

# Results of Air Screening for Mercury Phase 1 Remedial Investigation – October 2007 Klau and Buena Vista Mines Superfund Site San Luis Obispo County, California

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CH2M HILL Project: 349863**

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This memorandum presents the results of air screening for mercury vapor conducted at the Klau and Buena Vista Mines Superfund Site in San Luis Obispo County, California. The air screening was performed as a component of the Phase I Remedial Investigation as presented in the Sampling and Analysis Plan (CH2M HILL, October 2007). The purpose of the vapor screening was to assess whether further investigation and air sampling is necessary as part of the remedial investigation for the site.

## Vapor Screening Activities and Procedures

Vapor screening for mercury was performed October 24 and October 26, 2007. The maximum daily temperatures were 95°F and 79°F for October 24 and October 26, respectively. Winds both days were light and variable from 0-10 mph, with clear skies and an average humidity varying from 31 percent to 56 percent (as reported from the Municipal Airport, approximately 20 miles to the east). Vapor screening was performed inside buildings, in outdoor areas where field X-ray fluorescence (XRF) readings for mercury were higher compared with other mine site areas, and within selected mine processing equipment areas. The vapor screening was performed using a Lumex RA-15+ analyzer. The continuous monitoring portable field analyzer is contained in a shoulder-mounted case with a 4-foot hand-held “sniffing” probe. The instrument is switched on and the lamp is ignited and allowed to warm up for 15 minutes. The analyzer serviceability is tested by measuring the relative deviation (%R) of the measured value of the mercury vapor concentration in the test cell. If the %R is less than 25 percent, the device is ready for operation. The instrument is reported to be capable of measuring mercury concentrations in air at levels down to 2 nanograms per cubic meter (ng/m<sup>3</sup>). The instrument is operated in the On Stream mode, with the compressor pumping 20 liters of air per minute via the “sniffing” probe. The stream of air flows through the test cell, producing two separate readings: mercury concentration at the current time, and averaged over a 10-second period. The hand-held probe allows the operator to carry the analyzer comfortably while “sniffing” very specific locations. No operational issues were encountered during this screening.

## Results

Mercury vapor concentrations in air were recorded at 32 locations, including inside existing buildings at the Buena Vista Mine; in outdoor areas around former processing equipment at Klau and Buena Vista Mines; and within specific features such as processing equipment, adits and vertical pipes into the ground at both Klau and Buena Vista mines. These locations are grouped by areas: the Buena Vista Mine area, the Buena Vista Rotary Furnace area, the Klau Pond area, the Klau Mine Western Mill area, the Klau Mine Western Retort area, and the Klau Mine Area Adits. The locations of the vapor screening activities for the Buena Vista Mine area and Klau Mine are shown in Figures 1 and 2, respectively (figures and tables are located at the end of this memorandum). The results are summarized in the subsections below and in Table 1.

### Buena Vista Mine Area

**Inside Buena Vista Mine Area Buildings:** Mercury concentrations in breathing zone air (approximately 5 feet above the ground) ranged from 11 to 70 ng/m<sup>3</sup> inside the four accessible buildings (maintenance building assay shed, mine shop (see Photograph 1), and compressor shed). The mercury concentration in air directly over a large crack in the concrete floor at the back of the mine shop building was 75 ng/m<sup>3</sup>.



Photograph 1. Mercury vapor meter sampling inside the Mine Shop Building

**Outdoor Buena Vista Mine Area Breathing Zone Ambient Air:** The mercury concentration in outdoor ambient breathing zone air in the Buena Vista Mine area was a maximum of 105 ng/m<sup>3</sup> in all areas tested. The analyzer was operated continuously while walking

between test locations and around the perimeter of accessible buildings, maintaining the probe approximately 5 feet above the ground. The mean value (averaged over 10-second time frames) was monitored visually and recorded.

