Heavy Metals and Water Quality in an Urban Creek Watershed, Oakland, CA

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Introduction

We are middle school students from Oakland, CA interested in the water quality of Leona Creek and also Lake Aliso located at the Mills College campus in Oakland, California. After playing in the creek on warm summer days, we became interested in the quality of its water. Initial testing found levels of lead above the EPA legal limit (15 ppb). When we saw the high concentration of lead in the water samples, we embarked on figuring out the source of lead within the creek. We decided to come together to focus on the different heavy metals in the water, such as lead and iron. We traced the headwaters of Leona Creek up to an abandoned sulfur mine, known as the Leona Heights Mine (See Figure 2.), located at the end of McDonell Avenue in Oakland, CA . There we found water with a pH of 2, much lower than the water downstream in Leona Creek on the Mills College campus. The lower pH indicates that sulfuric acid from the mine (acid mine drainage) has contributed to the release of heavy metals into the watershed. Notable algal blooms in the creek confirm that there are high levels metals, which provide a substrate for their growth. We discovered that the owner of the sulfur mine has been fined, but still has not restored the mine to prevent the continued release of harmful elements into the creek, which could affect the health of the large urban population downstream.

Figure 1: The headwaters of Leona Creek at Leona Heights Mine. There is notable acid mine drainage and algal blooms (in orange).

Methods:

1) We observed that children and adults study and play in the Leona Creek at the Mills College campus.
2) Next we gathered water samples from the creek on the Mills campus.
3) We analyzed lead levels in the samples using a spectrophotometer at Lawrence Hall of Science.
4) In the field we tested for pH and Arsenic levels using a Hach test kit.
5) We gathered and analyzed water samples at the headwaters of the creek on campus and analyzed them for lead, iron and arsenic in the lab at Lawrence Hall of Science.

Works Cited:

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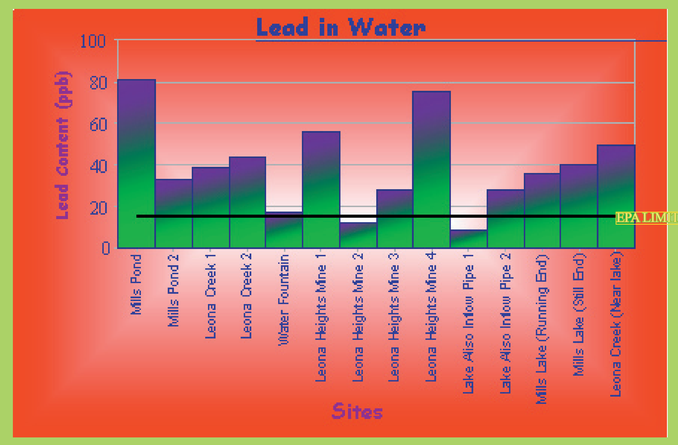

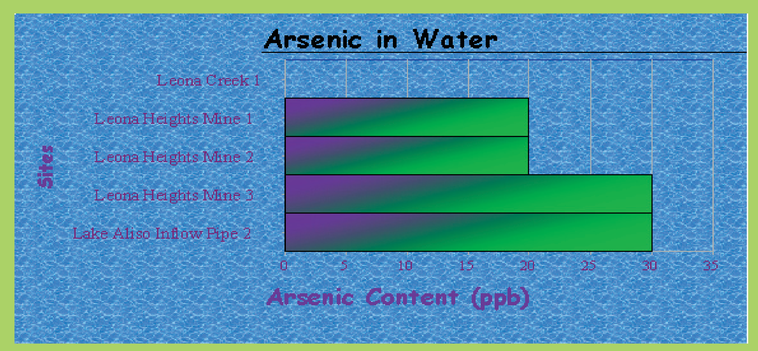

Sites	Iron Content (ppb)
Leona Heights Mine 1	Over Range > 180
Leona Heights Mine 2	33
Leona Heights Mine 3	56.68
Leona Heights Mine 4	Over Range > 180
Leona Heights Mine Pond	Over Range > 180
Lake Aliso Inflow Pipe 1	4

