Health Consultation

RIVER CITY METAL FINISHING

SAN ANTONIO, BEXAR COUNTY, TEXAS

EPA FACILITY ID: TXN000606915

Prepared by:

Texas Department of State Health Services

JANUARY 23, 2023

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Office of Capacity Development and Applied Prevention Science
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from the Agency for Toxic Substances and Disease Registry (ATSDR) or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

The Texas Department of State Health Services (DSHS) prepared this health consultation for the River City Metal Finishing site, located in San Antonio, Bexar County, Texas under a cooperative agreement program (program #TS20-2001) with the federal Agency for Toxic Substances and Disease Registry (ATSDR). DSHS evaluated data of known quality using approved methods, policies, and procedures existing at the date of publication. ATSDR reviewed this document and concurs with its findings based on the information presented by DSHS.

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Summary

Introduction

The River City Metal Finishing (RCMF) site, located at 12040 Potranco Rd (FM 1957), San Antonio, Bexar County, TX is a former metal plating shop that operated from 1994 until approximately 2002. The facility consisted of a main building and external operation areas. While in operation, RCMF was investigated and cited for environmental compliance issues regarding hazardous waste management. The site was abandoned sometime between 2002 and 2006. The Texas Commission on Environmental Quality (TCEQ) completed a removal action of the waste drums and containers on site and demolished the building, garage/carport, and foundation in 2013.

In 2016, the United States Environmental Protection Agency (EPA) completed a site investigation to determine if hazardous substances used and stored at the site had contaminated soil and groundwater. EPA detected various metals and chemicals, including antimony, cadmium, copper, cyanide, lead, nickel, selenium, silver, zinc, total chromium, and hexavalent chromium, at levels above EPA's regional screening levels (RSLs) in surface soil and shallow groundwater, located directly beneath the facility. In addition, hexavalent chromium was detected in two off-site public water supply (PWS) wells completed in a deeper groundwater aquifer (Edwards Aquifer). These results suggested possible contaminant migration from the shallow groundwater to the deeper regional Edwards Aquifer, which is the sole source of drinking water in the San Antonio area. EPA proposed the RCMF site to the National Priorities List (NPL) in January 2018 and listed the site as final on the NPL in May 2018.

The Texas Department of State Health Services (DSHS) has a cooperative agreement with ATSDR to perform public health assessment activities for all NPL sites in the state of Texas. DSHS prepared this health consultation to evaluate chemicals that people may come into contact with on or near the RCMF site and provided recommendations to protect the health of the community.

Conclusions

Based on the available information, DSHS and ATSDR reached four conclusions about the site:

Conclusion 1

Past, current, and future exposure to residential drinking water from some of the nearby private wells may be a health concern.

Basis for Conclusion

Nearby residents may be exposed to metals in groundwater from some residential wells by drinking or from coming in contact with water while bathing and showering.

Metals, including antimony, arsenic, cadmium, copper, hexavalent chromium, iron, zinc, lead, and thallium, were detected in groundwater samples collected from private residential wells. Although long-term exposure to most of the metals detected is not expected to cause noncancer and cancer health risks, long-term exposure to arsenic from one private water well may cause a low increased risk of developing cancer. However, there is uncertainty with the cancer risk because it assumes long-term exposure from one sample collected from one residential well.

In a second private water well, the estimated dose of iron for children (less than 11 years of age) exceeds effect levels identified in humans and might cause mild gastrointestinal effects, such as nausea and vomiting. In a third private water well, lead was detected slightly above the EPA’s action level. Children drinking from this well have an elevated increased risk of harmful effects from lead exposure. Lead in drinking water should be reduced or removed as much as feasible.

Conclusion 2

Past exposure from incidental ingestion and skin contact to contaminants found in on-site surface soil is not expected to harm people’s health. Current and future exposure is not expected to occur.

Basis for Conclusion

Nearby residents and visitors, including adults and children older than 11 years of age, may have come into contact with the contaminants in the surface soil through incidental ingestion and skin contact while trespassing on the site. However, exposure to contaminants was too low to result in harmful effects.

In March 2019, EPA repaired and installed new fencing to secure the site. Given this update in security, current and future trespassing onto the site is not expected to occur.

Conclusion 3

Past, current, and future exposure from incidental ingestion and skin contact to polycyclic aromatic hydrocarbons (PAHs) in off-site surface soil is not expected to harm people's health.

Basis for Conclusion

Nearby residents and visitors, including adults and children older than 11 years of age, may have come into contact with the contaminants in the off-site surface soil through incidental ingestion and skin contact while participating in outdoor activities outside the site property. However, the calculated exposure doses for long-term (more than 1 year) PAH exposures among recreational users did not exceed health guidelines for noncancer effects, and cancer was not a concern.

Conclusion 4

Past, current, and future exposure to contaminants in residential drinking water from the nearby public water supply (PWS) is not expected to harm people's health.

Basis for Conclusion

Nearby residents are not likely to come into contact with contaminants in groundwater from wells serving the Coolcrest and San Antonio PWS.

Monitoring data from the Texas Drinking Water Watch, which monitors the potable water being delivered to residential tap from these PWS wells, do not show any contaminants above reporting limits (TDWW, 2020).

Recommendations

People living near the site should respect the site's property boundaries and not trespass beyond the fence installed by the EPA. People that play near the site area, especially near the site's southern border along Tallowood Street, may have an increased chance of contacting off-site contaminated soil through incidental ingestion and skin contact. Practicing good personal hygiene habits (such as washing hands after playing in the area, and before eating) can reduce or prevent the exposure to contaminants in soil.

EPA, in consultation with TCEQ, continue efforts to monitor and maintain the perimeter fence surrounding the RCMF site to prevent trespassing onto the site. In addition, monitor and maintain the hay berm to reduce, or prevent, off-site migration of soil contaminants.

EPA plug and abandon all on-site monitoring wells that were drilled for the site investigation to prevent further contamination of the shallow groundwater.

Owners of residential private wells concerned about potential contaminants in their water consult with the Texas Well Network (https://twon.tamu.edu/). The Texas Well Network is an educational program hosted by the Texas A&M University AgriLife Extension Service that offers trainings and information on well water sampling, well maintenance, and contamination preventative measures.

Owners of residential private wells take steps in reducing exposure to lead in their drinking water, including, but not limited to:

- Running water for 30 seconds before using water for cooking, drinking, and preparing infant formula. However, the time to run the water will depend on whether the home has a lead service line, and the length of the line.
- Using cold water for cooking, drinking, and preparing infant formula.
- Removing brass and old copper fixtures and plumbing in a house that could contain lead.
- Regularly clean faucet strainers to remove lead particles and sediment.
- Removing service lines that are known to have lead.

Parents should talk to their child's healthcare provider about whether their child needs to be tested for lead. DSHS Childhood Lead Poisoning Prevention Program (CLPPP) and Centers for Disease Control and Prevention (CDC) guidance for guardians and providers regarding testing is available at: https://www.dshs.texas.gov/lead/child.shtm and https://www.cdc.gov/nceh/lead/advisory/acclpp/actions-blls.htm.

Owners of private water wells may also use an appropriate treatment system to remove metals (such as arsenic, iron and lead) from their well water. A CDC guide to drinking water treatment technologies can be found at: https://www.cdc.gov/healthywater/pdf/drinking/Household_Water_Treatment.pdf.

Individuals concerned about possible past exposures to contaminants during the RCMF site operations are advised to speak with their personal physician.

Individuals are encouraged to follow the EPA's homepage for the RCMF site to stay informed with the site's cleanup status and progress. The site can be found at: https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0606915.

Next Steps

This document will be made available to community members, city officials, the EPA, and other interested parties.

DSHS will continue to work with EPA and TCEQ to evaluate additional data as they become available. The results may be summarized in additional health consultations or a public health assessment, as needed.

DSHS may aid EPA in communicating to private residential wells owners concerned about potential contamination in their water and provide educational resources on preventive measures to reduce or eliminate contaminant exposures.

For More Information

For more information about this health consultation, contact the Texas Department of State Health Services, Health Assessment and Toxicology Program at 1-888-681-0927.

Purpose and Statement of Issues

This health consultation was prepared for the River City Metal Finishing (RCMF) site in accordance with the cooperative agreement between the Agency for Toxic Substances and Disease Registry (ATSDR) and the Texas Department of State Health Services (DSHS). Located in San Antonio, Bexar County, Texas, the site was a metal plating facility until 2002. While in operation, the Texas Commission on Environmental Quality (TCEQ) issued several violations to the facility for inappropriate storage and management of hazardous waste as well as operating an on-site evaporator system without proper air emission controls. In 2016, the United States Environmental Protection Agency (EPA) completed preliminary assessments and site inspections and proposed the RCMF site to the National Priorities List (NPL). EPA listed the site on the NPL in May 2018.

During the remedial investigation in 2019-2020, EPA collected on- and off-site surface soil and groundwater samples from monitoring wells, private residential wells, and public water supply wells. The samples were analyzed for metals, semi-volatile organic compounds (SVOCs), and volatile organic compounds (VOCs). DSHS reviewed the environmental data to evaluate potential human exposures to the contaminants and to determine whether the exposures are of public health concern.

Background

Site Description

The RCMF site is located in a rural mixed residential-industrial area in Bexar County, Texas, approximately 14 miles west of downtown San Antonio. The site is bordered by Potranco Road to the north, an automobile repair shop to the east, residential properties to the south and an abandoned building to the west. The site address is 12040 Potranco Rd (FM 1957), San Antonio, TX (Figures 1 and 2).

The RCMF property consists of one land tract that is 0.64 acres and is primarily covered with native grass. The former RCMF facility consisted of a main building and an external operation area that included two storage sheds, a paint booth, paint stripping area, drums and recycling area, and a septic tank area. The main building housed five areas: an office, a main plating room, a polish room, a brass room, and a paint stripping room. RCMF provided custom electroplating, polishing, anodizing, and coloring services to various industries (USEPA, 2018). The site was abandoned sometime after operations ceased in 2002 and EPA installed a new chain-link fencing with barbed wiring around the site's perimeter in March 2019 (USEPA 2021a).

Figure 1. River City Metal Facility Location (USEPA 2016b)

