Region 2 Water Board Mines Cleanup Program

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SAN FRANCISCO BAY WATER BOARD

CA ABANDONED MINE LANDS AGENCY GROUP MEETING,

JANUARY 24, 2018

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https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/MinesCleanupProgram.html

Talk Outline

- Region 2 mines
- Prioritization strategy & desktop analysis tool
- Tool implementation (inspection prioritization results)
- Inspection/data collection strategy
  - Data Quality Objectives, XRF Standard Operating Procedures
- Initial inspection results
- Next steps & regulatory tools

Inactive Mines in Region 2

(WATER CODE DEFINES "ABANDONED MINE" AS NO RP)

Inactive Mines in Region 2

Completed Mine Cleanups
(By WB & Others)

- Gambonini (Marin) - **mercury**
- La Joya (Napa) - **mercury**
- New Almaden (Santa Clara) - **mercury**

  Mine Hill, Senator, Jaques Gulch, Hicks Flat, San Mateo, Enriquita, San Francisco Open Cut, and portions of Alamitos Creek and Deep Gulch
- Challenge/Stulsaft (San Mateo) - **mercury**
- Leona (Alameda) – **sulfur**
- Black Diamond (Contra Costa) – **coal**

Leona Heights Sulfur Mine: Before

Leona Heights Sulfur Mine: After Cleanup

https://www.waterboards.ca.gov/sanfranciscobay/water_issues/hot_topics/Leona.shtml

Current Investigations/Remedial Efforts

- Guadalupe (Santa Clara) - **mercury**
- Hillsdale (Santa Clara) – **mercury**
- New Almaden (Santa Clara) - **mercury**

  Randol, Hacienda Furnace Yard, Santa Mariana, Valesco, Harry, Central Stope, Cora Blanca
- April, Cristobal, San Francisco, Enriquita, Santa Teresa, and Bernal (Santa Clara) - **mercury**
- Cycle and Franciscan (Marin) - **mercury**

Hillsdale Mercury Mine
(GeoTracker T10000007018)

Unaddressed Mines

- 6 mercury mines
- 1 sulfur mine
- 3 coal mines
- 1 chromium mine district
- 2 copper mines
- 2 silver mines
- 13 manganese mine districts
- 2 magnesium mines

Prioritization Strategy

GOALS AND OBJECTIVES

Prioritization Goals

Maximize efficient use of available resources to identify and rank mines that impact water quality

Project phases:

I. **Desktop analysis to prioritize for inspection**

II. **High priority mine inspection, site screening data collection**

   I. **Interim remedy implementation**

III. **Prioritize for regulatory action**

IV. Regulatory action

   i. Investigation

   ii. Remediation

   iii. Efficacy Verification & Maintenance

V. Medium priority mine inspection, eval unknowns (see USGS MRDS)

Prioritization Objectives

Key questions for all phases of prioritization:

- Is the site contaminated?
  - Solid mining wastes

    Tailings/**C**alcines **O**verburden **L**ow Grade Ore **E**xposed Vein **F**all out…

  - Liquid mining wastes

    ARD **S**eeps **A**dit Drainage **L**eachate…

  - Other sources (processing chemicals, equipment chemicals…)
- Is the contamination mobile?
  - Erodible, eroding solids; liquids discharging offsite
- Is the site impacting water quality (hydrologically connected)?

Prioritization Strategy

DESKTOP ANALYSIS - DATA COLLECTION

Inspections Are Resource Intensive

Estimate Impacts from Desktop Using…

Google Earth

GIS

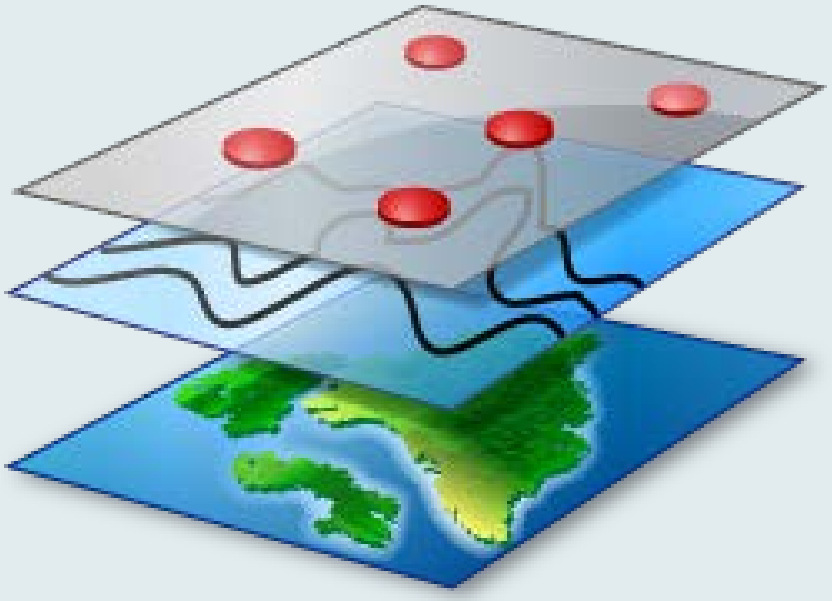


Image from Icons-Land

Mines Summary Database (MSD)

Collate and summarize available data, highlight factors relevant to potential impacts, score and rank mines for inspection.

Category	***Column Type***	***Purpose***
MINE	Data	Site identification data for ease of scrolling through large excel database.
STATUS	Results	Status summary information for use in documents and GIS Layer.
LOCATION	Data	Location data for virtual and literal inspections.
PRIORITIZATION SCORES	Results	Prioritization ranking scores, summarize relevant data columns.
MINE CHARACTERISTICS	Data	Summarize relevant information from data sources columns.
HYDROLOGY/GEOMORPHOLOGY/WATERSHED CHARACTERISTICS	Data	Summarize relevant information from data sources columns.
ADMIN	Data	Administrative information, including ownership and access information.
DATA SOURCES	Data Sources	Summarize information obtained from each existing and new source of data reviewed.

Data Sources in MSD

Table 2. DATA SOURCES Mine Characteristics	Hydrologic Connectivity
GIS Database: USGS MRDS	GIS Database: USGS topo maps
GIS Database: USGS Prospects and Mine-Related Features	GIS Database: USGS NHD (med & high resolution)
GIS Database: DOC PAMP	Google Earth and ArcGIS ruler and grade tools
Minedat.org, Westernmininghistory.com	
Historical images (Google Earth and NMMR)	
* XRF metal/metalloid concentration data of mining waste, soils, sediments	
* Inspection findings	
Previous inspection/er reports, notes, input	
Google Earth and ArcGIS satellite images	
Chemical Impairment Status - GIS Database: EPA MyWaters (303d, TMDLs)	
GIS Database: OEHHA Fish Advisories	
GeoTracker and Envirostor	

* Collected during inspection, thus only used to prioritize regulatory action.
GIS – Geographical Information System (https://www.nationalgeographic.org/encyclopedia/geographic-information-system-gis/)
MRDS – Mines Resources Data System
DOC PAMP – California Department of Conservation Abandoned Mine Lands Unit Principle Areas of Mine Pollution
NMMR – National Mine Map Repository
NHD – National Hydrography Dataset

Prioritization Factors

- Site specific data on prioritization factors
  - How to identify potential water quality impacts?
    - Mine characteristics
    - Hydrologic/geomorphic characteristics

* There must also be sufficient data available for all mines, to avoid skewing the results.

