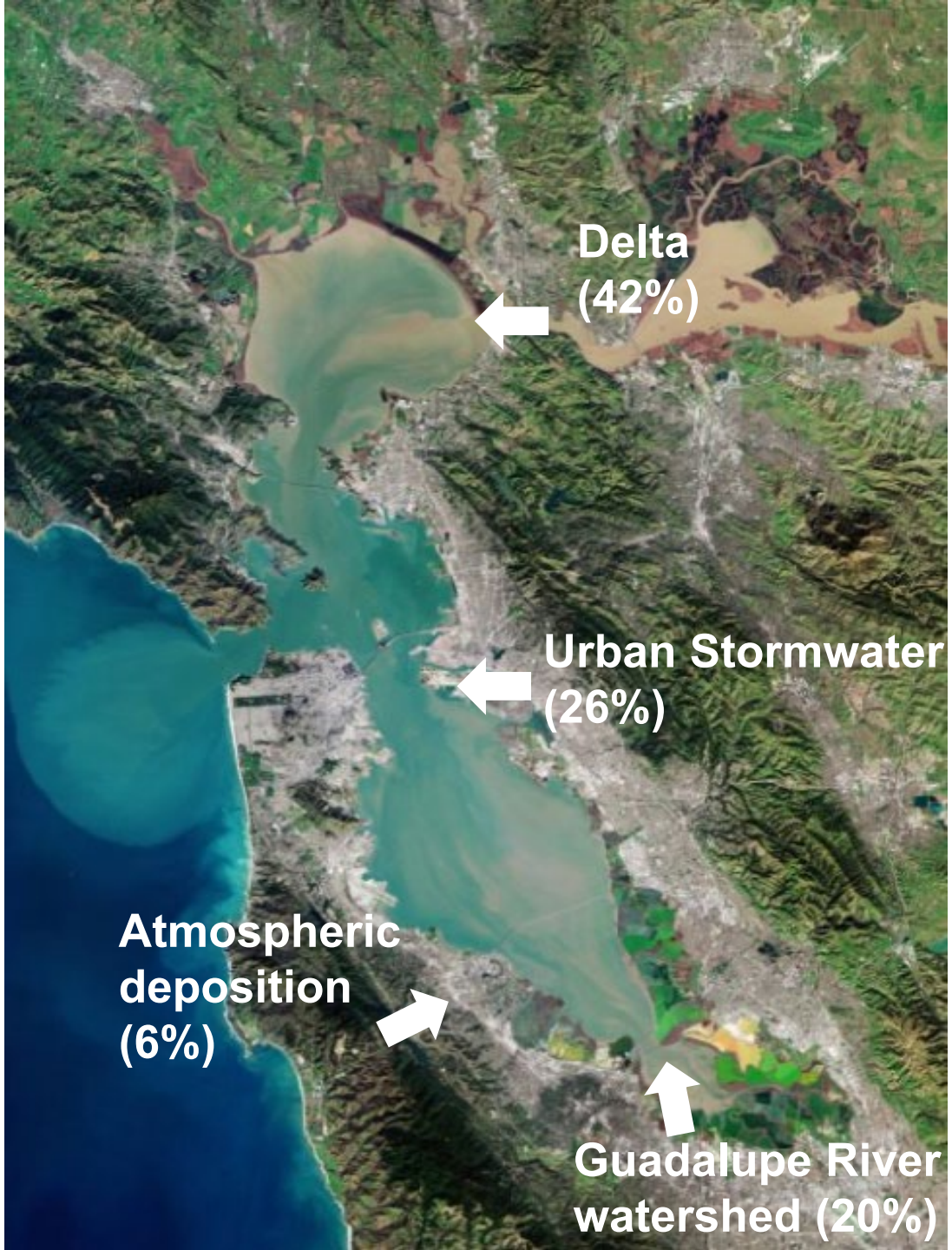


John Riverson
Paradigm Inc.
(Ulteig)



Stormwater is an important source of mercury pollution to the Bay

- Sources: soils, industrial activities, commercial products
- Mercury mining legacy in the Guadalupe River watershed



Data from The Pulse of the Bay 2019

Image from the European Space Agency
(Copernicus Sentinel-2 mission)

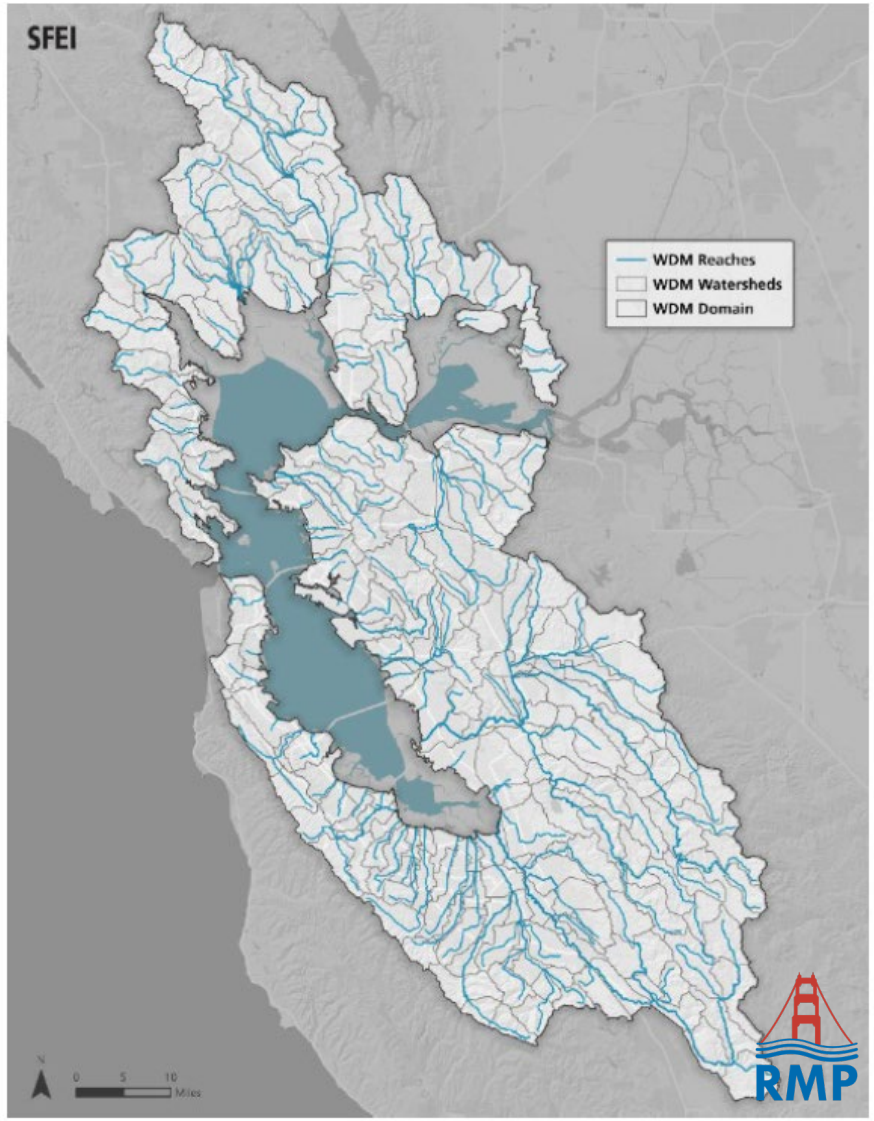
Why is sediment and mercury modeling important?