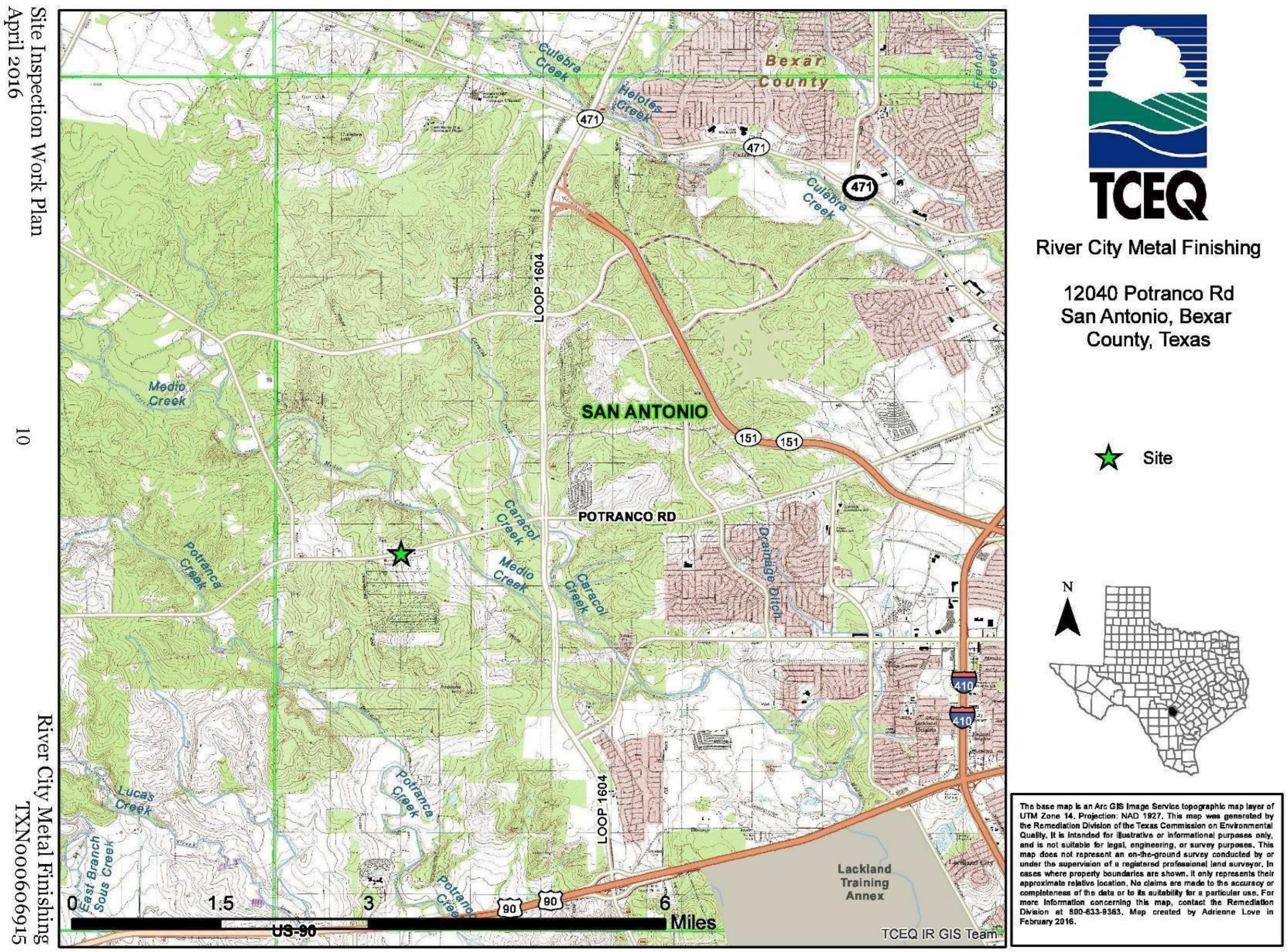
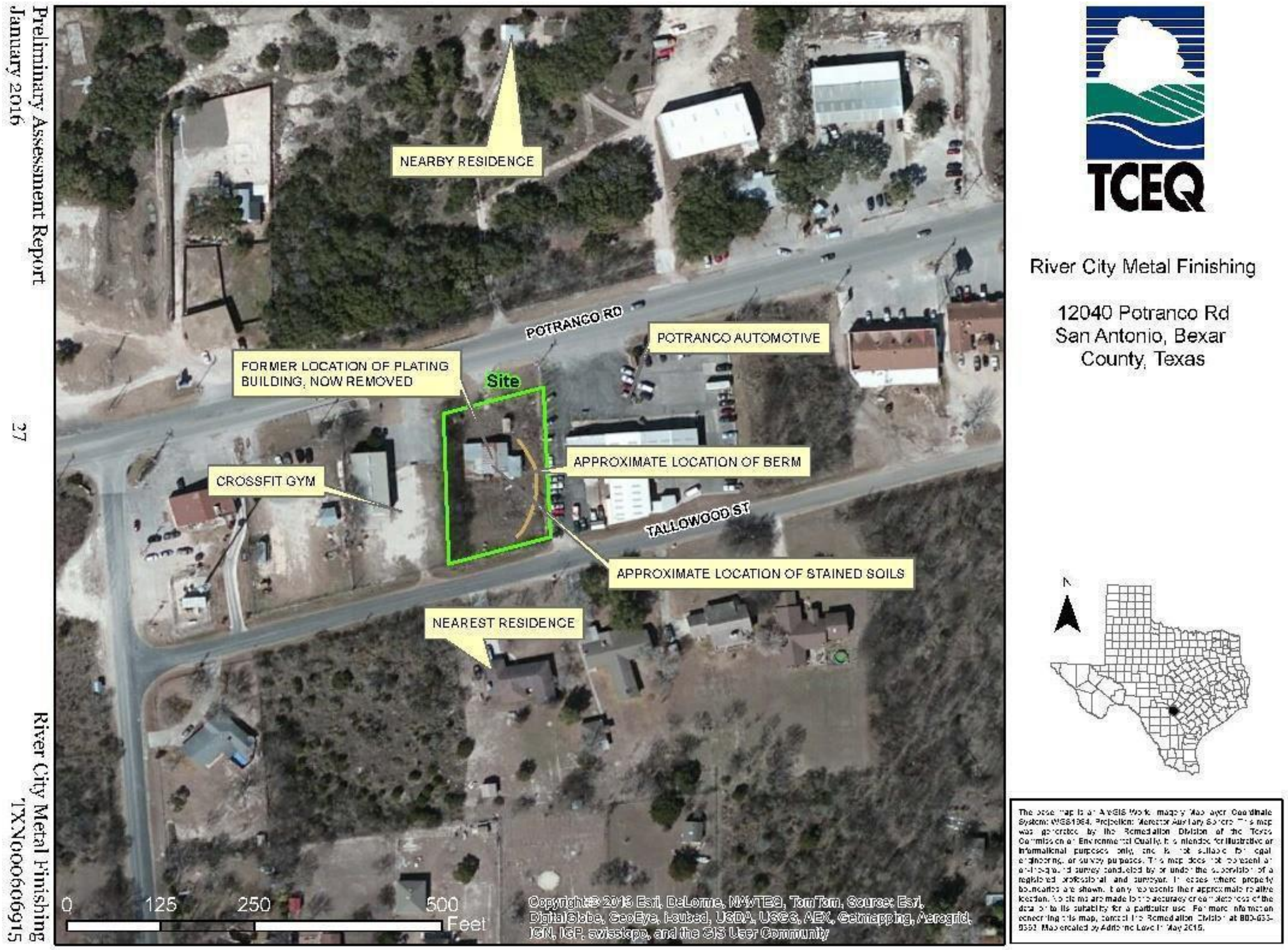


Figure 2. River City Metal Facility Site and Nearby Locations (USEPA 2016a)



Site History

Although the exact dates are unknown, available information suggests that RCMF operated as a metal plating facility between 1994 to approximately 2002 and was closed/abandoned sometime between 2002 and 2006.

RCMF provided custom electroplating, polishing anodizing, and coloring services to various industries (USEPA 2018). Items were pre-treated with caustic or acidic solutions to clean the surfaces for plating. Electroplating services included chrome, nickel, copper, brass, silver, gold, and aluminum etching. The electroplating process involved immersing the materials in plating and rinse water solutions, producing sludge which would be stored on-site until it was taken off-site for disposal (USEPA 2016b).

From 1995 to 2001, TCEQ inspected the facility numerous times and identified numerous regulatory compliance issues with how the facility stored and managed hazardous waste (USEPA 2018). In May 2010, TCEQ installed on-site monitoring wells and sampled shallow groundwater, located at a depth of 25 feet below ground surface (bgs). The samples contained total chromium concentrations above EPA's maximum contaminant level (MCL) of 0.1 milligram per liter (mg/L). Based on the results, EPA concluded that facility operations caused a release of chromium into groundwater (USEPA 2018).

In August 2013, TCEQ removed on-site drums and containers that were storing hazardous waste from the site. In addition, the office building, including the carport and concrete foundations, were demolished and disposed off-site. In March 2015, TCEQ filed a restrictive covenant to limit the NPL property to commercial/industrial use and to restrict the use of the contaminated shallow groundwater beneath the property (USEPA 2018).

EPA completed a preliminary assessment in January 2016 based on site visits conducted in January and July 2014. The on-site monitoring well was re-sampled and still indicated chromium levels above the MCL. EPA noted surface soil stains in the former main shop building area and concluded contamination from former facility operations to the shallow groundwater occurred and recommended a site inspection (USEPA 2016a).

Also, during the preliminary assessment, EPA collected samples from four public water supply (PWS) wells and three private residential wells. Wells were located within a two-mile radius of the site in both upgradient and downgradient directions. Results show metals, such as barium, copper, lead, nickel, selenium, and zinc below MCLs or action levels (USEPA 2016a). Another private residential well, located over

2 miles northwest and upgradient from the site, served as a background sampling location. Metals were not detected in the background well (USEPA 2016a).

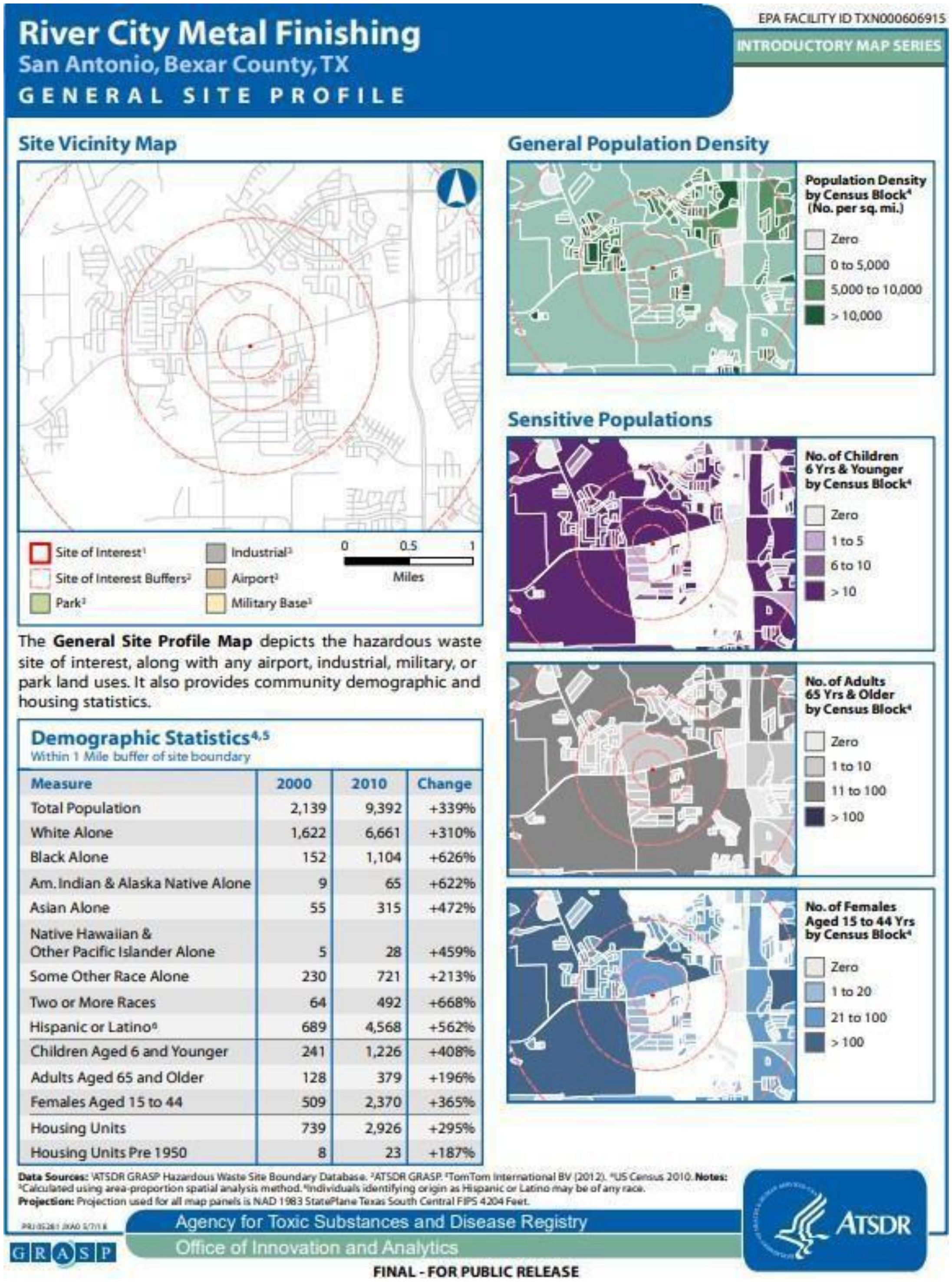
The site inspection field sampling was conducted in May 2016, and metals were detected in soil and groundwater at levels that exceeded EPA's regional screening levels (RSLs). The on-site monitor well was sampled again, and sampling results confirmed contamination of chromium, hexavalent chromium, and arsenic in shallow groundwater beneath the site. In addition, six PWS wells within a 2-mile radius from the site were sampled. Hexavalent chromium was detected in samples collected from two off-site Coolcrest PWS wells, located 0.3 miles southwest and 0.8 miles southeast from the site. These results suggested possible migration of the contamination from the shallow groundwater to the deeper regional Edwards Aquifer, which is the sole source of drinking water in the San Antonio area. The site inspection recommended a Hazard Ranking System for the site in November 2016 (USEPA 2016b). EPA proposed the RCMF site to the NPL in January 2018, and the site was finalized in May 2018.

Site Visits

DSHS staff conducted a site visit on June 25, 2018. DSHS noted that the site was covered in vegetation and gravel. The facility's gate had no signs and was broken with a gap wide enough to allow public access to the site. A hay berm was present along the east and southeast portions of the site. DSHS recommended for EPA to conduct a follow-up visit to ensure that the gate be secured to prevent trespassing (DSHS 2018).

Demographics

The 2010 United States Census Bureau reported the total population for Bexar County and the City of San Antonio as 1,714,773 and 1,327,407, respectively (USCB 2010). The Census Bureau reported 9,392 people residing in 2,926 housing units within a 1-mile radius of the site. At the time of the census, 1,226 children under the age of six and 2,370 women of child-bearing age (15-44 years old) resided in this area (Figure 3).



Demographic Statistics[4,5]
Within 1 Mile buffer of site boundary

Measure	2000	2010	Change
Total Population	2,139	9,392	+339%
White Alone	1,622	6,661	+310%
Black Alone	152	1,104	+626%
Am. Indian & Alaska Native Alone	9	65	+622%
Asian Alone	55	315	+472%
Native Hawaiian & Other Pacific Islander Alone	5	28	+459%
Some Other Race Alone	230	721	+213%
Two or More Races	64	492	+668%
Hispanic or Latino[6]	689	4,568	+562%
Children Aged 6 and Younger	241	1,226	+408%
Adults Aged 65 and Older	128	379	+196%
Females Aged 15 to 44	509	2,370	+365%
Housing Units	739	2,926	+295%
Housing Units Pre 1950	8	23	+187%

Data Sources: [1]ATSDR GRASP Hazardous Waste Site Boundary Database. [2]ATSDR GRASP. [3]TomTom International BV (2012). [4]US Census 2010. **Notes:** [5]Calculated using area-proportion spatial analysis method. [6]Individuals identifying origin as Hispanic or Latino may be of any race.
Projection: Projection used for all map panels is NAD 1983 StatePlane Texas South Central FIPS 4204 Feet.