Mine Characteristic Factors

Data Type	Applicability
Mineralogy (commodity and gangue)	Indicates potential COCs and ARD
Mine productivity	More productive mines may contain more contamination
Mine size	Larger mines may contain more contamination
Mining waste at surface (known /suspected from aerials)	Wastes at the surface may be more mobile
Volume of mining waste (known/suspected from aerials)	If mining waste is contaminated, the larger the volume the greater the threat
Mining waste mobility, e.g., evidence of erosion or drainage (known/suspected from aerials)	Increases probability of offsite discharge
Evidence ore processed on site	- Processed ore (tailings) can contain more environmentally available contaminants, and - Ore processing was generally inefficient, leading to contamination of native soils.

Mine Characteristic Factors (cont.)

Data Type	Applicability
Mining Equipment remains on site (known/suspected from aerials)	- Evidence Ore processed on site - Can be a continuing source of contamination (and can inform targeted sampling)
WB files/reports	Indicates previous inspectors determinations and recommendations regarding water quality threat
*** XRF data of mining waste, soil, sediment**	Indicates metal/metalloid contamination
*** pH data**	
*** Inspection of geotechnical characteristics of mining waste and/or contaminated soils/sediments and for evidence of leaching or ARD.**	Indicated offsite discharge

*** Collected during inspection, thus only used in second phase of analysis to inform regulatory action.**

Hydrologic Connectivity Factors

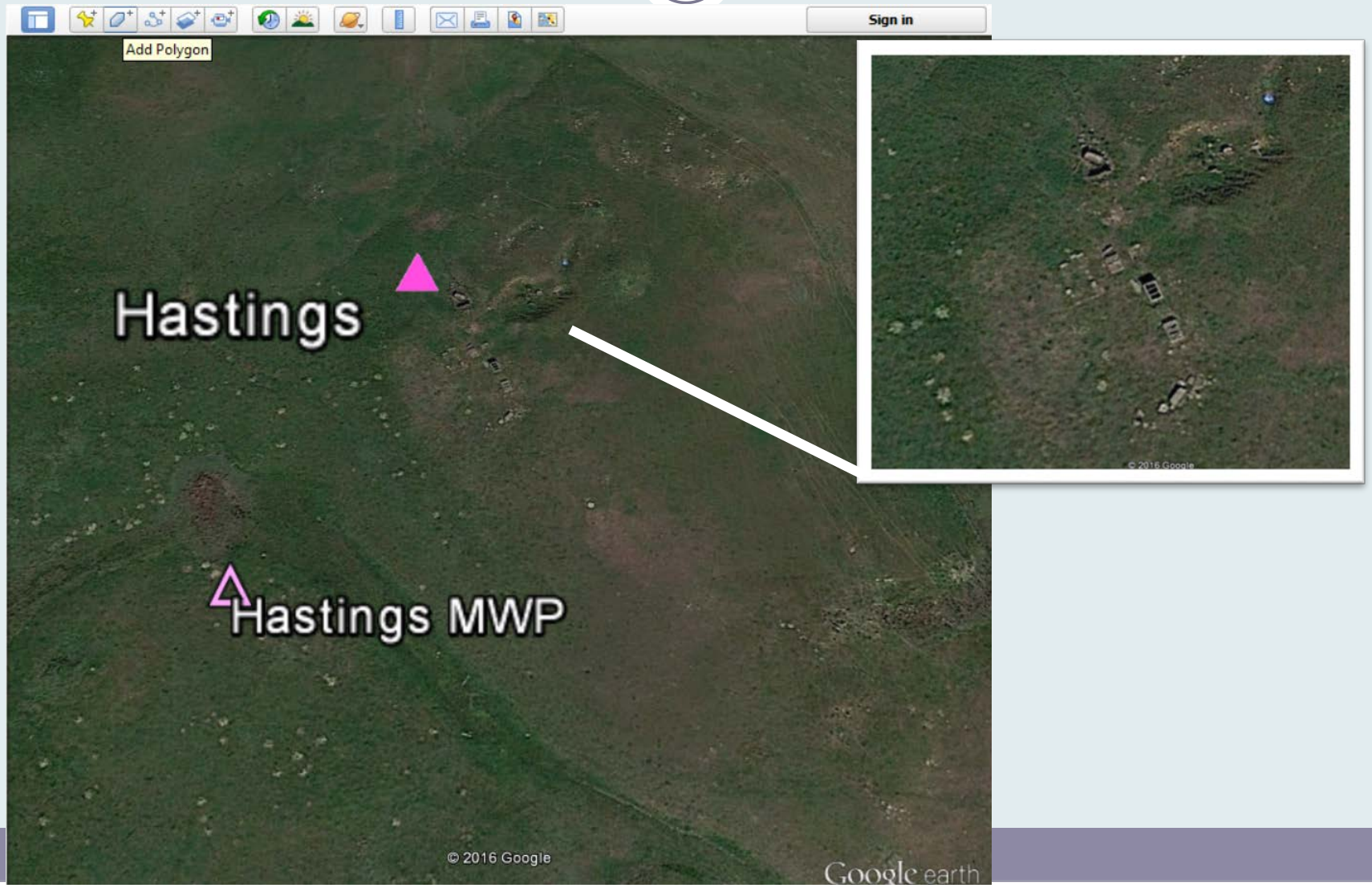
Data Type	Applicability
Satellite and historical images	Indicates current and historic drainages
National Hydrography Dataset (NHD)	Indicates drainages and receiving waters
USGS Topographic Maps	Provides rough estimate potential for off-site discharges to reach receiving waters
"Ruler" and "Grade" tools to estimate distance and grade of mine and mine features (e.g., piles of mining waste) to receiving waters or drainages	Provides rough estimate potential for off-site discharges to reach receiving waters
Receiving water impairment with potential mine COC (e.g., 303d)	- Can signal potential discharge - Indicates potential sensitive habitat
Fish advisories	- Can signal potential discharge - Indicates potential sensitive habitat
WB files/reports	Indicates previous inspectors determinations and recommendations regarding water quality threat

Hydrologic Connectivity Factors (cont.)

