

Solano Historian, 1991

# Abandoned Mine Program & Mercury Mine Investigation and Cleanup Strategy Status Report

December 12, 2018  
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# Talk Outline

- Why we care
- Status of abandoned mines
- Desktop analysis and prioritization
- Inspections
- Innovative approaches



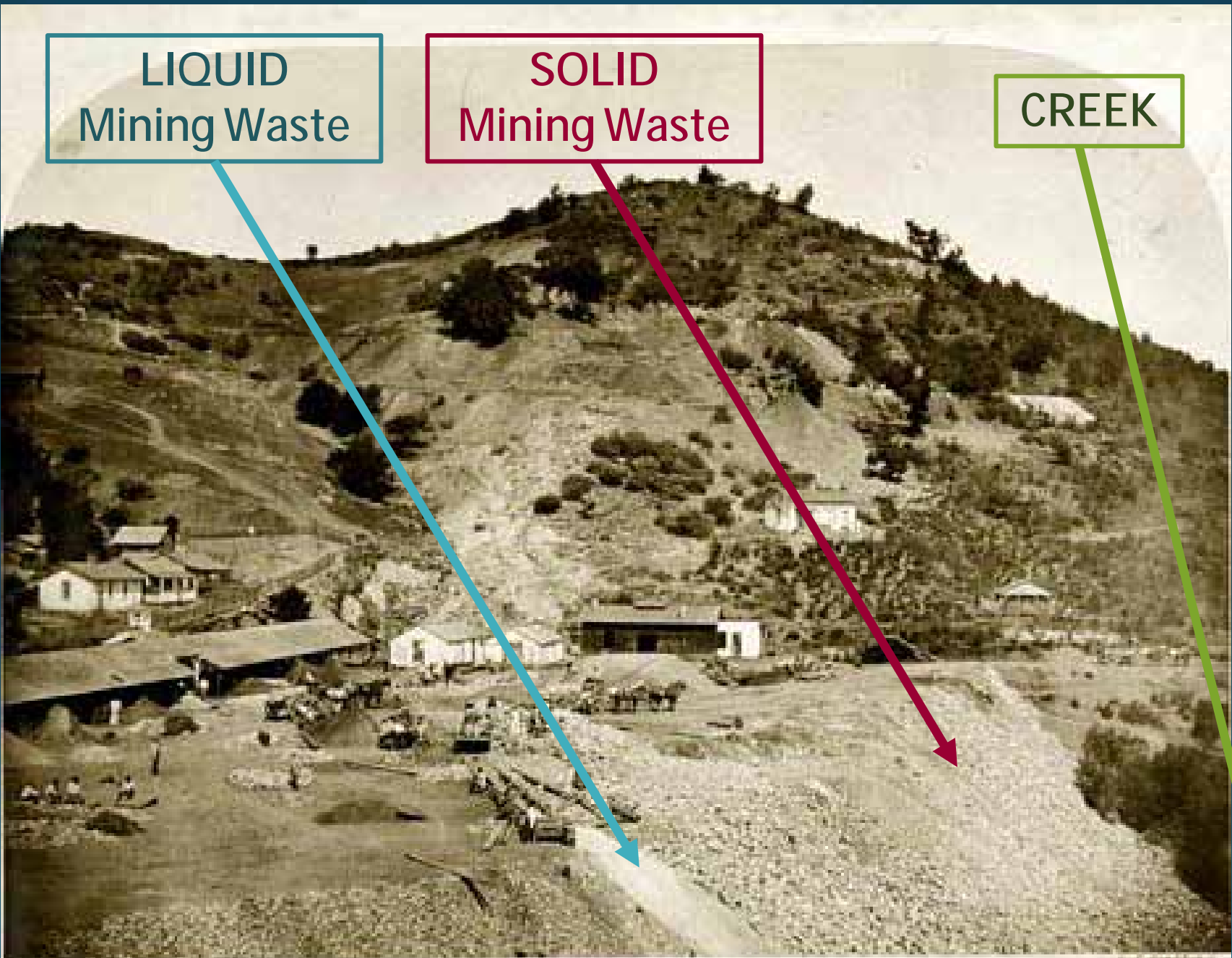
