



A Model For Re-“Mediation”: Balancing Historic Preservation And Environmental Remediation At Bodie State Historic Park

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Background



Bodie

- Located in Mono County in the hills north of Mono Lake at 8,400' elevation. Heavily mined area with peak mining production in 1870s.
- Became Bodie State Historic Park in 1962.
- Now owned and managed by the California Department of Parks and Recreation (State Parks).
- Bodie is preserved in a state of "arrested decay."
- Legacy mining wastes present in Park.



Waste pile at Bodie
(town in background)

The Project

Time Critical Removal Action

- Pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA; 42 U.S.C. 9601 et seq.)

Agencies Involved:

AGENCY	ROLE
State Parks	Landowner, Cultural Resources, Visitor Control
U.S. Environmental Protection Agency (USEPA) Region 9	Regulator, Project Implementer
California Department of Conservation's Abandoned Mine Lands Unit (AMLU)	Coordination, Funding
Department of Toxic Substances Control/ Regional Water Quality Control Board	Regulator, Project Review (as needed)

The Project



Remediate Legacy Contaminants

- **Mercury (Hg)** from ore processing.
 - Elemental form in tailings piles.
 - Vapor form within the Standard Mill building.
- **Lead (Pb)** from the assay process (used to determine the amount of gold and silver in ore).
 - In sediment and dust near assay areas.
 - In cupels (absorbed lead oxide).
- **Arsenic (As)** associated with gold-rich mineral deposits.
- **PCBs** in transformers in Wheaton-Hollis Hotel.



Cupel



Relative size of a cupel



Project Areas of Concern (photos)

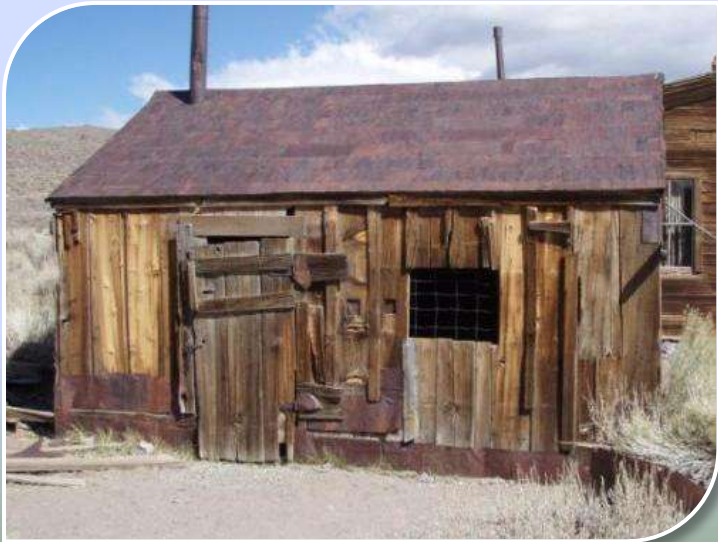
Standard Mill
(inside & slope)



Wheaton-Hollis Hotel



Assay Buildings



Tailings



Project Area (reference photo)



Project Sampling



Sampling Methodology

- Sampling performed in October 2007 by USEPA and its contractor.
- Sampling overseen by State Park archaeologists.
- To protect cultural resources, used the most feasible, least intrusive, & least destructive sampling methods.
 - Soil, wipe, and vapor (Lumex) sampling.
 - Most sampling done by hand.
 - State Parks archaeologists present during sampling to monitor that historical artifacts were left in place and/or not damaged.



Sampling (continued)



