UC DAVIS
UNIVERSITY OF CALIFORNIA

October 2025

San Bruno: Community Air Quality Report

An assessment of local air quality data, conditions, and findings relevant to San Bruno

Photo taken at a monitoring site in San Bruno (photo credit Michaela Anang).

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EXECUTIVE SUMMARY

Disadvantaged communities in California are disproportionately burdened by air pollution, yet often lack the localized data needed to inform local decision-making. This study addresses that gap in San Bruno, a designated Environmental Justice Community suffering from significant environmental disparities and ranked in the 74th percentile of pollution burden according to CalEnviroscreen. Employing a community-based participatory research approach, this project from UC Davis in collaboration with Rise South City, a local, community-based organization, deployed novel air quality sensor technology to identify metallic compounds in ambient air.

To this end, the Toxic-Metal Aerosol Real-Time Analysis (TARTA) instrument was deployed at six sites selected in partnership with Rise South City and the community. TARTA provides high-resolution, hourly data on metallic compounds in particulate matter, a significant advancement over traditional cost-prohibitive or less mobile methods. This approach provides empirical, ground-level data that fills in a gap which wider regional monitoring networks are not yet able to address.

Monitoring revealed the presence of seven metallic compounds in San Bruno's ambient air: **aluminum (Al), copper (Cu)**, **iron (Fe)**, **magnesium (Mg)**, **vanadium (V)**, **zinc (Zn)**, and most concerningly, **manganese (Mn)**.

Aluminum was found at all sites, with the highest peak of detection at site #5. **Copper** was found at all sites, with the highest peak at site #4. **Iron** was found at all sites, with the highest peak at site #1. **Magnesium** was found at sites 1-4 and 6, with the highest peak at site #1. **Vanadium** was found at site #5 and 6, with the highest peak at site 6. **Zinc** was found at all sites with the highest peak at site #5.

Manganese was found at sites 1-4, with the highest level at site #1. The detection of manganese is a critical finding, as it is regulated as a Hazardous Air Pollutant (HAP) due to its known health risks. The presence of this and other metal particulates is especially concerning in context with San Bruno's CalEnviroScreen data, which documents a pre-existing public health burden, including elevated rates of cardiovascular disease.

The findings from this analysis can help inform relevant authorities in their decision-making, enforcement of regulations, and devising relief efforts for the impacted community.

Based on this research, we recommend the following next steps:

- **Targeted Monitoring Expansion**: Deploy monitors near potential emission sources, such as facilities permitted by the Bay Area Air Quality Management District (BAAAMD), to better understand the relationship between industrial activity and community exposure of metallic compounds.
- **Strengthened Regulatory Oversight**: Advocate for continuous, or more frequent monitoring for manganese and other HAPs at both the facility and community level.
- **Policy Advocacy**: Utilize these findings to assist with Vallejo's inclusion in the AB 617 Community Air Protection Program, which would direct critical resources toward improving local air quality.
- **Support Research**: Support of additional research into air quality monitoring particularly into the unknown health effects of exposure to pollutants, including metallic compounds.

Community-engaged air quality monitoring research is needed to address gaps in regional monitoring networks. Developing and deploying novel and cost-efficient monitoring instruments is key for addressing such gaps. Community engagement is critical for building both civic capacity and trust, especially in communities that have experienced historical and contemporary disparities.

INTRODUCTION

Disadvantaged communities in California bear a disproportionate burden of air pollution . These communities include *Consistently Nominated AB 617 Communities*, which have been nominated since the inception of the California Air Resources Board (CARB) AB 617 program but have not been formally selected under the California Air Protection Program (CAPP), and Nominated AB 617 communities. These communities often lack access to adequate air quality monitoring and resources to address such environmental injustice. The UC Community Air Project (CAP) specifically aims to empower these disadvantaged communities through collaborative research and access to novel air quality monitoring technology, TARTA ***(Toxic-Metal Aerosol Real-Time Analysis)***, to better identify and quantify atmospheric metallic compounds. This novel instrument enables us to better understand an aspect of air quality that has until recently been difficult to measure due to prohibitive expense and mobility. TARTA is both relatively inexpensive and highly mobile enabling us to help empower local organizations and residents in disadvantaged communities through this community-engaged research.

Through collaborative research and deployment of ***TARTA*** , we provide data on atmospheric metallic compounds, enabling communities like San Bruno to better understand their local air quality and make meaningful decisions and take effective action. As a community-engaged project, researchers are working with *Rise South City,* a local community-based organization focused on air quality and environmental justices, in collaboratively identifying local air quality needs and concerns, monitoring locations, and report back. Our objective is to: 1) identify, quantify, and analyze metallic compounds, including hazardous air pollutants (HAPs),in San Bruno using novel instrumentation (TARTA); 2) enhance community capacity and empower local organizations and residents through collaborative research and knowledge sharing; 3) communicate the research, including findings, accessibly and responsively; and, 4) advance broader equity and justice goals of AB 617 across California.

This report includes a discussion of existing air quality conditions, a summary of applicable regulations, and an analysis of preliminary findings and implications derived from our work through the Community Air Project (CAP) in San Bruno.

REGULATORY SETTING

Air quality in the project area is regulated through the efforts of various federal, state, regional, and local government agencies. These agencies work jointly, as well as individually, to improve air quality through legislation, planning, policymaking, education, and a variety of programs. Specific to air quality in the San Bruno region, criteria air pollutants, hazardous air pollutants, and toxic air contaminants are discussed below.

Criteria Air Pollutants

Criteria Air Pollutants of note are called particulate matter (PM), which encompasses a complex mixture of solid particles and liquid droplets suspended in the air, varying in size, composition, and origin. PM10, which includes particles with an aerodynamic diameter of 10 micrometers or less, and PM2.5, a subset of PM10 with an aerodynamic diameter of 2.5 micrometers or less, are of particular concern due to their ability to penetrate deep into the respiratory system. PM originates from both direct emissions and secondary formation processes. Direct emissions arise from various sources, including combustion processes (e.g., vehicles, power plants), industrial activities, construction and demolition, agricultural practices, and natural sources like windblown dust and wildfires. Secondary formation involves gas-to-particle conversion processes, where gaseous precursors, such as sulfur dioxide (SO2), NOx, and VOCs, undergo chemical reactions in the atmosphere to form particulate matter. The composition of PM is diverse, including sulfates, nitrates, ammonium, organic carbon, elemental carbon, and various trace elements. The size and composition of PM determine its atmospheric behavior, transport, and deposition, as well as its potential health and environmental impacts. Metallic compounds, such as lead, zinc, manganese, are one form of PM.

Federal: The U.S. Environmental Protection Agency (EPA) has been charged with implementing national air quality programs. EPA's air quality mandates draw primarily from the federal Clean Air Act (CAA). EPA's air quality efforts address both criteria air pollutants (CAPs) and hazardous air pollutants (HAPs).The CAA required EPA to establish national ambient air quality standards (NAAQS) for six common air pollutants found all over the U.S. referred to as criteria air pollutants (CAPs). EPA has established primary and secondary NAAQS for criteria air pollutants, including respirable particulate matter with aerodynamic diameter of 10 micrometers or less (PM_{10}) and fine particulate matter with aerodynamic diameter of 2.5 micrometers or less ($PM_{2.5}$), and lead. The primary standards protect public health, and the secondary standards protect public welfare.

State: The CAA also requires each state to prepare a state implementation plan (SIP) for attaining and maintaining the NAAQS. In compliance with federal mandates, California's SIP is modified periodically to reflect the latest emissions inventories, planning documents, and rules and regulations of the air basins as reported by their jurisdictional agencies. EPA is responsible for reviewing all SIPs to determine whether they conform to the mandates of the CAA, and whether implementation will achieve air quality goals. If EPA determines a SIP to be inadequate, EPA may prepare a federal implementation plan that imposes additional control measures. If an approvable SIP is not submitted or implemented within the mandated time frame, sanctions may be applied to transportation funding and stationary air pollution sources in the air basin.

Additionally, the California Air Resources Board (CARB) is the agency responsible for coordination and oversight of State and local air pollution control programs in California and for implementing the California Clean Air Act (CCAA). The CCAA, which was adopted in 1988, required CARB to establish California ambient air quality standards (CAAQS).

CARB has established CAAQS for several kinds of air pollutants (i.e., sulfates, hydrogen sulfide, vinyl chloride, visibility-reducing particulate matter), and criteria air pollutants. In most cases the CAAQS are more stringent than the NAAQS. Differences in the standards are generally explained by the health effects studies considered during the standard-setting process and the interpretation of the studies. In addition, the CAAQS incorporate a margin of safety to protect sensitive individuals.

The CCAA requires that all local air districts in the state endeavor to attain and maintain the CAAQS by the earliest practical date. The CCAA specifies that local air districts should focus particular attention on reducing the emissions from transportation and area-wide emission sources. The CCA also provides air districts with the authority to regulate indirect sources.

Hazardous Air Pollutants and Toxic Air Contaminants

Hazardous air pollutants (HAPs), are a defined set of airborne pollutants that may pose a present or potential hazard to human health. HAPs are usually present in minute quantities in the ambient air; however, their high toxicity or health risk may pose a threat to public health even at low concentrations. While criteria air pollutants (CAPs) are the six most common air pollutants regulated by the EPA, HAPs are substances known or suspected to cause cancer or other serious health effects.

A wide range of sources, from industrial plants to motor vehicles, emit HAPs. The health effects associated with HAPs are quite diverse and generally are assessed locally, rather than regionally (EPA, 2025).[1] HAPs – at different exposure rates and concentrations - have been associated with long-term health effects such as cancer, birth defects, neurological damage, asthma, bronchitis, or genetic damage; or short-term acute effects such as eye watering, respiratory irritation (a cough), running nose, throat pain, and headaches. For evaluation purposes, HAPs are separated into carcinogens and non-carcinogens based on the nature of the physiological effects associated with exposure to the pollutant. This contrasts with criteria air pollutants (discussed above) for which acceptable levels of exposure can be determined and for which ambient standards have been established.

Federal: EPA regulates HAPs through its National Emission Standards for Hazardous Air Pollutants. The standards for a particular source category require the maximum degree of emission reduction that the EPA determines to be achievable, which is known as the Maximum Achievable Control Technology—MACT standards.

State: HAPs in California are regulated primarily through the Tanner Air Toxics Act (Assembly Bill [AB] 1807, Chapter 1047, Statutes of 1983) and the Air Toxics Hot Spots Information and Assessment Act of 1987 (AB 2588, Chapter 1252, Statutes of 1987). AB 1807 sets forth a formal procedure for CARB to designate substances as HAPs. Research, public participation, and scientific peer review are required before CARB can designate a substance as a HAP. To date, CARB has identified more than 21 HAPs and adopted EPA's list of HAPs.

After a HAP is identified, CARB then adopts an airborne toxics control measure for sources that emit that HAP. If a safe threshold exists for a substance at which there is no toxic effect, the control measure must reduce exposure below that threshold. If no safe threshold exists, the measure must incorporate the best available control technology for toxics to minimize emissions.

The Hot Spots Act (AB 2588) requires that existing facilities that emit toxic substances above a specified level prepare an inventory of toxic emissions, prepare a risk assessment if emissions are significant, notify the public of significant risk levels, and prepare and implement risk reduction measures.

AB 617, implemented in 2017, aims to help protect air quality and public health in communities around industries subject to the state's cap-and-trade program for GHG emissions. AB 617 imposes a new state-mandated local program to address non-vehicular sources (e.g., refineries, manufacturing facilities) of

[1] https://www.epa.gov/haps

criteria air pollutants and HAPs. The bill requires CARB to identify high-pollution areas and directs air districts to focus air quality improvement efforts through adoption of community emission reduction programs within these identified areas. Currently, air districts review individual sources and impose emissions limits on emitters based on best available control technology, pollutant type, and proximity to nearby existing land uses. This bill addresses the cumulative and additive nature of air pollutant health effects by requiring community-wide air quality assessment and emission reduction planning. TARTA can aid in these efforts by identifying and quantifying metallic compounds, including criteria air pollutants and HAPs.

ENVIRONMENTAL SETTING

Environmental Justice and Air Quality

San Bruno is located within the San Francisco Bay Area Air Basin. San Bruno is considered an "Environmental Justice Community." CalEnviroScreen[i] lists San Bruno in the 74 percentile of pollution burden. The population of San Bruno is majority minority with 43% Hispanic and 33% Asian American residents. Sensitive populations of San Bruno report over 60% asthma and low birth weight and 47% cardiovascular disease. Housing burden in the area is at 86% and unemployment at 62%.

Sensitive receptors are generally considered to include those land uses where exposure to pollutants could result in health-related risks to sensitive individuals, such as children or the elderly. Residential dwellings, schools, hospitals, playgrounds, and similar facilities are of primary concern because of the presence of individuals particularly sensitive to pollutants and/or the potential for increased and prolonged exposure of individuals to pollutants. It's important for city planners and public health officials in San Bruno to consider the locations of these sensitive receptors when making decisions about land use, transportation, and air quality management. Minimizing exposure to air pollution for these groups is crucial for protecting public health.

Air pollution in San Bruno is primarily monitored and addressed by the Bay Area Air District (BAAD). This regional agency is responsible for regulating stationary sources of air pollution (like factories and refineries) throughout the nine counties surrounding San Francisco Bay. They monitor air quality through a network of monitoring stations, conduct inspections of facilities, and enforce regulations to limit emissions.

In addition to the BAAD, other organizations play a role. CARB sets statewide air quality standards and oversees local agencies like the BAAD. Locally, San Bruno, located in San Mateo county, has its own initiatives to address air quality. For example, the City of San Bruno General Plan includes a Climate Action Plan to reduce greenhouse gas emissions as well as regulations regarding hazardous materials in order to minimize possible hazards for residents.[ii] Citizen groups and environmental organizations also contribute by raising awareness, advocating for stricter regulations, and monitoring air quality through independent means.

REPORT FINDINGS

Methodology

This project employs a mixed-methods approach combining community-based participatory research and air pollution monitoring.

1. **Community Engagement:** Collaborate with community partners throughout all stages of the project. This includes strategizing on siting locations for air monitoring, facilitating community connection and engagement as well as dissemination strategies for study results.
2. **Air Pollution Monitoring:** Deploy the TARTA instrument to collect real-time data on the size and chemical composition of toxic metal aerosols for between 1 and 3 weeks.
3. **Data Analysis:** Identify pollutant types, levels, and further understand spatial-temporal trends.
4. **Knowledge Translation:** Findings will be translated into accessible formats for community members and policymakers (e.g., Air Quality Management Districts)
5. **Policy Advocacy:** Use research findings to advocate for evidence-based policy changes to improve air quality in disadvantaged communities.

TARTA was developed by the University of California, Davis with funding from CARB and US EPA. TARTA uses a Spark-Induced Breakdown Spectroscopy (SIBS) system which operates by generating a high-voltage spark between two electrodes to create a plasma from the collected air sample. This plasma excites particles, and as it cools, the emitted light reveals the unique elemental signatures present in the sample. A photodiode triggers data acquisition, which is collected and processed through the programming software MATLAB and machine learning algorithms, specifically LASSO, are employed for in-depth analysis. TARTA takes in air for 55 minutes and then sparks, with collection totaling 24 collections a day and is ongoing for the entire time it is in the field.

Air monitoring with TARTA was conducted at six sites in San Bruno. At sites 1-4 version 1.0 of TARTA was used. Version 2.0 of TARTA was used at sites 5-6 which included technical updates to the instrument. These updates allow for higher sensitivity of the instrument.

All of the data sampling were conducted within the red circle on the map below, but specific locations have been purposely omitted for confidentiality and respect to the community members who allowed us to conduct research at their chosen locations.

Sampling Radius

Results

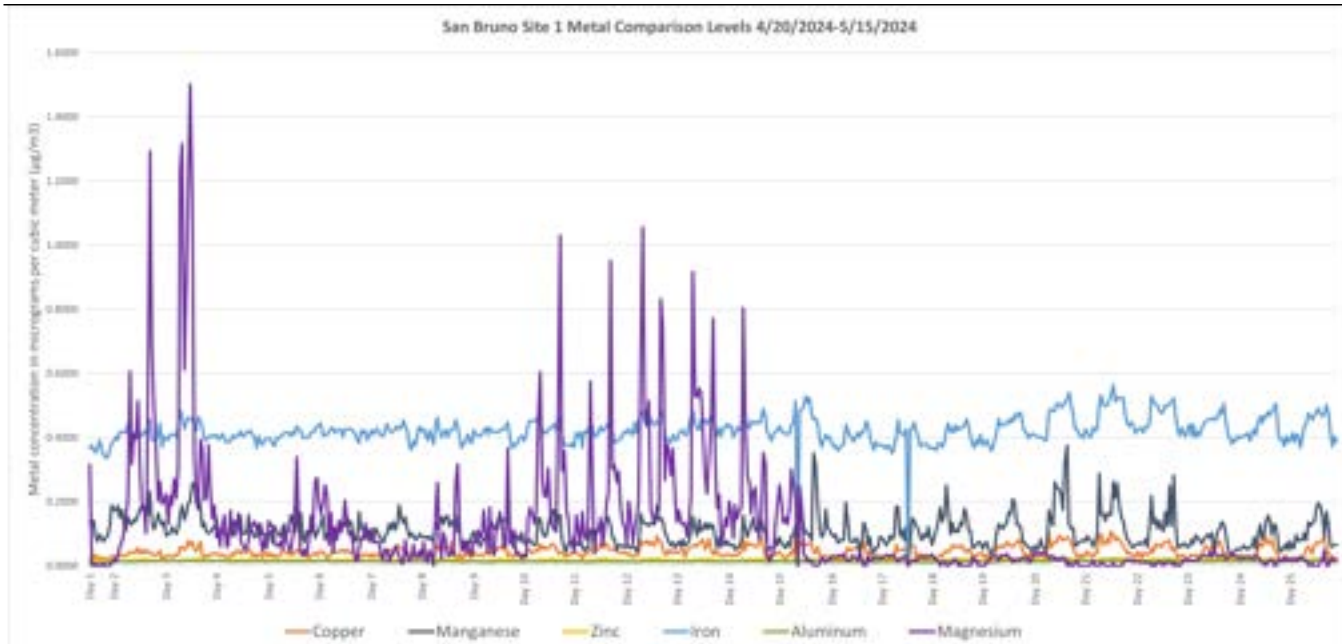
Of the sixteen elements TARTA can detect, seven metallic compounds were found in the ambient air at San Bruno: aluminum (Al), copper (Cu), iron (Fe), magnesium (Mg), manganese (Mn), vanadium (V) and zinc (Zn). Only Manganese is classified as a hazardous air pollutant (HAP, described above). While the TARTA also detected Nickel (Ni) and Chromium (Cr), which are also classified as HAPs, the levels in San Bruno were below the level above which TARTA can provide measurements. While in small amounts, each of these metals is normal, above certain thresholds and exposure levels, all the identified elements may still pose health risks.

The results are broken down first by comparison of all the metals across the four sampling sites. Then, each metal is described including possible health effects and the measurements across sites are graphed. All figures display the concentrations in micrograms per cubic meter ($\mu g/m^3$) of the seven metallic compounds found in the ambient air across the four sites in San Bruno.