# Why we care Mines



LIQUID  
Mining Waste

SOLID  
Mining Waste

CREEK

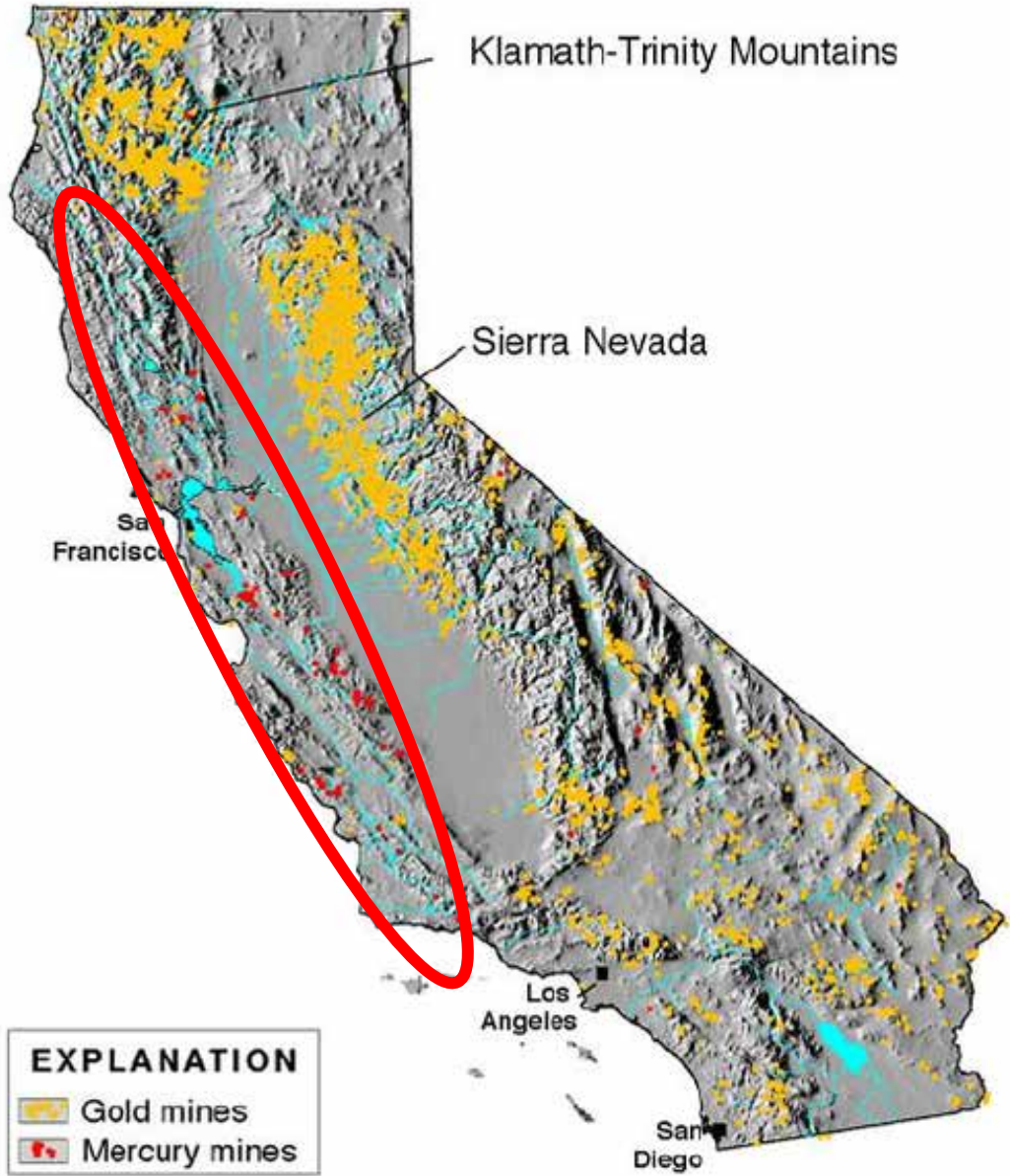


New Almaden Quicksilver Mine, 1863 (Oakland Public Library)



# California Mines

California  
Department of  
Conservation,  
Division of Mine  
Reclamation



# California Gold & Mercury Mines

US Geological Survey (Alpers 2005)