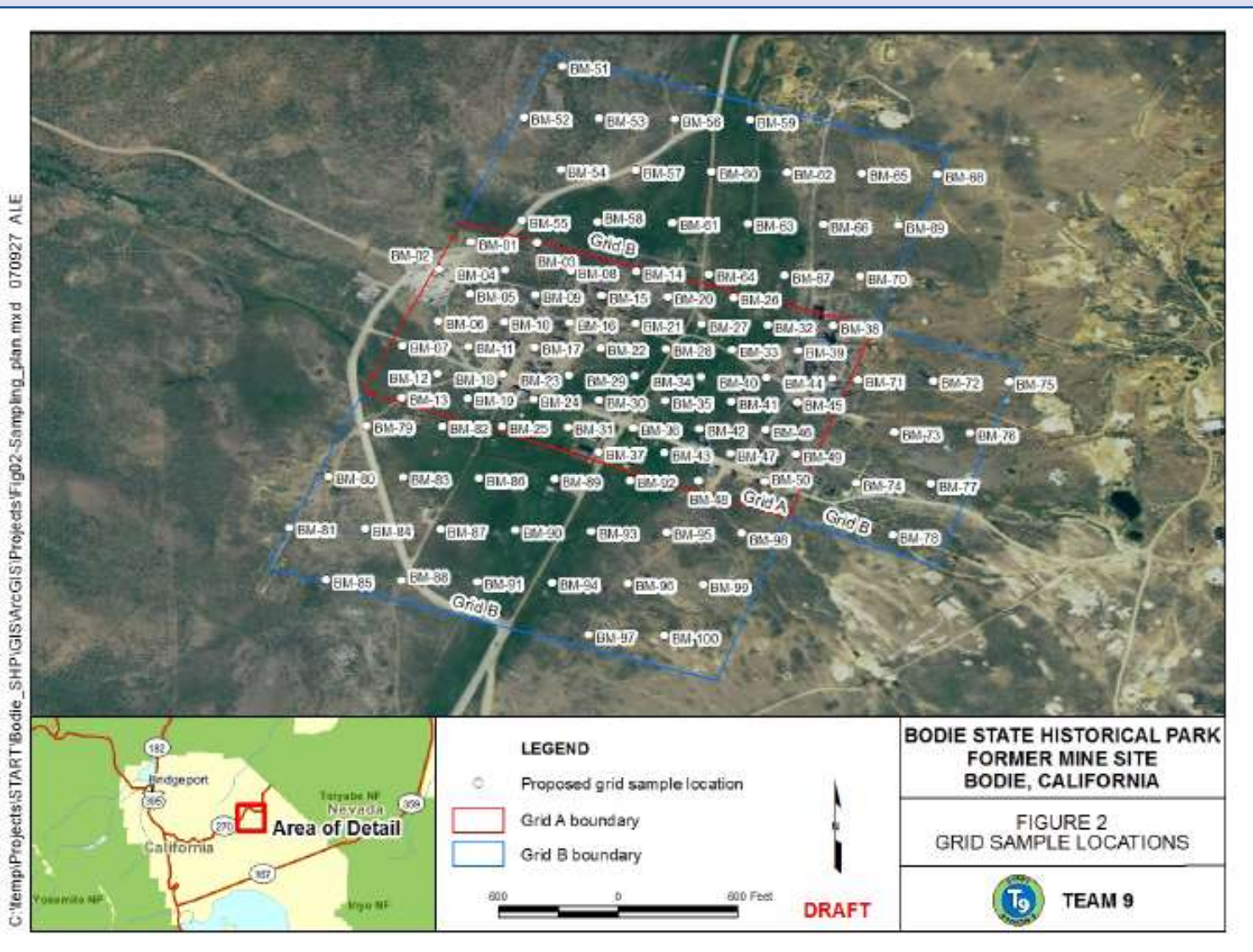
Soil Samples

- X-ray fluorescence (XRF) unit used in the field; subset of samples sent to a laboratory for QA/QC.
- Two sampling grids established (see next two slides):
 - Large grid encompassing an 88-acre section of the Park;
 - Smaller grid within town.



Sampling (continued)