San Bruno Site Specific Compilation of Metals

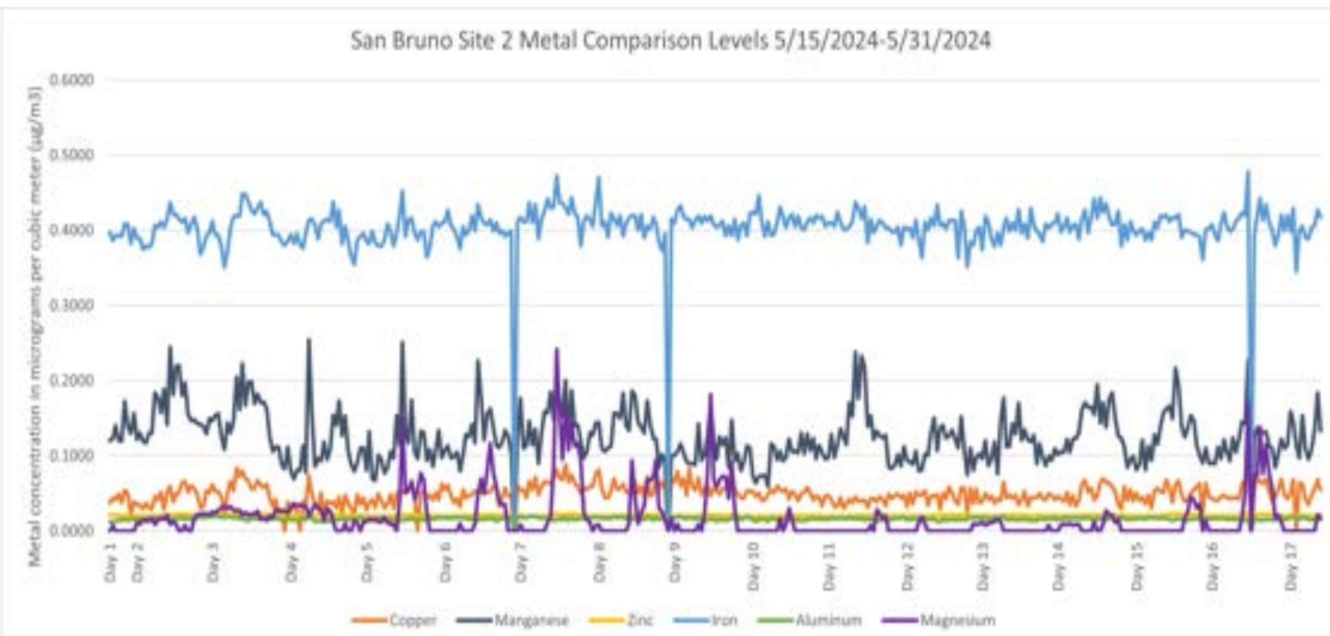
Site 1 (SB1)

Site 1 was a residential location that experiences high air traffic due to its proximity to the San Francisco airport and highways 101 and 380. There are also several industrial businesses in the vicinity. Sampling was conducted for 25 days from 4/20/2024 until 5/15/2024.



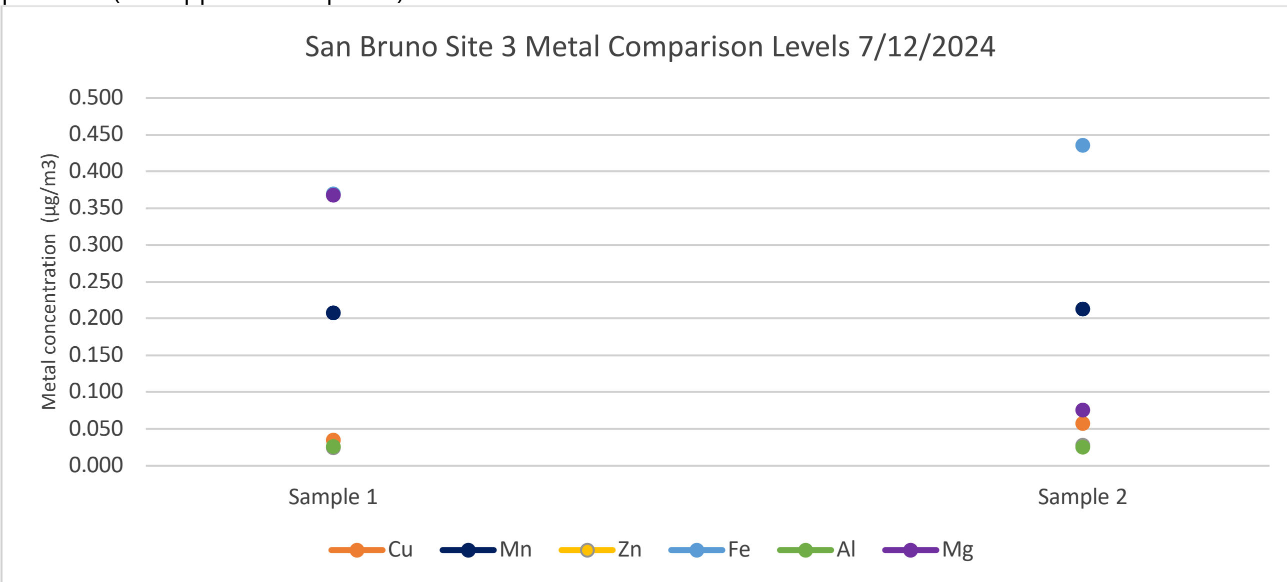
Site 2 (SB2)

Site 2 was a residential location located adjacent to high traffic highways. Sampling was conducted for 17 days from 5/15/2024 until 5/31/2024.



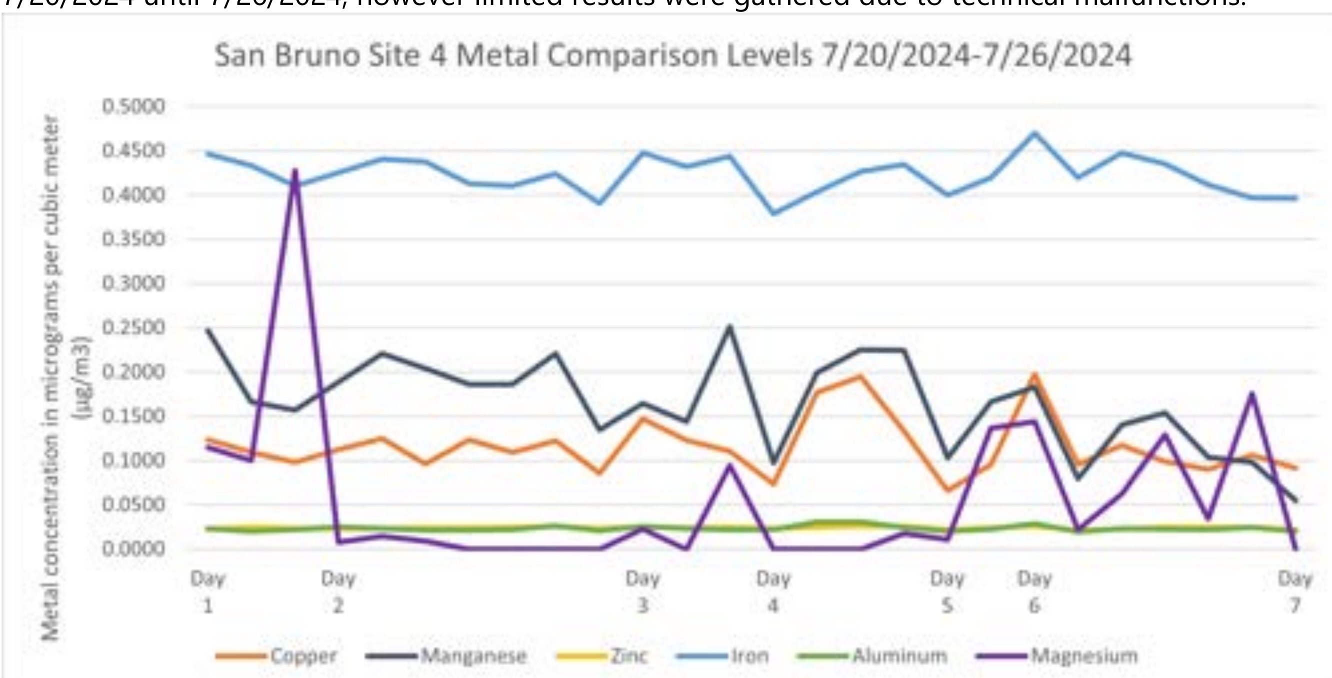
Site 3 (SB3)

Site number 3 was a stationary monitoring site near a number of highway intersections. Sampling took place for three hours on 7/12/2024 to test stationary monitoring protocol with EV and in a site of high priority by community partners. (see Appendix for photo)



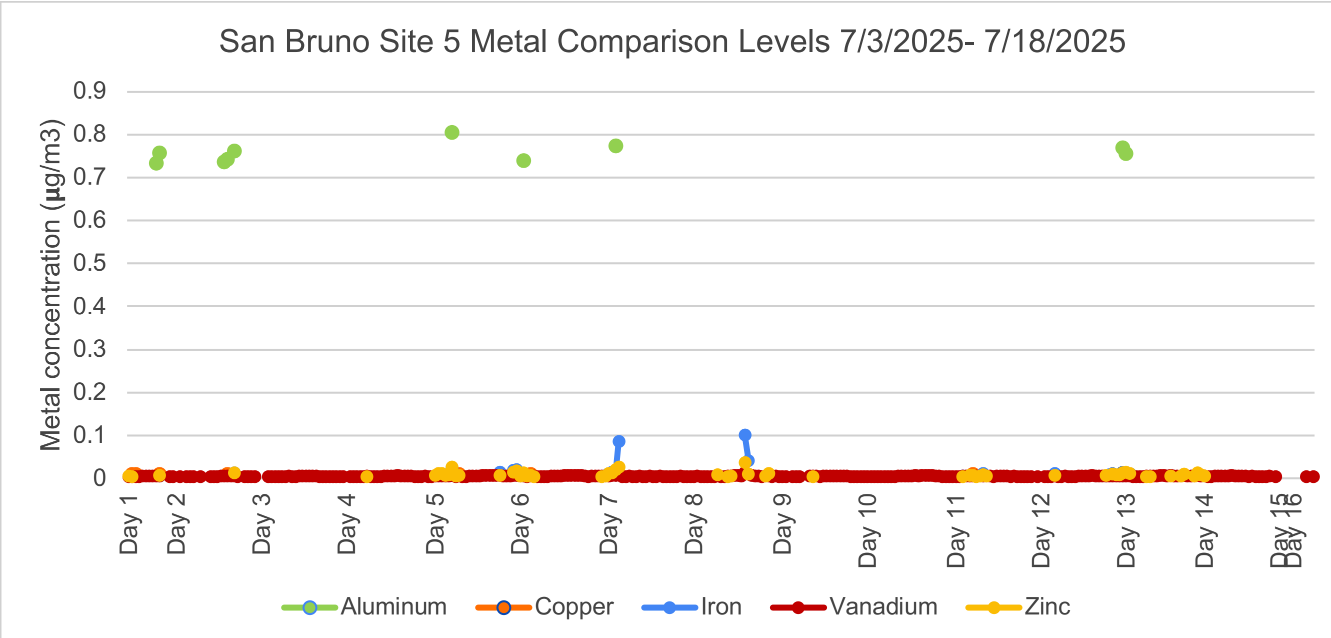
Site 4 (SB4)

Site 4 was located at a school building. This was stationary monitoring using TARTA connected to a Ford F150 truck for power outside of the location (see appendix). Sampling was conducted for seven days from 7/20/2024 until 7/26/2024, however limited results were gathered due to technical malfunctions.



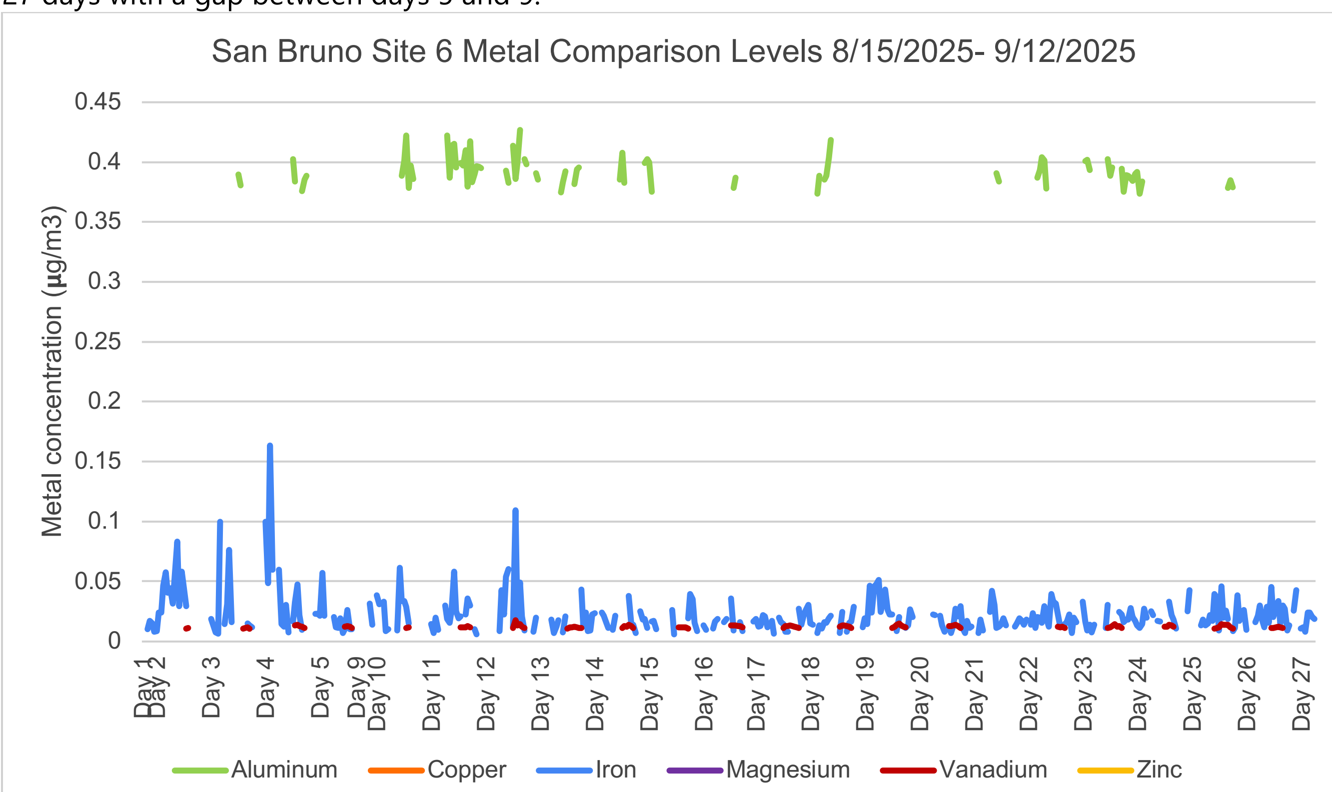
Site 5 (SB5)

Site 5 was a residential location near to the San Francisco airport. Sampling was conducted for 16 days.



Site 6 (SB6)

Site 6 was a residential location near train tracks and automotive repair shops. Monitoring took place for 27 days with a gap between days 5 and 9.



Metal Measurements

Below are the measurements of the six metallic compounds detected by TARTA in San Bruno. Each metal is described including possible health effects and regulatory limits of exposure and the measurements across sites are graphed. Manganese is the first metal reported due to its status as a HAP; the subsequent metals are listed in alphabetical order. All figures display the concentrations in micrograms per cubic meter (μg/m^3).

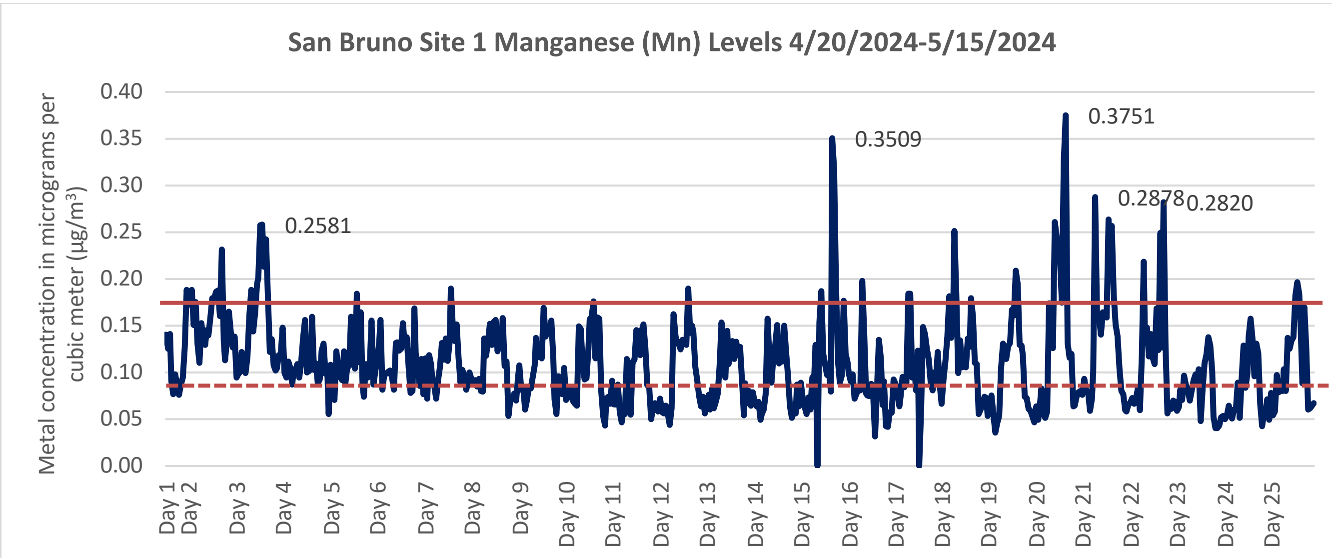
- **Aluminum** was found at all sites, with the highest peak of detection at site #5.
  - The Occupational Safety and Health Administration (OSHA) limits workers' exposure to aluminum in dusts to 15000 μg/m^3 (total dust) 5000 μg/m^3 (respirable fraction). However, no acute-, intermediate-, or chronic-duration inhalation respirable limits were derived for aluminum because it is unclear whether the observed respiratory effects are related to aluminum toxicity or to dust overload..
- **Copper** was found at all sites, with the highest peak at site #4.
  - OSHA lists the occupational exposure limit for 8 hours in a 40-hour work week as 100 μg/m^3 (fume) and 1000 μg/m^3 (dusts & mists).
- **Iron** was found at all sites, with the highest peak at site #1.
  - OSHA lists the occupational exposure limit for 8 hours in a 40-hour work week as 10000 μg/m^3 (dust & fume).
- **Magnesium** was found at sites 1-4 and 6, with the highest peak at site #1.
  - OSHA lists the occupational exposure limit for 8 hours in a 40-hour work week as 15000 μg/m^3.
- **Manganese (HAP)** was found at sites 1-4 with the highest level at site #1.
  - The Office of Environmental Health Hazard Assessment (OEHHA) lists the Reference Exposure Levels (REL) for Manganese at 0.17 μg/m^3 for 8 hour exposure, and 0.09 μg/m^3 for chronic exposure. Where relevant, the graphs below show these levels.
- **Vanadium** was only found at sites 5-6 with the highest peak at site #6. *Emission Concentrations for Vanadium have been overestimated and therefore are considered "Low Confidence" due to ongoing software issues*
  - OEHHA lists the REL for acute exposure at 30 μg/m^3 for vanadium pentoxide.
- **Zinc** was found at all sites with the highest peak at site #5.
  - OSHA has set an average limit of 1000 μg/m^3 (zinc chloride) and 5000 μg/m^3 (zinc oxide) in workplace air during an 8-hour workday, 40-hour workweek.