# Hydraulic gold mining

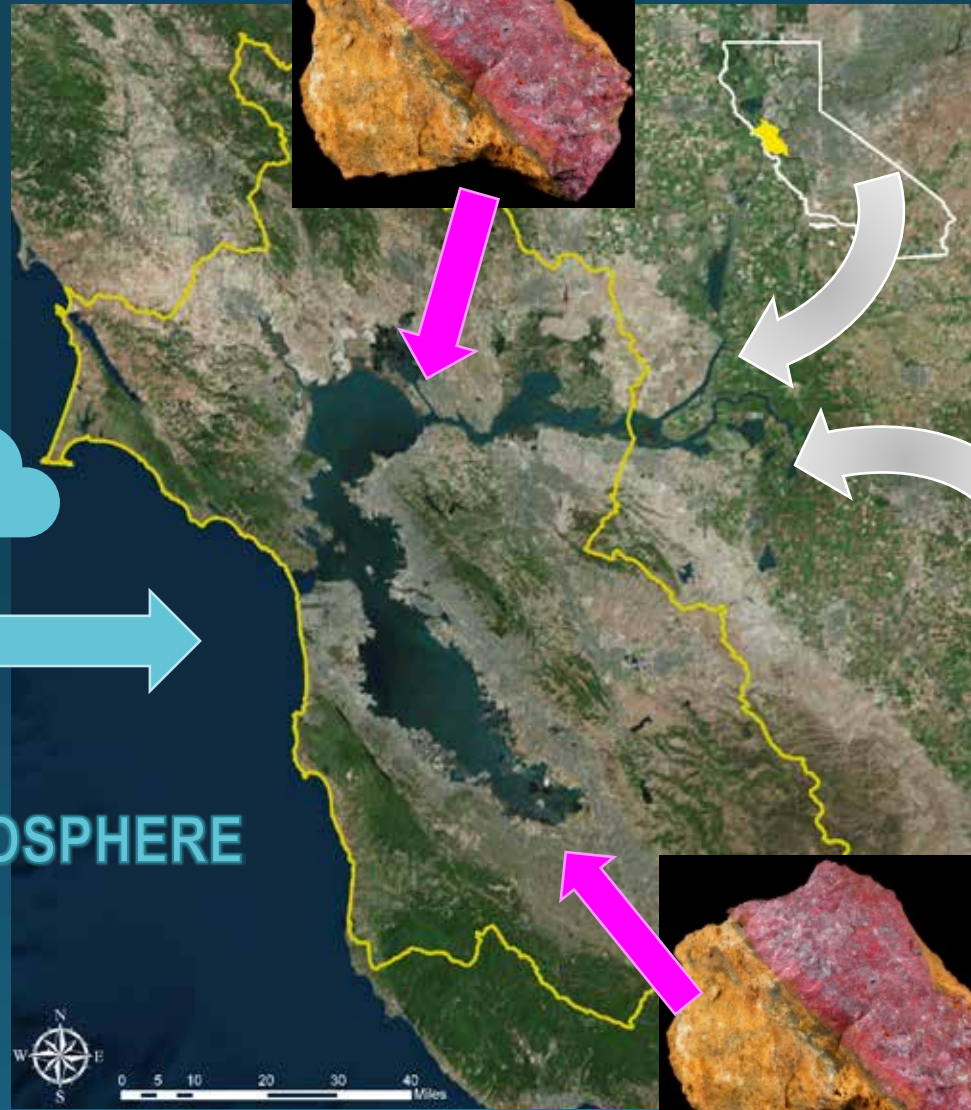
Denver Public Library

Carlton Watkins

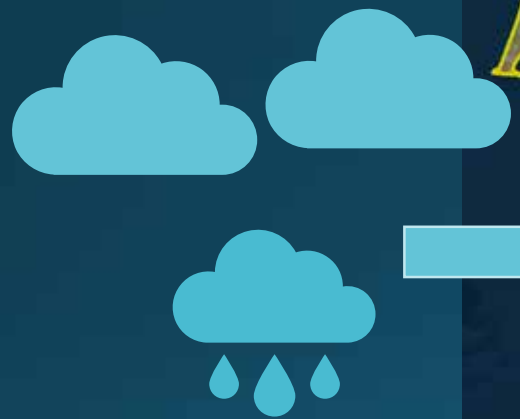
Mix with liquid mercury in sluice box  
(~30% loss USGS)