- Sediments create and maintain tidal marshes and mudflats
- Sediments transport nutrients and contaminants
- Mercury concentrations in Bay fish are above the threshold to protect human health (0.20 ppm wet weight)

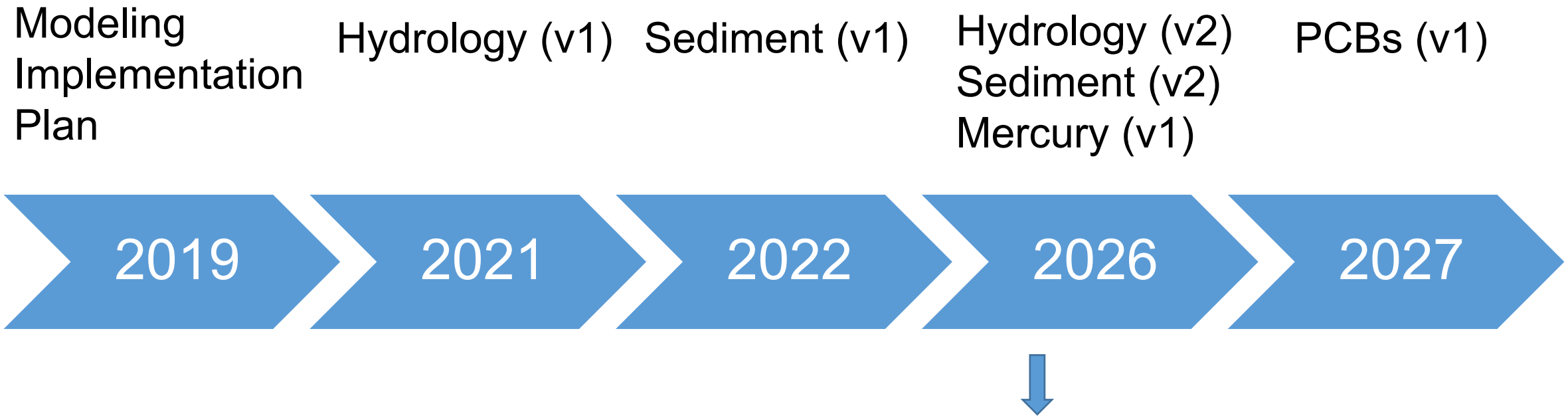


We do no have a crystal ball, but we can create models

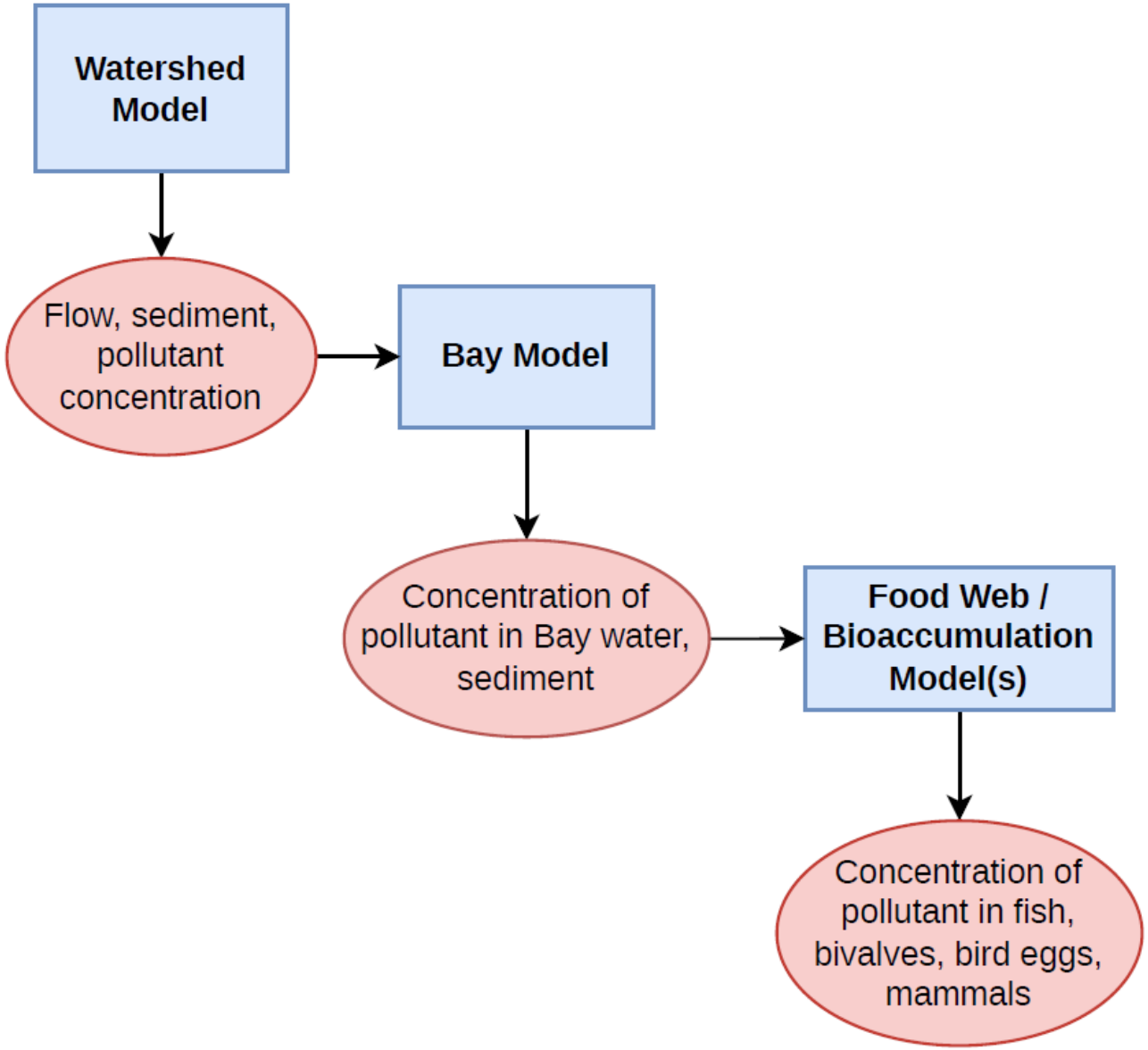
- Cost effective means to address many types of watershed monitoring program management questions
- Estimate concentrations and loads of mercury over a long time period
- “What if” questions. For example: What are the potential impacts of land use changes or green stormwater infrastructure?