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Figure 3. Demographic Information for the Population within 1 mile of the River City Metal Finishing Site

Land and Natural Resource Use

The site and drainage areas are covered with gravel and grass. The site is outside the 100- and 500-year floodplains (FEMA 2020). The average annual precipitation is 33 to 39 inches. Surface water runoff from the site flows to east and southeast from the facility. However, in 2013 TCEQ installed a berm comprised of a line of hay bales along the east and southeast portions of the site to prevent downgradient migration of contaminants in the soil.

The site is located near the western edge of the San Antonio metropolitan area. The nearest residential home is located across Tallowood Street, approximately 200 feet south of the site building. Additional residences occur to the south and approximately 0.5 miles to the west. Businesses exist on the eastern and western boundaries of the site and directly across the street to the north is a vacant lot. There are two churches and three schools located within an approximate 0.5-mile radius of the site.

The aquifer system in the San Antonio metropolitan area is the Edwards Aquifer. In the subject area, the Edwards Formation is approximately 500 feet thick consisting largely of gray to white limestone. The top of the groundwater table in the San Antonio area varies from 200 to 1,000 feet bgs. The site is not located within the Edwards Aquifer transition zone or recharge zone. Groundwater generally flows from west to east in Bexar County.

There are three PWS wells within a mile of the site. One of these wells, the Coolcrest #2 PWS well, is located nearest to the site and is approximately 0.3 miles southwest, which is upgradient of the site. The closest domestic and irrigation wells are within one to two miles from the site. The Coolcrest PWS wells obtain water from the Georgetown Limestone, the uppermost formation of the Edwards Aquifer, which is located at a depth of 501 feet bgs (USEPA, 2016b). See Figure 4 for the location of all public and private water wells sampled.

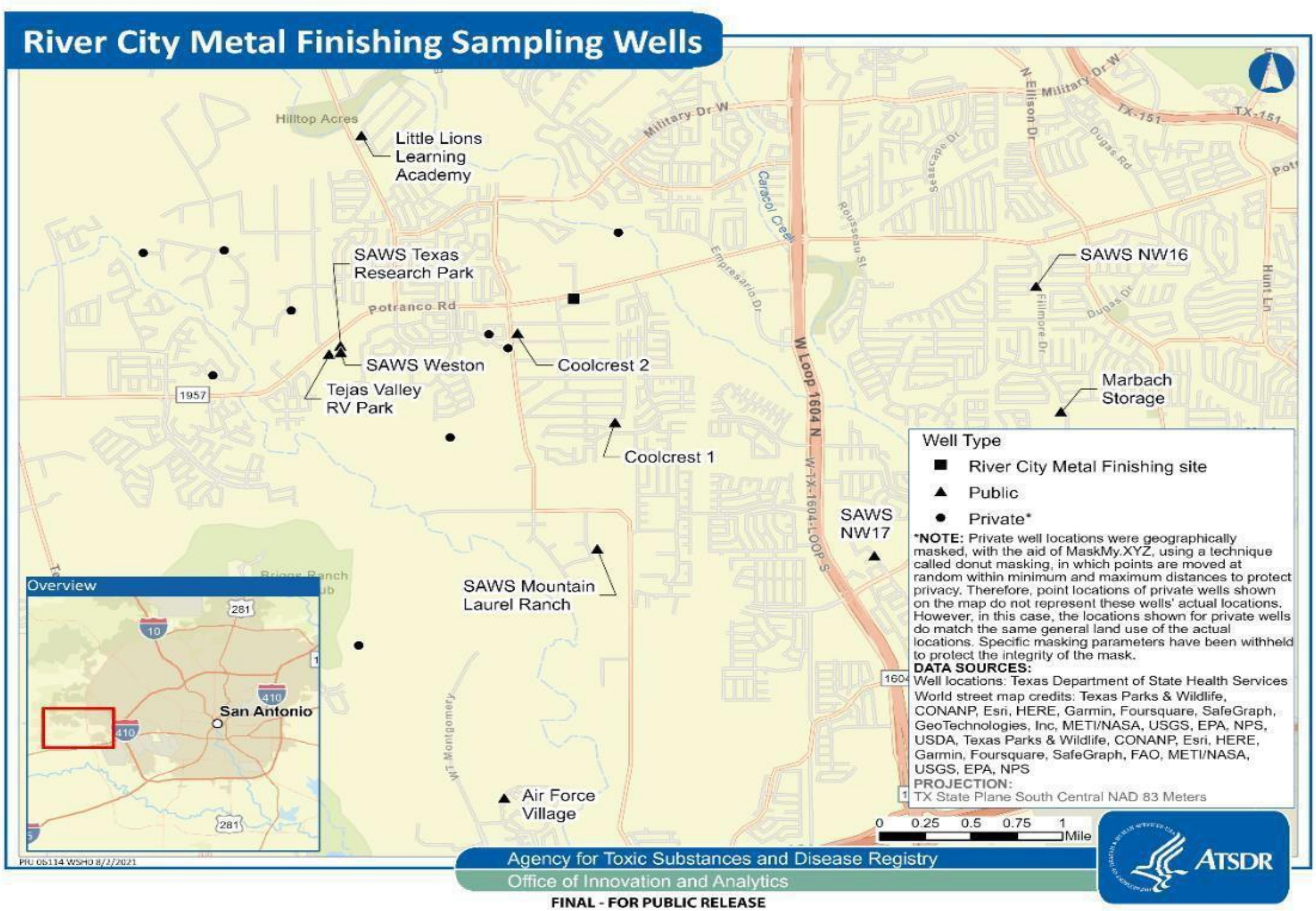

Figure 4. Locations of Public and Private Groundwater Wells Sampled

Discussion

Environmental Data Used

Data evaluated in this health consultation includes on-site surface soil, off–site surface soil, and groundwater sampling results collected by either EPA, TCEQ or the Edwards Aquifer Authority (EAA). The samples were collected during EPA's site and remedial investigation activities and analyzed following EPA's standard protocols and quality assurance/quality control guidelines. Thus, DSHS and ATSDR assumed adequate quality assurance/quality control procedures were followed regarding data collection, chain of custody, laboratory procedures, and data reporting. Below is a chronological account of sampling activities at the site:

- In May 2016, TCEQ/EPA collected 7 on-site surface soil samples (including one duplicate) and one background surface soil sample from a location approximately 1 mile south-southwest from the RCMF site. EPA also collected a total of 12 groundwater samples from 6 PWS and 6 private residential wells.

- In July-August 2018, the EAA collected a total of 8 groundwater samples from 4 PWS and 4 private residential wells. Water samples were collected directly from the well head.

- In April 2019, EPA collected 11 on-site and 3 off-site surface (top 6 inches) soil samples and a total of 15 groundwater samples (including duplicates) from 7 PWS and 6 private wells.

- In December 2019, EPA collected a total of 12 groundwater samples (including 3 duplicates) from 7 PWS and 2 private residential wells.

Samples were analyzed for various metals, SVOCs, and VOCs. Duplicate samples were collected for quality control purposes. DSHS used the higher concentration of the duplicate sample when determining the exposure point concentration in this health consultation.

Process to Evaluate Environmental Contamination

DSHS conducted a three-step process to evaluate the public health implications using available environmental data. First, DSHS conducted an exposure pathway analysis to identify how people may be exposed. Second, DSHS conducted a screening analysis by comparing the sampling data to media-specific screening levels known as comparison values (CVs). Third, when CVs were exceeded, DSHS conducted a more detailed public health evaluation of contaminants of concern identified in the screening analysis to determine whether harmful effects might be possible (ATSDR 2005a).

Exposures Pathway Analysis

An exposure pathway describes how a chemical moves from its source and comes into physical contact with people. Identifying exposure pathways is important in a health consultation because adverse health impacts from contaminants can only happen if people are exposed to them. The presence of a contaminant in the environment does not necessarily mean that people are coming into contact with it. DSHS divided exposure pathways into three categories: completed, potential, and eliminated.

There are five elements considered in the evaluation of exposure pathways:

1. a source of contamination,
2. an environmental media that could absorb or transport the contamination,
3. a point of exposure where people could contact the contaminated media,
4. a route of exposure, such as inhalation, ingestion, or dermal contact, and
5. an identifiable exposed population.

A completed exposure pathway occurs when all five elements are present, and exposure has occurred, is occurring, or will occur in the future. A potential exposure pathway occurs when one or more of the five elements cannot be confirmed but may have been present in the past or be present at some point in the future. Eliminated exposure pathways are missing one or more elements and exposure cannot occur.

DSHS identified likely site-specific exposure pathways for people living near or trespassing on the site based on available environmental data and knowledge of accessibility to contaminated areas.

Completed Exposure Pathways

<u>Past (prior to March 2019) incidental ingestion and skin contact of on-site surface soil</u>

Nearby residents and visitors may have come into contact with the contaminants in the surface soil through incidental soil ingestion and skin contact while trespassing on site property.

In June 2009, the EPA conducted a preliminary assessment and observed a chain-linked fence with barbed-wire along the perimeter of the site restricting access to the property. However, it was also noted that there was a man-made gap in the south gate, suggesting that unauthorized pedestrian access has occurred. During DSHS site visit in 2017, dirt pathways from regular and heavy usage by people and signs of regular mowing were observed.

Potential Exposure Pathways

Past, current, and future incidental ingestion and skin contact of off-site surface soil

Nearby residents and visitors may come into contact with the contaminants in off-site surface soil through incidental soil ingestion and skin contact while participating in outdoor activities, such as playing near the site or walking along Tallowood Street.

Surface water runoff from the site flows to the east and southeast along Tallowood Street immediately adjacent to the site. In 2013 TCEQ installed a hay berm along the eastern and southeastern portions of the site to prevent contaminants from migrating off the site to Tallowood Street and reaching the residential area approximately 200 feet south of the site.

Past, current, and future incidental ingestion and skin contact of water from private residential wells

Residents with private water wells may come into contact with contaminants through ingestion and skin contact of groundwater.

Water from the contaminated shallow groundwater (25 feet bgs) directly under the RCMF site is not used for drinking water purposes. In addition, the restricted covenant prohibits use of on-site shallow groundwater for drinking purposes. However, the contaminated shallow groundwater may migrate off-site and to the deeper groundwater aquifer that is used for drinking. Residential private water wells are located 1 to 2 miles from the site and these wells are completed in the Edwards Aquifer, which is located 200 feet deeper than the shallow groundwater aquifer. These wells are also located upgradient from the site, except for one well located northeast from the site.

Eliminated Pathways

Past (from March 2019), current and future incidental ingestion and skin contact with on-site surface soil

Starting in March 2019, EPA began its remedial investigation and installed a new fence to secure the site before collecting more soil and groundwater samples. Given this update in security, current and future trespassing onto the site is not expected to occur.

<u>Past, current, and future ingestion of water from PWS wells</u>

Residences near the site may get drinking water from PWS, including the Coolcrest PWS and San Antonio PWS. The PWS wells are completed in the Georgetown Limestone, the uppermost formation of the Edwards Aquifer, which located at a depth of 501 feet bgs. Additional groundwater sampling for residential and PWS wells in 2018 was conducted and EPA concluded that the metals detected in wells within the Edwards Aquifer are naturally occurring. Monitoring data from the Texas Drinking Water Watch, which monitors the potable water being delivered to residential tap from these PWS wells, do not show any contaminants above reporting limits (TDWW, 2020). In addition, EPA has suggested in recent updates that the contamination from the facility is likely limited to the shallow groundwater aquifer.

Table 1. Human Exposure Pathway Evaluation

Source	Medium	Point of Exposure	Route of Exposure	Potentially Exposed Population	Time Frame & Type of Exposure Pathway
RCMF	Surface Soil	On-site soil	Incidental ingestion, dermal contact	Trespassers	Past: Complete Current: Eliminated Future: Eliminated
RCMF	Surface Soil	Off-site soil near site border	Incidental ingestion, dermal contact	Nearby residents living along Tallowood Street/ recreational users	Past: Potential Current: Potential Future: Potential
Private Well	Residential Drinking Water	Residential tap	Ingestion	Residents	Past: Potential Current: Potential Future: Potential
Public Water Supply	Residential Drinking Water	Residential tap	Ingestion	Residents	Past: Eliminated Current: Eliminated Future: Eliminated

Abbreviation: RCMF= River City Metal Finishing.

Screening Analysis

Following identification of a completed/potential exposure pathway, DSHS conducted a screening analysis to identify contaminants of concern. The analytical results for each contaminant were compared to health comparison values (CVs) published by ATSDR. When CVs were not available from ATSDR, RSLs, MCLs and drinking water action levels published by the EPA or TCEQ's protective concentration levels (PCLs) were used. Comparison values are media-specific (e.g., air, soil, and water) levels below which no adverse health effects are expected to occur. It is important to note that if a chemical concentration exceeds a CV, it does not necessarily mean there is a health hazard. It means the chemical- and site-specific exposure scenario warrants further public health evaluation based on site-specific exposure conditions.

Off-site Groundwater Evaluation from Residential Private Wells

DSHS reviewed groundwater sampling results collected from residential private wells. The closest residential wells were located 1 to 2 miles from the site and were completed in the Edwards Aquifer, which is 200 feet deeper than the shallow contaminated groundwater unit. Generally, metals were detected in wells located upgradient of the site. The results show metals, such as antimony, arsenic, cadmium, copper, hexavalent chromium, zinc, and thallium, above CVs (Table 2). However, EPA has indicated that there is no evidence of off-site migration for site-related contaminants. Therefore, these contaminants detected in the private residential wells are not likely to be site related. Because these chemicals can be harmful at high levels, they were further evaluated for their potential to cause adverse noncancer and cancer health effects. In addition, lead was detected once slightly above the EPA's action level of 15 micrograms per liter (μg/L) in one private well during the 2019 sampling event. ATSDR and Centers for Disease Control and Prevention (CDC) recommend preventing lead exposure whenever possible because there is no safe level of lead in blood. Please see the Health Effects Evaluation section for further discussion.