# Mercury from all directions



Mercury from GOLD mining

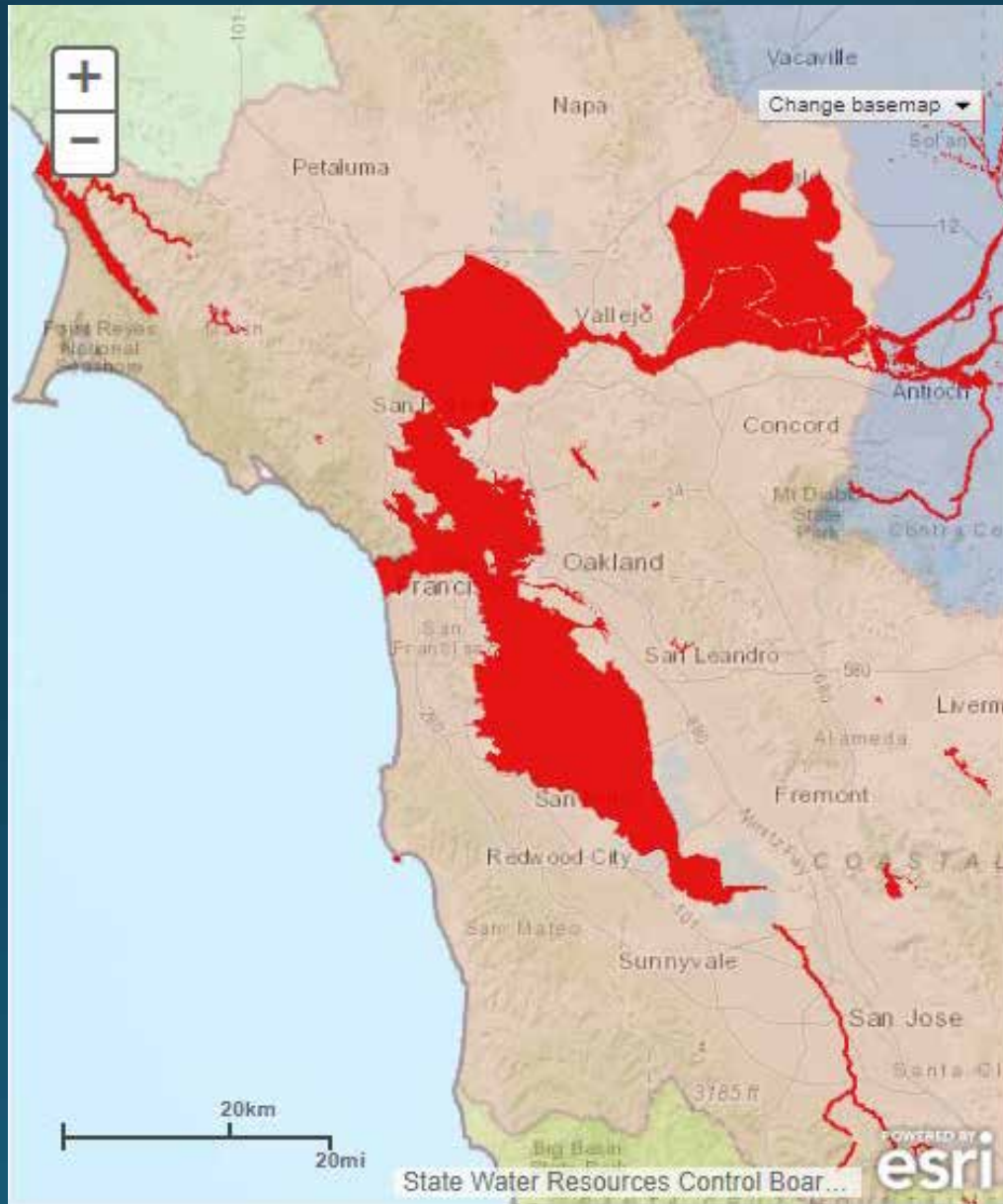


Mercury from ATMOSPHERE

Mercury from CINNABAR mining



# Mercury impaired water bodies



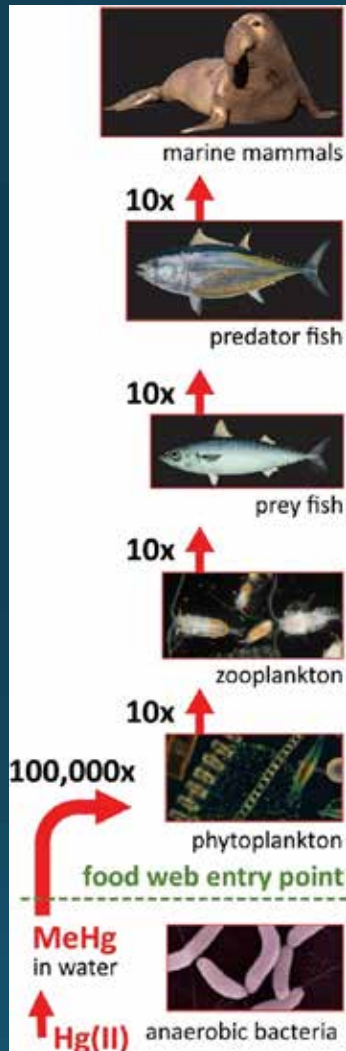


# Why we care

# Mercury

# Methylmercury biomagnifies up the food web

... and is a neurotoxin



## FISH SMART in San Francisco Bay

Harmful chemicals like mercury and PCBs are in some fish in San Francisco Bay. **Women 18 - 45 years old and children should *only* eat the fish with less chemicals in them.**