Watershed Dynamic Model timeline



Our vision for an integrated suite of models

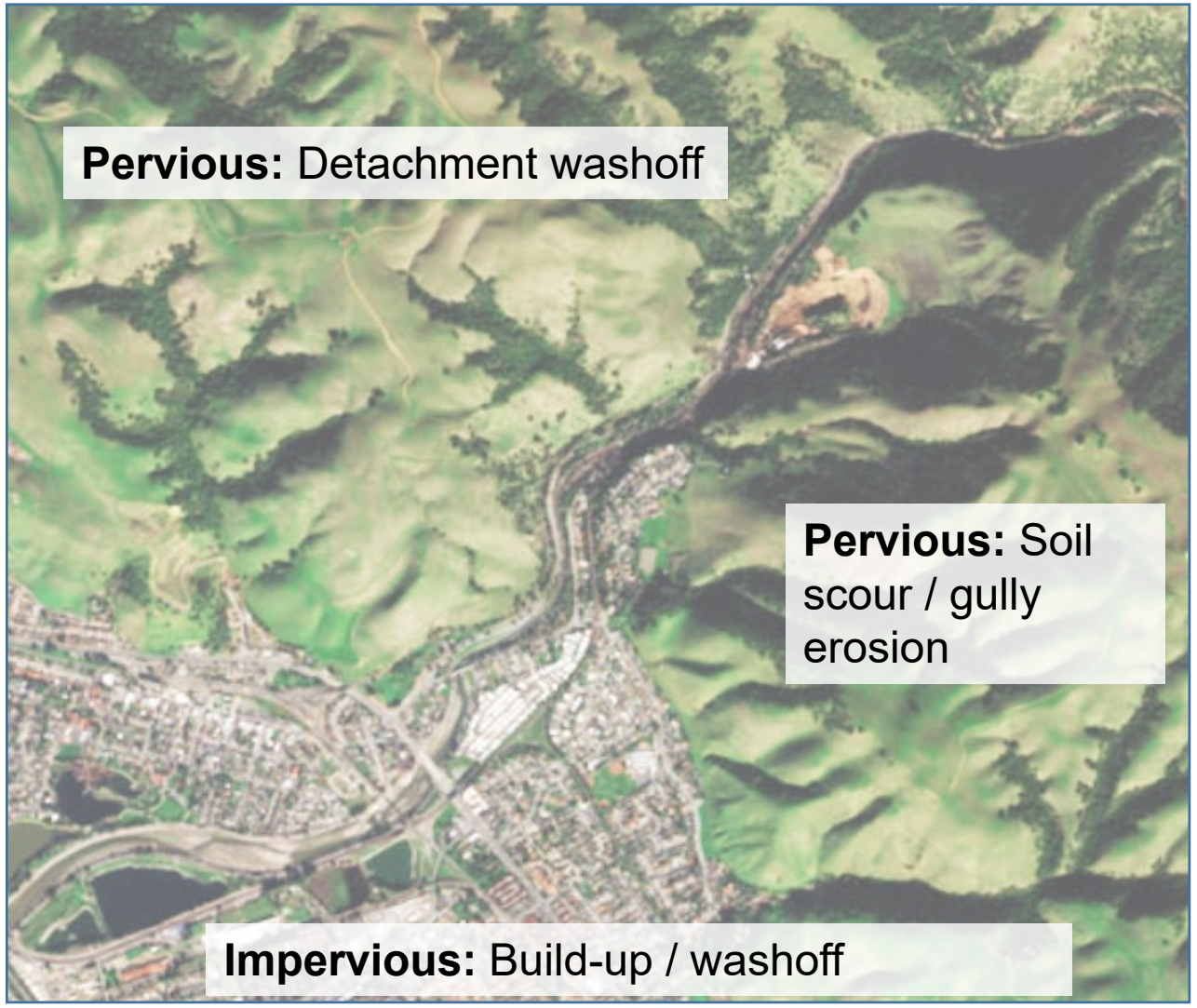


RMP

The Watershed Dynamic Model (WDM) applies traditional approaches for hydrology, sediment, and water quality simulation

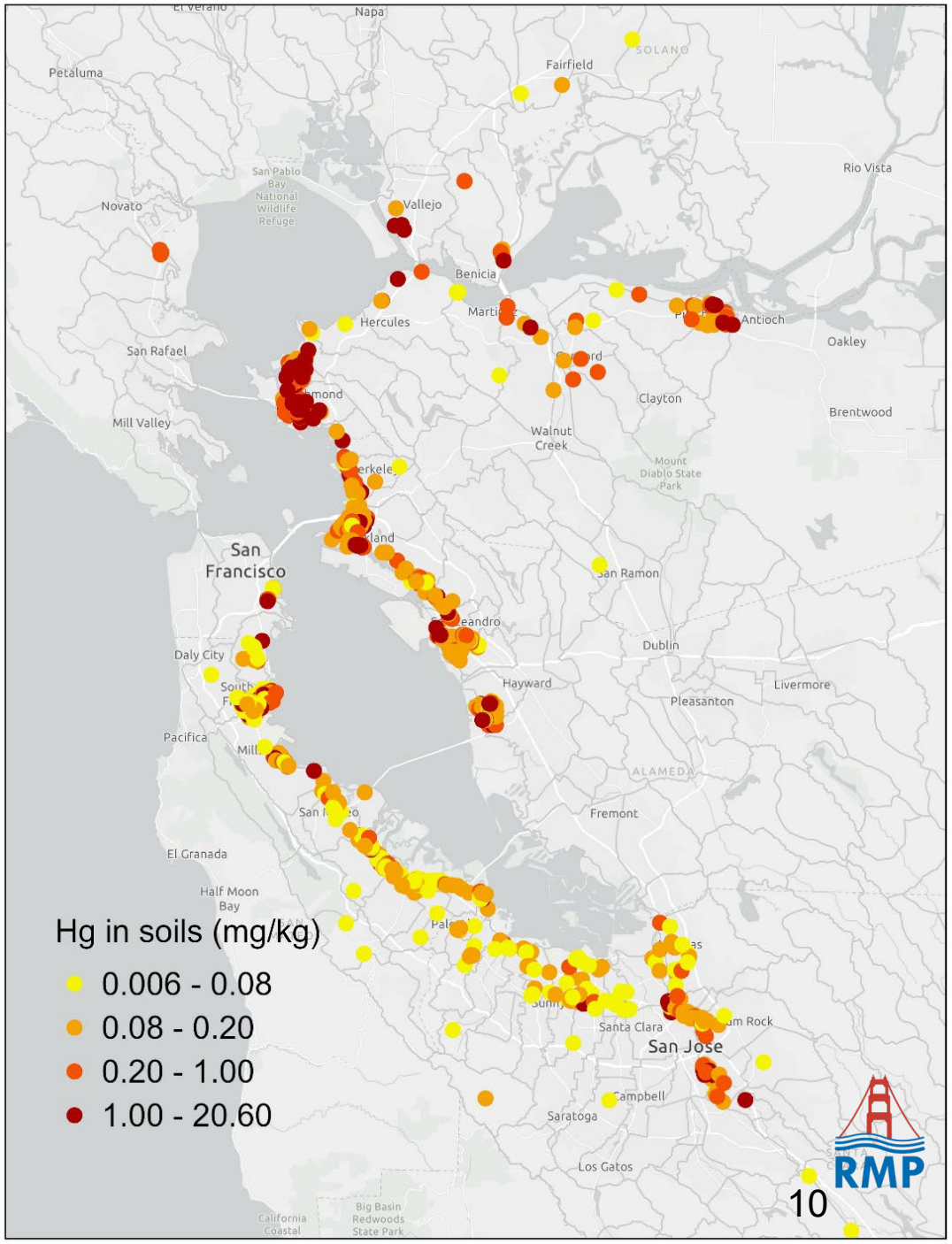
- The WDM is a regional model
- LSPC (Loading Simulation Program in C++) is the numerical engine
- Output on a daily time step
- 241 subbasins, 15 reservoirs

