



**Assessment of Soil of the Cesar Vallejo School Grounds, IE 100716  
Araqueda, Cajamarca, Peru**

Sample Date: July 2022

The Environmental Health Council

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On July 15, 2022 The Environmental Health Council (The EHC), a non-profit, apolitical environmental organization, analyzed soil and air at the César Vallejo primary/secondary school in Araqueda, La Libertad, Peru. The objective of the assessment was to determine if contaminants from former gold milling operations conducted in the area of the school during the eighteenth and nineteenth centuries existed within the school grounds. The location of former gold milling operations was identified with the assistance of the Araqueda register of public documents, Lica. Elvira Cuenca Vigo, the school principal, Lic. Manuel Gilberto Urbina, and on the basis of the account of the naturalist Antonio Raimondi. Lic. Urbina also provided a tour of the school grounds, general information about the school construction activities, some historic/anecdotal mine/milling location information and consent to sample.

Most of the school grounds were capped with concrete for outdoor patios/playgrounds and for concrete floors within the school. During construction, several areas with tailings with elevated gold were removed for off-site refining to raise funds for the school. In addition, an area in the courtyard near the entrance had exposed soil with elevated heavy metals. An approximate 10 cm layer of contaminated imported infill (broken adobe walls) was placed in the courtyard entrance to replace the soil which had been removed for reprocessing. This was to be vegetated but was exposed during the July 2022 visit.

Assessment activities consisted of analyzing shallow soil samples with a field portable X-Ray Fluorescence (XRF) for assessment of heavy metals. Where mercury was detected in soil or where amalgamation was suspected of taking place, a low-level mercury vapor analyzer was used to assess the breathing zone and within several centimeters of freshly exposed soil.

Sample results are presented in the attached table and chart and ranges of results are presented below:

Arsenic soil results ranged from 14 to 1233 parts per million (ppm)

Mercury soil results ranged from below the detection limit to 66 ppm

Lead results soil ranged from 7 to 1417 ppm

Mercury vapor ranged from 690 to 2200 nanograms per cubic meter (ng/m<sup>3</sup>)

The Peru Ministry of Environment (MINAM) screening values for residential exposure (which includes exposure to children) were used for a screening level comparison to the sample results. Arsenic was detected above the MINAM residential soil screening level of 50 ppm at eight of the eleven sample locations. Mercury was detected above the MINAM residential soil screening level of 6.6 ppm at four of the eleven locations. Lead was detected above the MINAM residential soil screening level of 140 ppm at three of the 11 locations. Mercury vapor was detected above the MINAM residential air screening level

of 2000 ng/m<sup>3</sup> in one of two locations. Mercury vapor was not detected above ambient outdoor concentrations in the several classrooms that were assessed. United States Environmental Protection Agency screening values are presented in the table for comparison.

In un-contaminated areas in La Libertad and much of the Andes, arsenic and mercury can naturally be encountered at or around the following concentrations: arsenic – 30 to 50 ppm, mercury – below detection of the XRF (< about 6 ppm), and lead – 20 to 140 ppm. Mercury vapor in outdoor air in the southern hemisphere ranges from 1 to 10 ng/m<sup>3</sup>, depending on proximity to urban areas (UNEP, 2028).

#### **Areas of Concern:**

The three areas of concern include the area by the water tank at the former furnace area with exposed soil, the area to the east of the main school building near the retaining wall where soil was removed for gold recovery, and the exposed soil area near the entrance to the school grounds. Imported fill in the area had elevated lead and the soil beneath was also contaminated. Red dots on the attached figure presents sample locations where arsenic, mercury, or lead were above the MINAM screening value for exposure to soil contamination. Any sample location with elevated mercury vapor (ie greater than 300 ng/m<sup>3</sup>) was identified on the figure as a red dot.

These areas are of concern because exposure, especially by children, to heavy metals such as lead, mercury and arsenic are known to cause neurological effects as well as many other health problems.

#### **Recommendations:**

The EHC recommends capping the remaining areas of exposed soil in the former furnace area and the gold recovery area, and either removing the lead-contaminated soil near the entrance or capping that area with new clean fill (at least 15 centimeters depth) or concrete. This should be an urgent priority for school officials and local public authorities. Similar sites with these types of soil concentrations and risks in other jurisdictions such as Environment Canada, US Environmental Protection Agency, European Union, and United Nations Environment Program, would be addressed with additional assessment and removal of contaminated soil, or potentially capping of contaminated soil. At a minimum, children should be kept out of the contaminated areas and workers should be warned of the contamination before working in those areas. The exposure route, and risk, is incidental ingestion of contaminated soil during play, or work activities in the exposed soil areas. There is limited mercury vapor inhalation risk, however there is an ongoing risk that children or workers could be exposed to mercury vapor if soil is disturbed or excavated. Breathing zone mercury vapor could be high enough to be a risk during prolonged disturbance of the soil.

#### **Attachments:**

- Table - Soil Results
- Chart - Soil Results
- Figure - Location of Samples