**Outdoor Buena Vista Mine Area Ground Level Ambient Air, Ambient Air in Adit and Ambient Air in Below Ground Features:** Mercury concentrations were recorded at or below the ground surface at locations in the Buena Vista ore cart trestle area (26 ng/m<sup>3</sup>), in the vertical pipe next to the ore cart trestle (1,805 ng/m<sup>3</sup>), in the vertical pipe near the Buena Vista Mine adit (23 ng/m<sup>3</sup>), inside the Buena Vista Mine adit (14 ng/m<sup>3</sup>) (see Photograph 2) and inside the hand auger boring hole at PAS-001-SL1-1007 (193 ng/m<sup>3</sup>).



Photograph 2. Mercury vapor meter sampling inside Buena Vista Mine adit; nearby vertical pipe in foreground.

### Buena Vista Rotary Furnace Area

**Buena Vista Rotary Furnace Area Breathing Zone Ambient Air:** The mercury concentrations in the outdoor breathing zone ambient air in the areas adjacent to the Rotary Furnace ranged from 2,000 to 4,000 ng/m<sup>3</sup>.

**Buena Vista Rotary Furnace Area Ground Level Ambient Air:** Mercury concentrations in the air at ground level around the outside of the hopper on the north side of the rotary furnace varied from 8,200 ng/m<sup>3</sup> measured around the perimeter of the hopper to 27,000 ng/m<sup>3</sup> directly underneath the hopper (see Photograph 3). Mercury in air inside the hand auger boring hole at BRF-001-SL1-1007 (east side of the furnace depth of approximately 1 foot) was recorded as 48,000 ng/m<sup>3</sup>. The mercury concentration in an eight-inch wide one-

inch deep trough across the width of the concrete base that supports the Rotary Furnace, was 35,000 ng/m<sup>3</sup>.

### Klau Pond Area

#### **Klau Pond Area Breathing Zone**

**Ambient Air:** The mercury concentrations in ambient air within the breathing zone recorded along a transect from the parking area above the Klau Pond to the condenser at Klau Pond ranged from 150 – 250 ng/m<sup>3</sup>.

**Klau Pond Area Equipment:** The “sniffer” was placed inside each of the condenser tubes on the west side of Klau Pond. Mercury concentrations in air within each tube were less than 200 ng/m<sup>3</sup>, with the exception of easternmost tube, where the mercury concentration in air was 20,000 ng



Photograph 3. Mercury vapor meter under Rotary Furnace Hopper.

### Klau Mine Western Mill Area

#### **Western Mill Area Equipment:**

Mercury concentration in air within the concrete condenser in the Western Mill area was 550 ng/m<sup>3</sup>.

### Klau Mine Western Retort Area

#### **Western Retort Area Breathing Zone**

**Ambient Air:** Mercury concentrations in ambient air within the breathing zone along a transect from the mine road to the Western Retort were less than 200 ng/m<sup>3</sup>, and in the vicinity of the Retort were 200 ng/m<sup>3</sup>.

**Western Retort Area Ground Level Ambient Air:** The mercury vapor concentrations in the air at ground level around the western retort ranged from 700 to 50,000 ng/m<sup>3</sup>.

**Western Retort Equipment:** Mercury concentrations in air within each end of the retort were 20,000 (east end) and 50,000 ng/m<sup>3</sup> (west end).

### Klau Mine Area Adits

**Klau Adits:** Two adits in the Klau Mine area were found that were accessible for vapor monitoring. The Carson-Wright adit is located south of Cypress Mountain Drive and north of the Klau Branch. Access into the adit is limited by a locked metal gate. The sniffing probe was inserted through the gate about 2-3 feet into the adit and a mercury concentration in air of 6 ng/m<sup>3</sup> was recorded.

A second unnamed adit was found on the south side of Cypress Mountain Drive at the approximate grid location R11. This adit is open and extends into the hillside approximately 20 feet. Mercury in the ambient air at the entrance to the adit was recorded as 12 ng/m<sup>3</sup>.

## Discussion

As an indication of the potential need for further characterization, the mercury concentrations in air were compared to USEPA Region IX Preliminary Remediation Goals (PRGs). In addition, values were compared with National Institute for Occupational Safety and Health (NIOSH) criteria for worker health and safety in order to assess the potential need for personal protection during worker field activities. Table 2 summarizes the values used for comparison.