Sampling Grid: Park

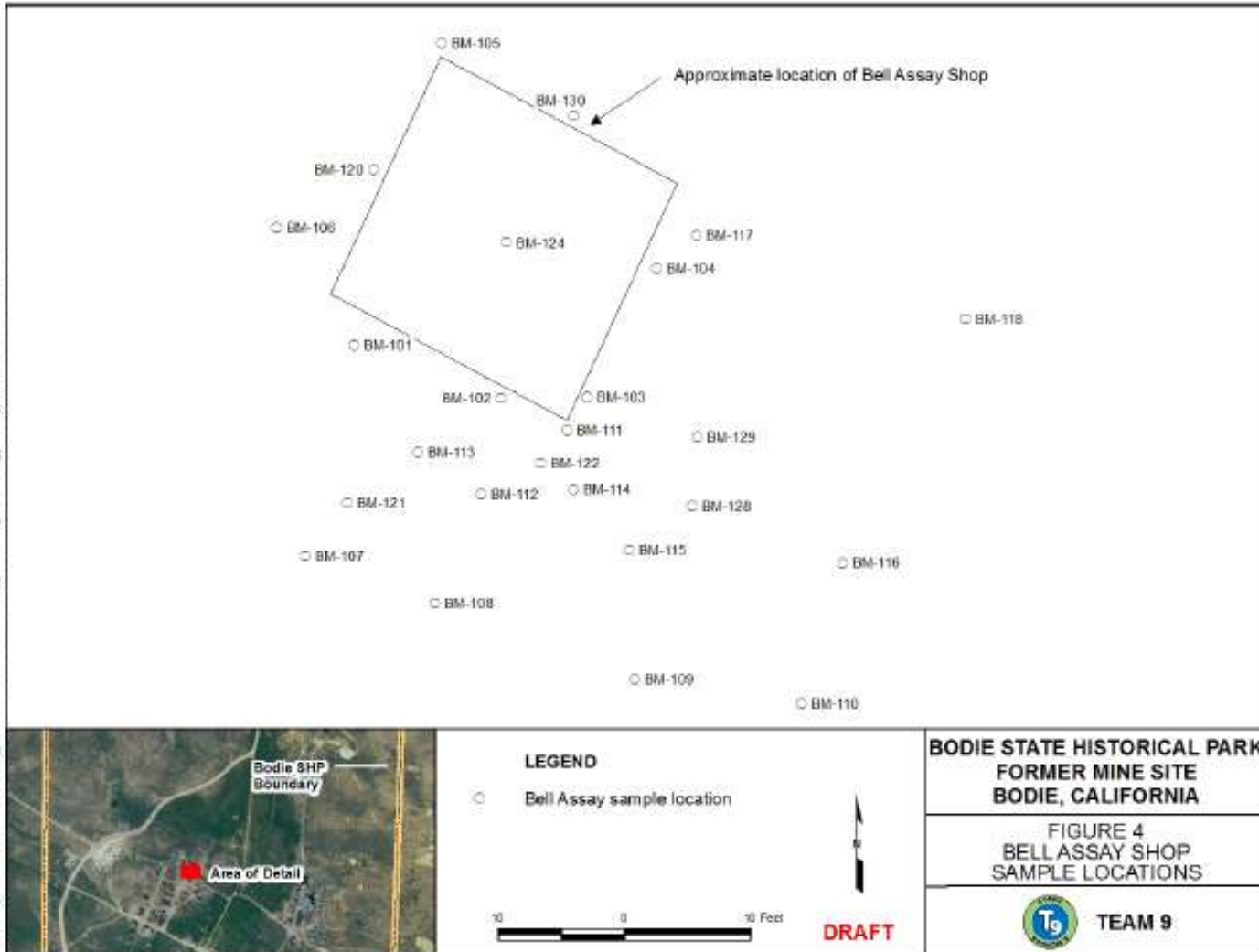


Sampling (continued)

Sampling Grid (In-Town example)



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Sampling (continued)