Some chemicals detected in private wells are dietary minerals, such as calcium, fluoride, and sodium. Although beneficial to human health, they can be harmful when ingested at high concentrations. DSHS compared the maximum concentrations per sampling event (assuming adult daily water intake) to dietary reference intake guidelines (NAS, 2019). Only iron was determined to be above the dietary reference intake guidelines in one well from one sampling event (Appendix B, Table B5).

On-site Soil Evaluation

DSHS evaluated on- and off-site soil samples. Given that the new fence was installed in March 2019, data from the 2016 site investigation (Figure 5) was used to evaluate past on-site exposure for trespassers. Metals (including antimony, cadmium, chromium, copper, lead, nickel, selenium, silver, and zinc, and cyanide) were detected in soil samples. Of these, chromium, copper, and nickel were detected above respective CVs and were evaluated further (Table 3). Other contaminants (not listed in Table 3) were all below CVs and therefore unlikely to result in harmful effects. Please note that lead is also evaluated further because there is no CV for lead.

Total chromium concentrations in soil ranged from 38.3 to 682 mg/kg. These results were above the background level of 8.9 mg/kg for total chromium detected during the 2016 TCEQ site inspection. ATSDR and EPA do not have a CV for total chromium. ATSDR has a cancer risk evaluation guide (CREG) CV of 0.22 mg/kg for hexavalent chromium, which is based on California Environmental Protection Agency's (CalEPA) cancer slope factor (CSF) for hexavalent chromium. DSHS compared total chromium concentrations to this hexavalent chromium CV because hexavalent chromium contamination was found on-site in the shallow groundwater. However, comparing total chromium, which is comprised of elemental chromium, trivalent and hexavalent chromium, to the CV for hexavalent chromium is a health protective approach. Sample results were also below the TCEQ screening level of 33,000 mg/kg for total chromium in residential soil.

Copper concentrations ranged from 21.8 to 650 mg/kg. One soil sample (SS-04) had a concentration that exceeded ATSDR's intermediate environmental media evaluation guide (EMEG) CV for children. Copper was not detected in the background sample.

Lead concentrations ranged from 17 to 106 mg/kg. These levels are above the background soil lead level of 8.2 mg/kg (sample SS-01) and above the Texas median background soil lead concentration of 15 mg/kg (TCEQ 2001). Please see the health effects section for further discussion about lead in soil.

Nickel concentrations ranged from 23.9 to 3,200 mg/kg. One soil sample (SS-04) had a nickel concentration above the ATSDR reference dose media evaluation guide (RMEG) CV for children. Nickel was not detected in the background sample.

Off-site Soil Evaluation

Off-site soil data from the April 2019 sampling event was used to evaluate past, current, and future potential exposure pathways. This consisted of three off-site soil samples (SB-04, SB-09 and SB-10). Two of these samples (SB-04 and SB-09) were collected in an area adjacent to the south part of the facility and in the right of way on Tallowood Street, and one of these samples (SB-10) was collected just east of the facility off Tallowood Street and south of the neighboring Potranco Automotive repair shop (Figure 6). Chromium, iron, lead, manganese, mercury, and PAHs, including carbazole, chrysene, benzo(a)pyrene, benzo(a)anthracene, phenanthrene and dibenz(a,h)anthracene, were detected in off-site soils and were compared to CVs (Table 4). While total chromium was detected in off-site soil, hexavalent chromium was not detected. Only benzo(a)pyrene was identified as a contaminant of concern. Benzo(a)pyrene and other PAHs (without CVs) were further evaluated for their potential to cause noncancer health effects. PAHs were detected in on-site soil samples below the CVs.

PAHs are a group of over 100 different chemicals that are formed through the incomplete burning of materials such as coal, garbage, combustible gas, oil, tobacco, wood, and charbroiled meat (ATSDR 1995). When evaluating cancer effects of PAHs, they are typically evaluated as mixtures because they rarely occur alone in nature. This approach includes using benzo(a)pyrene (BaP) as a surrogate to assess the relative toxicity of all PAHs in off-site soil based on EPA and ATSDR guidance for assessing PAHs (USEPA 1993; ATSDR 2022). To determine the toxicity of a mixture of PAHs, the concentration of each PAH was multiplied by its BaP Toxic Equivalency Factor (TEF), which results in its BaP toxic equivalency concentration

(USEPA 1993; ATSDR 2022). The toxic equivalency concentration for each PAH in a sample was then added together to determine the BaP toxic equivalency (BaP TE) concentration for the mixture (Table 5). Total BaP toxic equivalency concentrations for the three off-site soil samples ranged from 0.014 to 0.437 mg/kg. The total BaP toxic equivalency concentration in one soil sample (SB-10) was above the ATSDR CREG for BaP and PAHs were further evaluated for their potential to cause cancer.

Table 2. Summary of Residential Private Wells Groundwater Data from All Sampling Events

Contaminant	Sampling Event	Concentration Range (µg/L)	Comparison Value (µg/L)	Total Number of Samples	Number of Samples with Contaminant Detection	Number of Samples Exceeding Comparison Value	Well ID with Exceedances
Antimony	EPA/TCEQ 2019	4.1- **6.1**	2.8 ATSDR RMEG Child	8	2	2	WW-20
Arsenic	EPA/TCEQ 2019	ND - **3**	0.016 ATSDR CREG	8	1	1	WW-21
Cadmium	EPA/TCEQ 2019	ND - **1.1**	0.7 ATSDR Chronic EMEG Child	8	1	1	WW-20
Chromium	EPA/TCEQ 2019	0.309 – 1.8	100 EPA MCL	2	2	0	none
Chromium	EAA 2018	0.745 – 1.19	100 EPA MCL	4	4	0	none
Copper	EPA/TCEQ 2016	ND - **161**	70 ATSDR Intermediate EMEG Child	6	2	1	GW-05
Hexavalent Chromium	EPA/TCEQ 2019	**0.067 – 0.099**	0.024 ATSDR CREG	2	2	2	WW-10 WW-23
Hexavalent Chromium	EAA 2018	**0.13 – 0.19**	0.024 ATSDR CREG	4	4	4	5MR 4AH 711 4GB

Contaminant	Sampling Event	Concentration Range (µg/L)	Comparison Value (µg/L)	Total Number of Samples	Number of Samples with Contaminant Detection	Number of Samples Exceeding Comparison Value	Well ID with Exceedances
Lead	EPA/TCEQ 2016	ND – 10.2	EPA Action Level	6	2	0	none
Lead	EPA/TCEQ 2019	ND - **16**	15 EPA Action Level	8	2	1	WW-20
Lead	EAA 2018	ND – 2.16	15 EPA Action Level	4	1	0	none
Thallium	EPA/TCEQ 2019	ND – **4.2**	2 EPA MCL	8	1	1	WW-10
Zinc	EPA/TCEQ 2019	9.3 - **2,950**	2,100 ATSDR Chronic EMEG Child	8	8	2	WW-20

Abbreviations: µg/L: micrograms per liter are equivalent to parts per billion (ppb); ND – not detected; NA – not available; ATSDR - Agency for Toxic Substances and Disease Registry; CREG - cancer risk evaluation guide; EMEG - environmental media evaluation guide; RMEG - remedial media evaluation guide; EPA – Environmental Protection Agency; MCL – maximum contaminant level.
Bold values indicate the concentrations of a contaminant exceeded the CV(s).

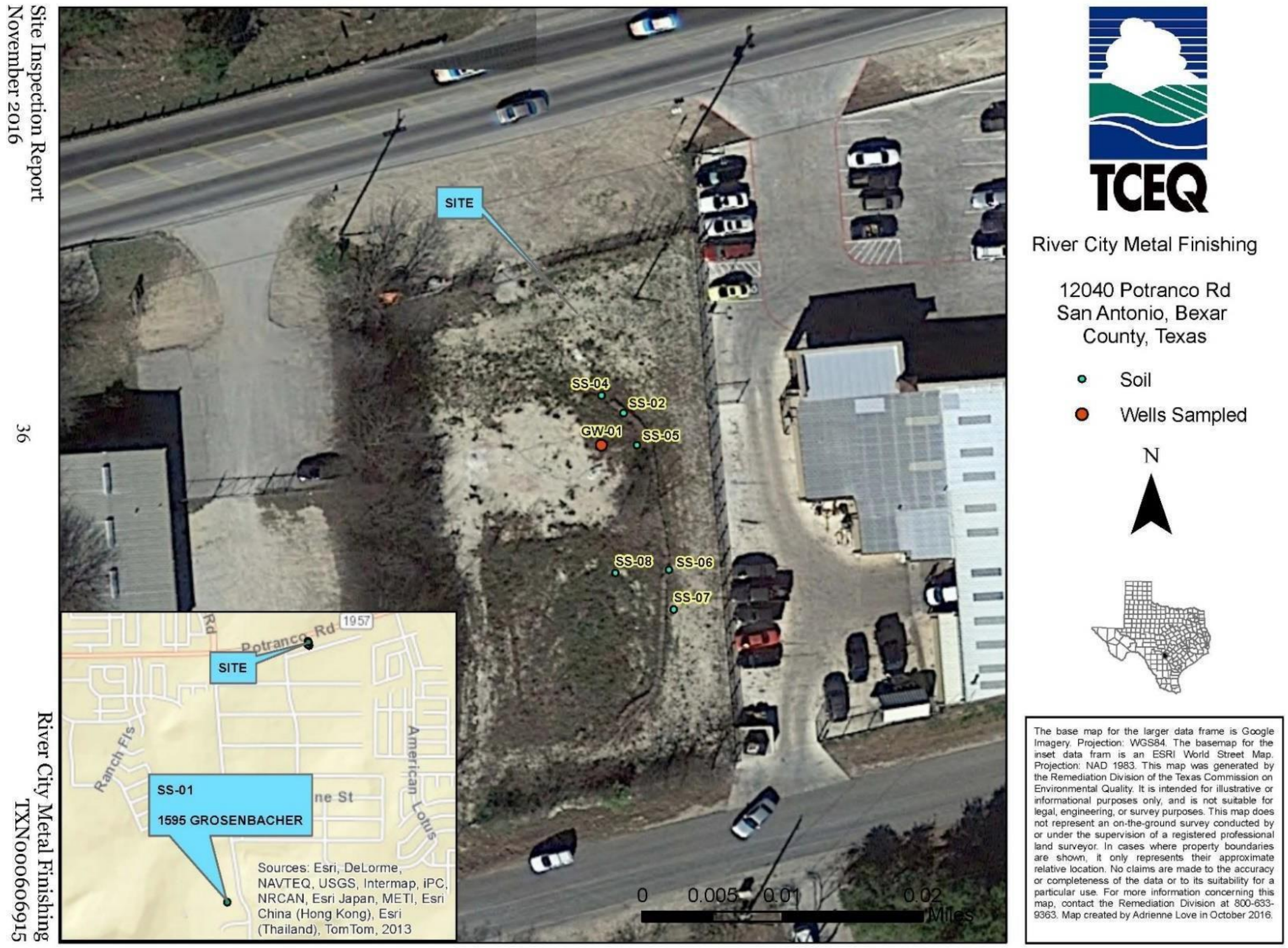

Figure 5. On-site Soil Sample Locations (USEPA 2016a)

Table 3. Summary of On-site Soil Results and Comparison Value Screening

Contaminant	Concentration Range (mg/kg)	Comparison Value (mg/kg)	Total Number of Samples	Number of Samples with Contaminant Detection	Number of Samples Exceeding Comparison Value
Chromium	**38.3 – 682**	0.22 ATSDR Soil CREG*	7	7	7
Copper	21.8 - **650**	520 ATSDR Child Intermediate/Acute EMEG	7	7	1
Lead	17 – 106	NA	3	3	NA
Nickel	23.9 – **3,200**	1,000 ATSDR Child Chronic RMEG	7	7	1

Abbreviations: mg/kg: milligrams per kilogram are equivalent to parts per million (ppm); NA – not available; ATSDR - Agency for Toxic Substances and Disease Registry; CREG - cancer risk evaluation guide; EMEG - environmental media evaluation guide; RMEG - remedial media evaluation guide.
*ATSDR CV used to compare chromium is derived from California EPA's Cancer Slope Factor (CSF) for hexavalent chromium.
Bold values indicate the concentrations of a contaminant exceeded the CV(s).