有害化学物质诸如汞，多氯联苯等存在于三藩市海的某些鱼体内。妇女18-45岁和儿童应当只吃化学物质含量少的鱼。

Algunos tipos de pescado de la Bahía de San Francisco contienen químicos dañinos como mercurio y PCBs. **Las mujeres de 18 a 45 años y los niños solo deben comer el pescado que contiene menos químicos.**

Learn more: [www.sfbayfish.org](http://www.sfbayfish.org) - (510) 622-3170

EAT THIS Less Chemicals	NOT THIS More Chemicals
Jacksmelt Brown rockfish Red rock crab California halibut Chinook (king) salmon	Striped Bass Surperches Sharks White croaker White sturgeon

Cossaboon et.al., 2015

# Climate Change Impact

US Forest Service



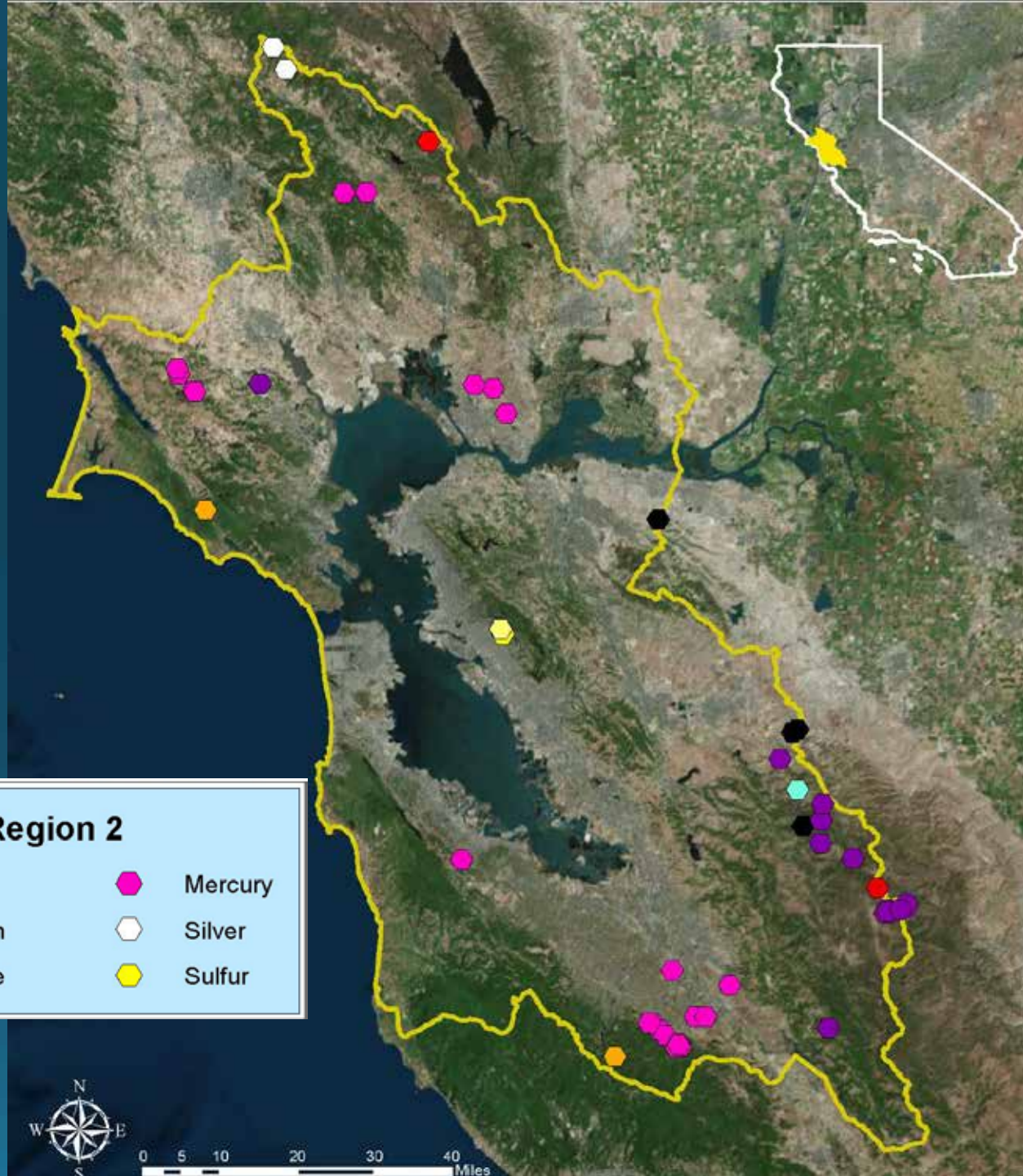
↑ Wildfires = ↑ Erosion of mining waste



Region 2 abandoned mine

Status

# Our Mines



## Abandoned Mines in Region 2

### Commodity

Chromium

Coal



Copper



Magnesium



Manganese



Mercury



Silver



Sulfur

# Remediated by Water Board and others



# Under Investigation by Water Board

Undergoing  
Water Board  
Cleanup

## Abandoned Mines in Region 2

### Commodity

Chromium

Coal



Copper



Magnesium



Manganese



Mercury



Silver



Sulfur













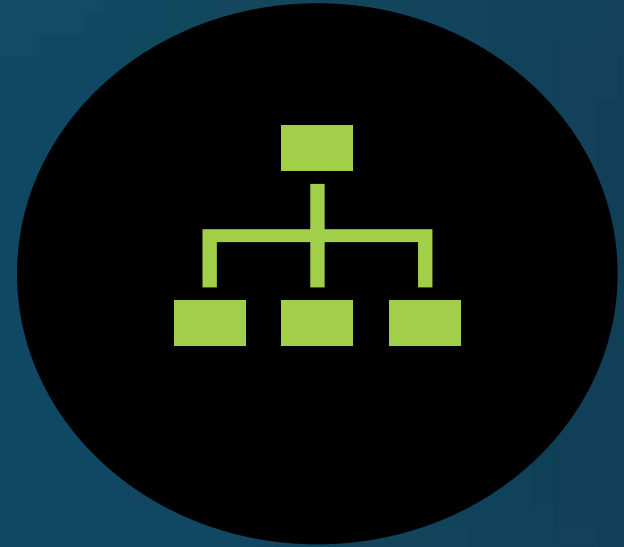
# Unaddressed Mines (2016)



## Abandoned Mines in Region 2

### Commodity

- |  |          |   |           |   |         |
|--|----------|---|-----------|---|---------|
|  | Chromium |  | Copper    |  | Mercury |
|  | Coal     |  | Magnesium |  | Silver  |
|  |          |  | Manganese |  | Sulfur  |



Region 2 abandoned mine

# 2016-17 Prioritization



# Desktop analysis and prioritization

- Evaluate available mine, hydrology, imagery data
  - § Reports
  - § GIS
  - § Google Earth satellite
- Score mines based on 12 weighted factors, including
  - § Mobile, toxic metal(loids)
  - § Mining waste, volume, mobility
  - § Connectivity to receiving waters, impairment
- Rank mines by score

# Prioritize by Risk

Ranked by water quality threat

Low

Medium

High



## Abandoned Mines in Region 2

### Commodity

- Chromium
- Coal

Copper

Magnesium

Manganese

Mercury

Silver

Sulfur

Ranked by  
water quality threat

Low

Medium

High





# Region 2 abandoned mine Inspections

# Inspections (screening investigations)

## ○ Visual Observations

### § Mine features

- Openings (adit, shafts...)
- Structures
- Waste - unnatural topo, soil characteristics, color, odor