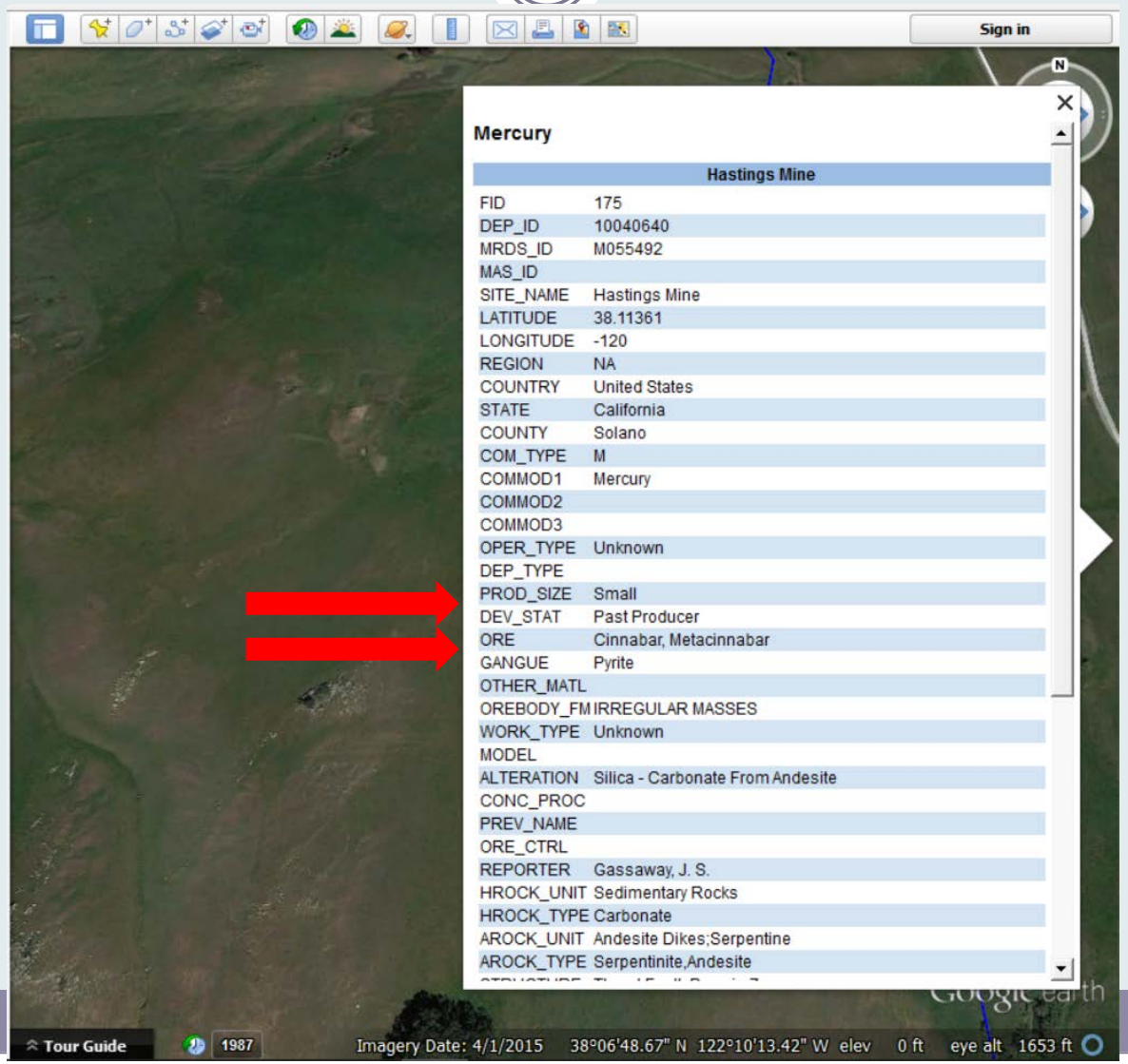
Data Type	Applicability
* Inspection of drainages, tributaries…	- Confirm surface water connectivity - Identify discharged waste - Identify sensitive habitats
* Inspection for geomorphological characteristics of site and drainage	
Potentially: - Sensitive Habitat (USFWS National Wetland Inventory, Inspections) - Fishing locations (CDFW https:///map.DFG.ca.gov/fishing/) - Protected species (California Natural Diversity Database) - Density of mine features density of mines discharging to same receiving water	

* Collected during inspection, thus only used in second phase of analysis to inform regulatory action.