Manganese (Mn) Measurements

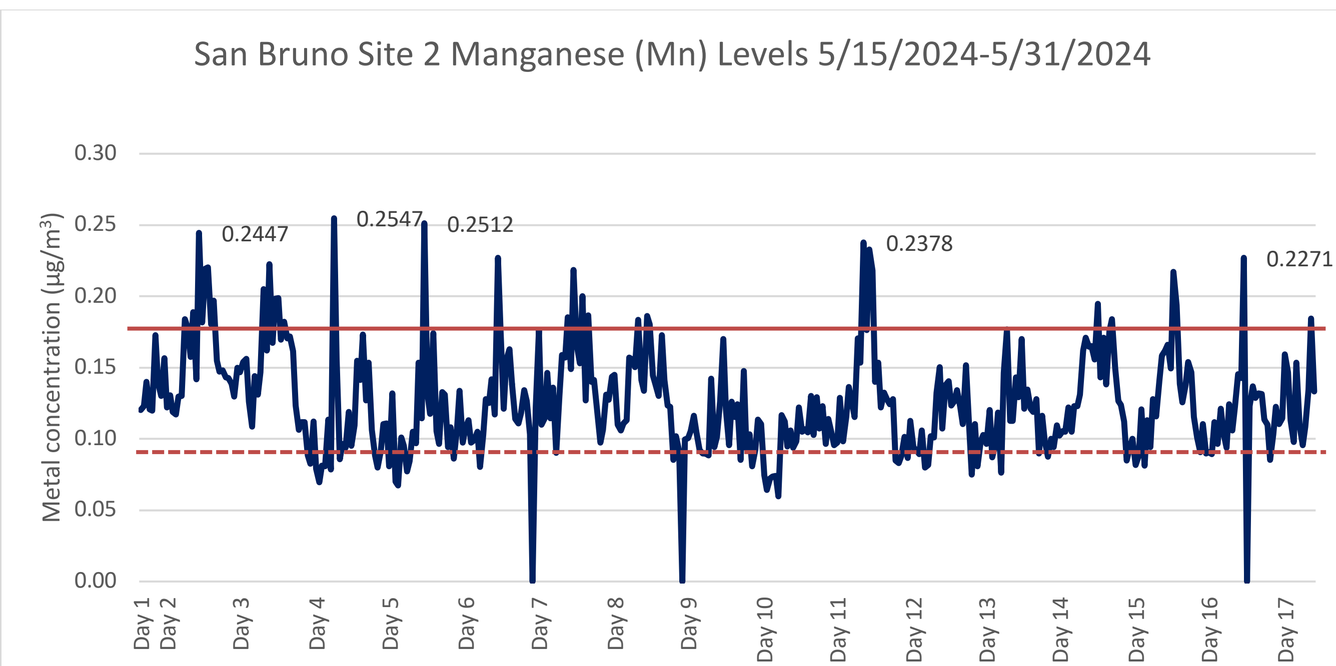
Manganese is classified as a hazardous air pollutant (HAP). Emissions sources of manganese are often industries using or manufacturing products which contain the metal, mining activities, and automobile exhaust.[iii] Manganese can pose health risks since inhaling Mn particles can cause lung inflammation, leading to coughing, bronchitis, and even minor lung tissue damage. Manganese is particularly concerning because it can inhibit the body's natural defenses, accumulating in the lungs, liver, kidneys, and central nervous system. According to The Office of Environmental Health Hazard Assessment

(OEHHA), a California state agency within CalEPA, the Reference Exposure Levels for Manganese are at 0.17 (µg/m^3) for 8-hour exposure, and 0.09 (µg/m^3) for chronic exposure.[iv] The graphs below show these levels with a solid red line for 8-hour exposure and a dashed line for chronic exposure levels.

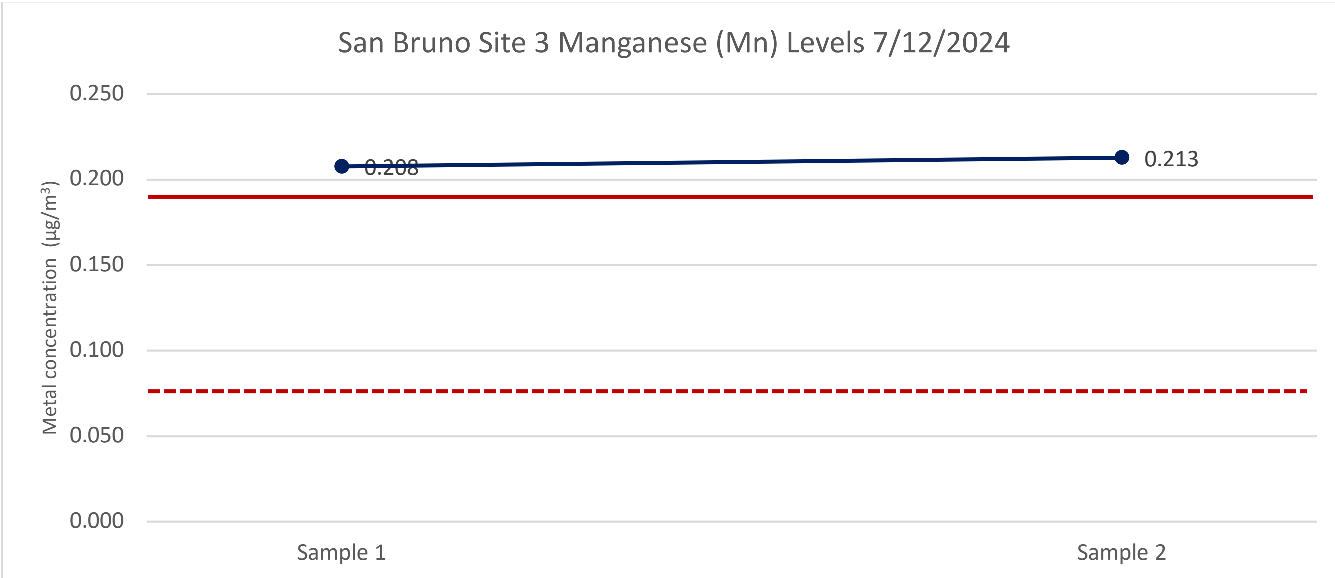
Site 1 (SB1)



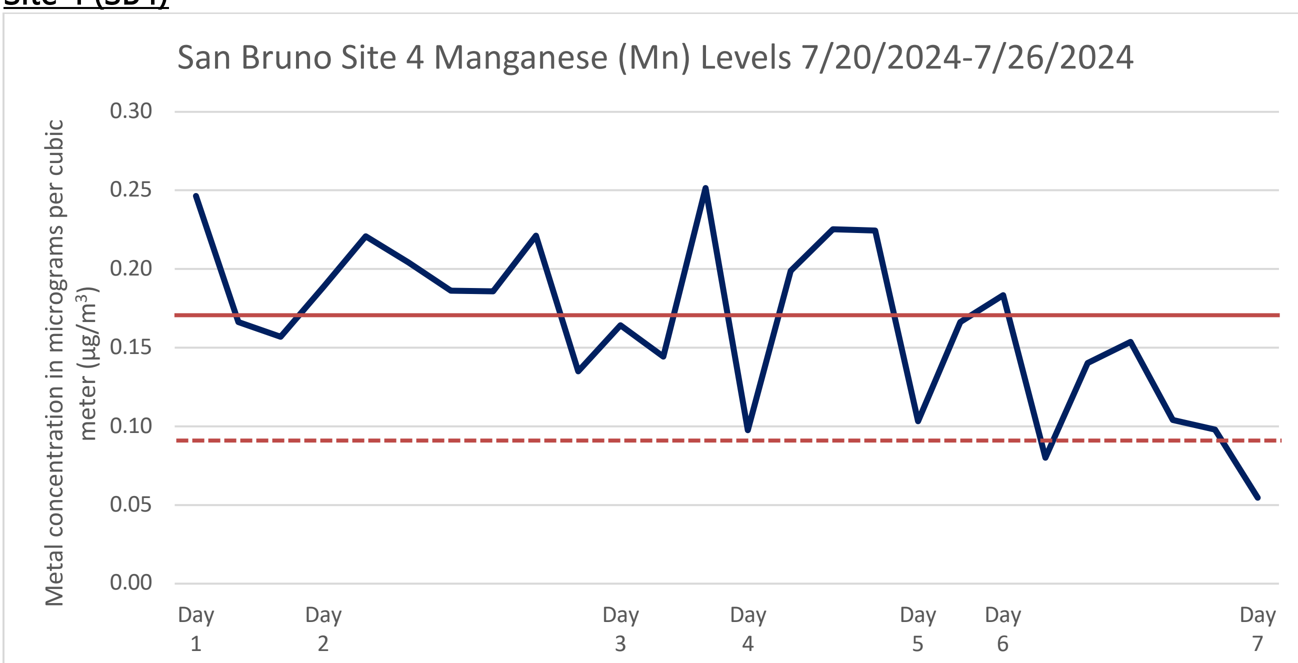
Site 2 (SB2)



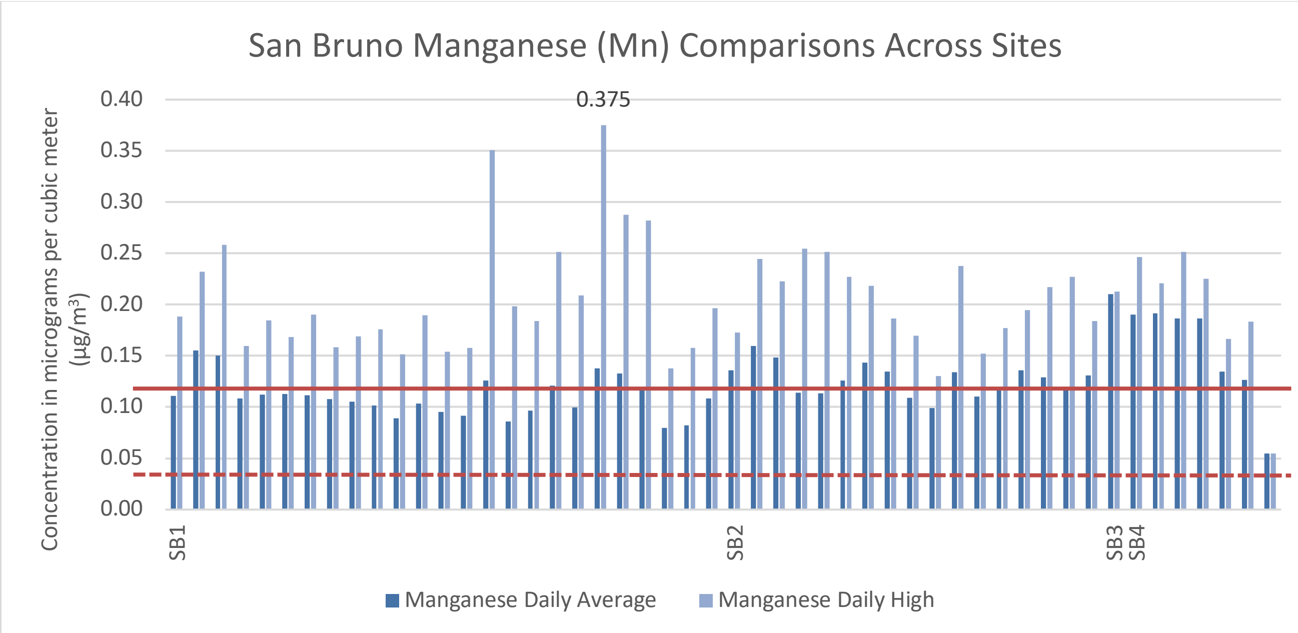
Site 3 (SB3)



Site 4 (SB4)



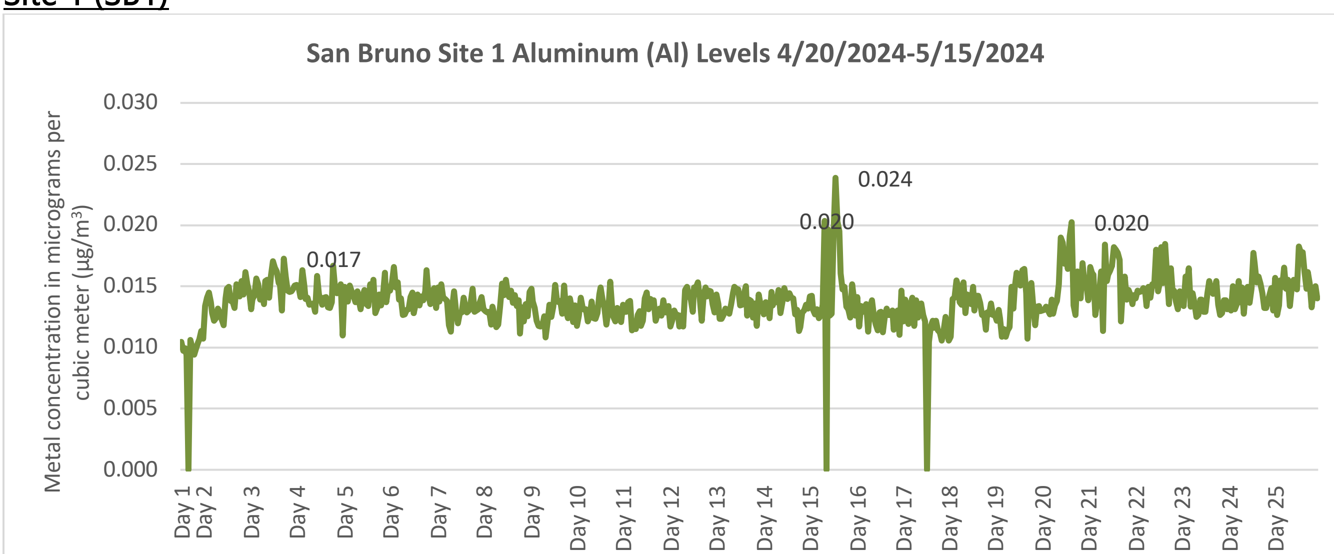
Comparison across sites



Aluminum (Al) Measurements

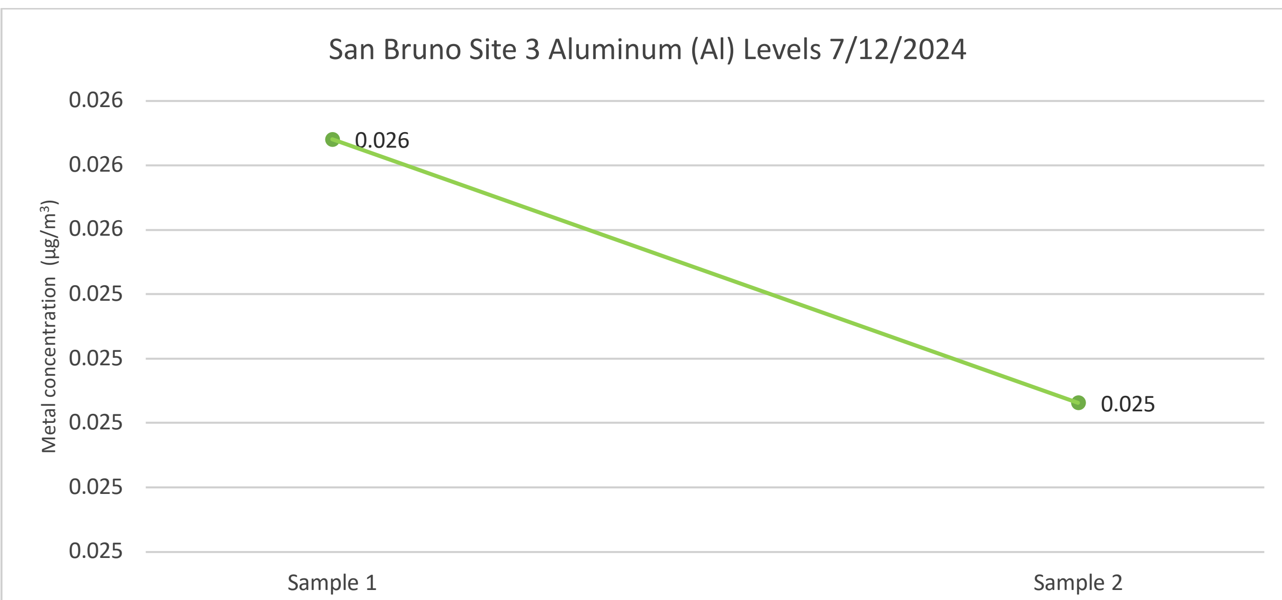
Aluminum in the air possibly results from aluminum production, coal combustion, mining, waste incineration, and motor vehicle exhaust.[v] High amounts can be caused by mining and processing aluminum ores, producing aluminum metal, alloys and compounds, while small amounts are released from coal-fired power plants and incinerators.[vi] Although the relative exposure for health risks are not addressed in this report, high levels of aluminum have been found in the brain tissues of Alzheimer's disease (AD), epilepsy, and autism patients.[vii]

Site 1 (SB1)