  Areas: 3.2 km^2 – 77 km^2

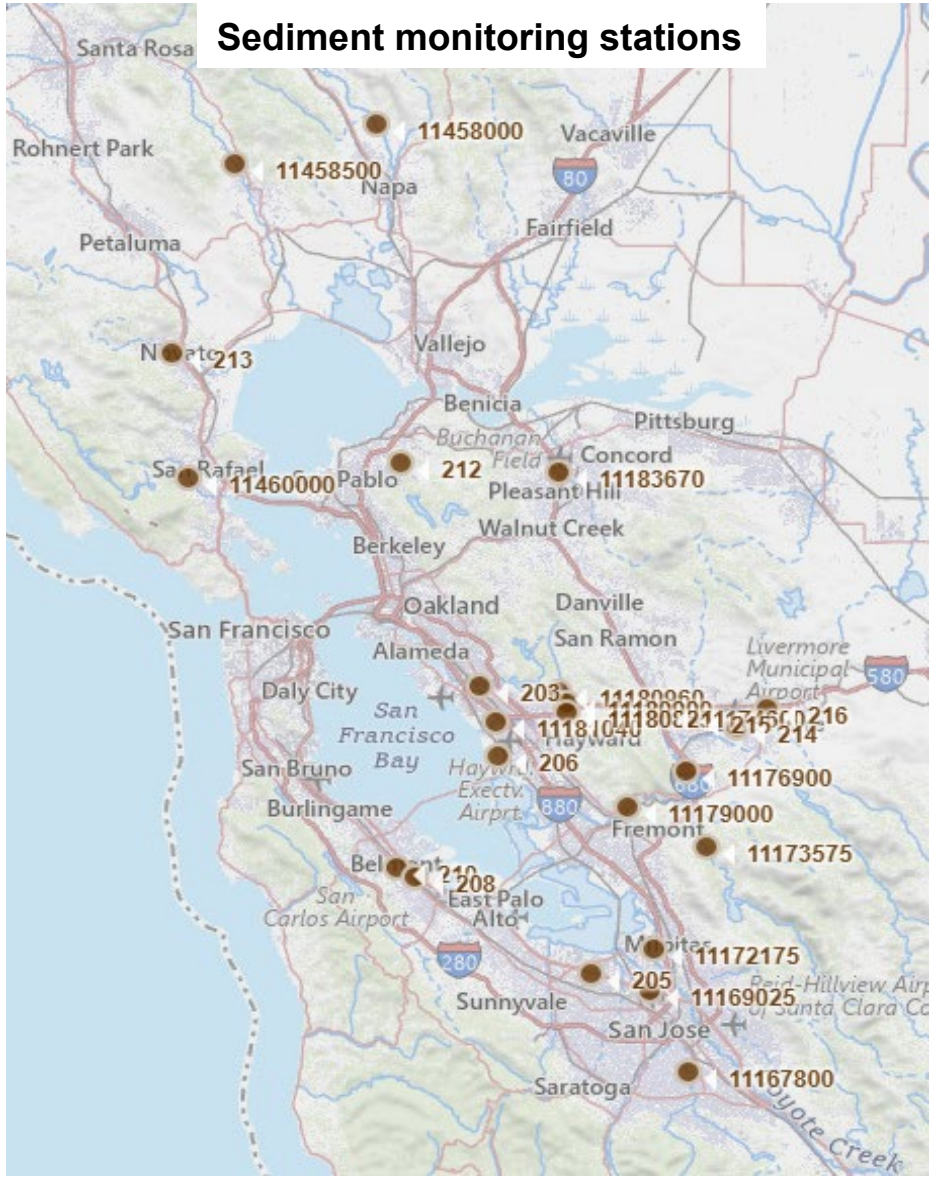


We have mined 24 years of monitoring data to set up our model

- The majority of data collected by different county stormwater agencies (mostly old industrial sites)
- Suspended sediment mercury concentration <u>target</u>: 0.2 mg mercury per kg dry sediment