### § Contaminant mobility

- Erosion and erodability
- Mine drainage, ARD

## ○ Measurements

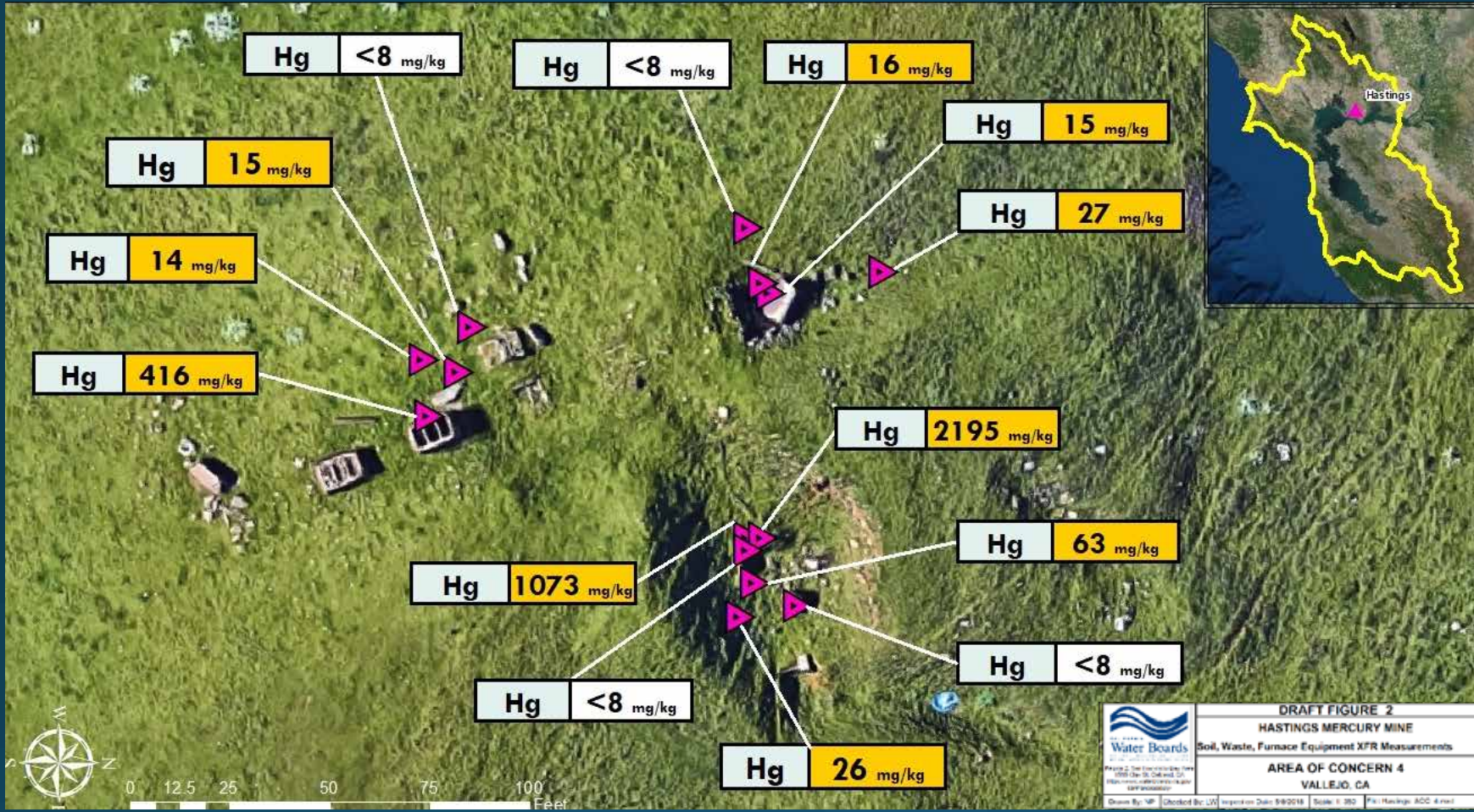
### § Distance/grade to water features

### § Solids

- Metal(loid)s via X-Ray Fluorescence Spec.

### § Liquids (mine drainage, creeks, seeps...)

- pH
- EC
- Potential contaminants



# Hastings Mercury Mine Inspection with XRF

above human health or ecotox water quality criteria

- Mining waste piles
- Ore processing area with contaminated soils and structures
- All located on slope above springs (groundwater seepage from slope)
- Drains to impaired water bodies



# Hastings mine and receiving waters... (by drone)





Region 2 abandoned mine

# Innovative Approaches

# X-Ray Fluorescence Spectrometer (XRF)



SCREEN  
Hg IN SITU



QUICK &  
CHEAP



BETTER  
CHARACTERIZATION





# Guadalupe Mercury Mine Potential Cleanup Strategy



Target erodible Hg first





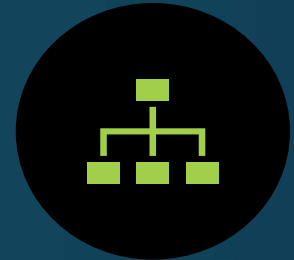


Aquaenviro.co.uk

# Selective Sequential Extraction (SSE)



ID MOBILE,  
TOXIC Hg



PRIORITIZE  
CLEANUP



TARGET  
Hg POSES RISK



# What's next?

- One more high priority mine to inspect
  - § Need dry conditions
- Prioritize for cleanup
  - § Factors associated with impacts
- Consider interim remedial actions for egregious discharges
- Take advantage of current efforts/funds...