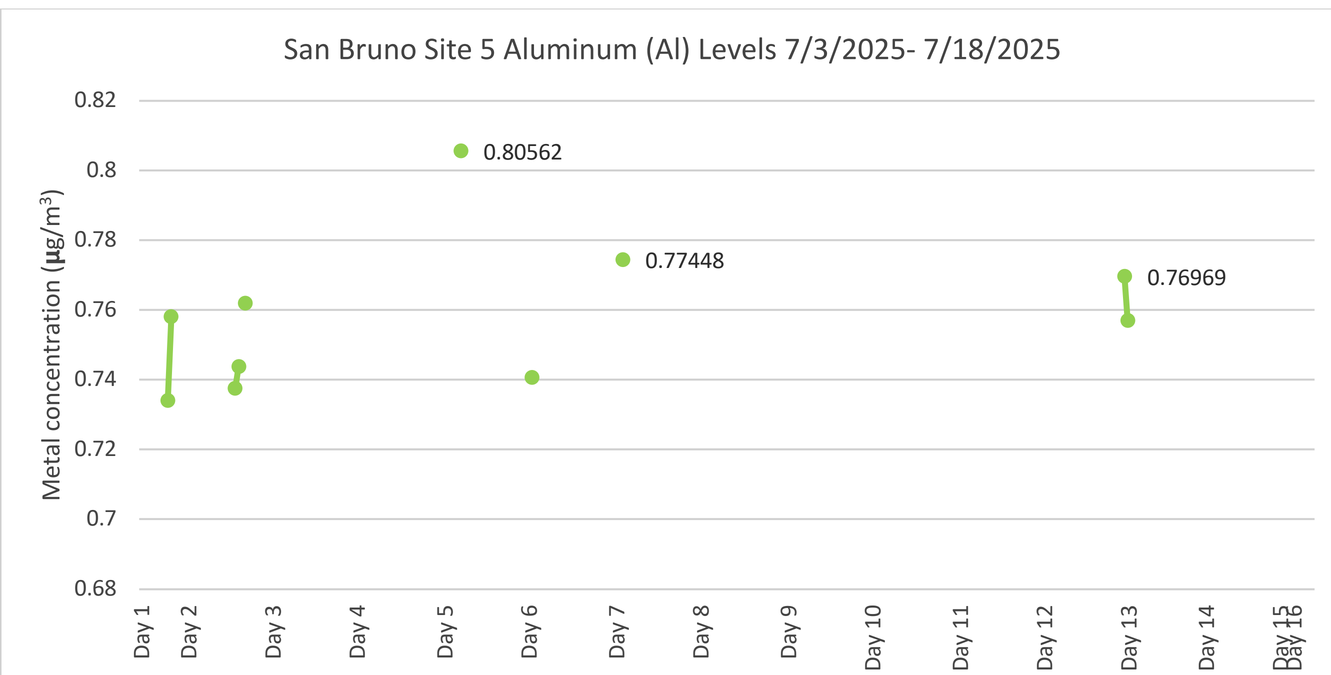
Site 2 (SB2)

Site 3 (SB3)

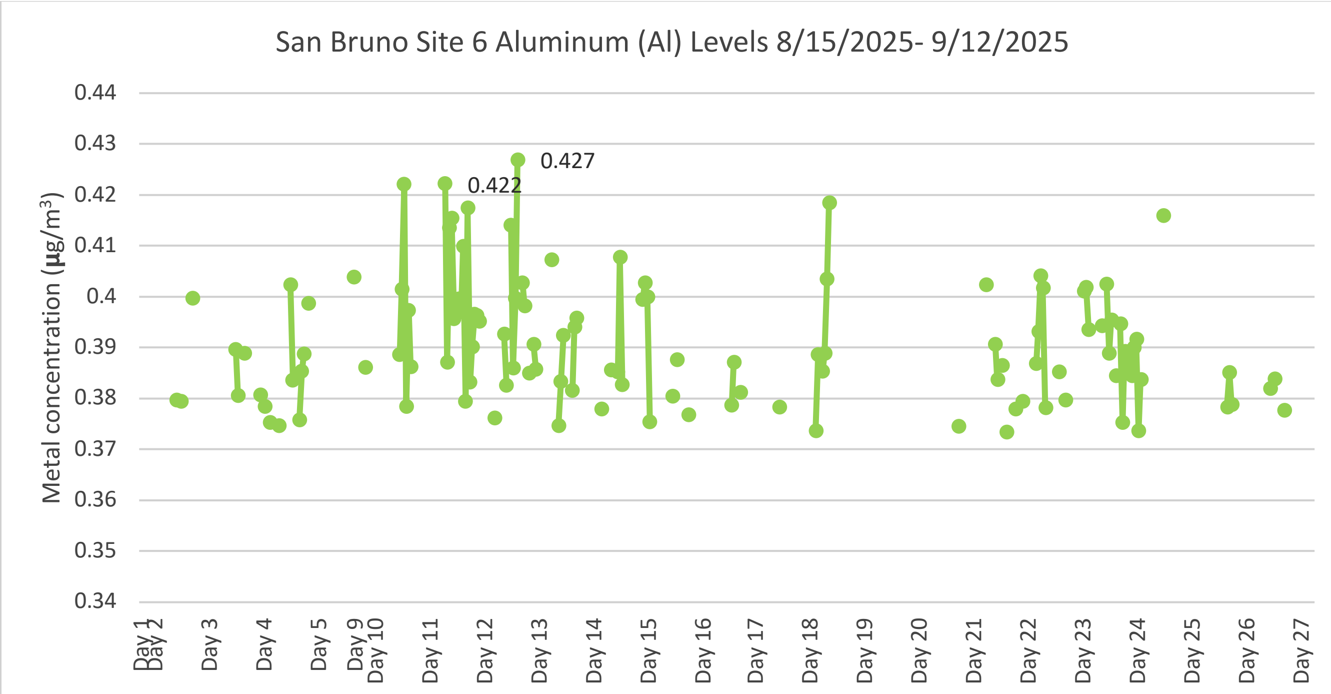


Site 4 (SB4)

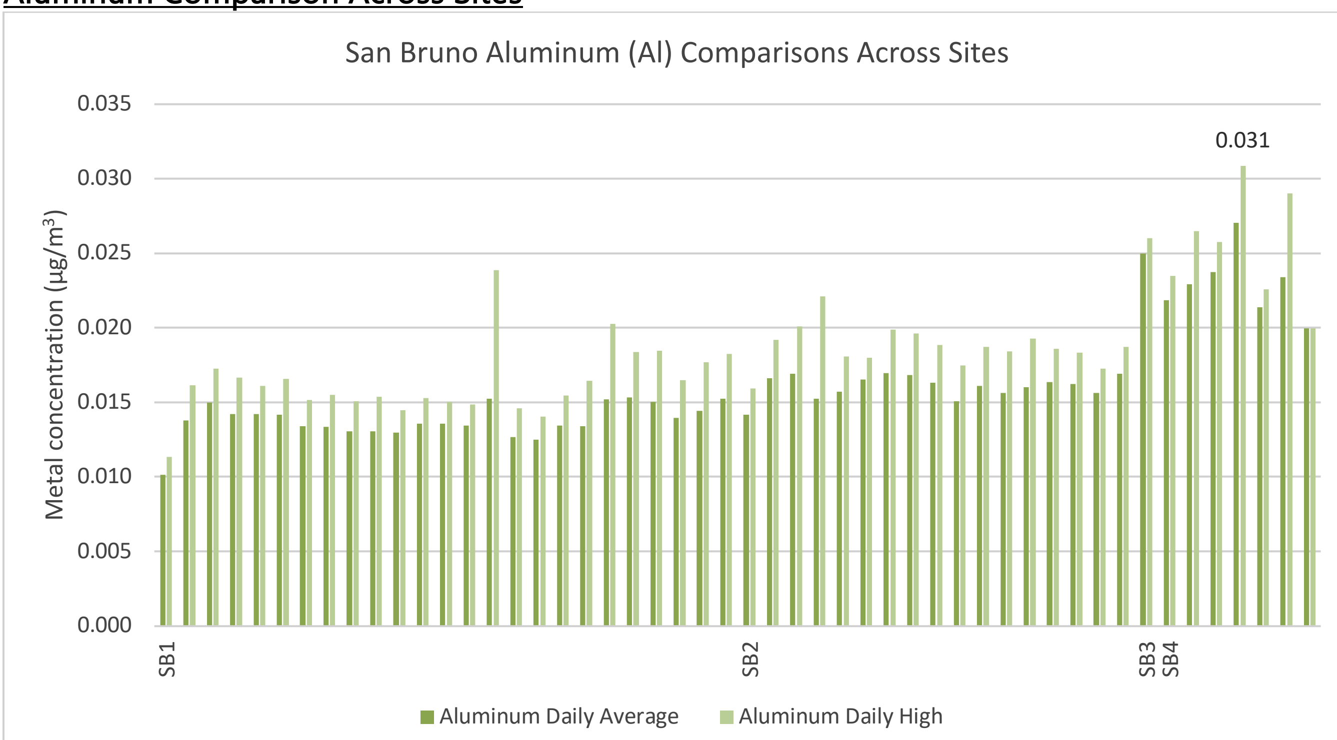
Site 5 (SB5)



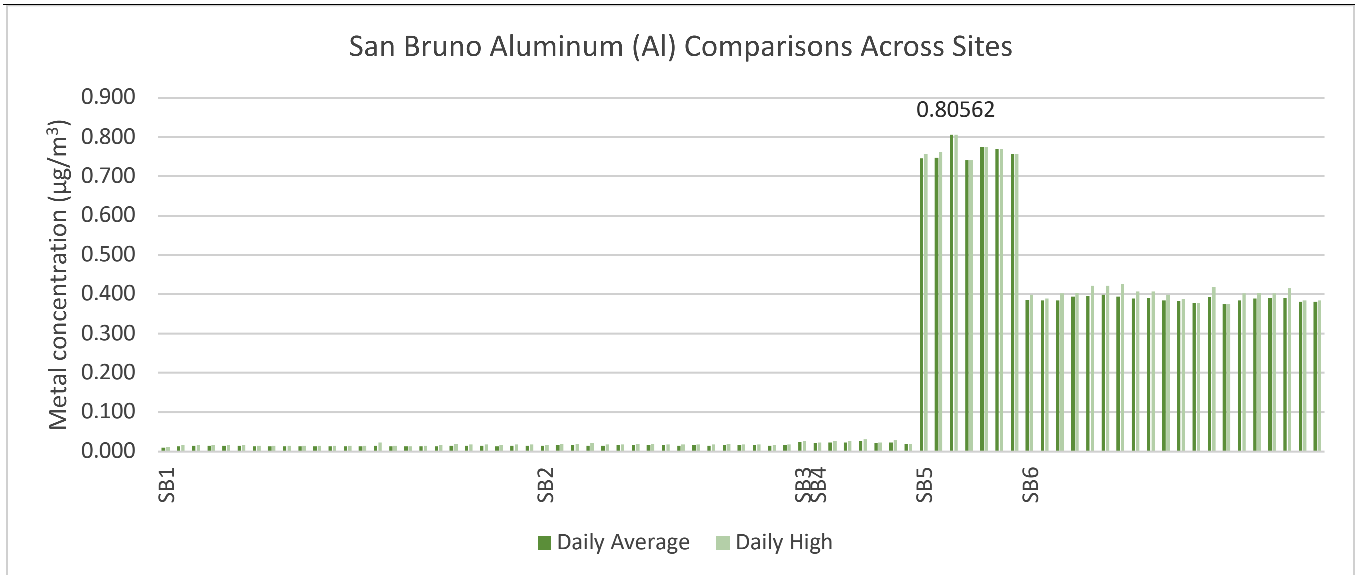
Site 6 (SB6)



Aluminum Comparison Across Sites



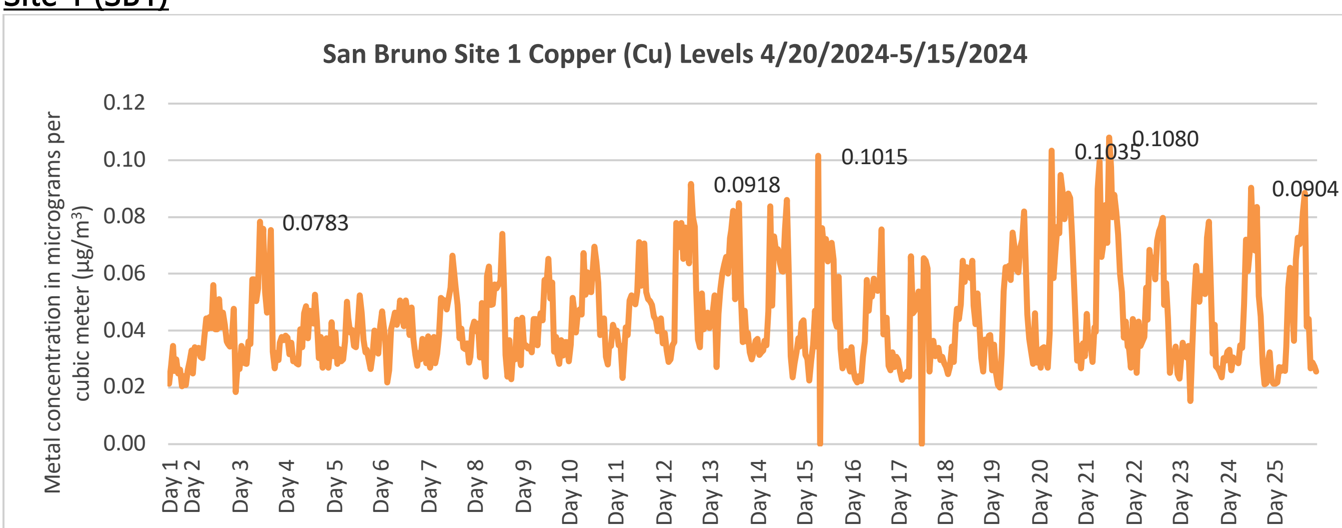
(Graph including sites 5 and 6 on following page)



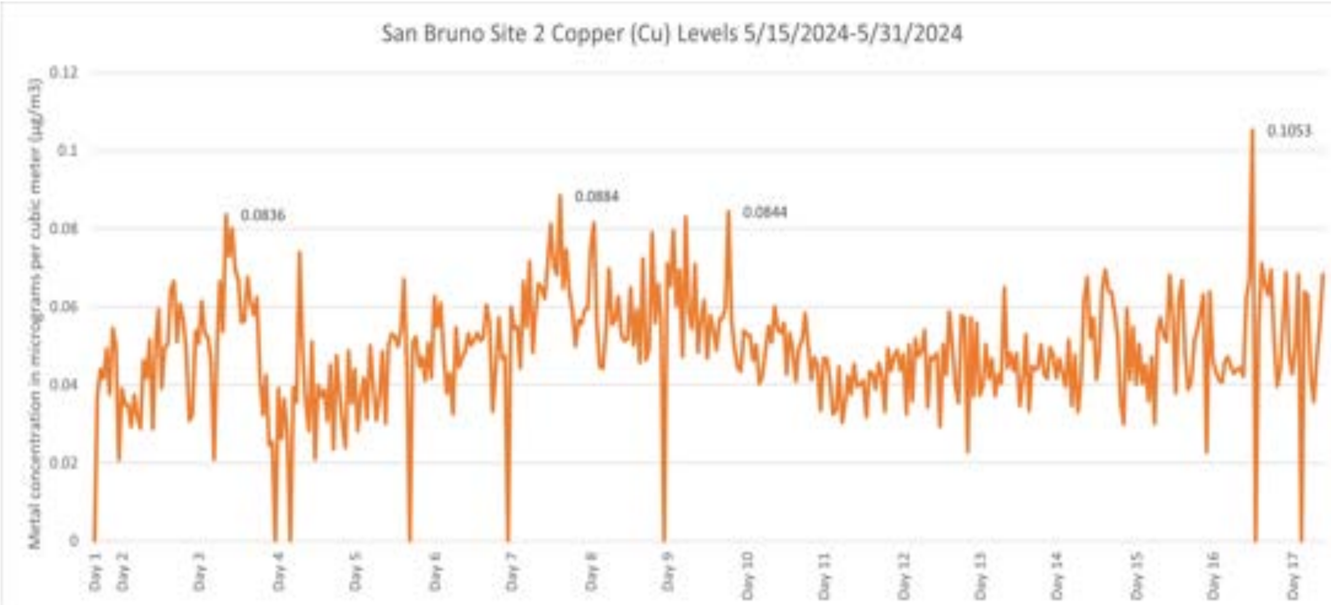
Copper (Cu) Measurements

Sources of copper emissions can vary from industrial to daily transportation. Copper emissions may result from manufacturing of: chemicals, cement, lime, plaster and concrete products, transport equipment, iron and steel, petroleum and coal products; beverages and malt, paper products, glass products, metal products, motor vehicles and parts, wood and ceramic products, textile and fabrics. Additionally coal mining, burning fuels or wildfires, fuel combustion, vehicle exhaust of cars, airplanes, railway and commercial shipping may cause copper emissions. Copper inhalation at high levels can cause irritation to the nasal passages, mouth, eyes and throat, and ingesting high concentrations can lead to nausea, vomiting and diarrhea. Exposure to very high levels of copper can damage the liver and kidneys and may lead to death.[viii] Excess intake of copper can result in toxicity and copper may adversely interact with other metals including zinc.[ix]

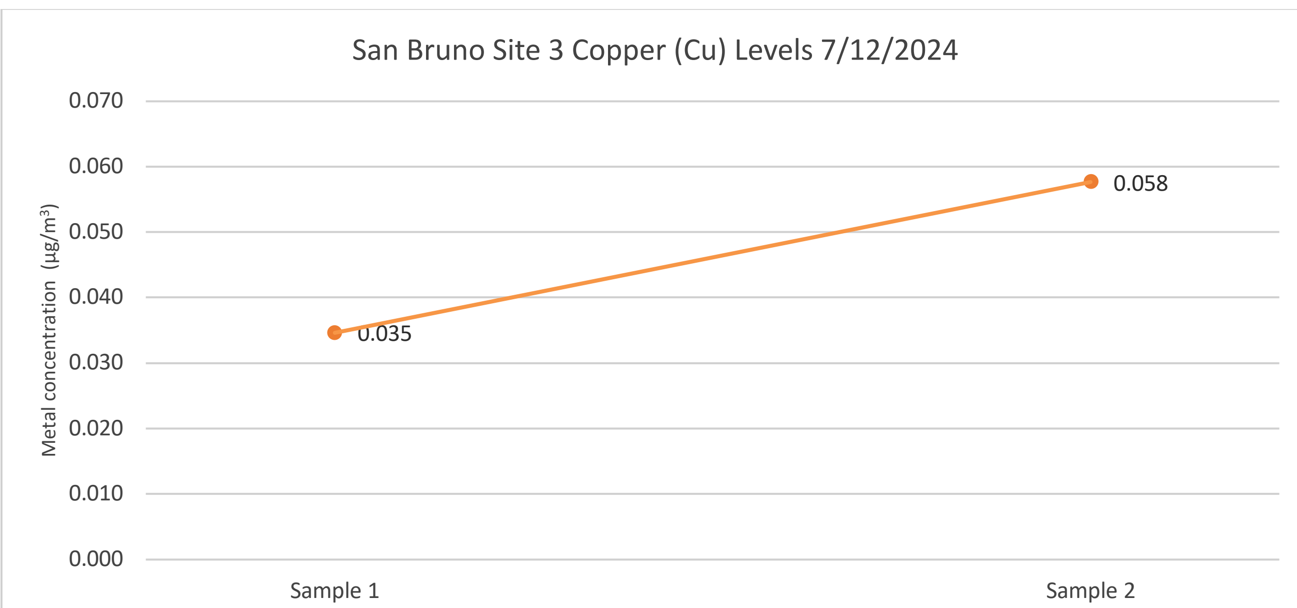
<u>Site 1 (SB1)</u>



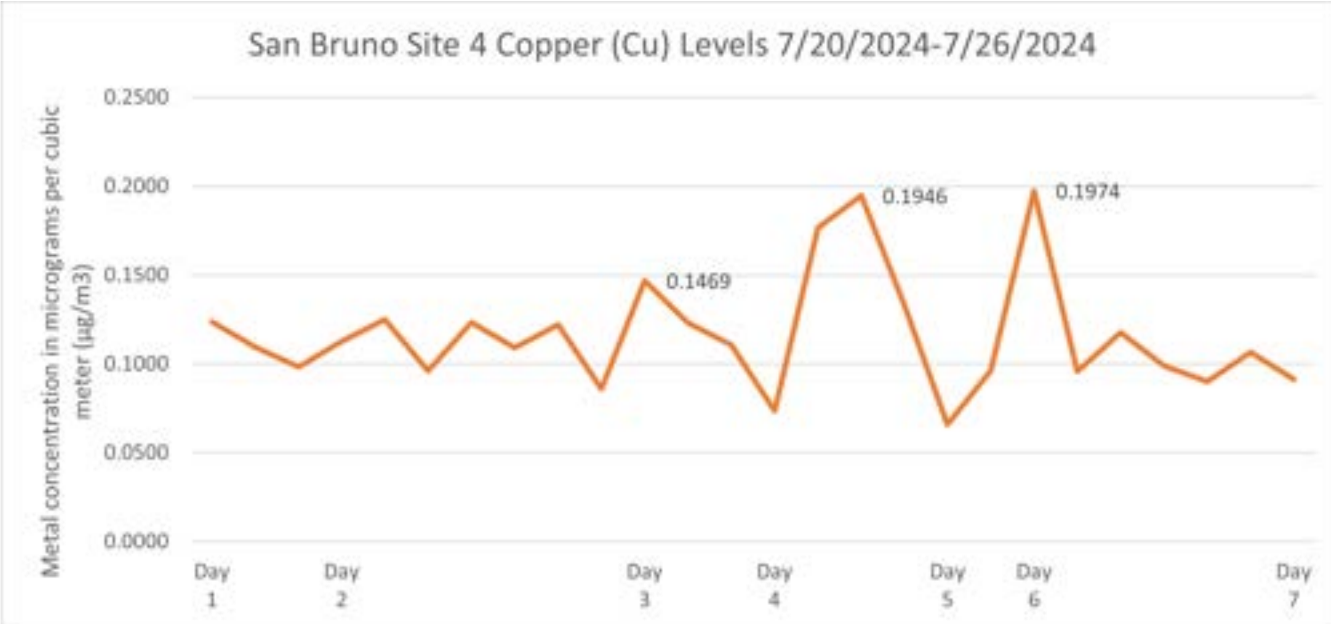
Site 2 (SB2)