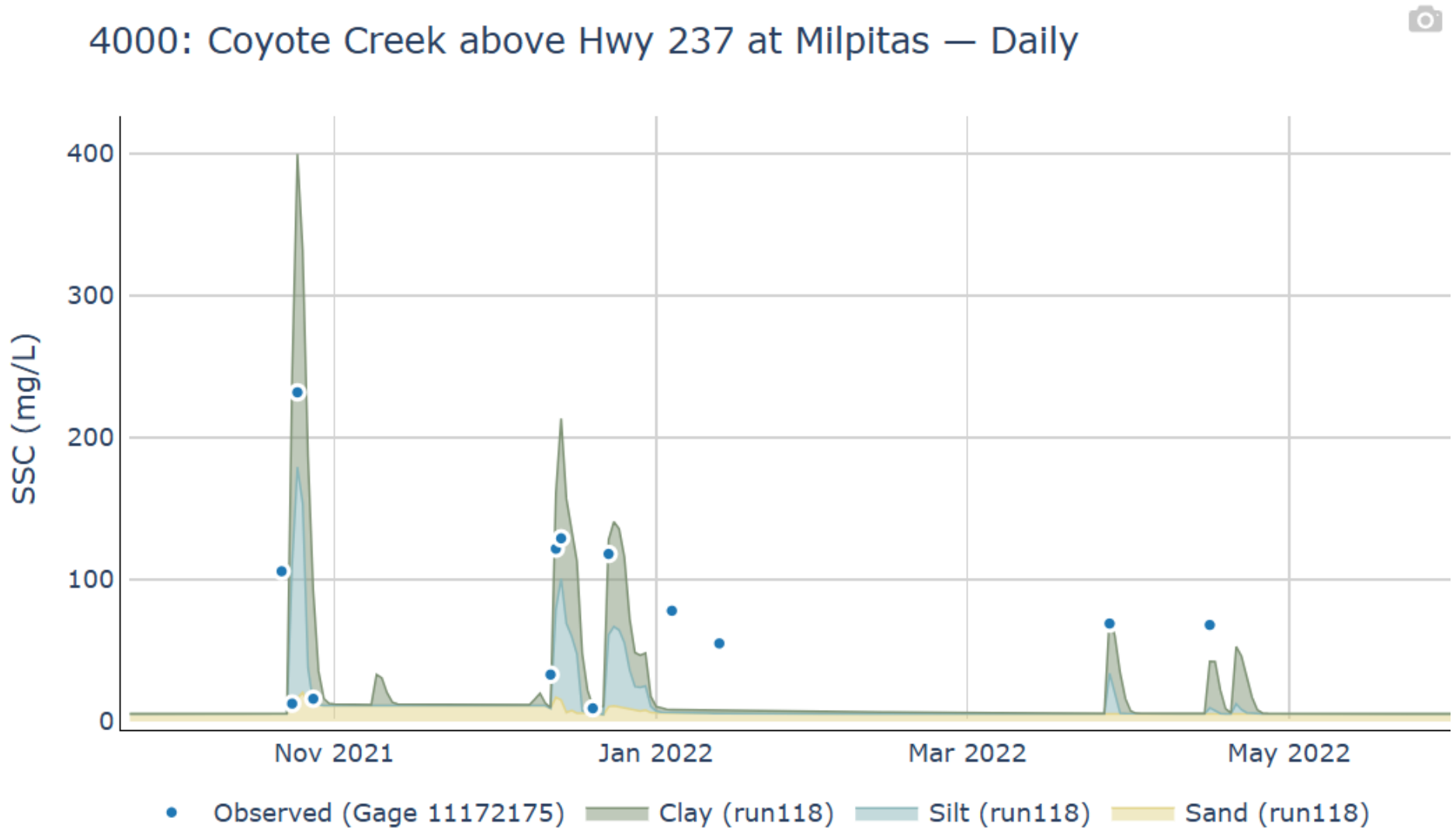


Dataset for sediment and mercury modeling





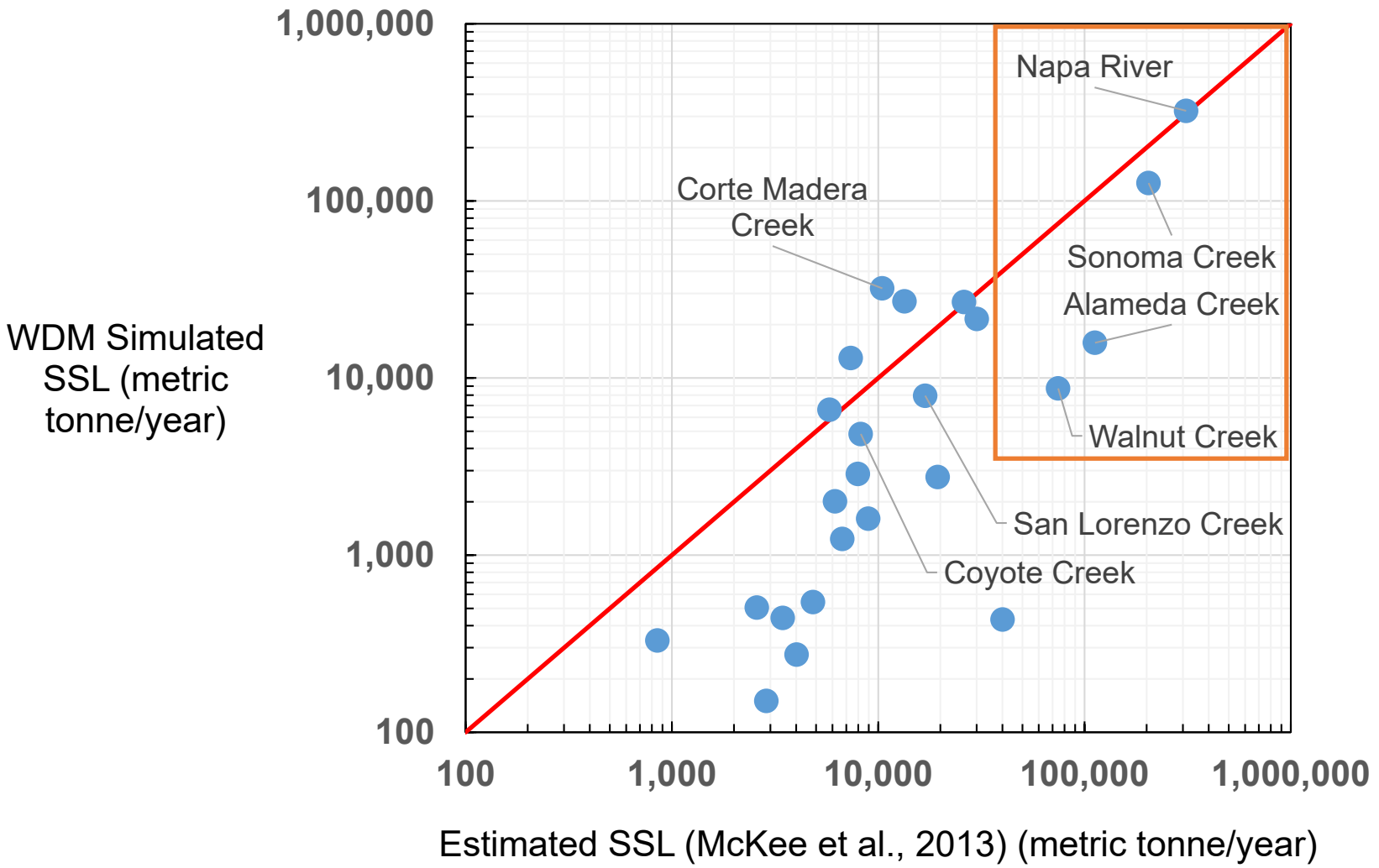
Use a weight-of-evidence approach to calibrate the model



SSC: suspended sediment concentrations

Preliminary sediment yields and loads are within the same order of magnitude than previous estimates (WY 1995 - WY 2010)

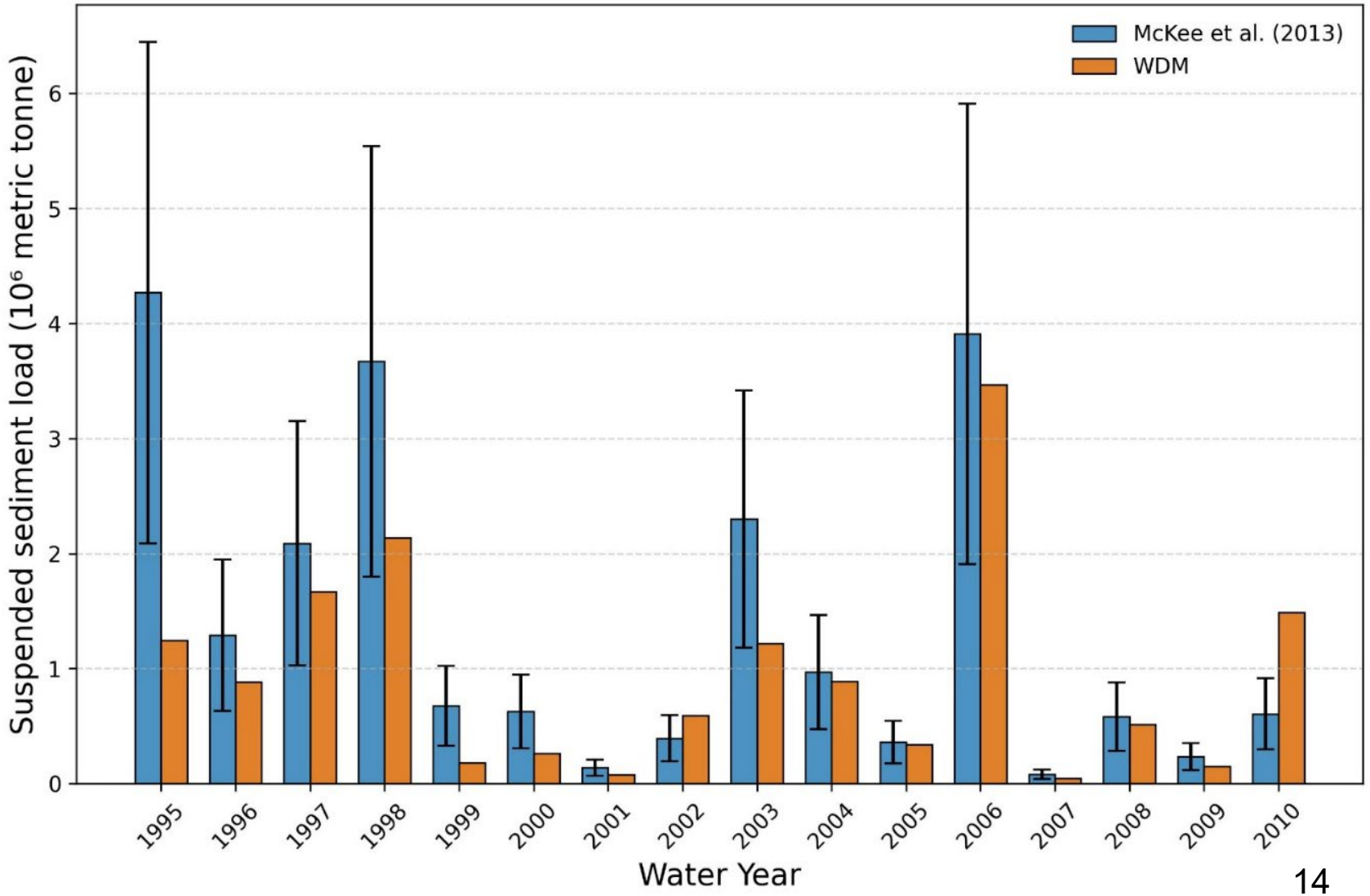
WDM results suggest 4 watersheds deliver 50% of the sediment load to the Bay, with a 22% to 64% range over the years.