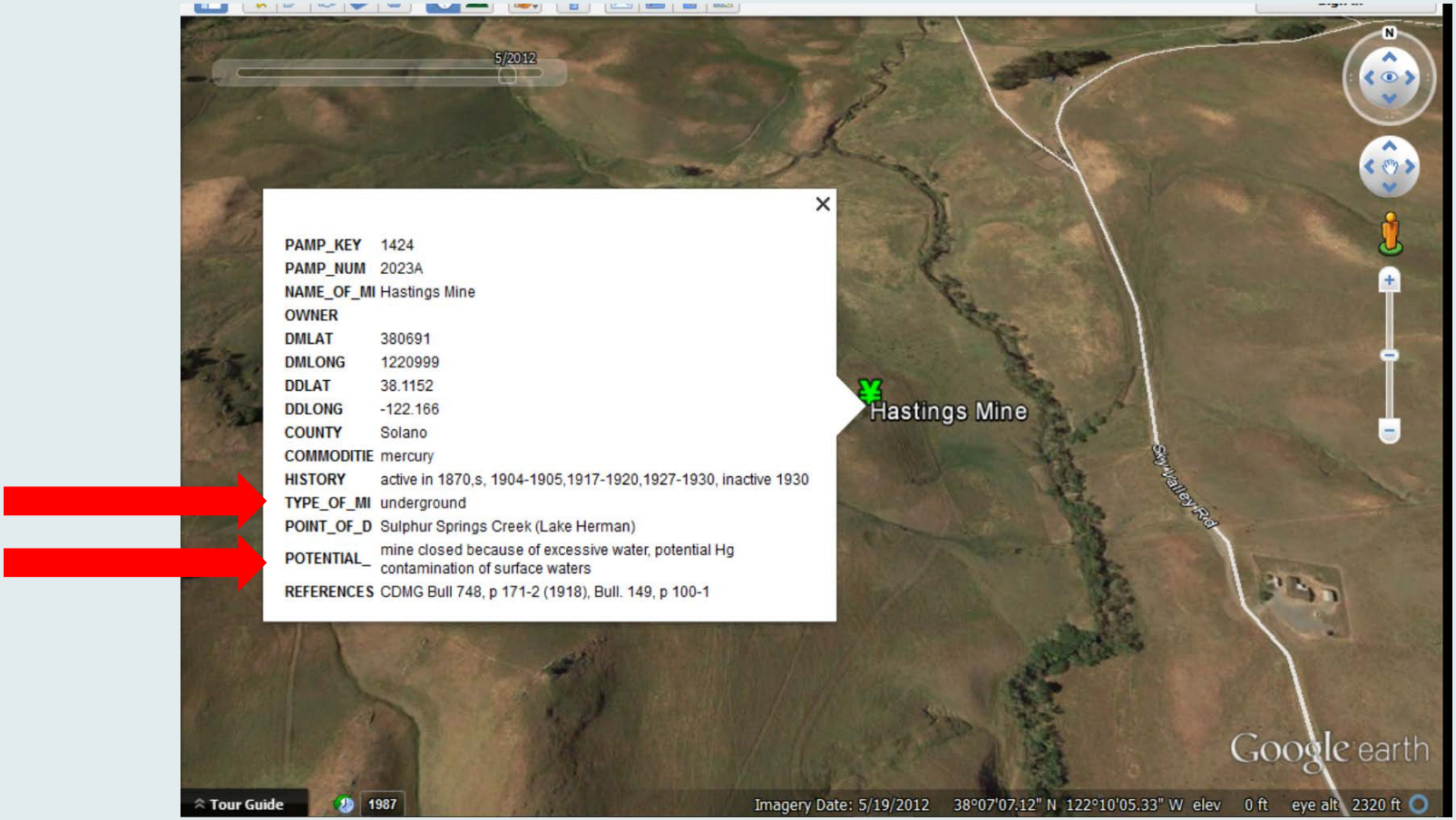
Satellite Reconnaissance



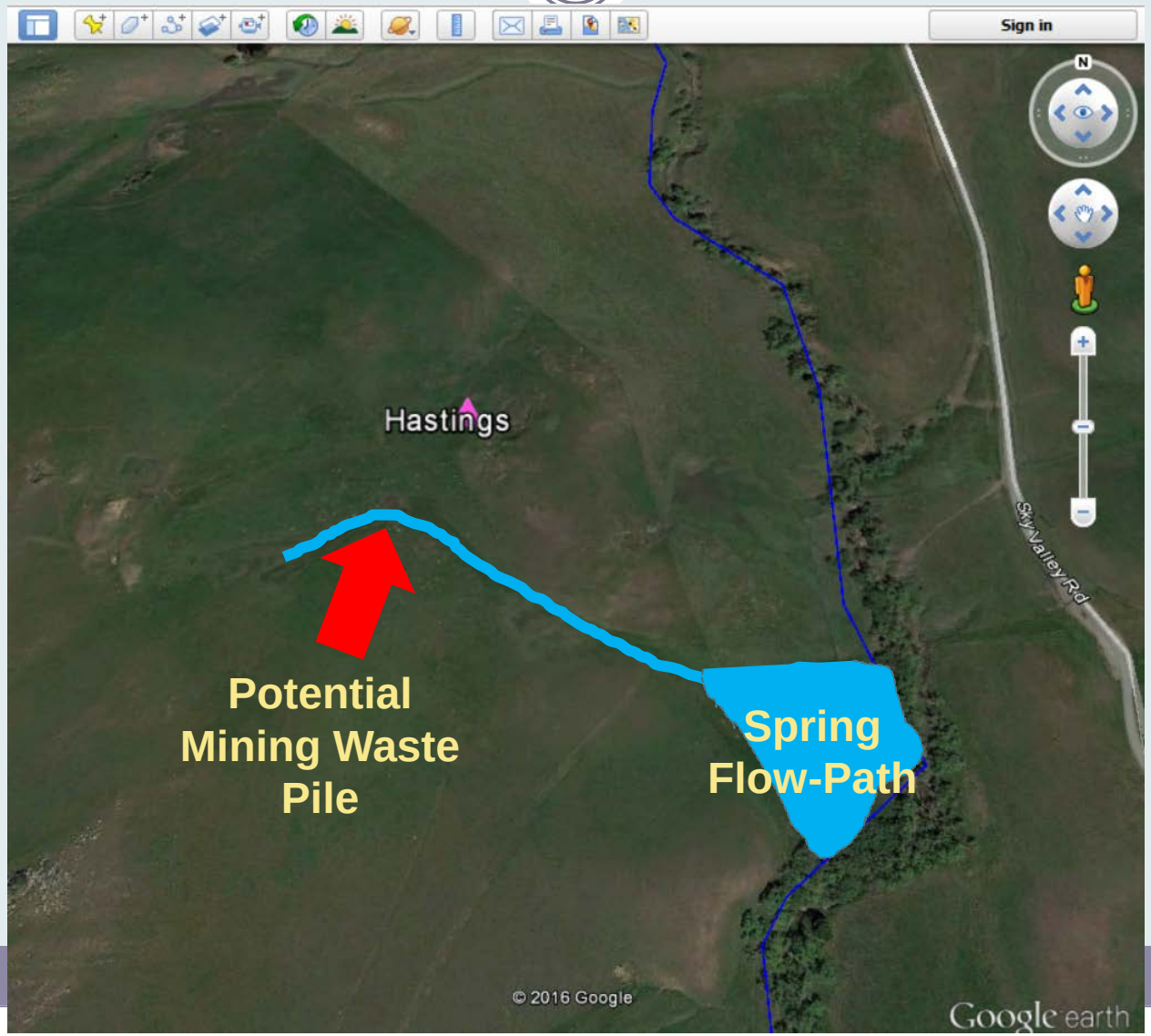
Satellite Reconnaissance GIS



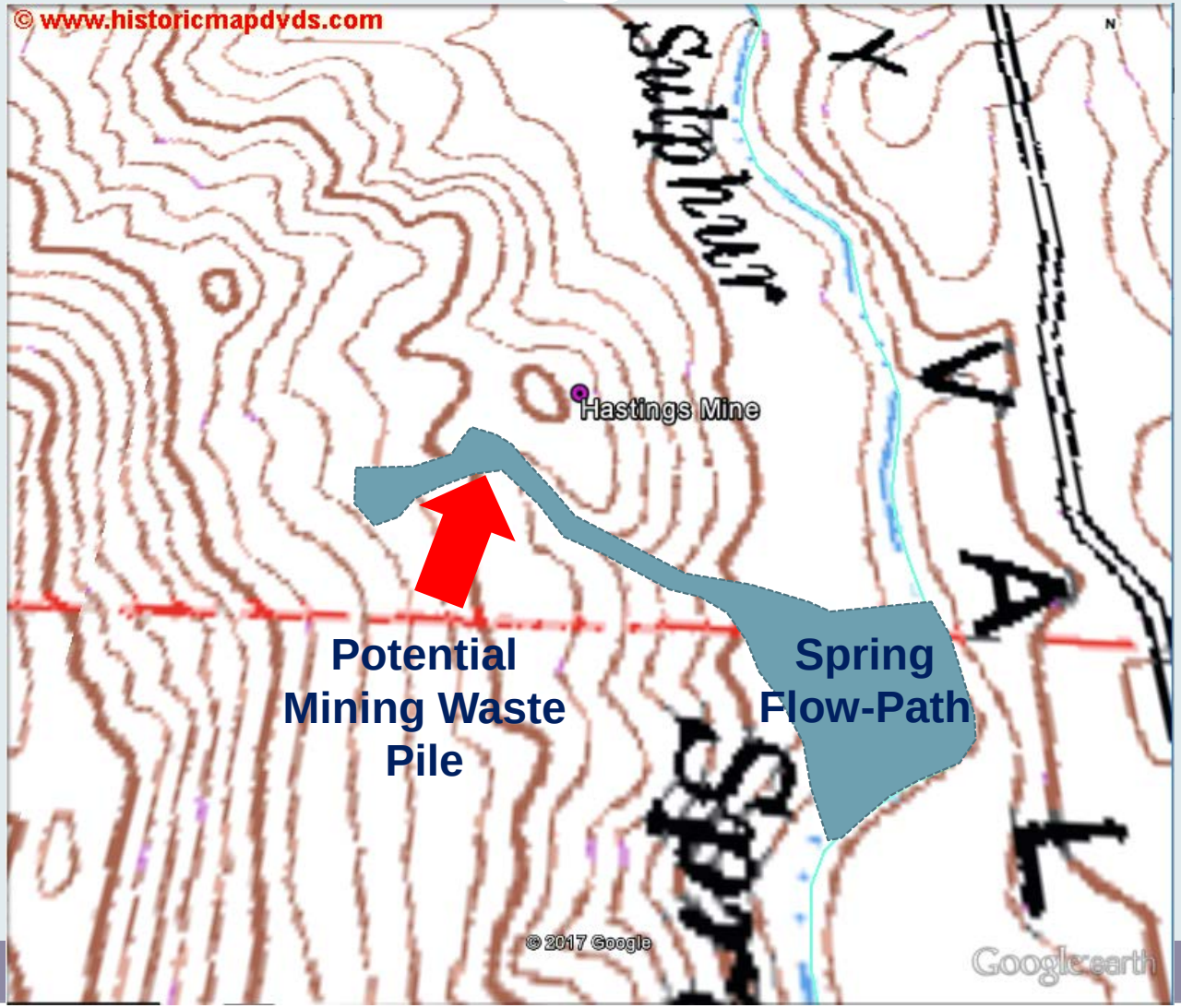
Satellite Reconnaissance GIS