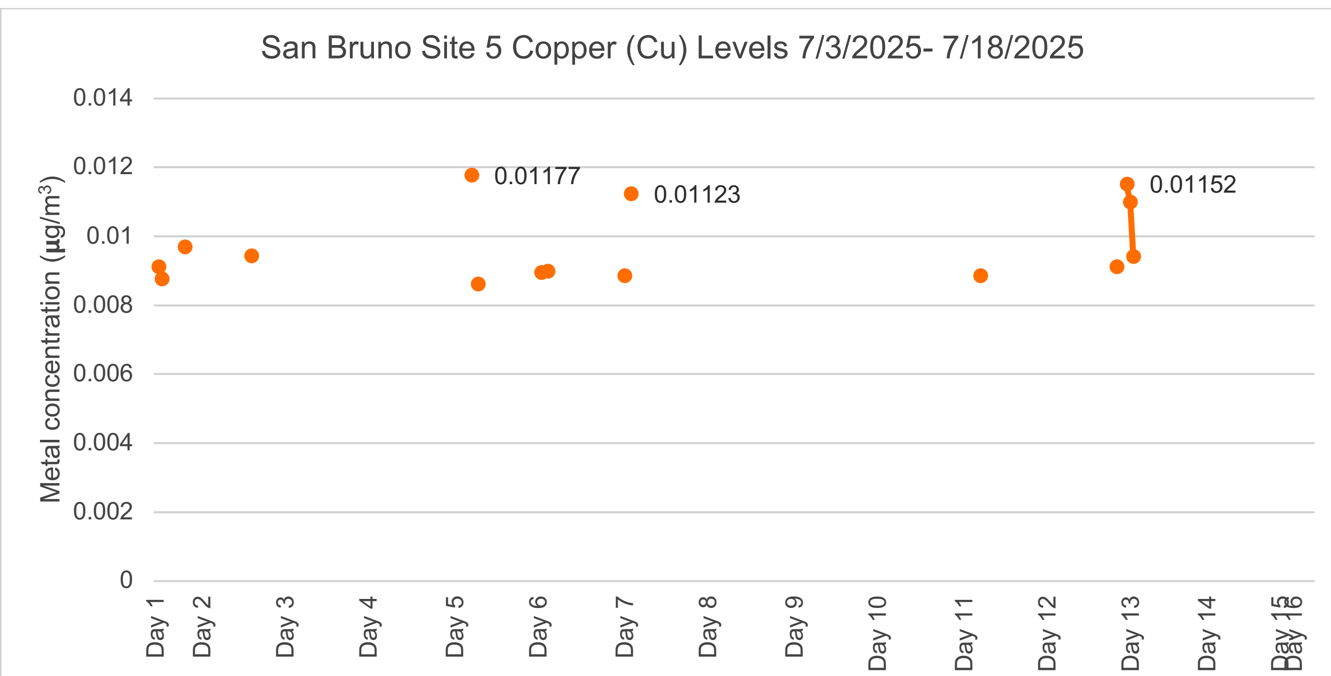
Site 3 (SB3)



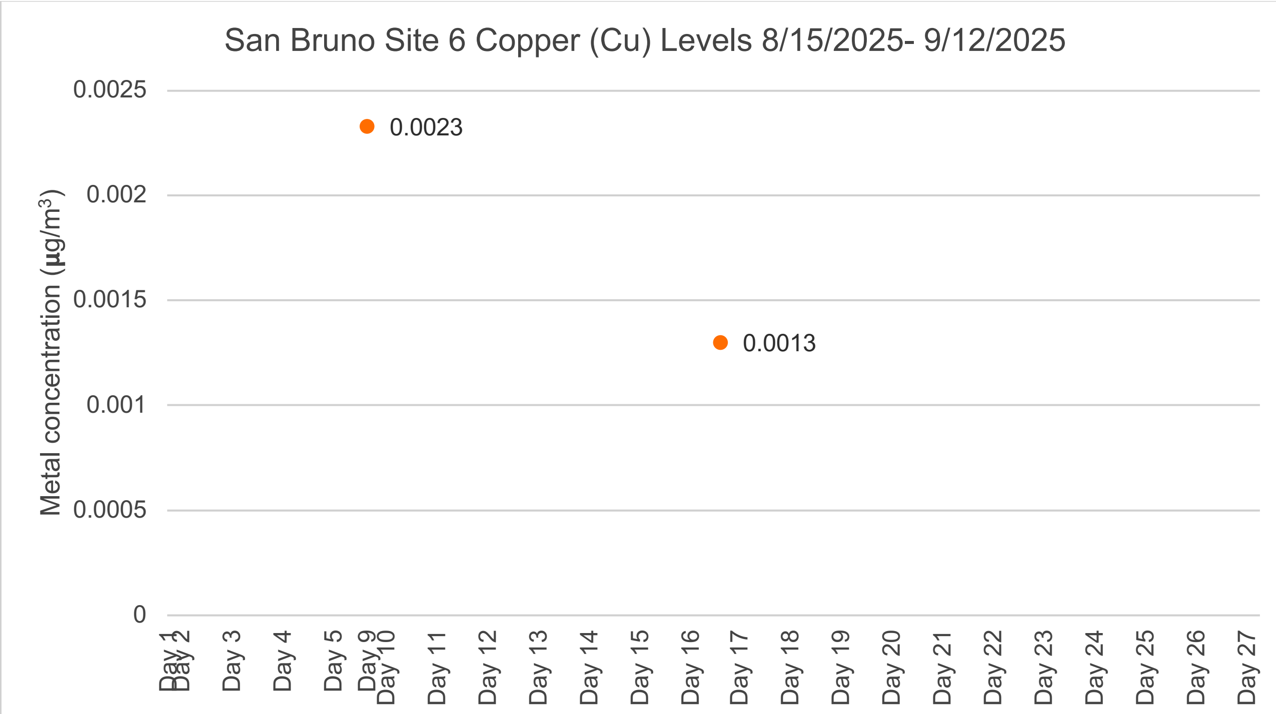
Site 4 (SB4)



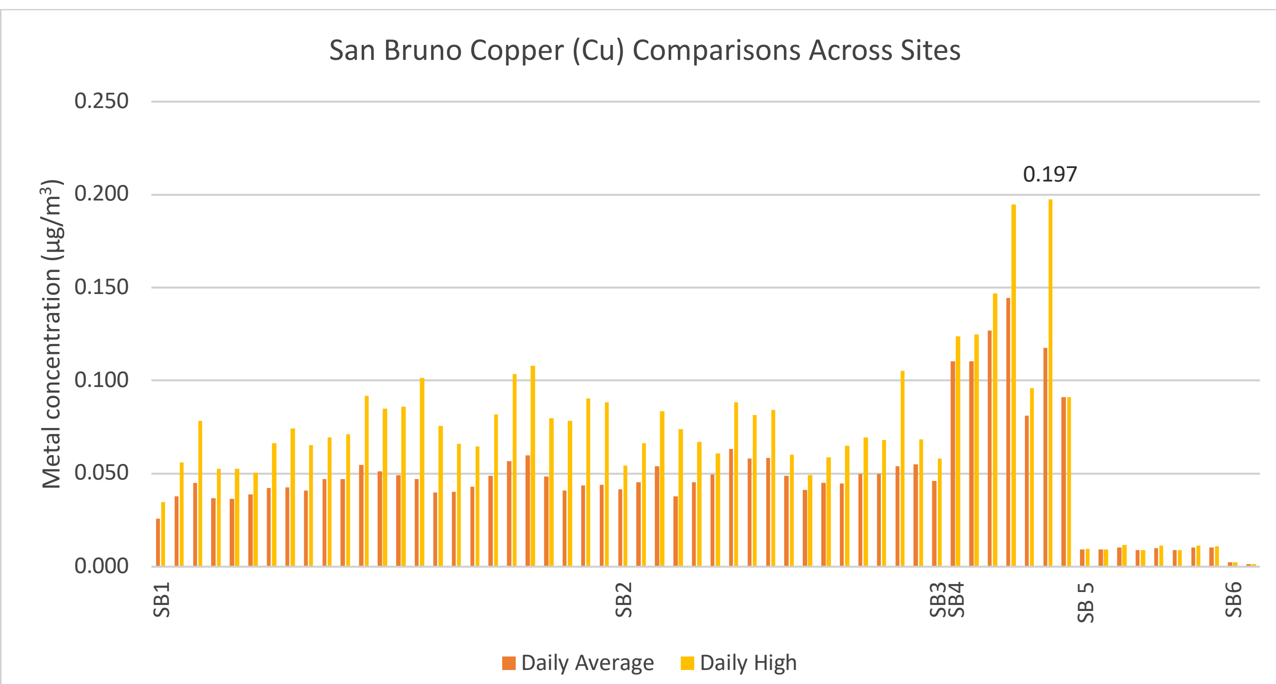
Site 5 (SB5)



Site 6 (SB6)



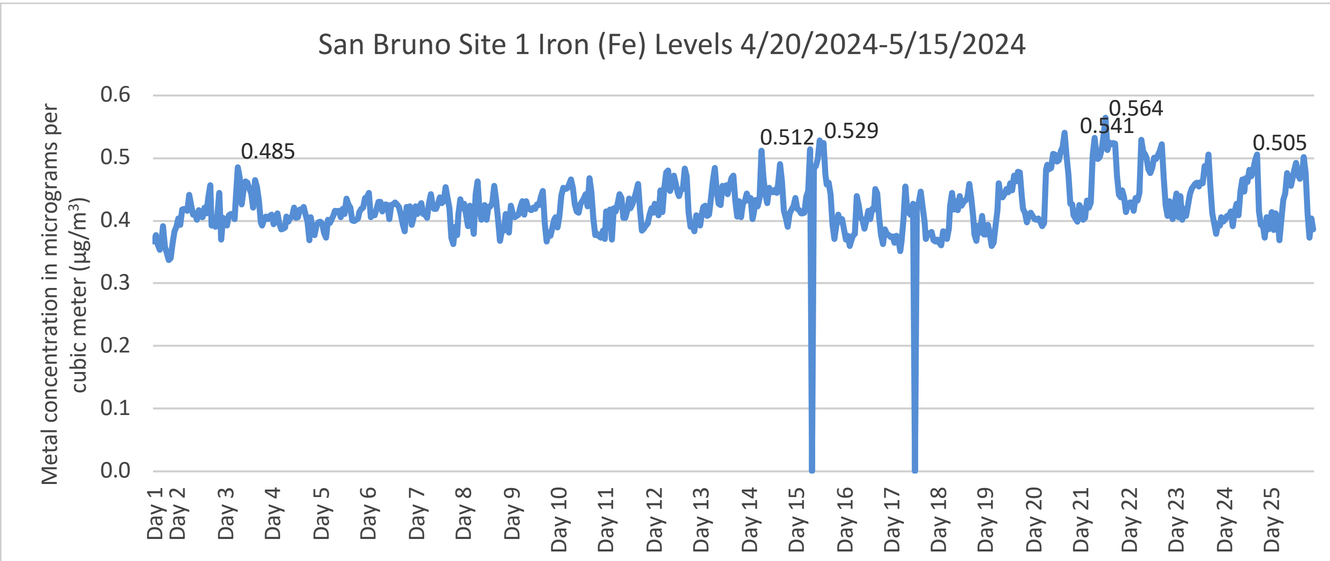
Copper Comparisons Across Sites



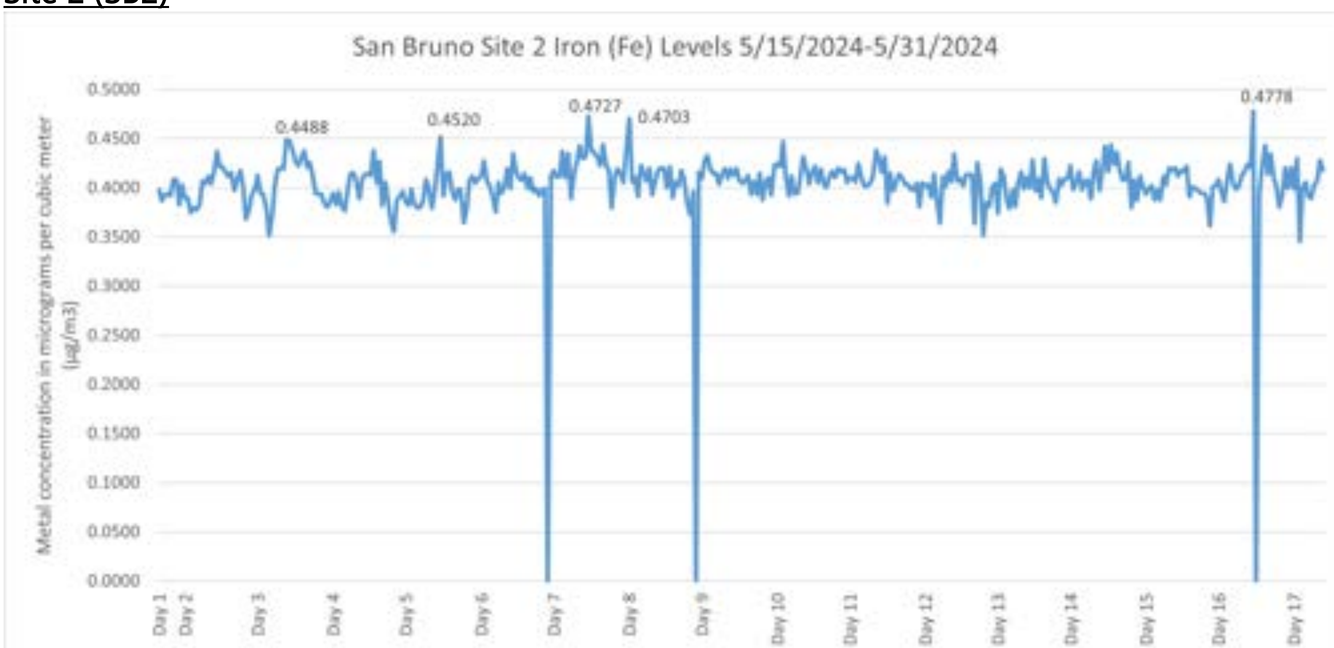
Iron (Fe) Measurements

A predominant source of iron is vehicle emissions such as brake and rail wear and engine abrasion[x] as well as steel and iron foundries.[xi] Iron at high concentrations has caused metal fume fever, pneumoconiosis, cough, shortness of breath, and iron staining of the eyes.[xii]

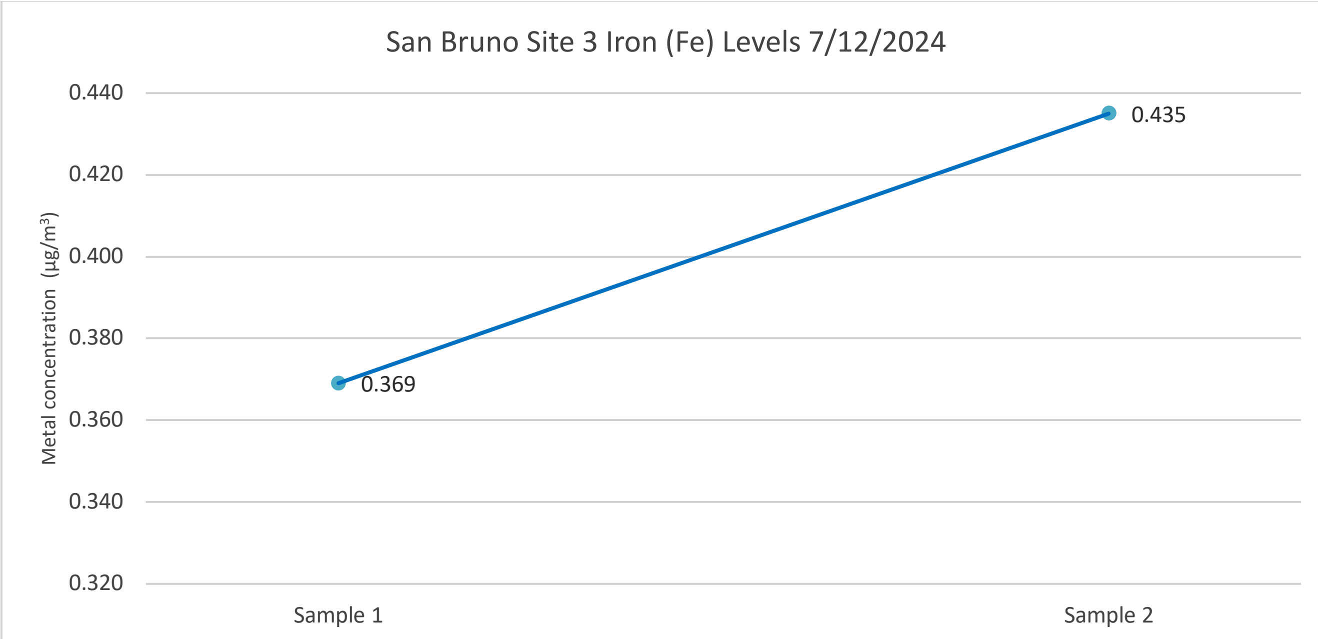
Site 1 (SB1)