Figure 6. April 2019 On-site and Off-site Soil Sample Locations (USEPA 2019)

Table 4. Summary of Off-site Soil Sample Results and Comparison Value Screening Exceedances

Contaminant	Concentration Range (mg/kg)	Comparison Value (mg/kg)	Total Number of Samples	Number of Samples with Contaminant Detection	Number of Samples Exceeding Comparison Value
Benzo(a)anthracene	0.0416 - 0.243	NA	3	3	NA
Benzo(a)pyrene	0.008 - **0.305**	0.065 ATSDR CREG	3	3	1
Benzo(b)fluoranthene	0.0119 – 0.446	NA	3	3	NA
Benzo(k)fluoranthene	0.00446 – 0.205	NA	3	3	NA
Carbazole	0.551	230 TCEQ Residential PCL	3	1	0
Chromium	**4.54 - 10.2**	0.22 ATSDR Soil CREG*	3	3	**3**
Chrysene	0.00981 – 0.381	NA	3	3	**3**
Dibenz(a,h)anthracene	ND – 0.0483	NA	3	1	NA

Contaminant	Concentration Range (mg/kg)	Comparison Value (mg/kg)	Total Number of Samples	Number of Samples with Contaminant Detection	Number of Samples Exceeding Comparison Value
Indeno(1,2,3-cd)pyrene	0.0075 – 0.251	NA	3	3	NA
Lead	1.81-6.49	NA	3	3	NA
Hexavalent Chromium	ND	0.22 ATSDR Soil CREG*	3	0	0
Iron	1960 – 3100	55,000 EPA RSL	3	3	0
Manganese	48.5 – 60.2	1,800 EPA RSL	3	3	0
Mercury	0.006	11 EPA RSL	3	1	0
Phenanthrene	0.0149 – 0.195	1,700 TCEQ Residential PCL	3	2	0

Abbreviations: mg/kg- milligrams per kilogram are equivalent to parts per million (ppm); ND – not detected; NA – not available; ATSDR - Agency for Toxic Substances and Disease Registry; CREG - cancer risk evaluation guide; EPA – Environmental Protection Agency; RSL – regional screening level; TCEQ – Texas Commission on Environmental Quality; PCL – protective contaminant level. Bold values indicate the concentrations of a contaminant exceeded the CV(s).

Table 5. BaP Toxic Equivalency Concentrations (mg/kg) in Off-site Soil Samples

Polycyclic Aromatic Hydrocarbon Fraction	TEF	BaP TE at SB 04	BaP TE at SB 09	BaP TE at SB 10
Benzo(a)anthracene	0.1	0.00416	0.004	0.0243
Benzo(a)pyrene	1	0.00764	0.0111	0.305
Benzo(b)fluoranthene	0.1	0.00119	0.00259	0.0446
Benzo(k)fluoranthene	0.1	0.000446	0.004	0.0205
Chrysene	0.01	0.0000981	0.000164	0.00389
Dibenz(a,h)anthracene	2.4	ND	ND	0.0139
Indeno(1,2,3-cd)pyrene	0.1	0.000703	0.004	0.0251
Total BaP Toxic Equivalency Concentration (mg/kg)	NA	0.0142	0.0258	**0.437**

Abbreviations: mg/kg- milligrams per kilogram are equivalent to parts per million (ppm); NA – not available; ND – not detected; TEF - Toxic Equivalency Factor; BaP - benzo(a)pyrene.
Bold values indicate the concentrations of a contaminant exceeded the ATSDR CV(s).

Health Effects Evaluation

The selected contaminants of concern shown in Tables 2 – 5 were further evaluated based on site-specific exposure conditions. Site-specific exposure doses were calculated and compared to levels at which adverse health effects have been observed in animal, clinical, and/or epidemiological studies. The evaluation considered the potential health impacts to the general public and sensitive groups. Cancer risks are also discussed in the Cancer Health Effects section below.

Estimation of Site-Specific Exposure Doses

An exposure dose is an estimate of the amount of a contaminant that gets into a person's body over a specific period of time (ATSDR 2005a). DSHS used EPA's ProUCL® to calculate the 95% upper confidence limit (UCL) of the arithmetic mean as the exposure point concentration if eight or more samples were collected. The maximum concentration was used as the exposure point concentration if less than eight samples were collected. Because of the lack of site-specific information regarding trespassing and off-site uses of area adjacent to the site, DSHS assumed a worst-case scenario that on-site trespassers and off-site recreational users visit the area 7 days per week for 52 weeks a year (ATSDR 2005a). No site-specific soil intake rates were available, so DSHS used default values. DSHS used ATDSR's recommended two exposure scenarios: an average, or central tendency exposure (CTE), scenario and a higher-than-average, or reasonable maximum exposure (RME), scenario (Appendix B).

Combined ingestion and dermal exposure doses were only calculated for children greater than eleven years of age and adults because children younger than eleven years of age are not likely to trespass onto fenced property without adult supervision. In addition, with the community's awareness of the Superfund site, children younger than eleven years of age are not expected to participate in recreational activities at or near the fenced property without adult supervision. Standard body weight, exposure duration, and EPA's default bioavailability factors were used to calculate the daily exposure doses (Appendix B).

Noncancer Health Effects

To evaluate possible noncancer health effects, the estimated exposure dose was compared to an appropriate health guideline, such as ATSDR's minimal risk level (MRL) or EPA's reference dose (RfD). A health guideline is an estimate of daily exposure dose to a substance over a specified duration that is unlikely to cause harmful, noncancer health effects in humans. If an estimated exposure dose is lower than the health guideline, adverse noncancer health effects are not expected to occur. If an estimated dose is higher than the health guideline, it does not necessarily mean it will harm people's health; rather, it means that DSHS must conduct an in-depth evaluation to determine if adverse health effects are possible and if the exposure poses a health hazard. This is done by comparing the dose to known noncancer health effect levels found in the scientific literature.

DSHS calculated the hazard quotients (HQs) to compare estimated exposure doses to health guidelines. The HQs were calculated by dividing the estimated exposure doses by the health guideline. If the HQ is less than 1, then adverse health effects are not likely. If the HQ exceeds 1, then a more in-depth evaluation takes place.

Cancer Health Effects

To estimate cancer risk for cancer-causing contaminants, such as arsenic, the estimated exposure dose was multiplied by the contaminant's cancer slope factor (CSF). The calculated cancer risk is called an excess lifetime cancer risk, which estimates the proportion of a population that may be affected by a carcinogen during their lifetime (Appendix C). An excess lifetime cancer risk represents the additional risk above the existing background cancer risk. For example, an estimated cancer risk of 2 per million (or 2E-6) represents potentially two extra cancer cases in a population of one million people over a lifetime. In the United States, the background cancer risk (or the probability of developing cancer at some point during a person's lifetime) is about 40 out of 100 for men and 39 out of 100 for women (ACS 2020). Note, cancer risk estimates in this document are not a measure of the actual cancer cases in a community; rather, they are a tool used by ATSDR for making public health recommendations.

Residential Private Wells

Antimony

Antimony is not classified as carcinogen, therefore, DSHS only evaluated noncancer health effects from antimony exposure.

Antimony was detected twice above the CV in one private residential well, WW-20 (Table 2). Because no other sampling data were available, DSHS assumed that residents drinking water from WW-20 were exposed to antimony at the maximum level detected (6.1 µg/L) over many years and calculated exposure doses using this level.

Estimated exposure doses for children range from 6.6E-5 mg/kg/day to 8.7E-4 mg/kg/day. The highest estimated exposure dose is for children less than 1 year of age (Table 6). The estimated exposure dose for adults ranged from 9.4E-5 mg/kg/day to 2.4E-4 mg/kg/day.

The RME exposure doses for children in the less than 1 year and 1 to less than 2 years age groups exceeded EPA's RfD for antimony (0.0004 mg/kg/day) (HQs ranged from 1.2 to 2.2). The RfD was derived from a chronic rat study showing effects on blood glucose and cholesterol levels (USEPA 1987). A lowest observable adverse effect level (LOAEL) was noted in rats exposed to 0.35 mg/kg/day of antimony. The highest estimated exposure dose for children is 402 times less than the LOAEL. Based on this information and health protective assumptions, exposure to antimony in drinking water at this level is well below the effect level and not likely to cause noncancer human health risks.

Table 6. Chronic Exposure Dose and Noncancer Hazard Quotient Estimations for Central Tendency Exposure (CTE) and Reasonable Maximum Exposure (RME) for Antimony in Residential Private Wells

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient
Birth to < 1 year	3.9E-04	1.0	8.7E-04	**2.2**
1 to < 2 years	1.6E-04	0.4	4.8E-04	**1.2**
2 to < 6 years	1.3E-04	0.3	3.4E-04	0.9
6 to < 11 years	9.8E-05	0.3	2.7E-04	0.7
11 to < 16 years	6.8E-05	0.2	2.1E-04	0.5
16 to < 21 years	6.6E-05	0.2	2.1E-04	0.5
Adult	9.4E-05	0.2	2.4E-04	0.6

Abbreviations: mg/kg/day = milligram per kilogram per day.
Bolded value indicates HQ greater than 1.

Arsenic

Arsenic was detected once above the CV in one private residential well, WW-21, at 3 µg/L. Because no other sampling data were available, DSHS assumed that the residents drinking water from WW-21 were exposed to arsenic at this level over many years.

Based on the concentration detected in the well, the estimated exposure dose for children ranged from 3.2E-5 mg/kg/day to 4.3E-4 mg/kg/day (Table 7). The highest estimated exposure dose (4.3E-4 mg/kg/day) is for children less than 1 year of age. The estimated exposure dose for an adult ranged from 4.6E-5 mg/kg/day to 1.2E-4 mg/kg/day.

The RME exposure dose for children less than 1 year exceeded ATSDR's MRL of 0.0003 mg/kg/day (HQ of 1.4). The MRL was derived from a study in Taiwan that observed dermal lesions such as hyperpigmentation (skin darkening) and hyperkeratosis (localized overgrowth of skin) in farmers exposed to 0.014 mg/day/kg (LOAEL). No adverse health effects (NOAEL) were reported among farmers exposed to 0.008 mg/day/kg (ATSDR 2007). The MRL was calculated by dividing the NOAEL by an uncertainty factor of 3 (ATSDR 2007). Other health effects at these exposure levels include an enlarged liver, bronchitis, gastrointestinal effects, and peripheral vascular effects, such as cyanosis, gangrene, and the condition known as blackfoot disease (ATSDR 2007). However, the overall database for dermal effects is considerably stronger than for effects for other end points and was used to derive the MRL.

The highest estimated exposure dose is 32 times below levels at which non-cancer health effects have been observed in people. Based on this information and health protective assumptions, exposure to arsenic in drinking water at this level is not likely to cause noncancer human health risks.

Evidence from multiple epidemiological studies suggest that ingestion of arsenic increases the risk of developing skin cancer (ATSDR 2007). The estimated excess cancer risk due to arsenic in drinking water is 2E-5 to 6E-5 among children (12 to 21 years of exposure), and 1E-5 to 7E-5 among adults (12 to 33 years of exposure) (Table 7). DSHS interprets this to be a low increased lifetime risk of developing cancer for both children and adults. However, there is some uncertainty with the cancer risk estimate because it is based on the results of one sample collected from one well and assumes long-term exposure to arsenic at this level over several decades.

Table 7. Chronic Exposure Doses, Noncancer Hazard Quotient and Cancer Risk Estimates for Arsenic in Residential Private Wells

PHAST Public Health Assessment Site Tool Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	RME Cancer Risk
Birth to < 1 year	1.9E-04	0.7	-	4.3E-04	**1.4**	-
1 to < 2 years	8.1E-05	0.3	-	2.4E-04	0.8	-
2 to < 6 years	6.5E-05	0.2	-	1.7E-04	0.6	-

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	RME Cancer Risk
6 to < 11 years	4.8E-05	0.2	-	1.3E-04	0.4	-
11 to < 16 years	3.4E-05	0.1	-	1.0E-04	0.4	-
16 to < 21 years	3.2E-05	0.1	-	1.0E-04	0.3	-
Total Child	-	-	**2E-5**	-	-	**6E-5**
Adult	4.6E-05	0.2	**1E-5**	1.2E-04	0.4	**7E-5**

Abbreviations: mg/kg/day - milligram per kilogram per day; CTE – central tendency exposure; RME – reasonable maximum exposure.
Bolded value indicates cancer risk greater than 1E-6.

Cadmium

Cadmium is not classified as a carcinogen. Therefore, DSHS only evaluated noncancer health effects from cadmium exposure.

Cadmium was detected above the CV once in one residential water well, WW-20, at 1.1 µg/L. Because no other sampling data were available, DSHS assumed that the residents drinking water from WW-20 were exposed to cadmium at this level over many years.

Based on the concentration detected in the well, the estimated exposure doses for children ranged from 1.2E-5 mg/kg/day to 1.6E-4 mg/kg/day. The highest estimated exposure dose (1.6E-4 mg/kg/day) is for children less than 1 year of age. The estimated exposure doses for adults ranged from 1.7E-5 mg/kg/day to 4.3E-5 mg/kg/day (Table 8).

ATSDR has derived a chronic oral MRL of 0.0001 mg/kg/day based on a database that examines the relationship between urinary cadmium levels and adverse health effects (ATSDR 2012a). A urinary cadmium level (0.00033 mg/kg/day) corresponding to a probability of 10 percent ($UCDL_{10}$) excess risk of kidney effects such as proteinuria (increased levels of protein in urine) was determined. The MRL was calculated by dividing the $UCDL_{10}$ by an uncertainty factor of 3 to account for human variability (ATSDR 2012a).

The RME exposure dose for children less than 1 year exceeded ATSDR's MRL of 0.0001 mg/kg/day (HQ of 1.6) but is 2 times less than $UCDL_{10}$ (0.00033 mg/kg/day). All other estimated exposure doses are less than the MRL. Based on this information and health protective assumptions, exposure to cadmium in drinking water at this level is not likely to cause noncancer health effects.