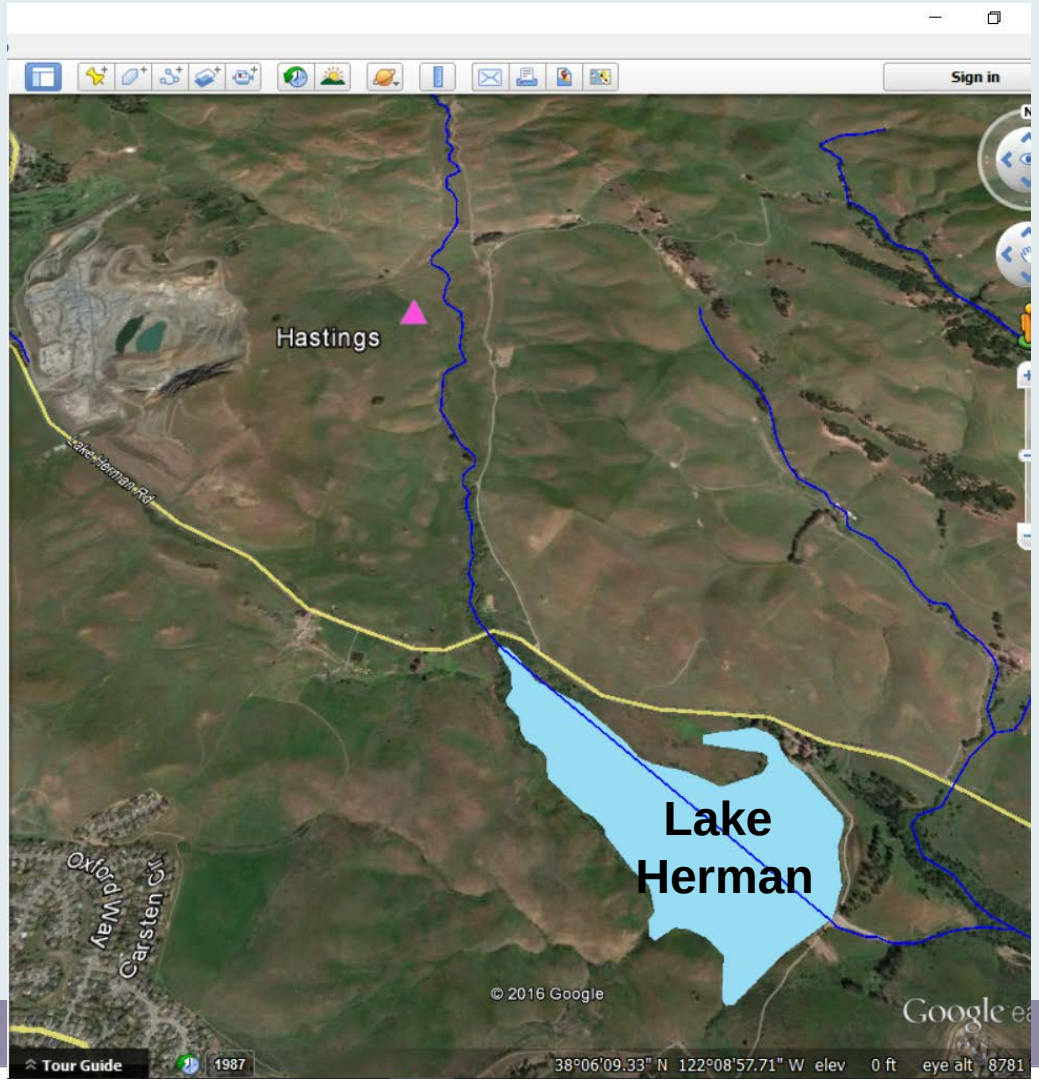
Surface Water Flow-Lines GIS



Topographic Data to Estimate Grade



Water/Habitat Quality Databases GIS



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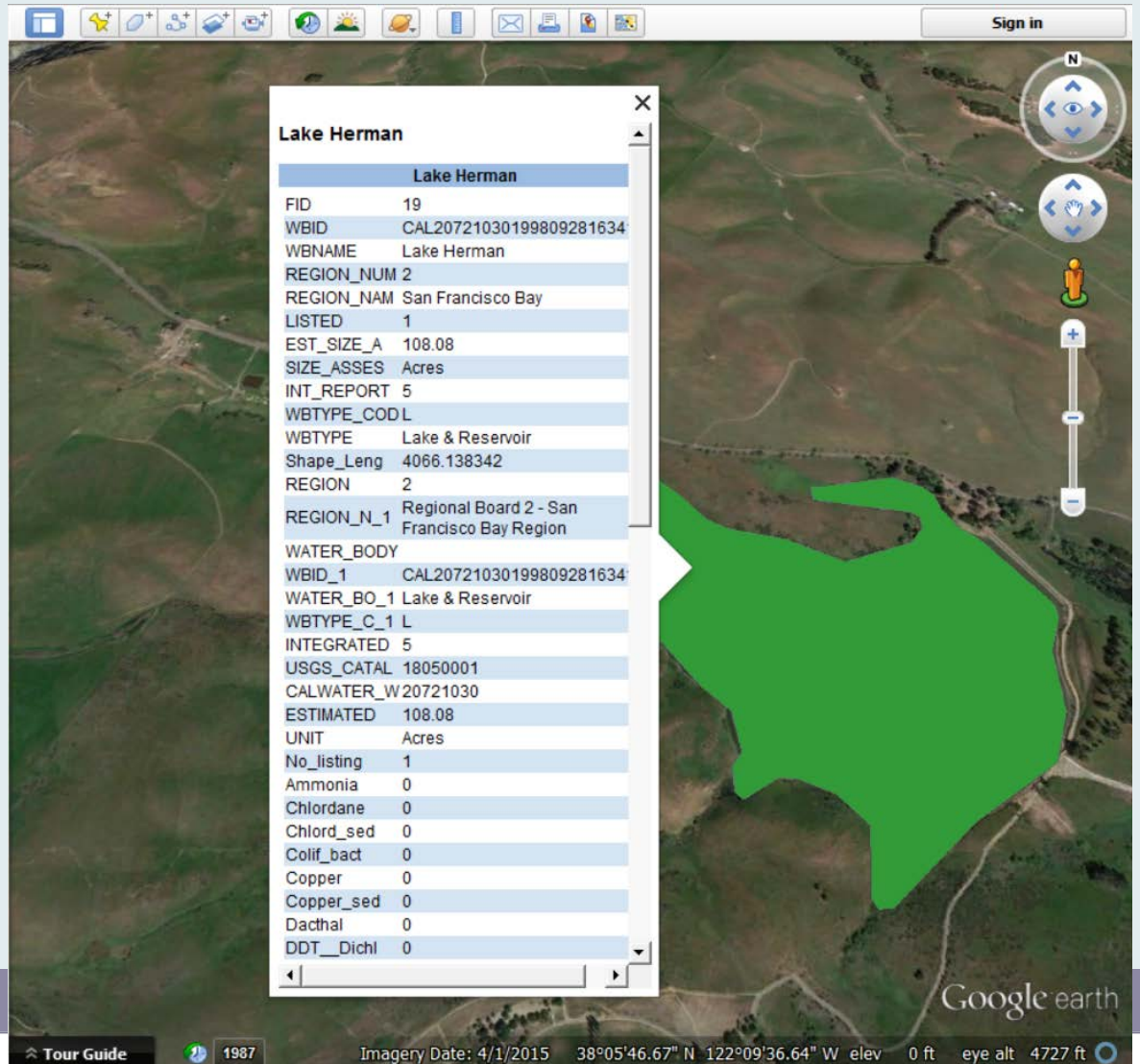