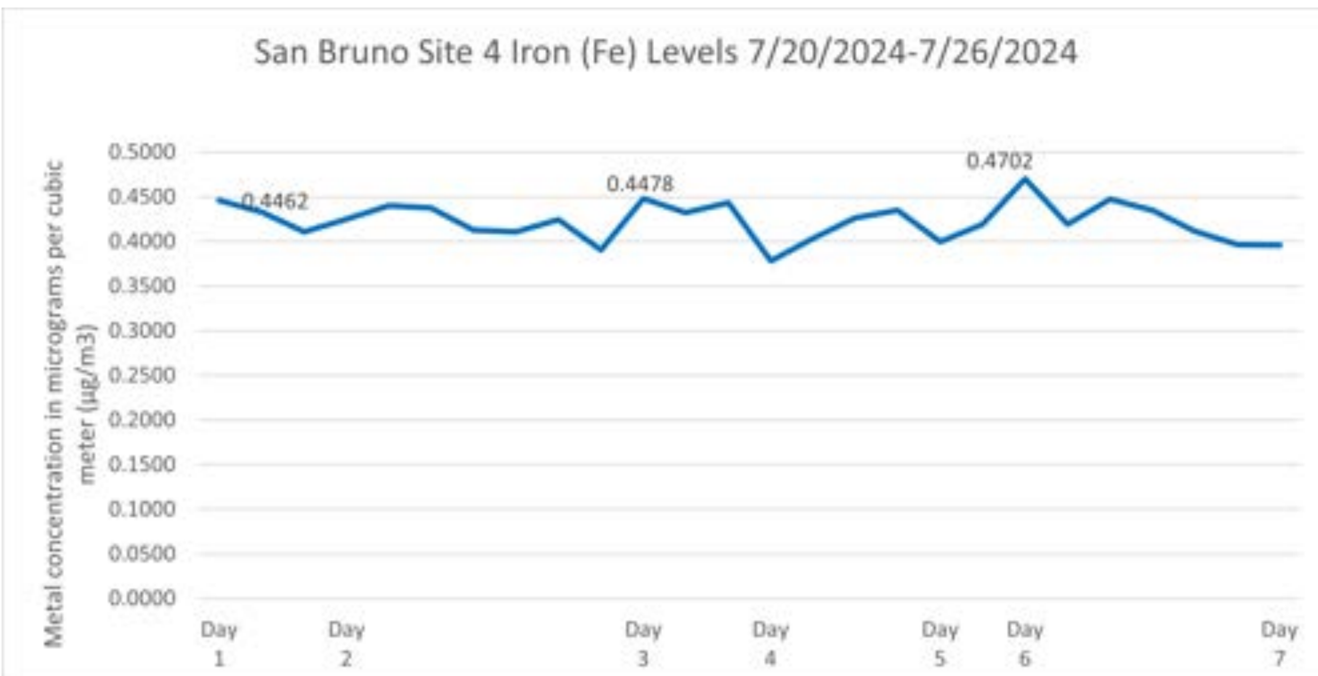
Site 2 (SB2)



Site 3 (SB3)



Site 4 (SB4)



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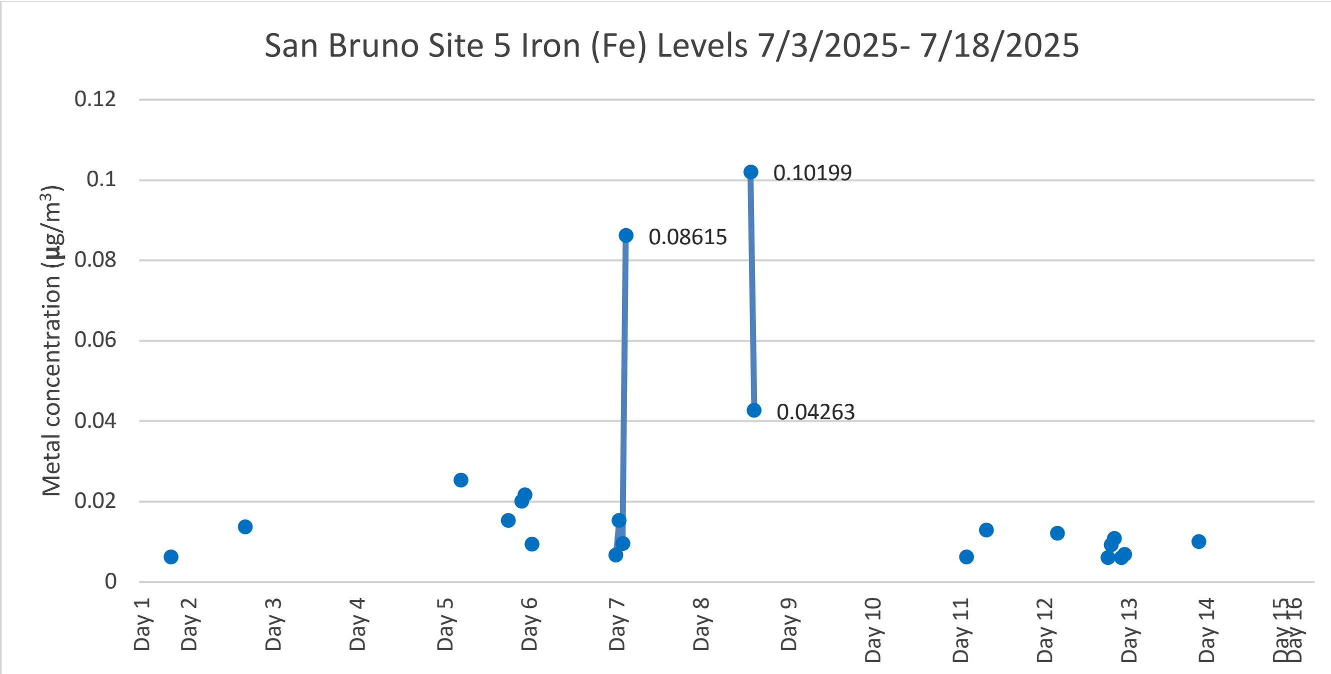
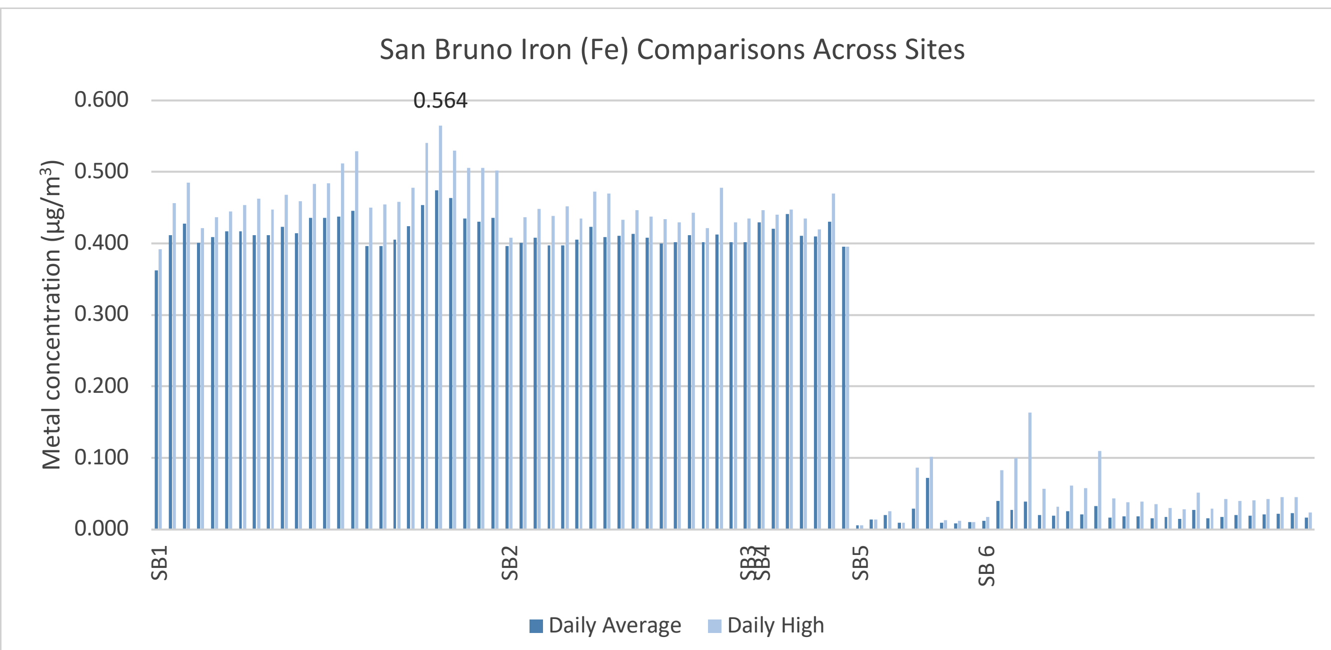


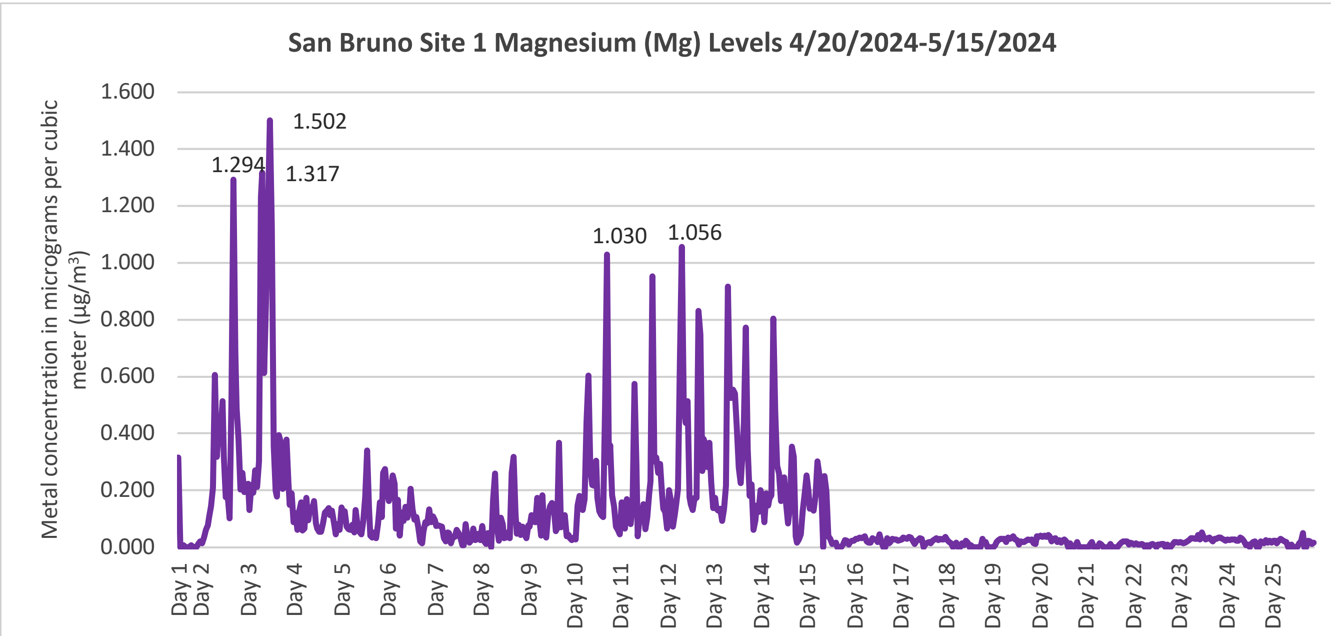
Iron Comparisons Across Sites



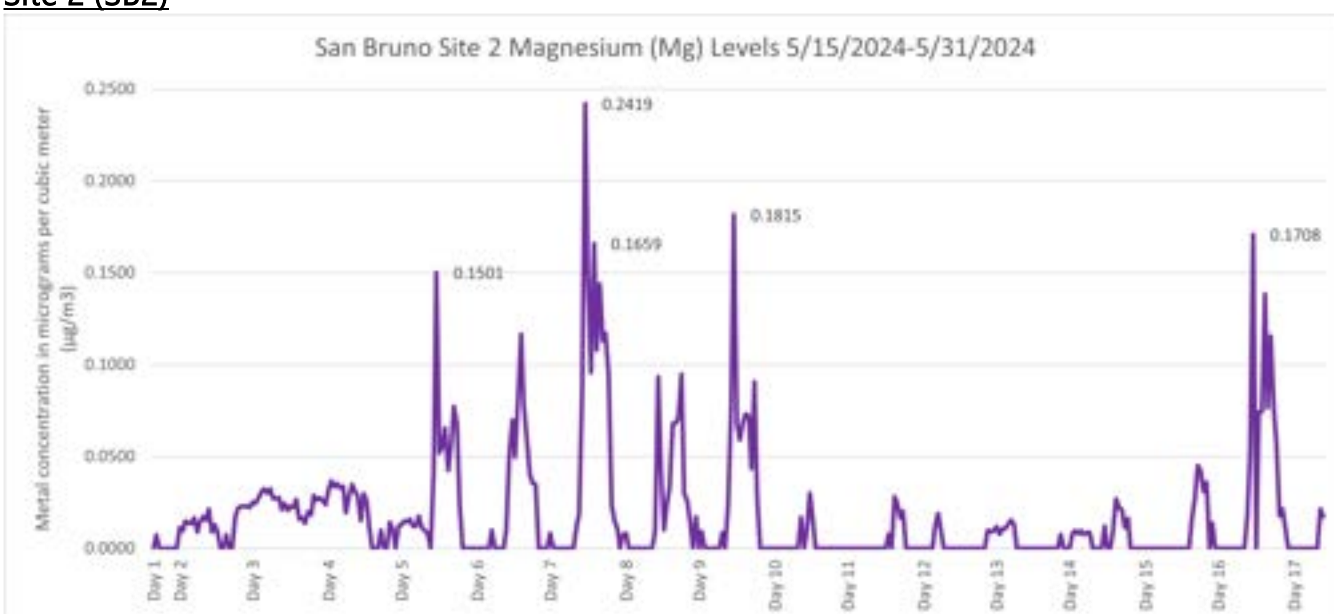
Magnesium (Mg) Measurements

Magnesium is used in making structural metals, flares, and pyrotechnics, and can be emitted in industrial workplaces with operations such as welding, brazing, and soldering.[xiii] Magnesium exposure at high rates can cause irritation to eyes & nose; metal fume fever triggering symptoms such as headache, cough, sweating, nausea, fever, oppression in the chest and leukocytosis (increase in the number of white blood cells in the blood).[xiv]

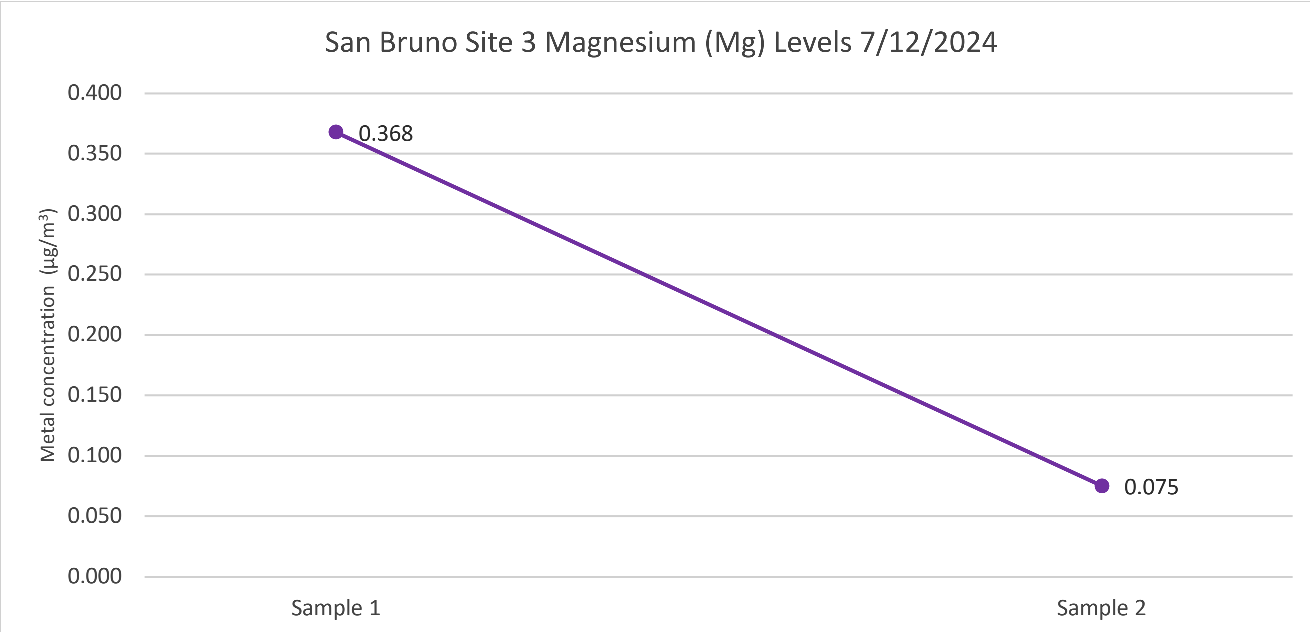
Site 1 (SB1)



Site 2 (SB2)



Site 3 (SB3)