Table 8. Chronic Exposure Dose and Noncancer Hazard Quotient Estimations for Central Tendency Exposure (CTE) and Reasonable Maximum Exposure (RME) for Cadmium in Residential Private Wells

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient
Birth to < 1 year	7.1E-05	0.7	1.6E-04	**1.6**
1 to < 2 years	3.0E-05	0.3	8.6E-05	0.9
2 to < 6 years	2.4E-05	0.2	6.2E-05	0.6
6 to < 11 years	1.8E-05	0.2	4.9E-05	0.5
11 to < 16 years	1.2E-05	0.1	3.8E-05	0.4
16 to < 21 years	1.2E-05	0.1	3.8E-05	0.4
Adult	1.7E-05	0.2	4.3E-05	0.4

Abbreviations: mg/kg/day = milligram per kilogram per day.
Bolded value indicates HQ greater than 1.

Hexavalent Chromium

Hexavalent chromium was detected once above the CV in several private residential wells, including WW-10, WW-23, 5MR, 4Ah, 711 and 4GB. Because no other sampling data were available, DSHS assumed that the residents drinking water from these wells were exposed to maximum hexavalent chromium level (0.19 μg/L) over many years.

Based on the maximum concentration detected in these wells (0.19 μg/L), the estimated exposure concentrations for children ranged from 2.0E-6 mg/kg/day to 2.7E-5 mg/kg/day. The highest estimated exposure dose (2.7E-05 mg/kg/day) is for children less than 1 year of age. The estimated exposure dose for adults ranged from 2.9E-6 mg/kg/day to 7.3E-6 mg/kg/day (Table 9).

The health guideline used for hexavalent chromium was ATSDR's MRL of 0.0009 mg/kg/day. The calculated exposure doses were less than the MRL (HQs less than 1) and no adverse noncancer health effects are expected. Because the well with the highest hexavalent chromium concentration is not a concern for noncancer effects, the other private wells with lower hexavalent chromium concentrations are also not a concern for noncancer effects.

Hexavalent chromium has been classified as a known human carcinogen (ATSDR, 2012b). Studies in China have shown association between drinking water chromium levels and stomach cancer mortality. Animal studies also demonstrated that chronic exposure to hexavalent chromium in drinking water resulted in an increased incidence of gastrointestinal tumors in mice and rats (ATSDR, 2012b). DSHS estimated excess cancer risk due to exposure to the maximum hexavalent chromium in groundwater to be 2E-6 to 5E-6 among children (12 to 21 years of exposure), and 2E-7 to 2E-6 among adults (12 to 33 years of exposure) (Table 9). DSHS interprets this to be a low increased lifetime risk of developing cancer for both children and adults. Cancer risk for children and adults at other private wells is likely lower than 1E-6 because the maximum hexavalent chromium concentration for these wells is less than the maximum level (0.19 µg/L) used to determine cancer risk. Therefore, hexavalent chromium in drinking water from these residential private wells is not a concern.

DSHS calculated the total cancer risk using CalEPA oral cancer slope factor for hexavalent chromium of 0.5 (mg/kg/day)$^{-1}$. CalEPA considers hexavalent chromium to be a mutagen. The final release of EPA's Integrated Risk Information System (IRIS) reassessment of the carcinogenic effects of hexavalent chromium through oral ingestion is pending. EPA is evaluating the carcinogenic mode of action (MOA) of hexavalent chromium. This MOA research is based on the hypothesis that ingestion of high concentrations of hexavalent chromium results in excessive oxidative stress that exceeds the cellular capacity to reduce it and points to the occurrence of a threshold for hexavalent chromium carcinogenesis (Health Canada 2018). Upon completion of the IRIS reassessment, EPA will determine whether the MCL for total chromium needs to be revised (USEPA 2019).

Table 9. Chronic Exposure Doses, Noncancer Hazard Quotient and Cancer Risk Estimates for Hexavalent Chromium in Residential Private Wells

PHAST Public Health Assessment Site Tool Exposure Group	CTE Dose (mg/kg/ day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/ day)	RME Noncancer Hazard Quotient	RME Cancer Risk
Birth to < 1 year	1.2E-05	<0.1	-	2.7E-05	<0.1	-
1 to < 2 years	5.1E-06	<0.1	-	1.5E-05	<0.1	-
2 to < 6 years	4.1E-06	<0.1	-	1.1E-05	<0.1	-
6 to < 11 years	3.1E-06	<0.1	-	8.4E-06	<0.1	-

Exposure Group	CTE Dose (mg/kg/ day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/ day)	RME Noncancer Hazard Quotient	RME Cancer Risk
11 to < 16 years	2.1E-06	<0.1	-	6.6E-06	<0.1	-
16 to < 21 years	2.0E-06	<0.1	-	6.5E-06	<0.1	-
Total Child	-	-	**2E-6**	-	-	**5E-6**
Adult	2.9E-06	<0.1	2E-7	7.3E-06	<0.1	**2E-6**

Abbreviations: mg/kg/day - milligram per kilogram per day; CTE – central tendency exposure; RME – reasonable maximum exposure.
Bolded value indicates cancer risk greater than 1E-6.

Copper

Copper is not classified as carcinogenic. Therefore, DSHS only evaluated noncancer health effects from copper exposure.

Copper (161 µg/L) was detected once above the CV in one private residential well, GW-5 (Table 2). Because no other sampling data was available, DSHS assumed that the residents drinking water from GW-5 were exposed to copper at 161 µg/L over many years.

Based on the concentration detected in the well, the estimated exposure concentrations for children ranged from 0.0017 mg/kg/day to 0.023 mg/kg/day. The highest estimated exposure dose (0.023 mg/kg/day) is for children less than 1 year of age. The estimated exposure dose for adults ranged from 0.0025 mg/kg/day to 0.0062 mg/kg/day (Table 10).

The RME exposure doses for the children less than 1 year and children 1 to less than 2-year age groups exceeded ATSDR's health intermediate MRL of 0.01 mg/kg/day (HQs of 2.3 and 1.3). The intermediate MRL is based on the results of a 2-month controlled human exposure study in men and women ingesting copper (ATSDR 2004). In this study, gastrointestinal effects (nausea, vomiting, abdominal pain, or diarrhea) were observed in humans orally exposed to 0.091 mg/kg/day (LOAEL) of copper sulfate in drinking water, but not at 0.042 mg/kg/day (NOAEL). The highest estimated RME exposure dose of copper for children (birth to less than 1 year) is 4 times less than the level that was shown to cause gastrointestinal effects. Based on this information and health protective assumptions, exposure to copper in drinking water at this level is not likely to cause noncancer human health risks.

Table 10. Acute and Intermediate Exposure Dose and Noncancer Hazard Quotient Estimations for Central Tendency Exposure (CTE) and Reasonable Maximum Exposure (RME) for Copper in Residential Private Wells

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient
Birth to < 1 year	0.010	1.0	0.023	**2.3**
1 to < 2 years	0.0043	0.4	0.013	**1.3**
2 to < 6 years	0.0035	0.4	0.0090	0.9
6 to < 11 years	0.0026	0.3	0.0071	0.7
11 to < 16 years	0.0018	0.2	0.0056	0.6
16 to < 21 years	0.0017	0.2	0.0055	0.6
Adult	0.0025	0.3	0.0062	0.6

Abbreviations: mg/kg/day = milligram per kilogram per day.
Bolded value indicates HQ greater than 1.

Iron

Iron is an essential nutrient. Excess intake of high levels of iron, however, may cause adverse gastrointestinal effects, and long-term excessive intake may damage the heart, pancreas, liver, and kidney (USEPA 2006).

DSHS determine the maximum level of iron (45.2 mg/L) to be above the dietary reference intake guideline of 45 mg/day (NAS, 2019) based on a drinking water intake of 1.227 liters/day (L/day) (Appendix B, Table B5). The next highest level of iron (0.1 mg/L) detected in private water wells was well below the dietary reference intake guideline. The maximum level of iron also exceeded EPA's secondary maximum contaminant level (SMCL) of 0.3 mg/L. Iron levels above the SMCL may cause water to have a bad taste and have a rusty color.

DSHS calculated exposure doses of iron using the maximum level (45.2 mg/L) detected in a private water well. The highest RME exposure dose was for children less than 1 year (6.4 mg/kg/day) and the highest RME exposure dose for adults was 1.7 mg/kg/day (Table 11).

The health guideline used for iron was EPA's provisional RfD of 0.7 mg/kg/day (USEPA 2006). The provisional RfD is based on a Swedish study where humans were orally exposed up to 60 mg of iron per day. Minor gastrointestinal symptoms (nausea and vomiting) were observed at 1 mg/kg/day (LOAEL). The MRL was calculated by dividing the LOAEL by an uncertainty factor of 1.5. All the RME and some of the CTE estimated exposure doses for children and adults exceeded the RfD (HQs ranged from 1.0 to 9.1) (Table 11). The RME estimated exposure doses for children less than 11 years are 2 to 6 times above the effects level. Intermediate and chronic exposure to the maximum level may cause mild gastrointestinal health effects, such as nausea and vomiting, in children less than 11 years.

Because iron was either undetected or detected at low levels from the other wells, including on-site monitoring wells, public supply wells and other private wells, the source of iron is not likely to be site related. The source of iron in the water sample may have been from the corrosion of iron or steel pipes or other components of the plumbing system.

Table 11. Chronic Exposure Doses, Noncancer Hazard Quotient Estimates for Iron in Residential Private Wells

PHAST PUBLIC HEALTH ASSESSMENT SITE TOOL Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient
Birth to < 1 year	2.9	**4.1**	6.4	**9.1**
1 to < 2 years	1.2	**1.7**	3.5	**5.0**
2 to < 6 years	0.98	**1.4**	2.5	**3.6**
6 to < 11 years	0.73	**1.0**	2.0	**2.9**
11 to < 16 years	0.51	0.7	1.6	**2.3**
16 to < 21 years	0.49	0.7	1.5	**2.1**
Adult	0.69	1.0	1.7	**2.4**

Abbreviations: mg/kg/day - milligram per kilogram per day; CTE – central tendency exposure; RME – reasonable maximum exposure. Bolded value indicates HQ greater than 1.

Lead

Lead (16 µg/L) was detected once slightly above the EPA's public water supply action level of 15 µg/L in one private residential well, WW-20 (Table 2). The source of lead in the water sample could have come from lead in the groundwater itself or from internal corrosion of the resident's piping and plumbing system (ATSDR 2020).

Health effects associated with lead exposure mainly include neurological effects such as decreased cognitive function, including attention, memory, learning deficits, and behavioral issues in both children and adults (ATSDR 2020). As previously mentioned, neither ATSDR nor EPA has developed an MRL or RfD for human exposure to lead (ATSDR 2020). Therefore, DSHS estimated exposure to lead in children by using EPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model v2.0. The IEUBK is a biological model that predicts a blood lead concentration resulting from exposure to environmental lead contamination (USEPA 2003, USEPA 2021b).

Using the highest lead concentration detected in private wells (16 µg/L), DSHS estimated that between 5.9 and 8.5 percent of children might have blood lead levels that exceed 5 µg/dL.[1] Children who drink water from this well might be at risk of harmful effects previously described. Steps to reduce the amount of lead in private residential wells where it was detected should be made. Please see the recommendations section for limiting lead exposure in drinking water.

Health Outcome Data

Using information from the DSHS Texas Childhood Lead Prevention Program, the percentage of children (under 16 years of age) with elevated blood levels residing within a 1-mile radius of the site, which includes portions of 6 census tracts (including census tracts 1719.16, 1719.17, 1720.02, 1720.03, 1720.06 and 1720.09), was compared to the percentage of children tested and with elevated blood lead levels for Bexar County, as a whole.

A review of the data (from 2013 to 2019) showed that 2.12 percent of children tested and living in the combined census tract area near the site had blood lead levels less than the CDC blood lead reference value of 3.5 µg/dL.[2] This percentage

[1] In October 2021, CDC updated the blood lead reference value (BLRV) from 5 µg/dL to 3.5 µg/dL [CDC 2021]. However, lead models are not currently validated for levels below 5 µg/dL. Therefore, ATSDR uses 5 µg/dL in the models in our health evaluations until the updated BLRV of 3.5 µg/dL can be verified by EPA in their models.
CDC's BLRV is a screening tool to identify children who have higher levels of lead in their blood compared with most children. The reference value is not health-based and is not a regulatory standard. States independently determine action thresholds based on state laws, regulations, and resource availability. CDC encourages healthcare providers and public health professionals to follow the recommended follow-up actions based on confirmed blood lead levels (https://www.cdc.gov/nceh/lead/advisory/acclpp/actions-blls.htm).

[2] The CDC level is based on the 97.5th percentile of blood lead values among U.S children ages 1-5 years from 2015-2016 and 2017-2018 National Health and Nutrition Examination Survey (NHANES). Children with blood lead levels at or above the blood lead reference value represent those at the top 2.5 percent with the highest blood lead levels (CDC 2021).

was also lower, but not statistically different, than the percentage of children tested and living in Bexar County (2.30 percent). When looking at each census tract separately, the percentage of children tested and with elevated blood lead levels was less than the CDC level at each census tract.

These results show that from 2013 to 2019 children tested and living near the site do not have elevated blood lead levels (higher than 3.5 µg/dL).

Thallium

Thallium is not classified as carcinogenic. Therefore, DSHS only evaluated noncancer health effects from thallium exposure.

Thallium (4.2 µg/L) was detected once above the CV in one private residential well, WW-10 (Table 2). Because no other sampling data were available, DSHS assumed that the residents drinking water from WW-10 were exposed to thallium at 4.2 µg/L over many years.