The results of this comparison are discussed below.

**All Data:** Mercury concentrations in air were highest within and at ground level around the Klau Western Retort (up to 50,000 ng/m<sup>3</sup>) and around the Buena Vista Rotary Furnace (up to 48,000 ng/m<sup>3</sup>). These concentrations are below the NIOSH ceiling level of 100,000 ng/m<sup>3</sup> and at or below the NIOSH 8-hour time weighted average of 50,000 ng/m<sup>3</sup>. These areas also had the highest reported concentrations of mercury in surface soil (650 to 10,500 milligrams per kilogram [mg/kg]).

**Indoor Air:** Mercury concentrations in indoor air were measured in four existing buildings (the assay shed, mine shop, maintenance building and compressor shed) at the Buena Vista Mine. There are no existing buildings at the Klau Mine. The concentrations in indoor air ranged from 11 to 75 ng/m<sup>3</sup>. These concentrations are all below the USEPA Region IX PRG residential screening level of 310 ng/m<sup>3</sup> mercury.

**Ambient or Outdoor Air:** Mercury concentrations in outdoor air within the adult breathing zone (at approximately 5 feet above the ground surface) were recorded for four areas (Buena Vista Mine Area buildings, Buena Vista Rotary Furnace, Klau Pond Area, and the Western Retort Area) and in three adits (two at Klau and one at Buena Vista) as identified on Table 1. The concentrations of mercury were highest around the Buena Vista Rotary Furnace (2,000 to 4,000 ng/m<sup>3</sup>). These concentrations are below the NIOSH values but above the USEPA Region IX residential PRG of 310 ng/m<sup>3</sup>. All other breathing zone readings in four areas and three adits were less than 250 ng/m<sup>3</sup> and below the USEPA Region IX PRG of 310 ng/m<sup>3</sup>.

Mercury concentrations were also measured in ambient air near the ground surface at the Klau Western Retort, at the Buena Vista Rotary Furnace, and at the Buena Vista Ore Cart Trestle. Except for the ground level reading at the Ore Cart Trestle the readings exceed the USEPA Region IX PRG of 310 ng/m<sup>3</sup> but are below the NIOSH 8-hour worker exposure value of 50,000 ng/m<sup>3</sup>.

**Air within Processing Equipment:** Mercury readings from within processing equipment at the Buena Vista and Klau Mines indicate that residual mercury is present within the equipment and that the concentrations in air within the equipment were below the NIOSH levels.

**Air within below-grade pipes:** Mercury readings in air within below-grade pipes and auger holes at the Buena Vista and Klau Mines were below the NIOSH levels.

## Conclusions and Recommendations

1. Based on the results of the vapor screening, indoor air does not exceed the USEPA Region IX PRG screening level for mercury and is not therefore a major pathway of concern for human health risk. The ambient outdoor air exposure pathway should be considered as part of the risk assessments. However, based on our experience at other mine sites, it is expected that the air pathway will not be the risk driver for human health or the environment.
2. Mercury in ambient air around the Klau Western Retort and the Buena Vista Rotary Furnace correlate with the mercury concentrations in soil samples collected in these areas: maximum of 10,500 mg/kg mercury in soil samples from Western Retort area and maximum of 14,300 mg/kg mercury in soil samples from the Buena Vista Rotary Furnace Area. Addressing mercury in soil at these locations would be expected to address the associated vapor pathway.
3. The air readings indicate that the existing mine processing equipment likely contains residual mercury. Institutional controls (signs/screens or other physical barriers) and/or decontamination should be considered if this equipment is to remain onsite for historical purposes. Otherwise, the equipment should be removed and properly disposed of.