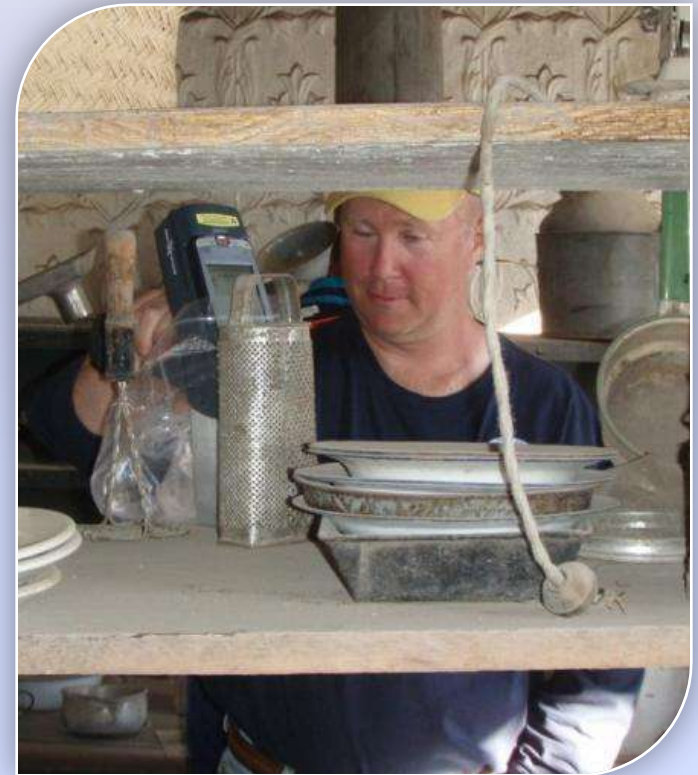


Soil samples (continued).

- Targeted (biased) sampling
 - Standard Mill and surrounding area
 - Bell, Soderling, & Rose Klyps Assay Buildings
 - Tailings Piles
 - Wheaton-Hollis Hotel
 - Picnic Area
 - (Note: Multiple sampling depths [up to 5 feet] in some areas.)

Other samples

- Wipe samples (for Pb & PCBs).
- Mercury vapor sampling (Lumex).



Using an XRF on dust in the Wheaton-Hollis Hotel kitchen



Sampling: Initial Results

- Elevated **Pb**.
 - In dust in Wheaton-Hollis Hotel (up to 17,800 micrograms/wipe).
 - In and around Bell & Rose Klyps Assay buildings (>550 ppm lead action level, up to 4,560 ppm at Bell Assay).
 - On slope below Standard Mill (> 550 ppm action level).
- Elevated **Hg** vapor concentration inside Standard Mill (>1,000 nanograms/meter³ action level).
 - Major source of mercury vapor from the basement.
- Elevated **Hg** and **As** in tailings adjacent to Bodie Creek (up to 168 ppm As and 77.8 ppm Hg).
- Small amount of **PCBs** found in one transformer (transformers were previously drained).

Exposure Considerations



Exposure Considerations

- Potential employee and/or visitor exposure to
 - Hg vapor during Standard Mill tours.
 - Pb in soil in town and in cupel artifacts.
 - Pb dust in Wheaton-Hollis Hotel (closed to public; occasional use by employees).
- Potential environmental impacts from tailings:
 - Potential fish tissue impairment by Hg in Bodie Creek.
 - Potential As, Hg, & methylmercury contributions downstream to Walker River & Lake (Nevada).