Based on the concentration detected in the well, the estimated exposure concentrations for children ranged from 4.5E-5 mg/kg/day to 6E-4 mg/kg/day. The highest estimated exposure dose (6 E-4 mg/kg/day) is for children less than 1 year of age. The estimated exposure dose for adults ranged from 6.4E-5 mg/kg/day to 1.6E-4 mg/kg/day (Table 12).

ATSDR has not derived any MRLs for thallium (ATSDR 1992) nor has EPA published an RfD in IRIS. EPA, however, has proposed candidate oral RfDs ranging from 1E-5 to 3E-6 mg/kg/day for soluble thallium salts that can be used for screening purposes. It should be noted, however, that these are provisional RfDs based on very limited data. The candidate RfD (1E-5 mg/kg/day) is based on a NOAEL and a benchmark dose ($BMDL_{10}$)[3] value (0.01 mg/kg/day) for female rats based on alopecia (hair loss) (USEPA 2012). The CTE and RME estimated exposure doses exceed the candidate RfD (HQs greater than 1), but the exposure doses are still far below the NOAEL and BMDL (16 to 162 times lower), and harmful effects are unlikely.

[3] Benchmark dose ($BMDL_{10}$) is the lower confidence limit on the dose that produces a significant magnitude of changes in a specified adverse response.

Table 12. Chronic Exposure Doses, Noncancer Hazard Quotient Estimates for Thallium in Residential Private Wells

Exposure Group	CTE Dose (mg/kg/ day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient
Birth to < 1 year	2.7E-04	**90**	6.0E-04	**200**
1 to < 2 years	1.1E-04	**37**	3.3E-04	**110**
2 to < 6 years	9.1E-05	**30**	2.4E-04	**80**
6 to < 11 years	6.7E-05	**22**	1.9E-04	**63**
11 to < 16 years	4.7E-05	**16**	1.5E-04	**50**
16 to < 21 years	4.5E-05	**15**	1.4E-04	**47**
Adult	6.4E-05	**21**	1.6E-04	**53**

Abbreviations: mg/kg/day - milligram per kilogram per day; CTE – central tendency exposure; RME – reasonable maximum exposure.
Bolded value indicates HQ greater than 1.

Zinc

Zinc is not classified as carcinogenic. Therefore, DSHS only evaluated noncancer health effects from zinc exposure.

Zinc was detected twice above the CV in one private residential well, WW-20 (Table 2). Because no other sampling data were available, DSHS assumed that the residents drinking water from WW-20 were exposed to the maximum level (2.95 µg/L) of zinc over many years.

Based on the concentration detected in the well, the estimated exposure concentrations for children ranged from 0.032 mg/kg/day to 0.42 mg/kg/day. The highest estimated exposure dose (0.42 mg/kg/day) is for children less than 1 year of age. The estimated total exposure doses for an adult ranged from was 0.045 mg/kg/day to 0.11 mg/kg/day (Table 13).

The exposure dose (0.42 mg/kg/day) for children less than 1 year of age was the only age group that exceeded the intermediate MRL for zinc (0.3 mg/kg/day). The ATSDR intermediate MRL was based on a study of adult women given supplements containing zinc gluconate for 10 weeks (ATSDR 2005c). A significant decrease in erythrocyte superoxide dismutase levels, a precursor to the more severe symptoms seen with zinc-induced copper deficiency and decrease in ferritin levels was reported at 0.83 mg/kg/day. This exposure level was designated a NOAEL. The MRL was derived from the reported human NOAEL of 0.83 mg/kg/day. The study used only one dose, so a LOAEL was not identified (ATSDR 2005c). The RME estimated exposure dose for the less than 1-year age group exceeded the MRL (HQ of 1.4) but was 2 times less than the human NOAEL. Based on this information and health protective assumptions, exposure to zinc in drinking water at this level is not likely to cause noncancer human health risks.

Table 13. Chronic Exposure Dose and Noncancer Hazard Quotient Estimations for Central Tendency Exposure (CTE) and Reasonable Maximum Exposure (RME) for Zinc in Residential Private wells

PUBLIC HEALTH ASSESSMENT SITE TOOL PHAST Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient
Birth to < 1 year	0.19	0.6	0.42	**1.4**
1 to < 2 years	0.080	0.3	0.23	0.8
2 to < 6 years	0.064	0.2	0.17	0.6
6 to < 11 years	0.047	0.2	0.13	0.4
11 to < 16 years	0.033	0.1	0.10	0.3
16 to < 21 years	0.032	0.1	0.10	0.3
Adult	0.045	0.2	0.11	0.4

Abbreviations: mg/kg/day - milligram per kilogram per day.
Bolded value indicates HQ greater than 1.

Past Exposure to On-site Surface Soil

Past exposure to on-site surface soil was used to evaluate a trespasser scenario for adults and for children greater than eleven years of age. Given the community's awareness of the site, children younger than eleven years of age are not likely to trespass onto fenced property or participate in recreational activities at or near the site without adult supervision.

Copper

Copper is not classified as carcinogenic, therefore DSHS only evaluated noncancer health effects from copper exposure.

Copper was detected once in on-site soils above the CV (Table 3). Based on the maximum concentration detected (650 mg/kg), the estimated exposure doses from contact with soil for children who trespass on the property ranged from 4.7E-4 mg/kg/day to 1.4E-3 mg/kg/day. The highest estimated exposure dose (1.4E-3 mg/kg/day) is for children 11 to less than 16 years of age. The estimated exposure doses for an adult range from 3.0E-4 mg/kg/day to 8.7E-4 mg/kg/day (Table 14).

ATSDR has derived an MRL of 0.01 mg/kg/day for both acute duration oral exposure (1–14 days) and intermediate duration oral exposure (15– 365 days) to copper (ATSDR 2004). The estimated exposure doses are less than MRL (HQs less than 1) for children 11 to 21 years and for adults. Therefore, noncancer health effects from copper exposure from on-site surface soils are not expected (Table 13).

Table 14. Acute and Intermediate Exposure Dose and Noncancer Hazard Quotient Estimations for Central Tendency Exposure (CTE) and Reasonable Maximum Exposure (RME) for Copper in On-site Surface Soil

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient
11 to < 16 years	5.6E-04	0.0	1.4E-03	0.1
16 to < 21 years	4.7E-04	0.0	1.1E-03	0.1
Adult	3.0E-04	0.0	8.7E-04	0.1

Abbreviations: mg/kg/day - milligram per kilogram per day.

Nickel

Nickel is not classified as carcinogenic, therefore DSHS only evaluated noncancer health effects from nickel exposure.

Nickel was detected once above the CV in an on-site soil sample (Table 3). Based on this concentration (3,200 mg/kg), the estimated exposure doses for children who trespass on the property ranged from 0.0015 mg/kg/day to 0.021 mg/kg/day. The highest estimated exposure dose (0.021 mg/kg/day) is for children 11 to less than 16 years of age. The estimated total exposure doses for an adult ranged from 0.0054 mg/kg/day to 0.0082 mg/kg/day (Table 15).

ATSDR has not derived an MRL for nickel, therefore DSHS used EPA's RfD of 0.02 mg/kg/day. The RfD is based on a 2-year animal study where rats experienced decreased body and organ weights following oral exposure to nickel. The LOAEL for this effect was 50 mg/kg/day and the NOAEL was 5 mg/kg/day. EPA divided the NOAEL by an uncertainty factor of 300 to determine the RfD (ATSDR 2005b, USEPA 1991). The estimated exposure doses are below the RfD (HQs are 1 or less than 1), and adverse health outcomes due to nickel exposure from on-site surface soil are not expected.

Table 15. Chronic Exposure Dose and Noncancer Hazard Quotient Estimations for Central Tendency Exposure (CTE) and Reasonable Maximum Exposure (RME) for Nickel in On-site Surface Soil.

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient
11 to < 16 years	0.017	0.9	0.021	1.0
16 to < 21 years	0.015	0.8	0.018	0.9
Adult	0.0054	0.3	0.0082	0.4

Abbreviations: mg/kg/day - milligram per kilogram per day.

Lead

Lead (17 mg/kg to 106 mg/kg) was detected in on-site soils. Health effects associated with lead exposure mainly include neurological effects such as decreased cognitive function, including attention, memory, learning deficits and behavioral issues in both children and adults (ATSDR 2020). As previously mentioned, neither ATSDR nor EPA has developed an MRL or RfD for human exposure to lead. Instead, human exposure to lead is evaluated by using a biological model that predicts a blood lead concentration resulting from exposure to environmental lead contamination (USEPA 2003).

Using EPA's IEUBK for lead in children and the highest lead concentration detected in on-site soil (106 mg/kg), DSHS estimated 1.2 percent of children might have a blood level that exceeds 5 µg/dL (USEPA 2021b).[4] However, the soil exposure pathway has now been eliminated by preventing site access with improved fencing,

[4] In October 2021, CDC updated the blood lead reference value (BLRV) from 5 µg/dL to 3.5 µg/dL [CDC 2021]. However, lead models are not currently validated for levels below 5 µg/dL. Therefore, ATSDR uses 5 µg/dL in the models in our health evaluations until the updated BLRV of 3.5 µg/dL can be verified by EPA in their models.
CDC's BLRV is a screening tool to identify children who have higher levels of lead in their blood compared with most children. The reference value is not health-based and is not a regulatory standard. States independently determine action thresholds based on state laws, regulations, and resource availability. CDC encourages healthcare providers and public health professionals to follow the recommended follow-up actions based on confirmed blood lead levels (https://www.cdc.gov/nceh/lead/advisory/acclpp/actions-blls.htm).

so DSHS does not expect adverse health outcomes due to lead exposure from on-site surface soil.

Off-site Surface Soil

Off-site surface soil was used to evaluate a recreational scenario for nearby residential adults and children greater than eleven years of age. Given the community's awareness of the site, children younger than eleven years of age were not likely to trespass onto fenced property or participate in recreational activities at or near the site without adult supervision.

Polycyclic Aromatic Hydrocarbons (PAHs)

Most people are exposed to PAHs by breathing the compounds in tobacco smoke, wood smoke, and ambient air, and eating charred food containing PAHs. PAHs in the body tend to be stored mostly in the kidneys, liver, and fat. Most PAHs that enter the body leave within a few days, primarily in the feces and urine (ATSDR 1995).

Noncancer Health Effects

Benzo(a)pyrene was detected in three off-site soil samples (Table 4). Based on the highest concentration (0.305 mg/kg), the estimated exposure doses for children who trespass on the property ranged from 8.0E-7 mg/kg/day to 1.3E-6 mg/kg/day. The highest estimated exposure dose (1.3E-6 mg/kg/day) is for children 11 to less than 16 years of age. The estimated total exposure doses for an adult ranged from 5.9E-7 mg/kg/day to 3.2E-7 mg/kg/day (Table 16).

EPA's RfD of 0.0003 mg/kg/day was used as the health guideline for BaP. The RfD is determined based on a neurodevelopmental study which showed abnormal behavioral effects in rats from Morris water maze[5], elevated plus maze[6], and open field tests in the exposed groups. A benchmark dose of 0.092 mg/kg/day was used to derive the RfD and an uncertainty factor was applied to account for using an animal study, individual variability, and deficiencies in the toxicity database (USEPA 2017). The estimated exposure doses were less than the RfD (HQs less than 1). Therefore, DSHS does not expect adverse health outcomes from exposure to benzo(a)pyrene in off-site surface soil.

Other PAHs (including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-c,d)pyrene, and dibenz(a,h) anthracene) were also detected in off-site soil samples (Table 4). These PAHs do

[5] Morris water maze is a circular pool filled with milky water.

[6] Elevated plus maze includes four narrow platforms of equal length that are oriented along a single plane and elevated a certain distance above the floor.

not have health guidelines for noncancer effects and could not be directly evaluated. However, the results of the benzo(a)pyrene, a PAH with highest toxicity compared to other PAHs, were evaluated without yielding any significant estimated CTE or RME concentrations. Therefore, exposure to the other detected PAHs with lower toxicity would not be expected to cause noncancer effects.

PAHs Cancer Health Effects

DSHS calculated combined ingestion and dermal exposure doses for CTE and RME for BaP TE concentration ranges. DSHS used the highest BaP TE value (0.446 mg/kg) to evaluate six of the PAHs detected in samples collected for RCMF (including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene and indeno(1,2,3-c,d)pyrene). The estimated total exposure doses for BaP TE ranged from 1.1E-6 mg/kg/day to 1.9E-6 mg/kg/day for children 11 and older. The highest estimated exposure dose (1.9E-6 mg/kg/day) is for children 11 to less than 16 years. The estimated total exposure doses for an adult ranged from 4.6E-7 mg/kg/day to 8.5E-7 mg/kg/day (Table 17).

PAHs have caused formation of lung, mammary and gastrointestinal tumors as well as leukemia in mice and rats through oral exposure (ATSDR 1995). DSHS calculated excess cancer risks using the EPA CSF of 1 $(mg/kg/day)^{-1}$ for BaP TE. DSHS calculated age-specific exposure doses and corresponding cancer risks for both CTE and RME exposure scenarios for BaP TE (Table 17). Cancer risks were estimated to be to be 6E-7 to 8E-7 for children and 1E-7 to 2E-7 for adults. DSHS interprets this as no as no health concern for children and adults following chronic exposure to all PAHs detected in off-site soil samples.