TABLE 1  
 Mercury Vapor Screening Results

Location	Category	Hg Conc. (ng/m <sup>3</sup> )
<b>Buena Vista Mine Area</b>		
Maintenance Building - Center of North room	Indoor Air BZ	31
Maintenance Building - Center of South room	Indoor Air BZ	28
Maintenance Building - Crack in floor of South room	Indoor Air	75
Assay shed - Center of West room	Indoor Air BZ	11
Assay shed - Center of Northeast room	Indoor Air BZ	23
Assay shed - Center of Southeast room	Indoor Air BZ	16
Mine shop - Through broken window on west wall	Indoor Air BZ	22
Mine shop - Exterior perimeter	Ambient Air BZ	<100
Compressor shed – Center of shed	Indoor Air BZ	70
Compressor shed – Exterior perimeter	Ambient Air BZ	<100
Ore cart trestle - perimeter	Ambient Air BZ	<105
Ore cart trestle -Gray material under ore cart trestle (ground level)	Ambient Air Ground-Level	26
BVM adit - inside	Other - BZ	14
Vertical pipe – inside pipe in front of BVM adit	Below Ground Feature	23
Vertical pipe – inside pipe in front of ore cart trestle	Below Ground Feature	1805
Hand auger hole PAS-001-SL1-1007, inside hole	Below Ground Feature	193
<b>Buena Vista Rotary Furnace Area</b>		
Rotary Furnace – ambient air east side	Ambient BZ	2,000
Rotary Furnace – ambient air west side	Ambient BZ	3,000-4,000
Rotary Furnace hand auger hole (BRF-001-SL0-1007) in hole	Below Ground Feature	48,000
Rotary Furnace Hopper – perimeter at ground level	Ambient Air Ground-Level	8,200
Rotary Furnace Hopper – under hopper	Ambient Air Ground-Level	27,000
Rotary Furnace – 8-inch cut on top of concrete pad	Ambient Air Ground-Level	35,000
<b>Klau Pond Area</b>		
Klau Pond Parking Area – from parking to condenser	Ambient BZ	150-250
Condenser tubes - Northeast tube 20,000, rest below 200	Equipment	200-20,000
<b>Klau Mine Western Mill Area</b>		
Western Mill Area Concrete condenser - inside	Equipment	550

TABLE 1  
 Mercury Vapor Screening Results

Location	Category	Hg Conc. (ng/m <sup>3</sup> )
<b>Klau Mine Western Retort Area</b>		
Western Retort area – dip in road to retort	Ambient BZ	<200
Western Retort - Perimeter	Ambient BZ	200
Western Retort - ground level perimeter	Ambient Air Ground-Level	700 – 50,000
Western Retort - Inside east side of retort	Equipment	20,000
Western Retort – Inside west side of retort	Equipment	50,000
<b>Klau Mine Area</b>		
Carson-Wright Adit - entrance	Other - BZ	6
Unnamed Adit south side Cypress Mountain Drive - entrance	Other - BZ	12

**Note:**  
 BZ = Breathing zone (approximately 5 feet above ground surface)  
 Hg = mercury  
 ng/m<sup>3</sup> = nanograms per cubic meter