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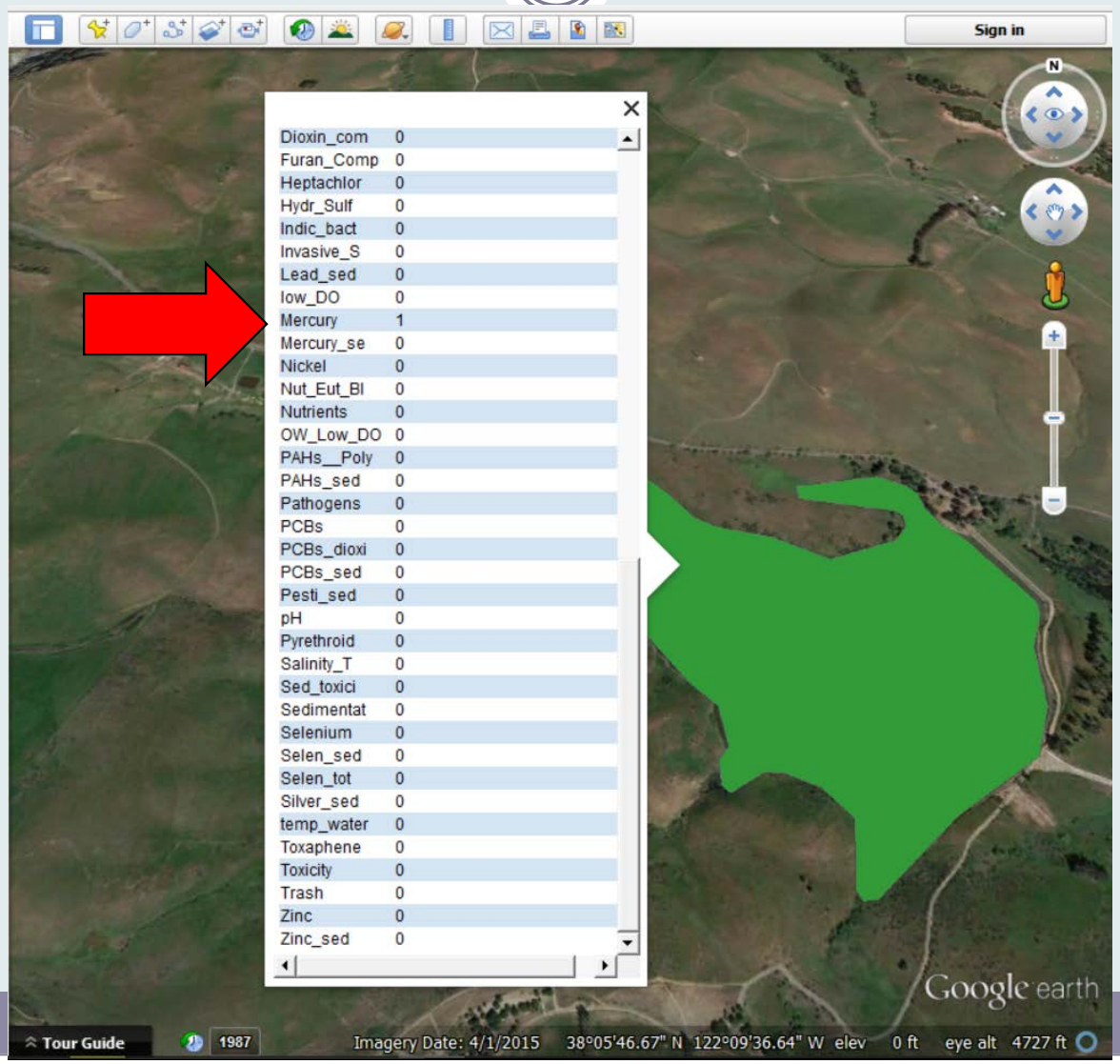

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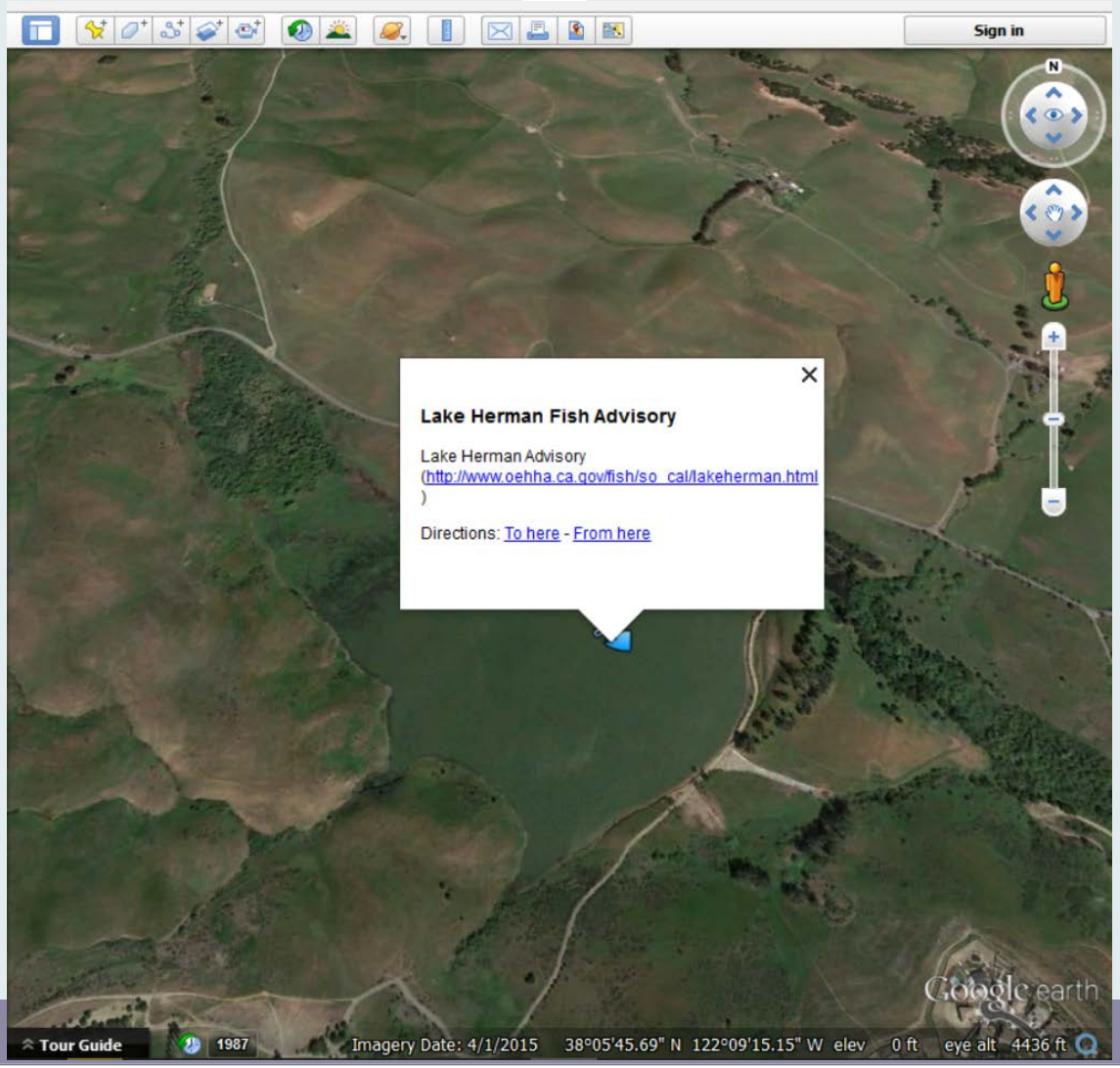


Prioritization Strategy

DESKTOP ANALYSIS - SCORING/RANKING TOOL

Prioritization
Scoring/Ranking System

Factors Affecting Water Quality

- Factors are weighted and mines scored
  - Exacerbating Factors +, ++, …
  - Mitigating Factors –, ––, …
  - Summed for total score
  - Higher score = higher water quality threat
- Mines ranked by score
- Relatively low tech, but sufficient for site screening/prioritization; balance between accurate and efficient.