SSL: suspended sediment load

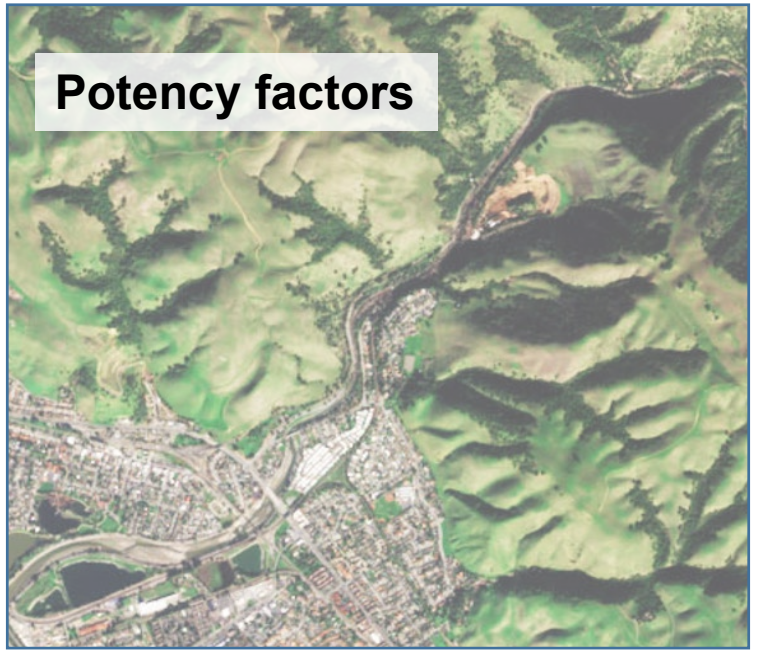
WDM estimates a total small-tributary annual mean suspended sediment load of 1.0 million metric tonne/yr (WY 1995 – WY 2010)

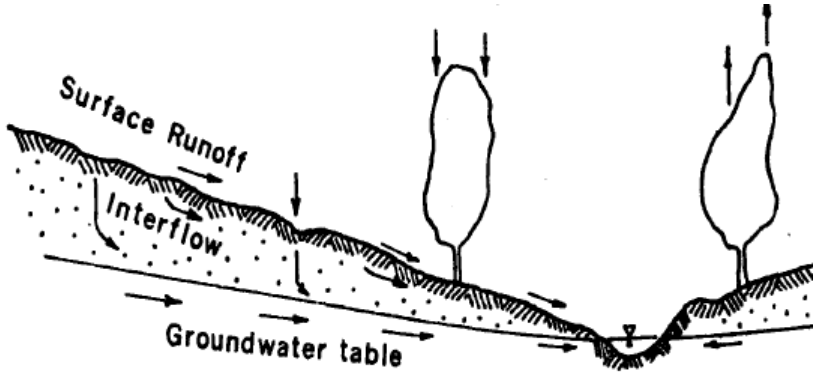
Previous estimate based on measurements: 1.4 ± 0.7 million metric tonne/yr (McKee et al., 2013)



Mercury model setup is deliberately parsimonious

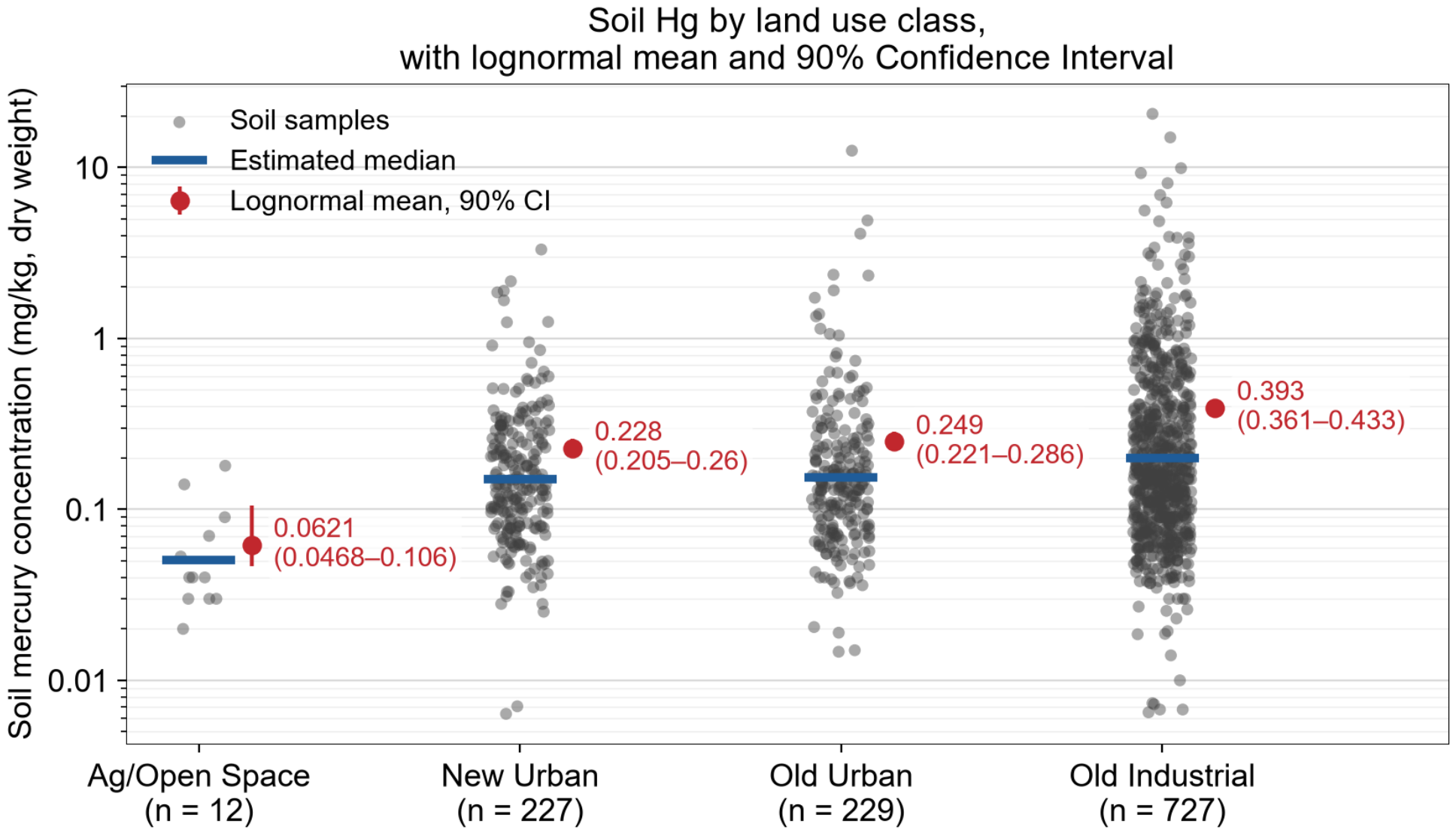
Hg is predominantly particle-bound and delivered with eroded sediment