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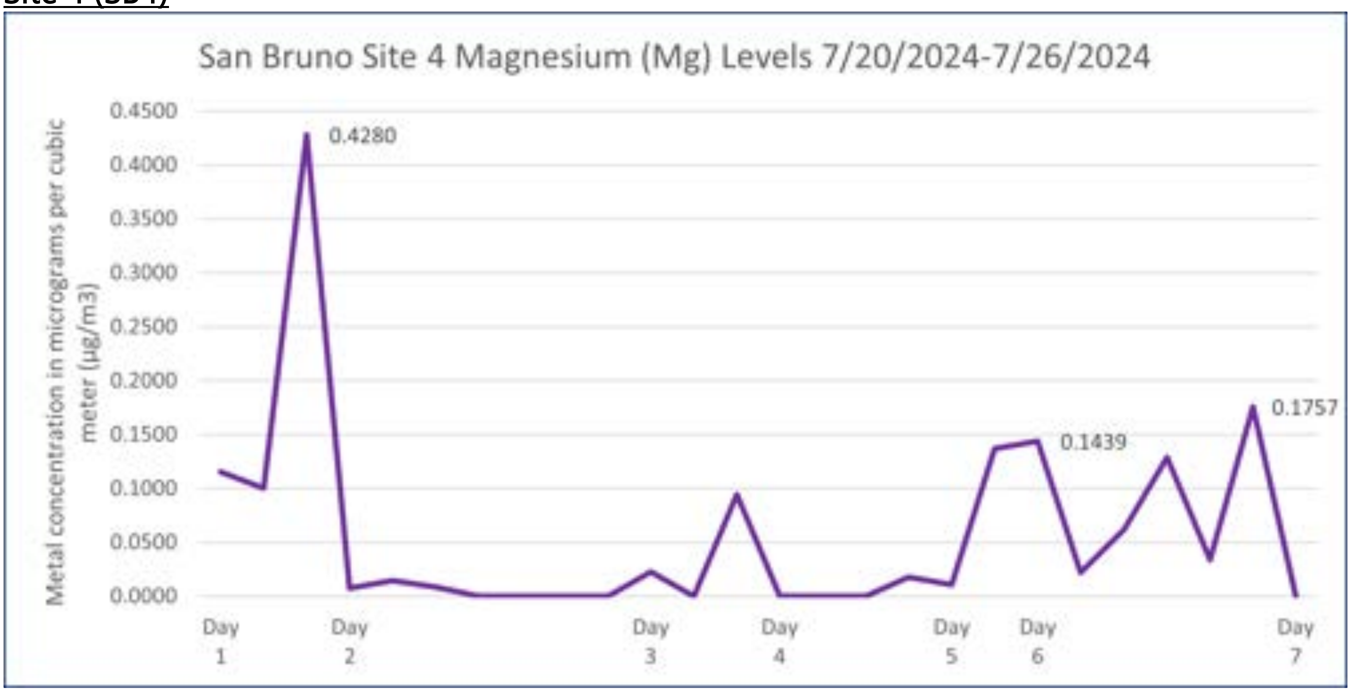
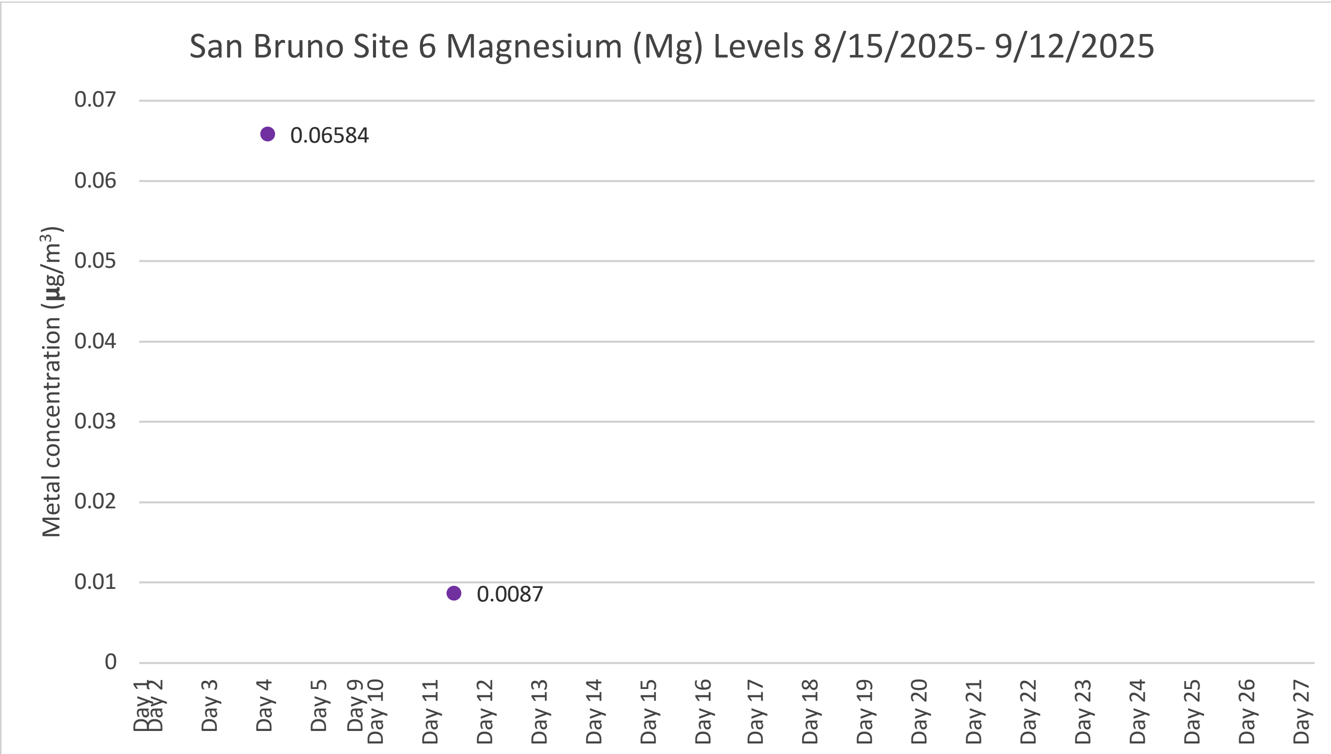
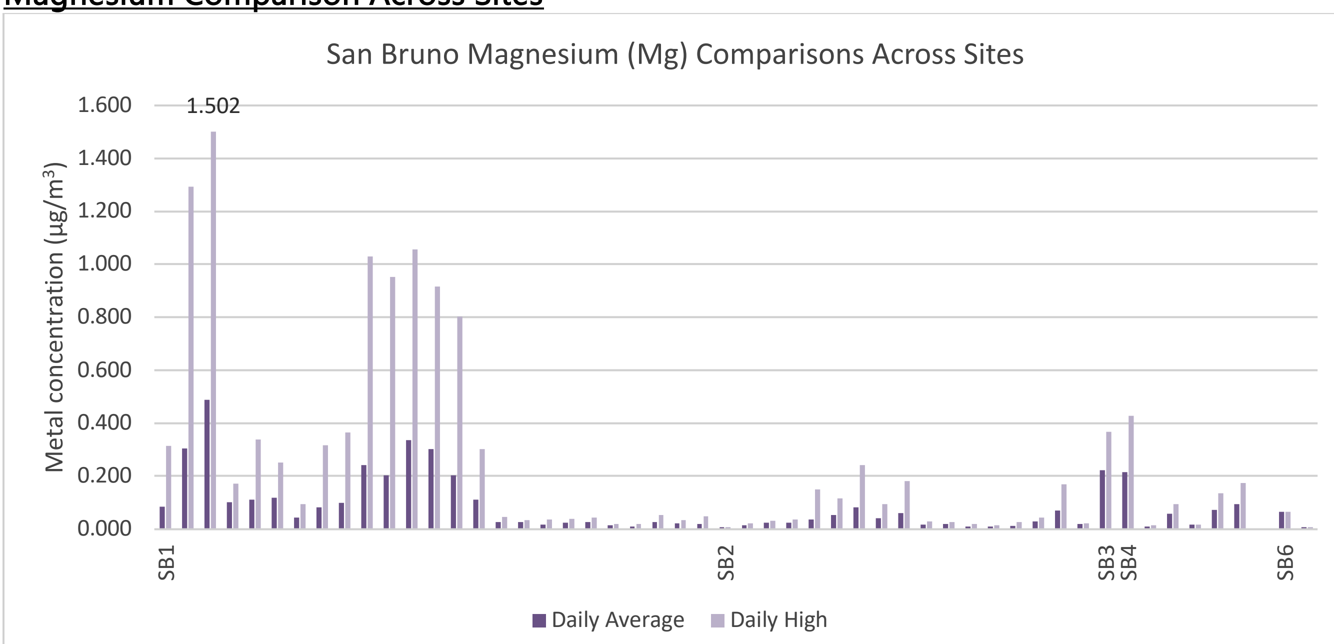


Site 6 (SB6)



Magnesium Comparison Across Sites

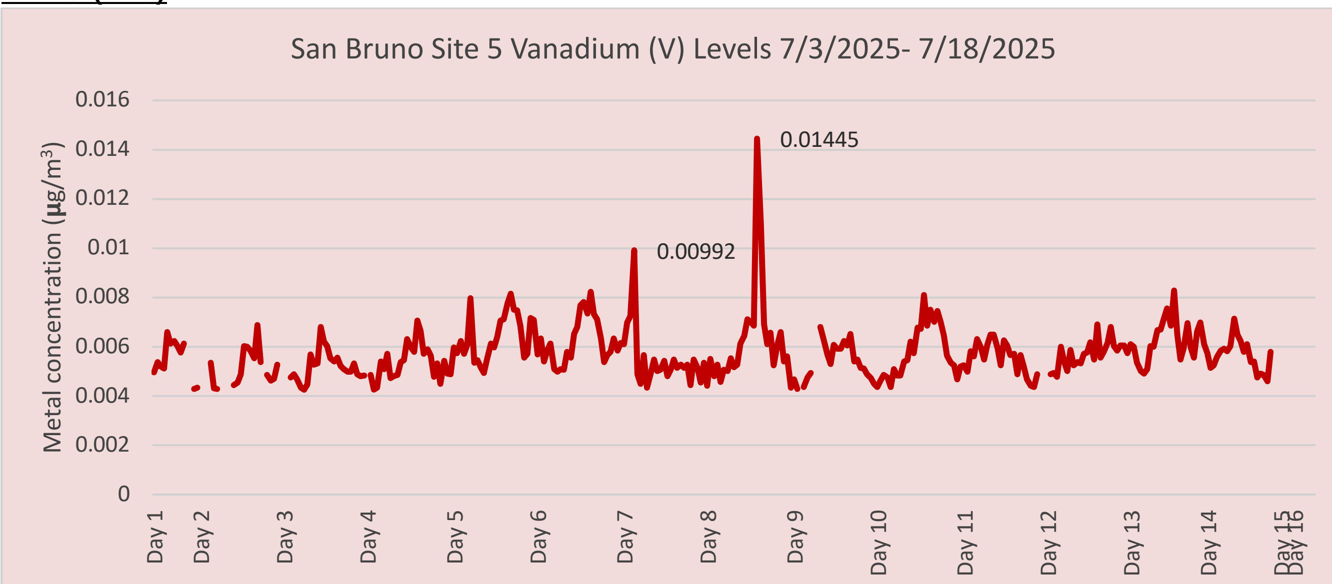


Vanadium (V) Measurements

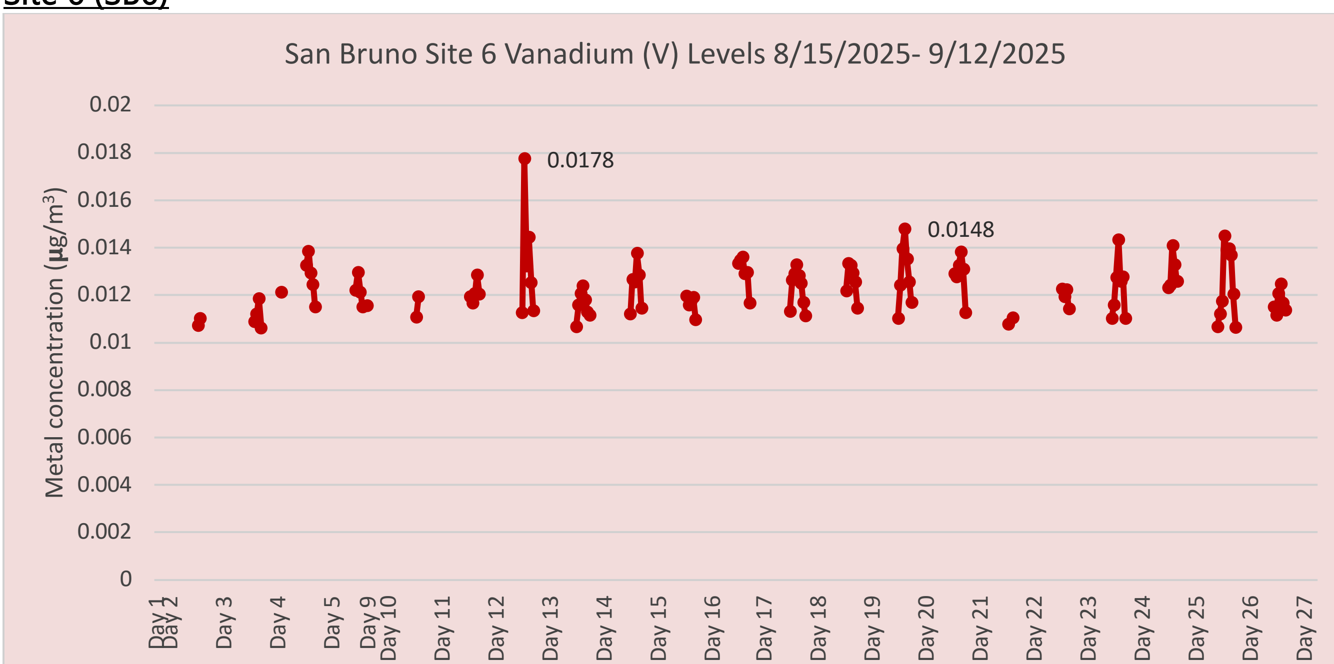
Vanadium results is a corrosion inhibitor, found in ceramic and glass coloring, and serves as a catalyst for sulfuric acid and other oxidated chemicals. Its impacts on the body primarily target the respiratory system and eyes.[xv] OEHHA lists the REL for acute exposure at 30 μg/m^3 for vanadium pentoxide.

Emission concentrations for Vanadium have been overestimated due to ongoing software issues and therefore are considered "Low Confidence."

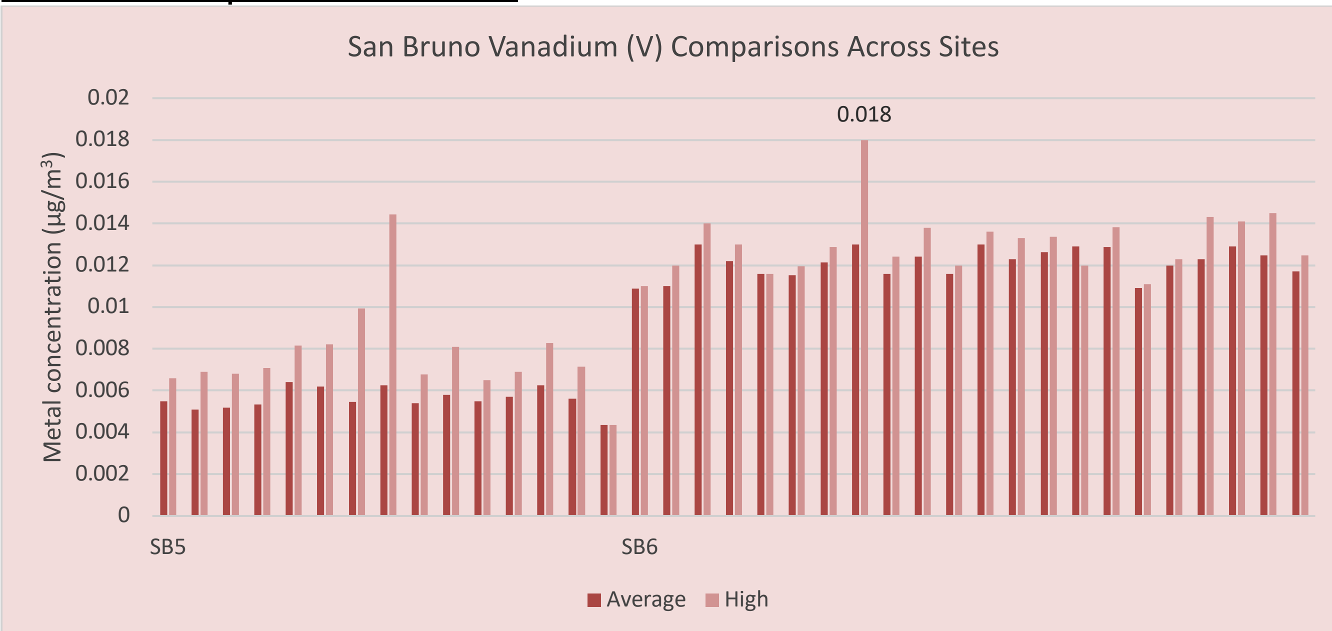
Site 5 (SB5)



Site 6 (SB6)



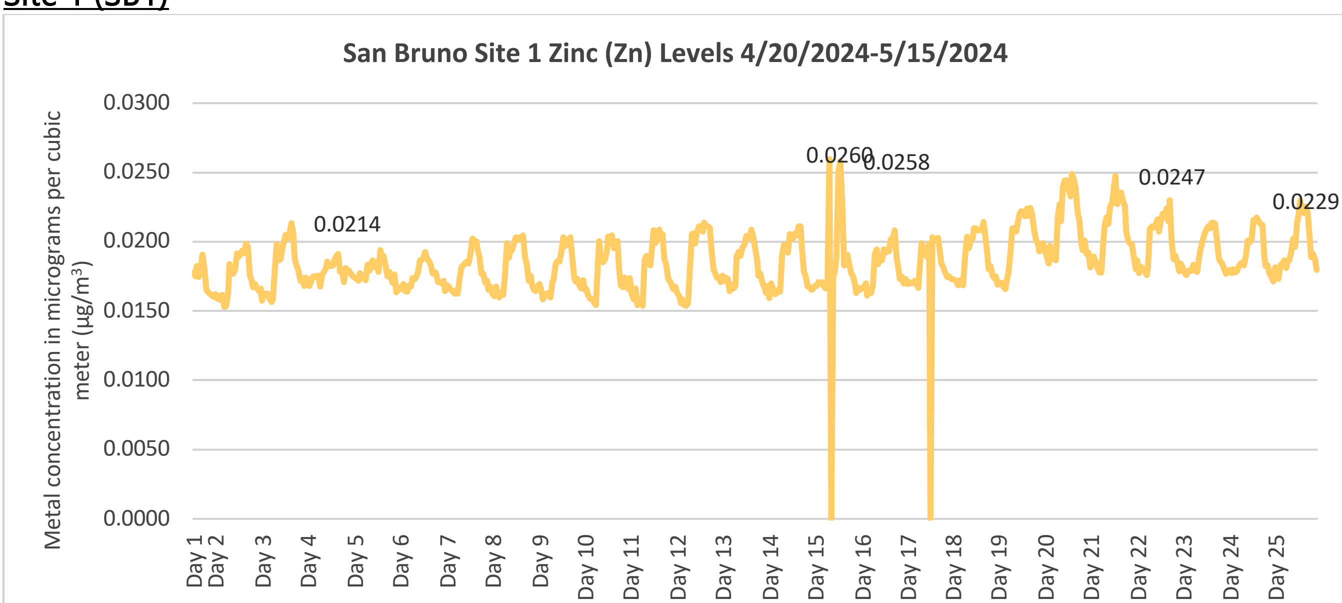
Vanadium Comparison Across Sites



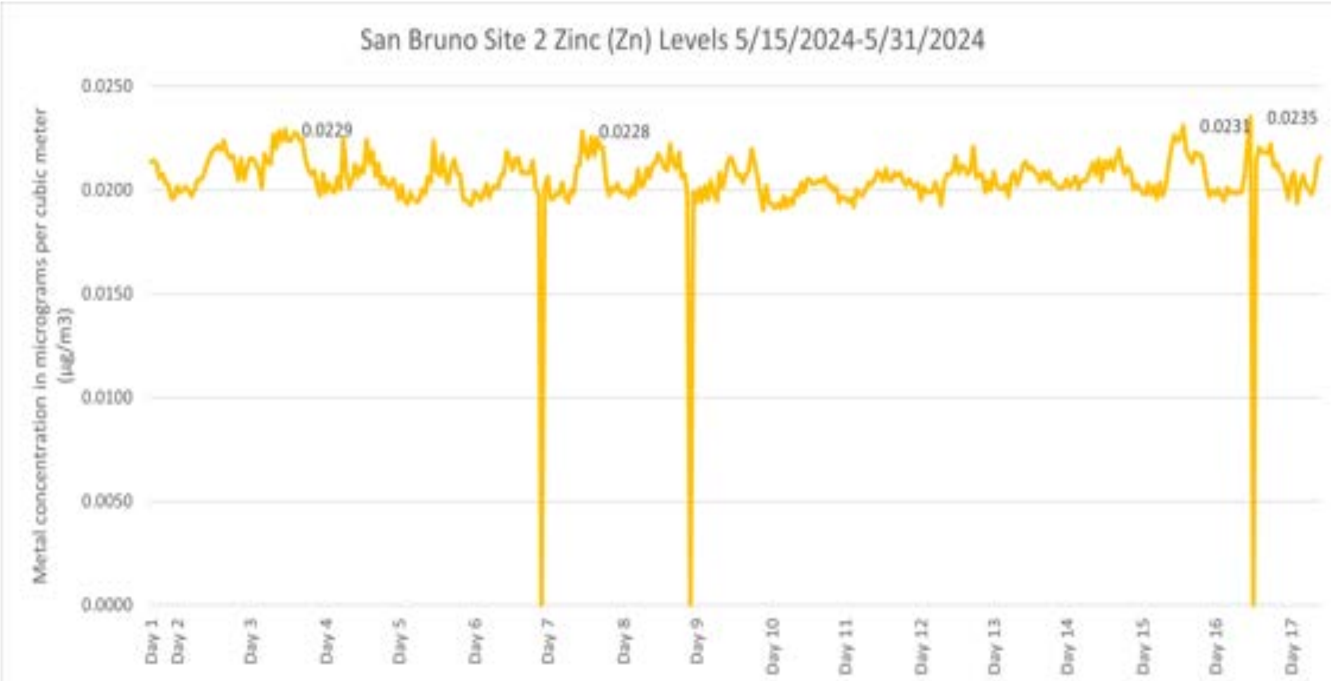
Zinc (Zn) Measurements

Zinc emissions have been found at sources of wood waste, municipal solid waste and sludge, in tire combustion, and in mining and steel production as well as other industrial releases.[xvi] Zinc at high levels can cause metal fume fever if breathing high levels of zinc dust/ fumes which causes chills, fever, excessive sweating and weakness, there are also possible cardiovascular disease mortality as well as respiratory syndromes and general symptoms like fever and fatigue.[xvii]