Prioritization Scoring/Ranking System

Mine Characteristics	Scores for Ranking
Commodity COC	++++ Hg, S (or ARD), Pb, Cr + Cu, Ag, Au, Sb, coal - Remaining
Other COC (e.g., associated with gangue)	++ Hg, S (or ARD), Pb, Cr + Cu, Ag, Au, Sb, coal 0 Remaining
Buffering Mineralogy	- For carbonates (Only relevant if commodity or COC indicates potential for ARD. Also, to be conservative, will only apply f0r carbonates in addition to silica-carbonate alterations of mercury)
Mine Productivity/Size	++ thru --
Ore Processed On Site	++ Known yes + Suspected yes -- Known no 0 Remaining

Prioritization
Scoring/Ranking System

Mine Characteristics (cont.)	Scores for Ranking
Waste Piles Evident	++ Known, large volume + Suspected, large volume or known or suspected small volume 0 Remaining
Erosion or Mine Drainage Evident	+++ Known, large volume ++ Suspected, large volume, Known or suspected small volume -- Known none 0 Remaining

Prioritization
Scoring/Ranking System

Hydrology Characteristics	Scores for Ranking
Potential Connection to Receiving Water (distance and grade from mine feature to receiving water)	+++ Known Waste Pile ++ Suspected Waste Pile, Known Connected Drainage + Suspected Connected Drainage, Known Closest Mine Feature -- Known none 0 Remaining
Potential Connection to Drainage (ephemeral or intermittent creek, distance and grade)	++ Known connection of waste pile + Suspected connection of waste pile, known connection of other mine feature -- Known none 0 Remaining
Adjacent Receiving Water Impaired By Mine COC	++ to +++ Yes 0 No
Distant Receiving Water Impaired By Mine COC	+ Yes 0 No

Prioritization Scoring/Ranking System

Hydrology Characteristics (cont.)	Scores for Ranking
Fish Advisory Based on Mine COC in Receiving Water	+ Yes (Cumulative with impairment) 0 No
- Mine Upstream of Sensitive Habitat (e.g., for mercury wetland, reservoir, or riparian habitat) USFWS National Wetland Inventory, Inspections) - Fishing locations (CDFW) - Protected species (California Natural Diversity Database) - Density of mine features density of mines discharging to same receiving water	TBD in cleanup prioritization

Prioritization Strategy

DESKTOP ANALYSIS - TOOL IMPLEMENTATION RESULTS

Desktop Analysis and Prioritization Successful

- Inspection priorities changed
  - Example - Bella Oak moved down in priority
    - Distance, grade to surface water long & flat
    - Other mines closer to surface waters, impaired receiving waters
- Found mines of previously unknown location
- Discovered mines and features not identified in previous efforts
- Drainage pathways, receiving waters corrected
- Confirmed several mines not in R2

Inspection Prioritization Results

- **Mercury**
  - Highest priorities - St. John's, Hastings, & Chileno Valley
  - Some medium, only a few low priority
- **Acid Mine Drainage**
  - Pendarin - **Coal**
  - Silverado, Palisades - **Silver**
- **Chromium**
  - Newman – Possible immediate human health concern (inhalation) – referred to DTSC

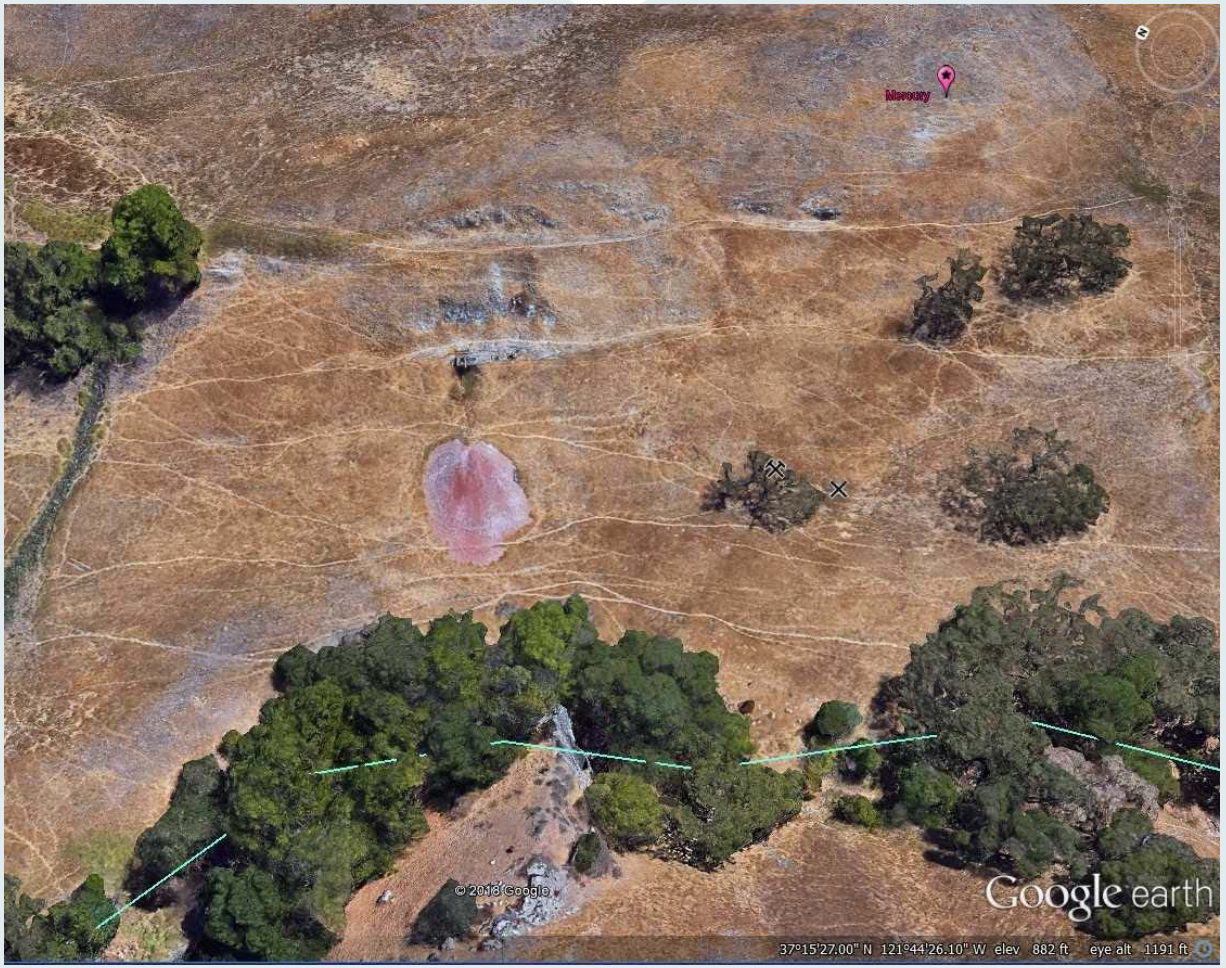
Details available as a link on webpage

Inspection/Data Collection Strategy

Site Specific Inspection Plans

- Site specific and comprehensive
- Designed to confirm desktop analysis/estimates
  - Potential Mine Features
    - Lat/long
    - Previous data/info
    - Satellite/photographic imagery suspicions
- Include historical photos for replication
- Double as inspection log for visual observations and data collection

Satellite Recon Identified Potential Mine Features



Potential Calcines and Adit

Inspections/On-Site Data Collection

To prioritize regulatory action, NOT to fully characterize site
To confirm desktop analysis findings