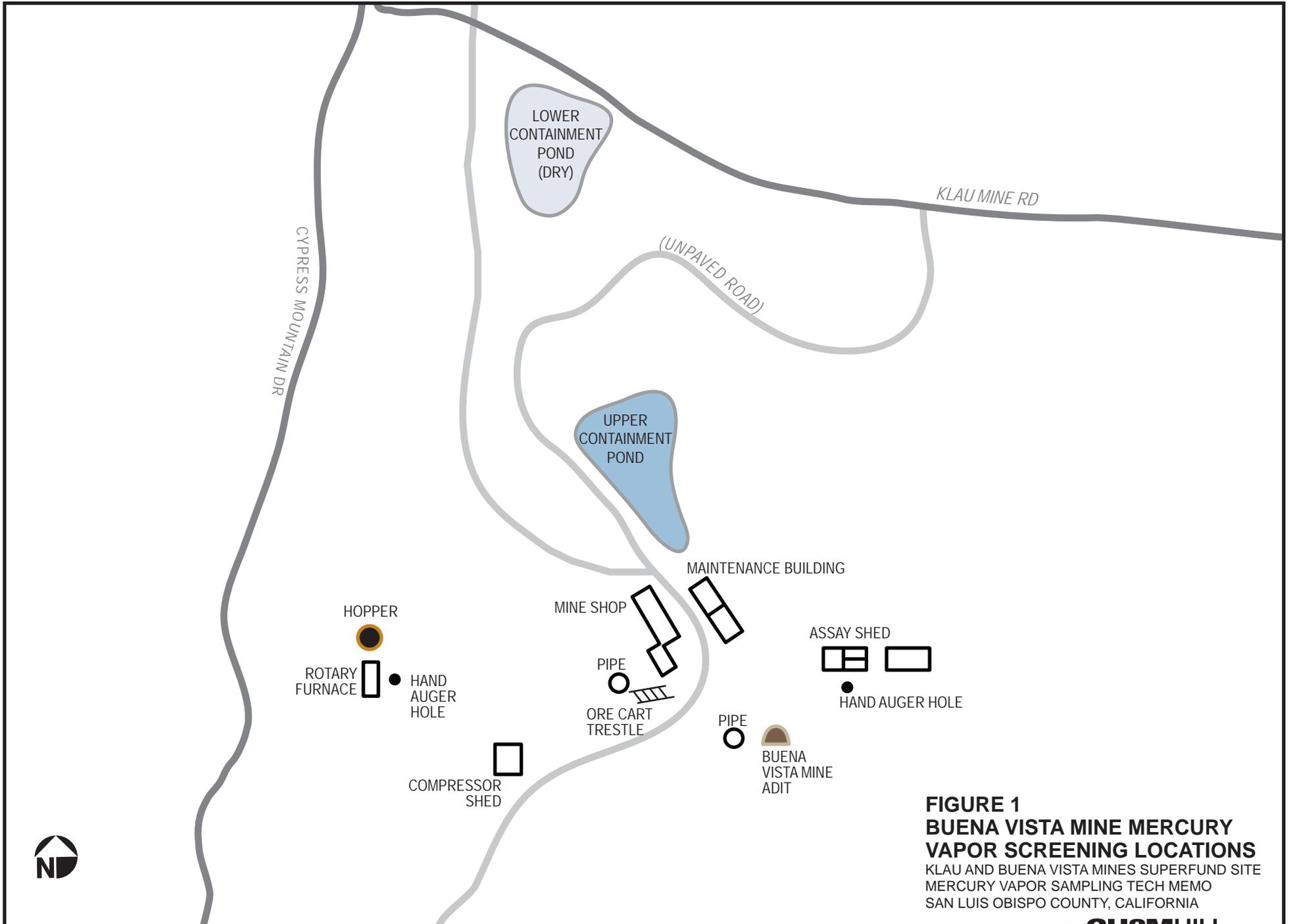
TABLE 2  
 Summary of Comparison Values for Mercury Concentrations in Air

Source	Description	Published Concentration	Comparison Concentration in ng/m <sup>3</sup>
PRG Region IX <sup>1</sup>	Residential Screening Level	0.31 µg/m <sup>3</sup>	310 ng/m <sup>3</sup>
NIOSH <sup>2</sup>	TWA (time weighted average) for 8-hour worker exposure	0.05 mg/m <sup>3</sup>	50,000 ng/m <sup>3</sup>
NIOSH <sup>2</sup>	Ceiling level	0.1 mg/ m <sup>3</sup>	100,000 ng/m <sup>3</sup>

**Notes:**  
<sup>1</sup> Preliminary remediation goals, USEPA Region IX, 2004  
<sup>2</sup> National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, Publication No. 2005-149

µg/m<sup>3</sup> = micrograms per cubic meter  
 mg/m<sup>3</sup> = milligrams per cubic meter  
 ng/m<sup>3</sup> = nanograms per cubic meter





**FIGURE 1**  
**BUENA VISTA MINE MERCURY**  
**VAPOR SCREENING LOCATIONS**  
 KLAU AND BUENA VISTA MINES SUPERFUND SITE  
 MERCURY VAPOR SAMPLING TECH MEMO  
 SAN LUIS OBISPO COUNTY, CALIFORNIA