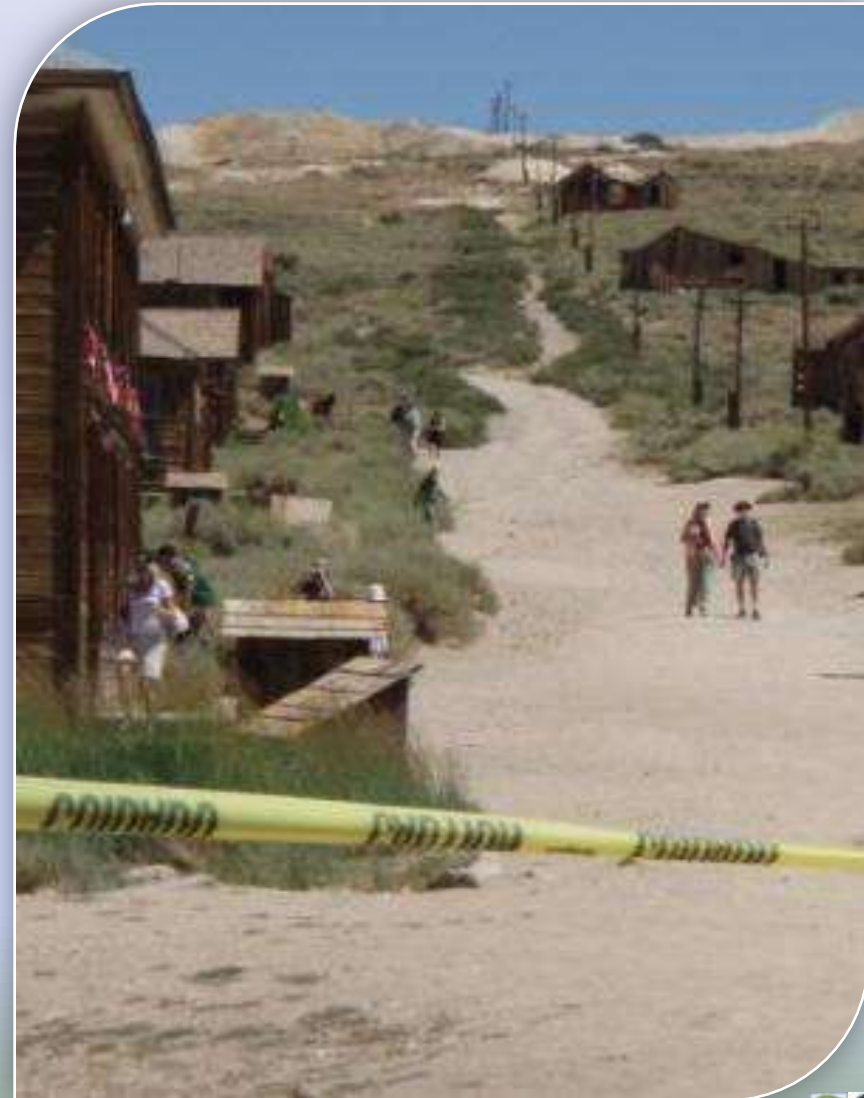


Remediation Considerations



Remediation Considerations

- Effectiveness of remediation method(s) selected.
- Protect public health & safety
- Protect artifacts and "historical fabric."
- Minimize disruption to visitors.



Other Challenges

- Weather and short project windows: Difficult if not impossible to conduct work in snow/frozen soil conditions.



**Photos taken on
May 22, 2008**



Remediation: Assay Buildings



- Removal of top one foot of soil.
- Placement of filter fabric.
- Placement of clean fill.
- Replacement of artifacts (where required).



Placement of clean fill
surrounding Rose Klyps
Assay building

Remediation: Bell Assay

Bell Assay: Before and After Remediation



Before: Bell Assay in October 2007



After: Bell Assay in May 2009

Remediation: Standard Mill



Inside Standard Mill:

- Modified Radon Extraction System.
 - Mill basement vapor barrier liner
 - Fans to remove vapors from basement
 - Expulsion of vapors through existing smokestacks

Below Standard Mill:

- Placement of filter fabric.
- Placement of minimum of one foot of clean fill.
- Revegetation.
- Fencing.



Remediation: Wheaton-Hollis Hotel



- HEPA vacuum dust removal.
- Institutional controls.



Historic artifacts



HEPA vacuuming inside
Wheaton-Hollis Hotel

Remediation: Tailings



- Stream diversion ditch (away from tailings).
 - Built for 100-year event (60 cubic feet/sec.).
 - Lined with 18 oz/ft² plastic liner and rip-rap.
- Weir construction to slow flows.
- Erosion control.
 - Composting with organic material.
 - Sand seeding with native grass.



The rocky, lined diversion ditch (right) intercepts runoff from the hills above so that it doesn't erode the mine tailings (light colored soil on left and above) and takes it downstream.

Physical Hazard Remediation



- The AMLU built fences at Bodie SHP in June, 2008.
 - Repaired nine fences around physical hazards.
 - Repaired two sections of perimeter fencing.
 - Built one new fence around a mine shaft.
- The AMLU supplied labor for the project and State Parks purchased materials.





Bodie Successes

- **Protected visitor and employee health and safety while preserving historic and cultural values.**
 - Hand excavated some areas around the Bell Assay due to concern for the building's stability.
 - Avoided artifacts and vegetation with equipment and during excavations. Left artifacts in place when possible.
 - Successfully located and characterized hot spots allowing for effective remediation with a smaller disturbed footprint.



Bodie Successes (continued)

- **Minimized or avoided disturbance to Park visitors during remediation.**
 - Staged equipment outside of the town.
 - Used secondary roads away from visitors.
 - Scheduled remediation activities around times of high visitation.
- **Coordinated successfully between several agencies, including state and federal.**

Contacts & Questions

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