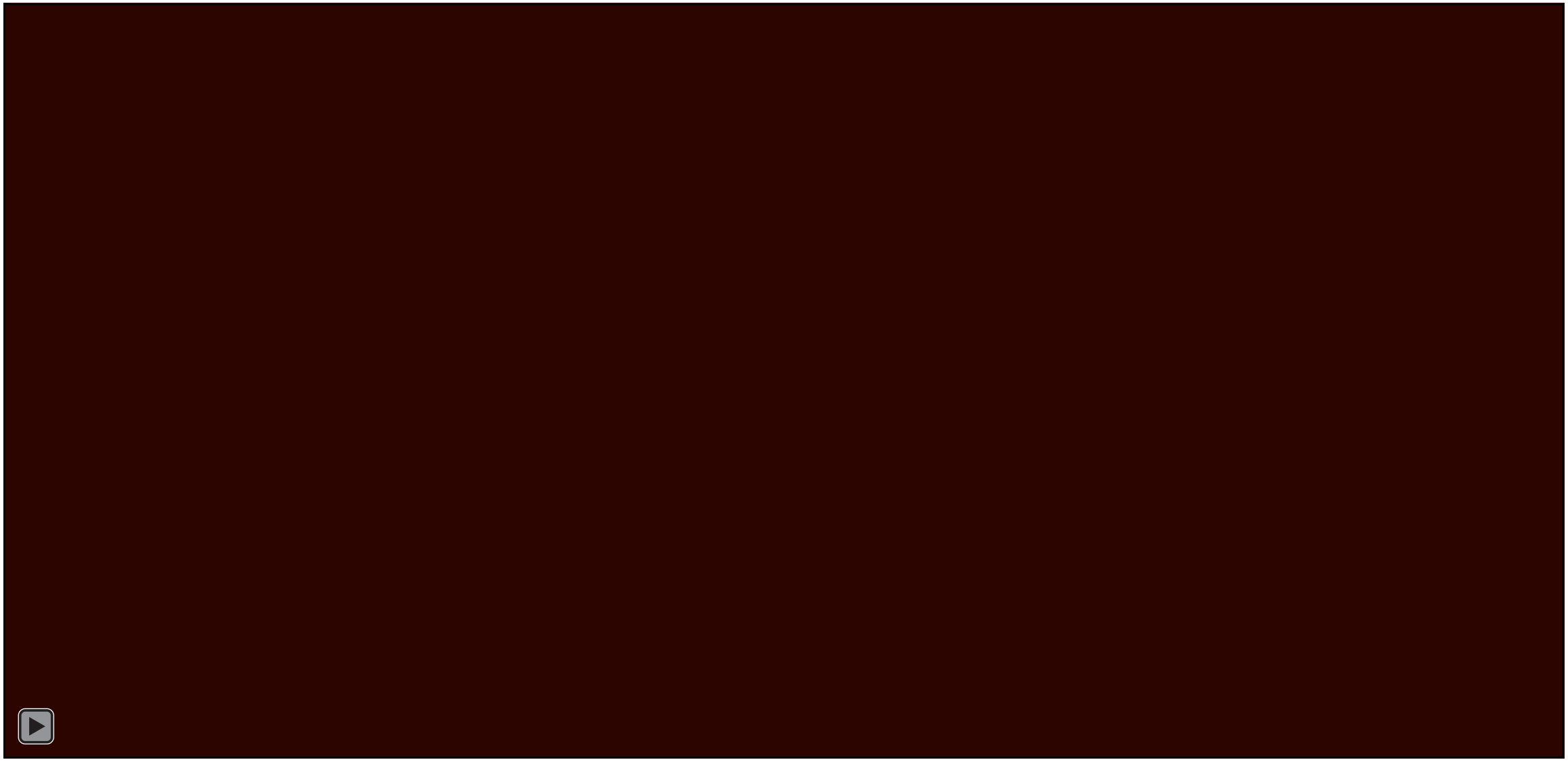
Bicknell et al. (1996)

A potency factor represents how much mass of mercury is associated with a mass of sediment