Site 1 (SB1)



Site 2 (SB2)



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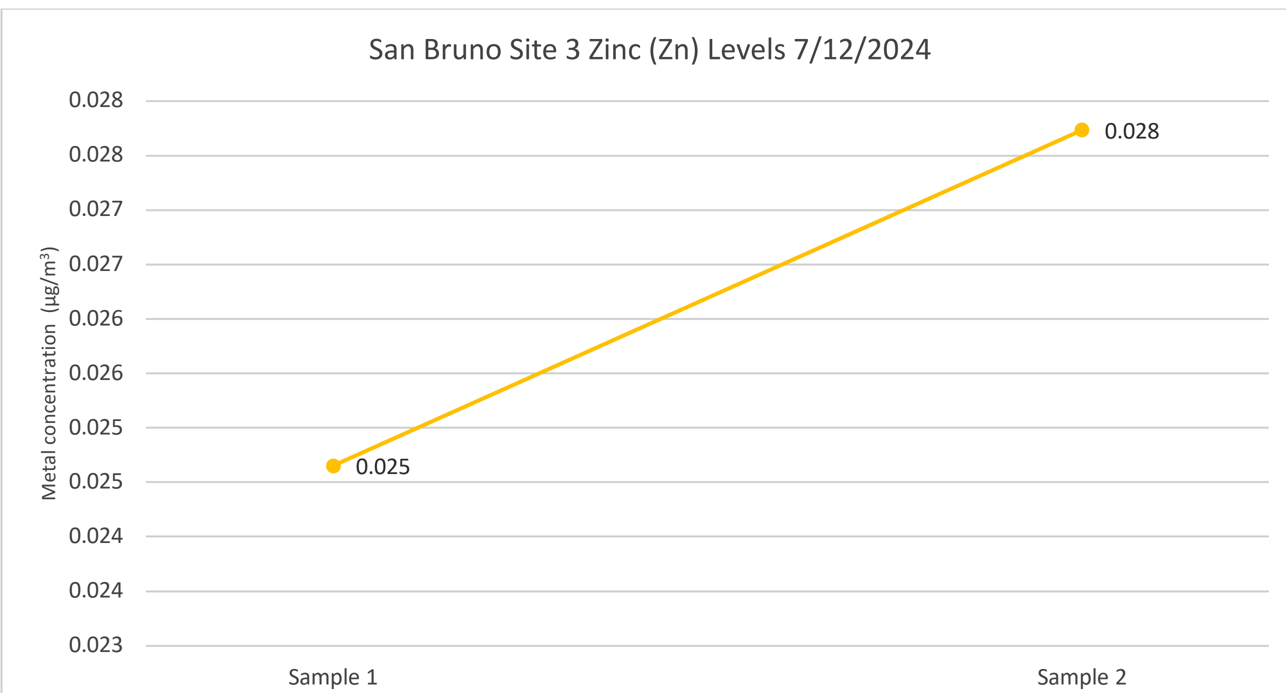
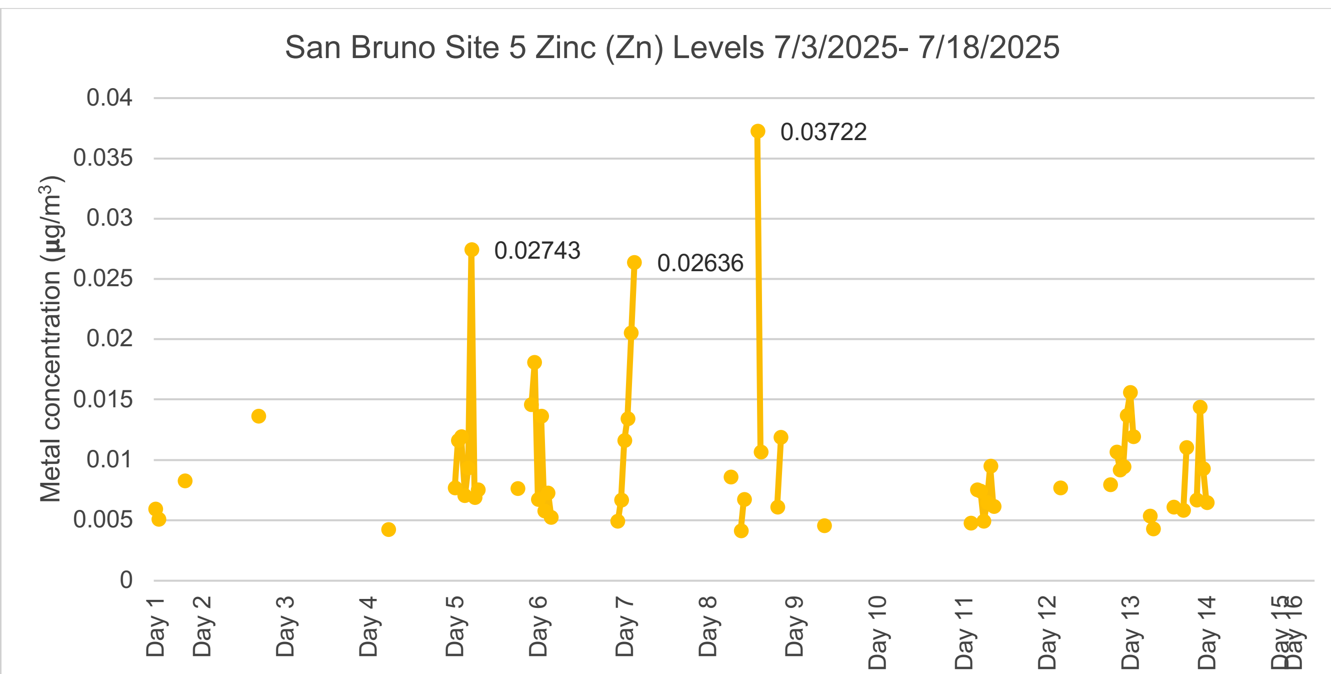
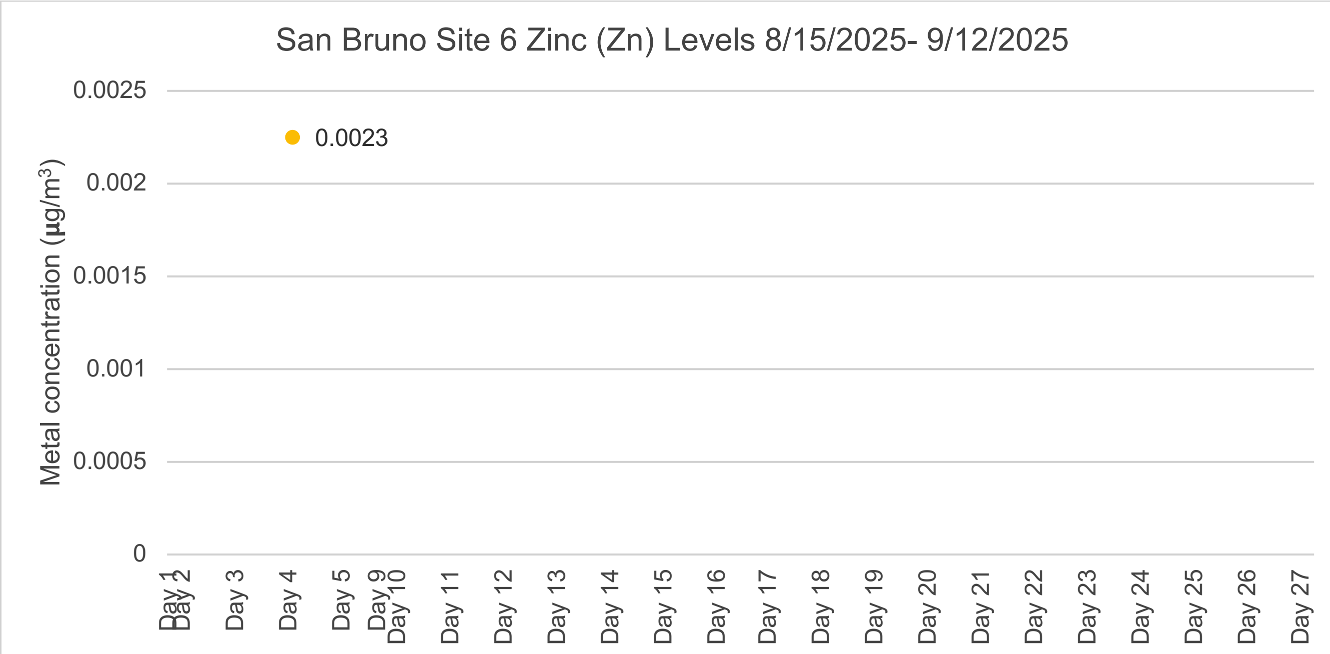


Site 4 (SB4)

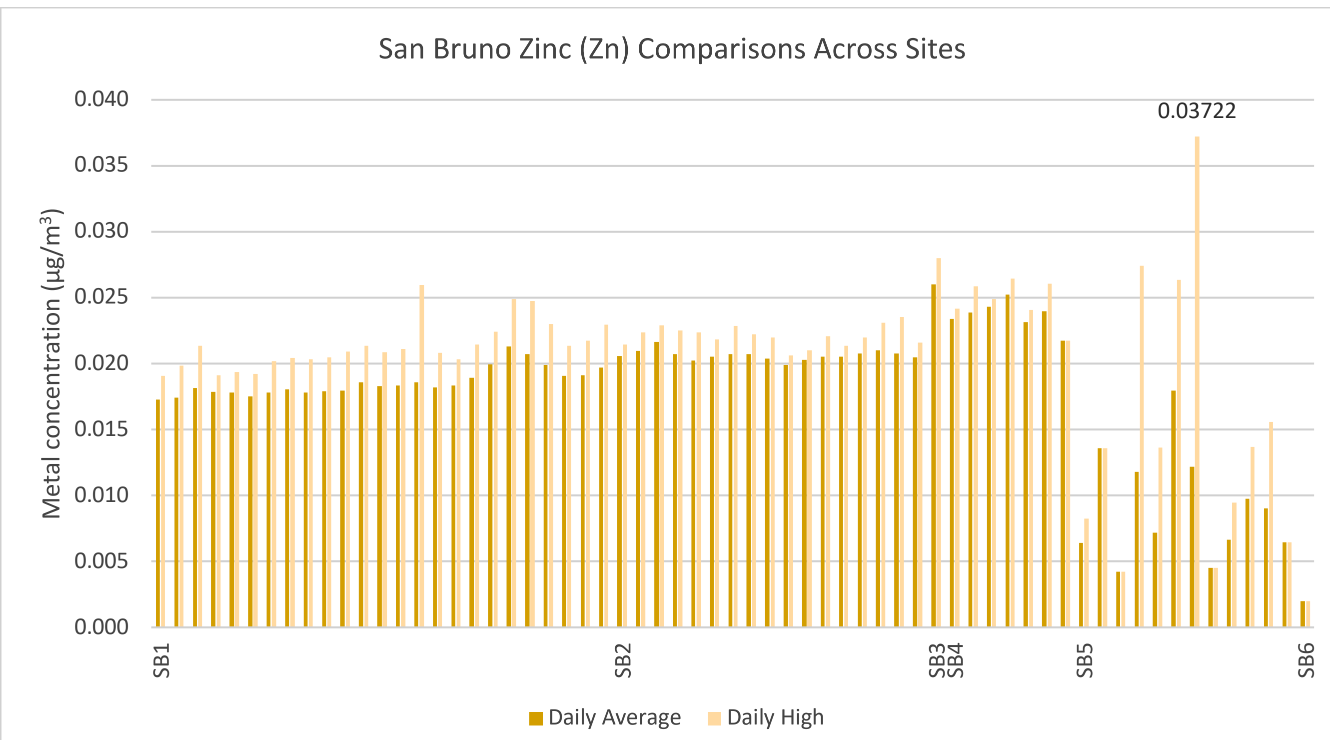
Site 5 (SB5)



Site 6 (SB6)



Zinc Comparisons Across Sites



AIR MONITORING & HAP EMISSION SITES

Since site selection was done with particular emphasis on communities of concern, cumulative impacts and effects of the measured data must be analyzed and considered both in the scope of this project and more generally in air quality monitoring. While most of the levels of measured metallic compounds were well below reported hazard levels by many regulatory bodies, the composite effects of exposure to these metals have not been studied, reported, or regulated. While not fully comprehensive of all sources, below is a map of emission sites for copper, nickel, and manganese as well as diesel engine exhaust.

Description: Under the Federal Clean Air Act, toxic air contaminants (TACs) are airborne pollutants that may be expected to result in an increase in mortality or serious illness or which may pose a present or potential hazard to human health. TACs are also referred to as toxic air pollutants or hazardous air pollutants. Each year the Bay Area Air District collects toxic air contaminant emissions data from permitted facilities. This map showcases the Air District's permitted facilities that emit copper, nickel, manganese, and diesel engine exhaust particulate compounds. Note that there may be other TACs present but were filtered to match the metals that have been identified and quantified by the TARTA instrument.

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Manganese was the metal with measured levels that exceeded mandated hazard limits across the monitoring sites in San Bruno. As a hazardous air pollutant (HAP), Manganese monitoring and regulation should be scrutinized in response to these results. While this report included permitted facilities that emit manganese, measurement barriers make it unclear whether these are the primary or sole sources of emissions.

Iron & Steel metallurgy (ferro-alloy plant) seems to be the most likely source of the Mn. The time-series graphs show that Mn, Fe, and Cu concentrations often follow a similar pattern during peaks. While Copper is a co-tracer for non-exhaust traffic wear, the corresponding co-tracer Zinc remains at very low concentrations.

Strong likelihood of manganese sources based on co-tracing are (bold: strong co-tracer):

1. Iron & Steel metallurgy (Co-tracers: **Fe**, Mo)
2. Non-exhaust traffic wear (Co-tracers: **Fe, Cu, Zn, Sb**)
3. Resuspended road dust (Co-tracers: **Al, Si, Ca, Fe**, Cu, Zn)

Below is an analysis of the other possible sources for metals found at the sites and their co-occurrence.

Site (s)	**Metal (s) detected**	**General possible source analysis**
1-6	Cu+Zn	non-exhaust traffic wear (brake and tire abrasion) and may also reflect light industrial metalworking
1-6	Al+Fe	points to construction dust or cement plant emissions
5, 6	V	tracer for oil or jet fuel combustion, suggesting contributions from refinery or airport emissions
1-4, 6	Mg	may reflect marine aerosol input due to proximity to the bay
1-4, 6	Mg+Al	supports a cement/concrete dust origin

DISCUSSION

This project implements community-driven research and innovative technology with the goal to address environmental injustice. By utilizing the TARTA instrument and collaborating closely with communities, we aim to empower residents with data on toxic metal air pollution.

The data represented above is the result of monitoring across four community-selected sites in San Bruno. This speciated data allows for future research into air quality and monitoring to be better informed.

Regulatory frameworks for metals are most often reported for workplaces, even for chronic exposure. Because the sites of TARTA monitoring include residential locations, further research is needed about long-term exposure to metallic compounds in the ambient air as well as interactions between metals and possible health impacts. The potential health risks associated with inhalation of metallic compounds needs further study in order to create meaningful regulations for community members residing in San Bruno.

Based on our findings, our next steps and recommendations emphasize the need for expanded and targeted air monitoring in San Bruno; this could include near potential emission sites (i.e., Bay Area Air District permitted heavy metal emission facilities). This could help us establish a comparative analysis between ambient heavy metal concentrations within communities and around possible emission sources. Regulatory air monitoring for manganese and other hazardous pollutants must be strengthened by mandating continuous or more frequent facility-based and community-level surveillance.

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More information on the project can be found at https://communityair.ucdavis.edu/

FUNDING

This research was funded by the University of California Office of the President through the Multicampus Research Program and Initiative.

ACKNOWLEDGEMENTS

We would like to thank our community partners, Rise South City, as well as our technical team led by Dr. Anthony Wexler, Dr. Brenda Lopez Reyna, Dr. Junbeom Jang, and Dr. Sabin Kasparoglu. We would also like to thank our larger project team including Drs. Mike Mendez (UCI) and Camila Alvarez (UCSD) and graduate students Sage Kime and Rasha Nasief.

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APPENDIX

Stationary monitoring at site 4 was conducted using the truck in the photo below.