# St. John's Mercury Mine



St. John's Mine Near Vallejo

Vallejo Naval and Historical Museum

Solano Historian, 1991



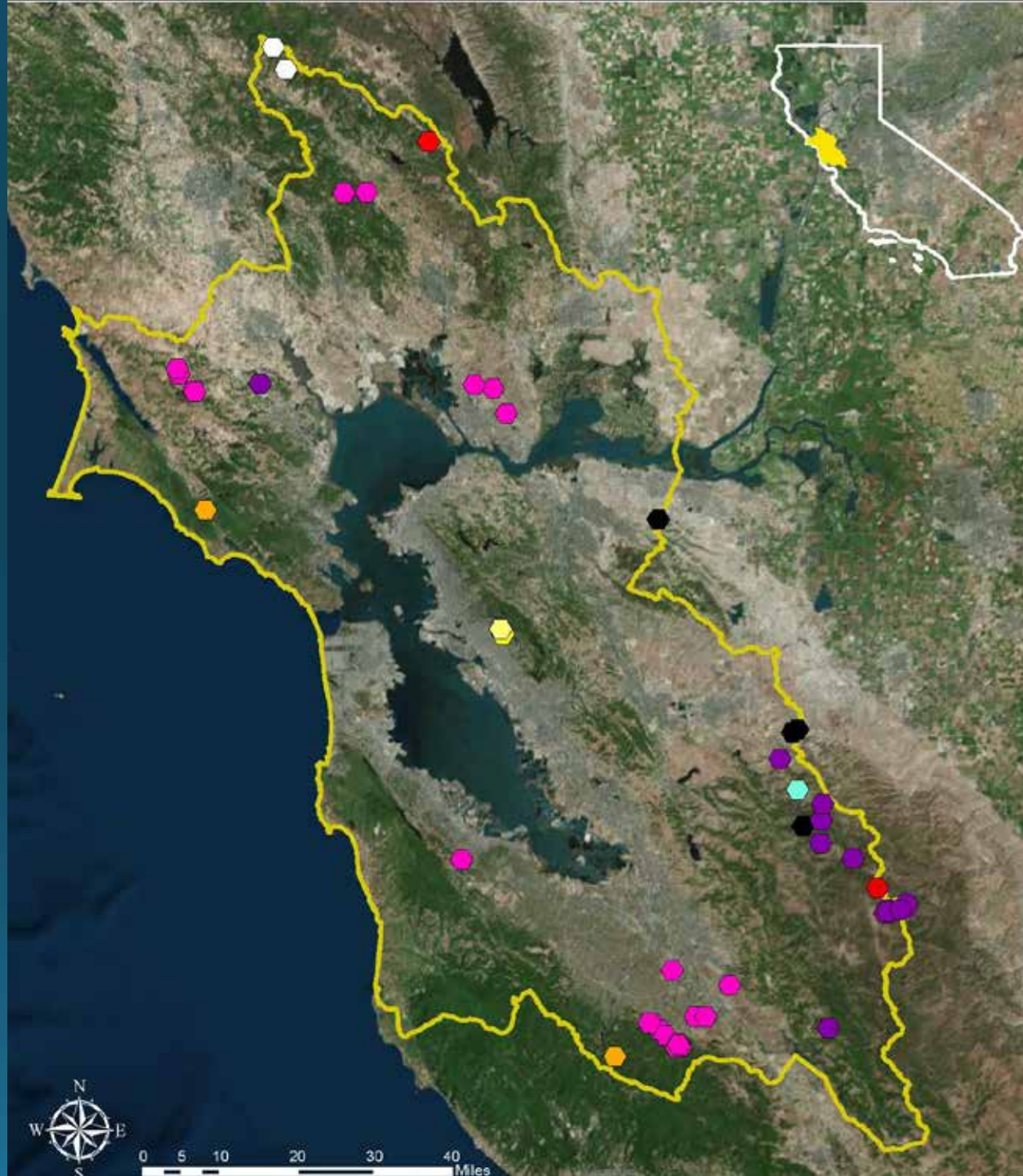


# St. John's Mercury Mine Potential Brownfield Investigation

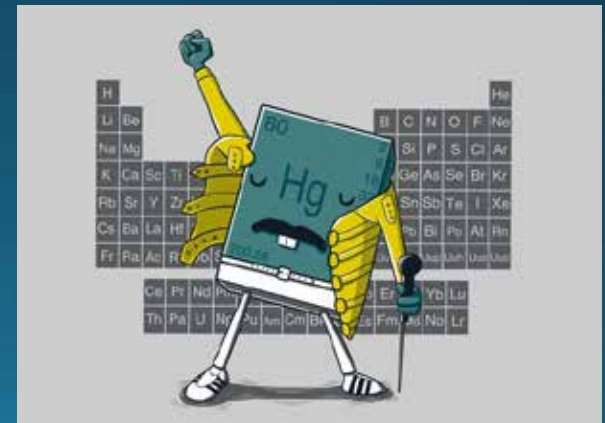


# Wrap up

- 11 remediated
  - 10 undergoing investigation or cleanup
  - 20 case closed
  - 7 prioritized
- § Strategy to address worst 1<sup>st</sup> using new tools and methods



Thanks!



"Freddie Mercury" by Pablo Bustos

*Scientific Aides*

Nicholas Piucci

Sarah Acker