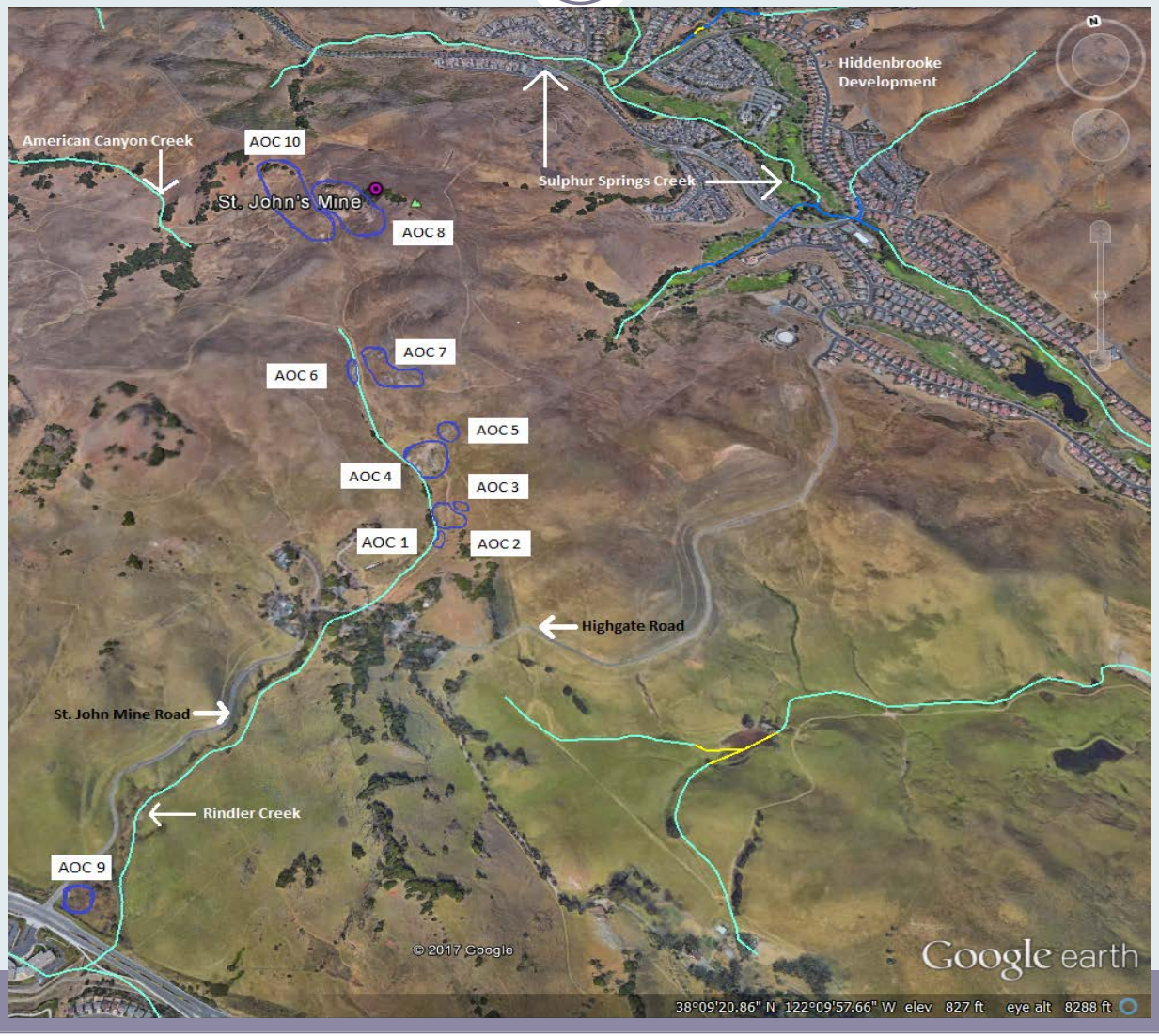
- Visual Observations
  - Mine features
    - Waste - unnatural topo, soil characteristics, color, odor
    - Openings (adit, shafts…)
    - Structures
  - Contaminant mobility
    - Erosion and erodability
    - Mine drainage, ARD
  - Hydrologic connection

- Measurements
  - Distance/grade to water features
  - Solids
    - Metals/metalloids via XRF
  - Liquids (mine drainage, creeks, seeps…)
    - pH
    - EC

XRF DQOs and SOP (see QAPP link on webpage)

- Data Quality Objectives relatively low, site screening
- Targeted sampling for waste, contamination with XRF
- In situ analysis (unless sample needs to be air dried)
- 90-360s analysis time, longer for higher quality
- Blanks before, after & any time contamination possible, “B” flagged subtract mean from results or reported as qualitative
- Calibration before, after, & any time drift suspected, “J” flag for results outside of ± 20% (Cr 30%)
- Detection Limit calculated as 1.5 x standard error (CL set at 95%) reported for blank (or low CRM)

Implementation



Implementation – XRF Analysis

St. John's Mercury Mine
(GeoTracker T10000011123)

- Confirmed contamination
  - Elevated **Hg**, **As**, Ni & Co (Tier 1 soil ESLs)
- Confirmed erosion and offsite discharge
- Confirmed hydrologic connectivity, intermittent (perennial flow miles downstream)
- Recommended next steps:
  - Consider interim remedial/mitigating actions, erosion of contamination discharging directly:
  - Consider requiring evaluation of risk to site visitors, grazing animals, and wildlife from arsenic:
  - Complete survey of highest priority mines, compare to remaining 2 sites, then:
  - Consider requiring investigation of remaining discharges.

Next Steps and Regulatory Tools

Next Steps

- 2 more high priority mines to inspect
- Prioritize sites for regulatory action
  - Additional factors might include:
    - Mine Upstream of Sensitive Habitat (e.g., for mercury wetland, reservoir, or riparian habitat)
  - Fishing locations
  - Protected species
  - Density of mine features density of mines discharging to same receiving water
  - IDEAS?? LMK

Regulatory Tools Provide Flexibility

- Require investigations
  - Water Code section 13267
- Require cleanup (Cleanup and Abatement Order)
  - Water Code section 13304
- Waste Discharge Requirements
  - California Code of Regulations Title 27
- NPDES Industrial Stormwater Permit
  - State Board general permit 2014-0057-DWQ

Acknowledgements

Thanks to:

Nicholas Piucci

Sarah Acker

Corie Hlavaty

Carrie Austin

Keith Roberson

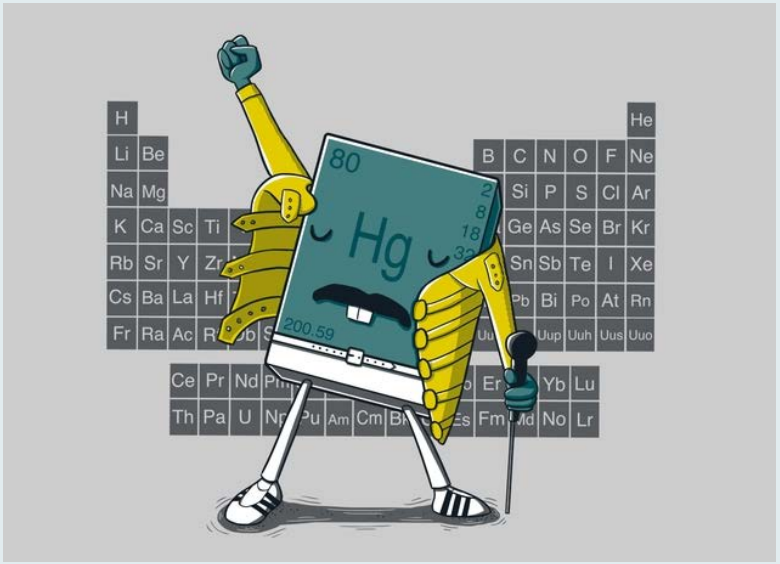
Kristina Yoshida

Melissa Gunter

Christina Toms

Glenda Marsh &

CAMLAG members



"Freddie Mercury" by Pablo Bustos