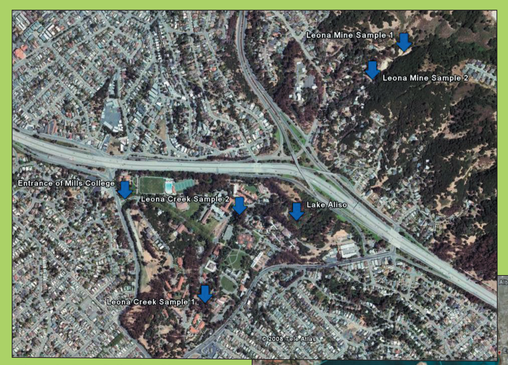

Figure 2: Data Collection Sites: Oakland, CA

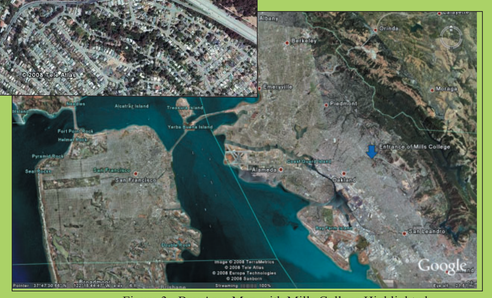

Figure 3: Bay Area Map with Mills College Highlighted

Results

Judging from the data we have collected at Leona Creek, almost all of the data samples have lead levels that are above the legal limit of lead (15 ppb), and almost all test areas, except the Lake Aliso pipe, have high levels (above EPA secondary drinking water regulations) limit of iron (30 ppb). Arsenic levels at the mine are all above the legal limit (10 ppb), however downstream on campus there was minimal arsenic. We found through a review of articles and from the San Francisco Bay Regional Water Quality Control Board that the Leona Heights Mine is owned by Dr. Collin Mbanugo, who is being fined for not cleaning up the mine and the high levels of heavy metals. We discovered how most of the high level of metal in the water came form the acidic mine drainage. The lead in the creek is not consistent but stays above the EPA limit. The level of arsenic and iron in the water at the mine is high but decreases as it flows downstream to Mills College, where it combines with other water sources. We also interviewed a former staff member of Mills College, Paul Richards, and we discovered that the university has found similar results in water metal levels. Mills College waters the campus grounds with the creek water, consequently, living things on the campus could be exposed to the high levels of heavy metals.

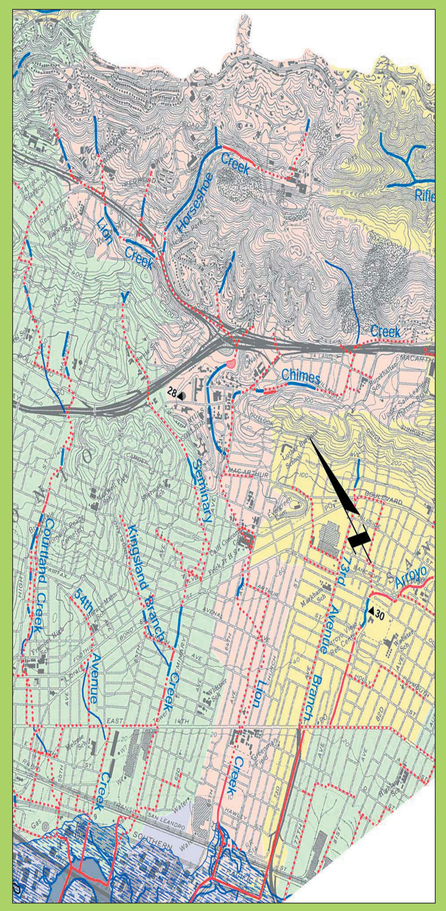

Figure 5: Lion Creek Watershed Map from the Oakland Museum. Lion Creek Watershed shown in pink.

Conclusion

Most of our water samples from the Leona Heights Mine had heavy metals concentration levels above the EPA legal limits due to the extremely acidic conditions. As the water flows downstream it combines with other primary streams which dilute the levels of metals in the creek on the Mills campus. Interestingly, lead remains high in the creek's waters on the Mills College campus. In the future, sampling other primary streams that flow into Mills College for heavy metals will help confirm this hypothesis. We also plan to sample other areas where Lion/Leona Creek discharges in Oakland, downstream from Mills College. It is dangerous for the community to leave the water the way it is. Heavy metal exposure can cause brain disorders and in particular has negative effects on women and their children. We will continue researching the surroundings and collecting samples at Leona Creek and other areas in Oakland in different seasons, especially the rainy season when the earth around the mine is weathered more heavily. In the long-term we would like to see the land at the mine restored through bioremediation so that heavy metals are no longer leached into the Lion Creek watershed.