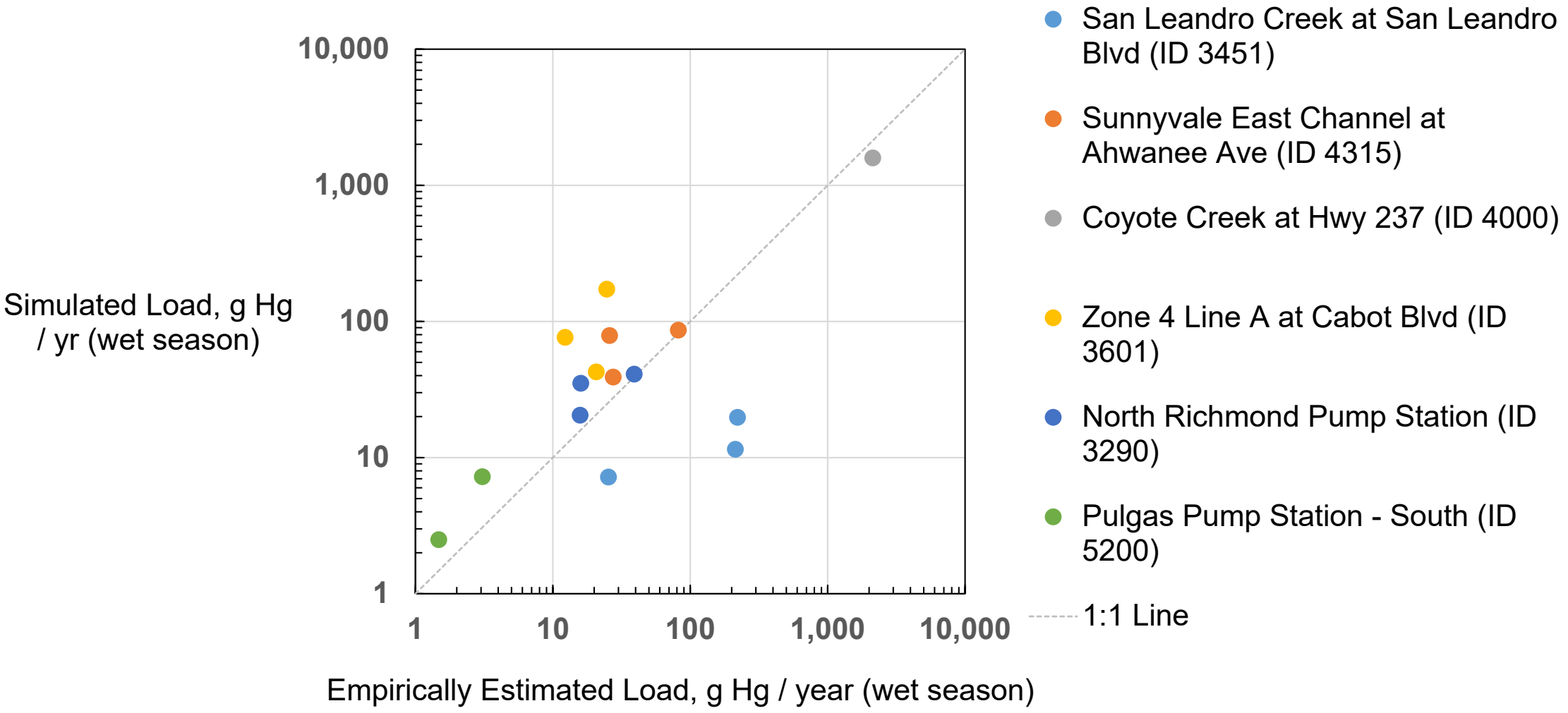


● Potency factor value

Visit our WDM website to visualize preliminary model output: https://wdm.sfei.org/



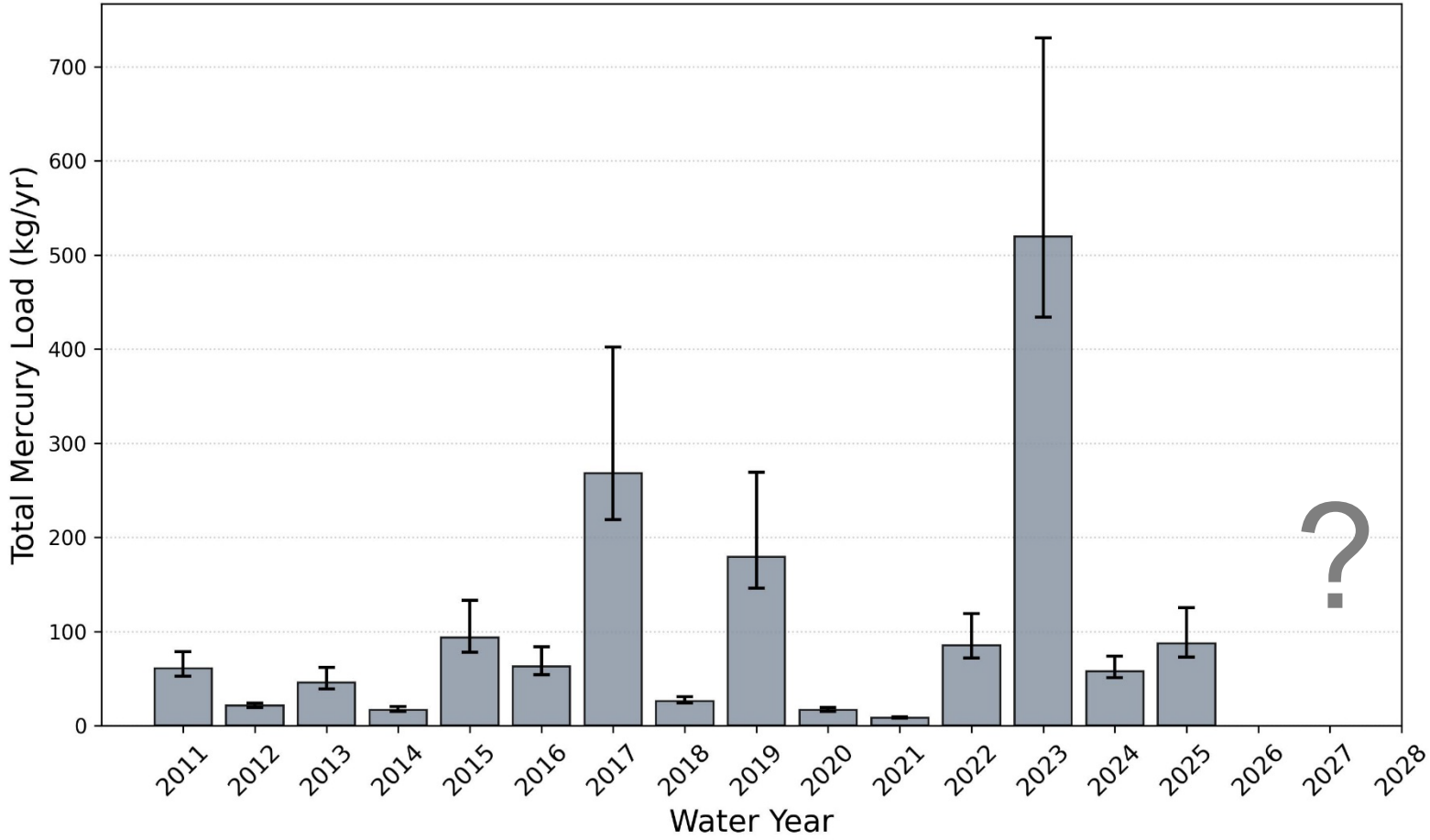
Observed and simulated mercury loads at 6 monitoring stations, 2005 – 2014 (wet season)



McKee et al. (2015), Gilbreath et al. (2015), Gilbreath et al. (2012)

Preliminary annual mean mercury load of 102 kg/yr (86 – 144 kg/yr) (WY 1994 – WY 2025)

- Previous estimate of long-term average Hg load: 110 kg/yr (McKee et al., 2016).
  Range: 80 kg/yr – 145 kg/yr
- WDM mercury results excludes mercury loads from the Guadalupe River
- Green stormwater infrastructure is not considered in the WDM



Watershed modeling applications

- Support mercury and PCBs TMDL updates
- Support CECs and MPs modeling needs
- Coupled watershed–Bay dynamic modeling: provide sediment loads as boundary condition of a refined in-Bay model
- Explore “what-if” watershed load reduction scenarios (e.g., land use change; redevelopment; planned GSI)

THANK YOU

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matth@sfei.org

https://wdm.sfei.org/