Table 16. Chronic Exposure Dose, Noncancer Hazard Quotient, and Cancer Risk Estimations for Central Tendency Exposure (CTE) and Reasonable Maximum Exposure (RME) for Benzo(a)pyrene (BaP) (0.305 mg/kg) in Off-site Surface Soil.

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	RME Cancer Risk
11 to < 16 years	9.2E-07	0.003	4E-7	1.3E-06	0.004	5E-7
16 to < 21 years	8.0E-07	0.003	4E-7	1.1E-06	0.004	5E-7
Adult	3.2E-07	0.001	2E-7	4.2E-07	0.002	3E-7

Abbreviations: mg/kg/day = milligram per kilogram per day.

Bolded value indicates HQ greater than 1.

Table 17. Chronic Exposure Dose and Cancer Risk Estimations for Central Tendency Exposure (CTE) and Reasonable Maximum Exposure (RME) for BaP Toxic Equivalency Concentration (0.437 mg/kg) in Off-site Surface Soil.

Exposure Group	CTE Dose (mg/kg/day)	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Cancer Risk
11 to < 16 years	1.3E-06	6E-7	2.0E-06	8E-7
16 to <21 years	1.1E-06	6E-7	2.0E-06	8E-7
Adult	4.6E-07	1E-7	8.5E-07	2E-7

Abbreviations: mg/kg/day - milligram per kilogram per day.
Bolded value indicates cancer risk greater than 1E-6.

Children's Health Considerations

In communities faced with air, water, or soil contamination, children could be at greater risk than adults from certain kinds of exposure to hazardous substances. A child's lower body weight and higher intake rate result in a greater dose of hazardous substance per unit of body weight, which often makes children more sensitive to chemical exposure compared to adults. Sufficient exposure levels during critical growth stages can also result in damage to the developing body systems of children. Children are dependent on adults for access to housing and medical care, and for risk identification and exposure prevention. Consequently, adults need as much information as possible to make informed decisions regarding their children's health.

Community Health Concerns

During the 2016 Site Investigation EPA collected samples from two off-site public water supply wells and detected hexavalent chromium at concentrations above the EPA RSL, suggesting possible contaminant migration from the shallow groundwater to the deeper regional Edwards Aquifer. These results led to the site being listed to the NPL and community health concerns regarding the safety of residential drinking water for both public and private residential wells.

While there was initial concern of contamination for the PWS and private residential wells, EPA, the United State Geological Survey (USGS), and EAA later agreed that levels detected in Edwards Aquifer are naturally occurring and not expected to result in adverse health effects.

Limitations

Sampling

- A small number of samples were collected, which may not adequately represent on-site (7 on-site samples, 1 background) or off-site (3 samples) exposure pathways.
- In 2013, TCEQ installed a hay berm to prevent off-site migration of on-site contaminants. Soil sampling results prior to 2013 were not collected and data from a 2019 sampling event was used to assess past off-site exposure pathways. This data may not represent contaminant levels prior to 2013. In addition, PAHs detected off-site may not have originated from the site because there is an auto repair shop, a known source of PAHs, currently operating adjacent to the site.

Exposure assumptions

- When estimating exposure, it's necessary to identify how much, how often, and how long a person may come into contact with the contaminants. DSHS made assumptions for site-specific exposure scenarios. Although DSHS' assumptions were health protective, each individual's exposure could be higher or lower depending on his/her lifestyle.

Chemical bioavailability in soil:

- Bioavailability refers to how much of a contaminant is absorbed into the body after ingestion (swallowing) of soil. If a contaminant is not absorbed (i.e., not bioavailable), it will leave the body. There is no site-specific bioavailability for copper, nickel, or PAHs, and therefore DSHS conservatively assumed 100 percent bioavailability.

Conclusions

Based on the available information, DSHS and ATSDR reached four conclusions about the site:

Conclusion 1

Past, current, and future exposure to residential drinking water from some of the nearby private wells may be a health concern.

Basis for Conclusion

Nearby residents may be exposed to metals in groundwater from some residential wells by drinking or from coming in contact with water while bathing and showering.

Metals, including antimony, arsenic, cadmium, copper, hexavalent chromium, iron, zinc, lead, and thallium, were detected in groundwater samples collected from private residential wells. Although long-term exposure to most of the metals detected is not expected to cause noncancer and cancer health risks, long-term exposure to arsenic from one private water well may cause a low increased risk of developing cancer. However, there is uncertainty with the cancer risk because it assumes long-term exposure from one sample collected from one residential well.

In a second private water well, the estimated dose of iron for children (less than 11 years of age) exceeds effect levels identified in humans and might cause mild gastrointestinal effects, such as nausea and vomiting. In a third private water well, lead was detected slightly above the EPA's action level. Children drinking from this well have an elevated increased risk of harmful effects from lead exposure. Lead in drinking water should be reduced or removed as much as feasible.

Conclusion 2

Past exposure from incidental ingestion and skin contact to contaminants found in on-site surface soil is not expected to harm people's health. Current and future exposure is not expected to occur.

Basis for Conclusion

Nearby residents and visitors, including adults and children older than 11 years of age, may have come into contact with the contaminants in the surface soil through incidental ingestion and skin contact while trespassing on the site. However, exposure to contaminants was too low to result in harmful effects.

In March 2019, EPA repaired and installed new fencing to secure the site. Given this update in security, current and future trespassing onto the site is not expected to occur.

Conclusion 3

Past, current, and future exposure from incidental ingestion and skin contact to polycyclic aromatic hydrocarbons (PAHs) in off-site surface soil is not expected to harm people's health.

Basis for Conclusion

Nearby residents and visitors, including adults and children older than 11 years of age, may have come into contact with the contaminants in the off-site surface soil through incidental ingestion and skin contact while participating in outdoor activities outside the site property. However, the calculated exposure doses for long-term (more than 1 year) PAH exposures among recreational users did not exceed health guidelines for noncancer effects, and cancer was not a concern.

Conclusion 4

Past, current, and future exposure to contaminants in residential drinking water from the nearby public water supply (PWS) is not expected to harm people's health.

Basis for Conclusion

Nearby residents are not likely to come into contact with contaminants in groundwater from wells serving the Coolcrest and San Antonio PWS.

Monitoring data from the Texas Drinking Water Watch, which monitors the potable water being delivered to residential tap from these PWS wells, do not show any contaminants above reporting limits (TDWW, 2020).

Recommendations

People living near the site should respect the site's property boundaries and not trespass beyond the fence installed by the EPA. People that play near the site area, especially near the site's southern border along Tallowood Street, may have an increased chance of contacting off-site contaminated soil through incidental ingestion and skin contact. Practicing good personal hygiene habits (such as washing hands after playing in the area, and before eating) can reduce or prevent the exposure to contaminants in soil.

EPA, in consultation with TCEQ, continue efforts to monitor and maintain the perimeter fence surrounding the RCMF site to prevent trespassing onto the site. In addition, monitor and maintain the hay berm to reduce, or prevent, off-site migration of soil contaminants.

EPA plug and abandon all on-site monitoring wells that were drilled for the site investigation to prevent further contamination of the shallow groundwater.

Owners of residential private wells concerned about potential contaminants in their water consult with the Texas Well Network (https://twon.tamu.edu/). The Texas Well Network is an educational program hosted by the Texas A&M University AgriLife Extension Service that offers trainings and information on well water sampling, well maintenance, and contamination preventative measures.

Owners of residential private wells take steps in reducing exposure to lead in their drinking water, including, but not limited to:

- Running water for 30 seconds before using water for cooking, drinking, and preparing infant formula. However, the time to run the water will depend on whether the home has a lead service line, and the length of the line.
- Using cold water for cooking, drinking, and preparing infant formula.
- Removing brass and old copper fixtures and plumbing in a house that could contain lead.
- Regularly clean faucet strainers to remove lead particles and sediment.
- Removing service lines that are known to have lead.

Parents should talk to their child's healthcare provider about whether their child needs to be tested for lead. DSHS Childhood Lead Poisoning Prevention Program (CLPPP) and Centers for Disease Control and Prevention (CDC) guidance for guardians and providers regarding testing is available at: https://www.dshs.texas.gov/lead/child.shtm and https://www.cdc.gov/nceh/lead/advisory/acclpp/actions-blls.htm.

Owners of private water wells may also use an appropriate treatment system to remove metals (such as arsenic, iron and lead) from their well water. A CDC guide to drinking water treatment technologies can be found at: https://www.cdc.gov/healthywater/pdf/drinking/Household_Water_Treatment.pdf.

Individuals concerned about possible past exposures to contaminants during the RCMF site operations are advised to speak with their personal physician.

Individuals are encouraged to follow the EPA's homepage for the RCMF site to stay informed with the site's cleanup status and progress. The site can be found at: https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0606915.

Public Health Action Plan

The public health action plan for the site contains a description of actions that have been or will be taken by DSHS, ATSDR, and other government agencies at the site. The purpose of the public health action plan is to ensure that this health consultation both identifies public health hazards and provides a plan of action designed to mitigate and prevent harmful human health effects resulting from breathing, ingesting, or skin contact with hazardous substances found in the environment. Included is a commitment on the part of DSHS and ATSDR to follow up on this plan to ensure that it is implemented.

Actions Completed

1. In 2013, TCEQ removed drums and containers on-site and demolished the building and foundation.

2. In 2016, a site investigation was conducted by the EPA and TCEQ. Soil and groundwater samples were collected.

3. In January 2018, the RCMF site was proposed to the NPL and listed as final on the NPL in May 2018. The Edwards Aquifer Authority (EAA) collected groundwater samples from nearby public water supply and private wells.

4. In March 2019, EPA began the remedial investigation at the site and collected soil and groundwater samples throughout the remainder of the year.

5. In October 2019 and January 2020, EPA held community meetings to share preliminary updates on the April and December 2019 remedial investigation sampling events and community involvement plan.

Next Steps

This document will be made available to community members, city officials, the EPA, and other interested parties.

DSHS will continue to work with EPA and TCEQ to evaluate additional data as they become available. The results may be summarized in additional health consultations or a public health assessment, as needed.

DSHS may aid EPA in communicating to private residential wells owners concerned about potential contamination in their water and provide educational resources on preventive measures to reduce or eliminate contaminant exposures.

Preparers of Report

The Texas Department of State Health Services (DSHS) prepared this health consultation for the River City Metal Finishing site, located in San Antonio, Bexar County, Texas. This publication was made possible by a cooperative agreement [APPLETREE #TS20-2001] with the federal Agency for Toxic Substances and Disease Registry (ATSDR). DSHS evaluated data of known quality using approved methods, policies, and procedures existing at the date of publication. ATSDR reviewed this document and concurs with its findings based on the information presented by DSHS.

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Appendix A: Acronyms and Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
BaP	Benzo(a)pyrene
BGS	Below Ground Surface
$BMDL_{10}$	Benchmark Dose Level 10% excess risk
CalEPA	California Environmental Protection Agency
CSF	Cancer Slope Factor
CTE	Central Tendency Exposure
DSHS	Texas Department of State Health Services
EAA	Edwards Aquifer Authority
EPA/USEPA	Environmental Protection Agency
LOAEL	Lowest Observed Adverse Effect Level
MCL	Maximum Contaminant Level
NOAEL	No Observed Adverse Effect Level
NPL	National Priorities List
PAHs	Polycyclic Aromatic Hydrocarbons
PCL	Protective Concentration Levels
PWS	Public Water Supply
RCMF	River City Metal Finishing
RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
SVOCs	Semi-Volatile Organic Compounds
TCEQ	Texas Commission on Environmental Quality
$UCDL_{10}$	Urinary Cadmium Level 10% excess risk

VOCs	Volatile Organic Compounds

Appendix B: Exposure Dose Equation Analysis

Estimated exposure doses are calculated to determine the amount of a chemical that could get into the body. These estimated exposure doses are calculated using the chemical concentration and default exposure parameters from ATSDR's Public Health Assessment Guidance Manual (ATSDR 2005a), EPA's Exposure Factors Handbook (USEPA 2011), and ATSDR's Exposure Dose Guidance (ATSDR 2005a) when site specific information is unknown.

Ingestion Dose

Describe which samples were used to complete these formulas, or other applicable formulas. Typically, the maximum concentration is used. Below are two equations taken from the ATSDR's Public Health Assessment Guidance (ATSDR 2005a). The equations used will vary depending on the completed exposure pathways at each site.

Water Ingestion Exposure Dose Equation

D = (C x IR x EF)/ BW

D = Exposure Dose (mg/kg-day)
C = Contaminant Concentration (mg/L)
IR = Intake Rate (L/day)
EF= Exposure Factor (Unitless)* default of 1, assuming person daily exposure.
BW = Body Weight (kg)

Soil Ingestion Exposure Dose Equation

D = (C x IR x EF x CF)/ BW

D = Exposure Dose (mg/kg-day)
C = Contaminant Concentration (mg/kg)
IR = Ingestion Rate (mg/day)
EF= Exposure Factor (Unitless)* default of 1, assuming person daily exposure.
CF= Conversion Factor (10-6 kg/mg)
BW = Body Weight (kg)

Soil Dermal Dose Equation

ADD = (C × EF × CF × AF × ABSd × SA) / (BW × ABSGI)

ADD = Administered Dermal Dose (mg/kg/day)

C = Contaminant Concentration (mg/kg)
EF = Exposure Factor (unitless)
CF = Conversion Factor (10-6 kg/mg)
AF = Adherence Factor to Skin (mg/cm2-event)
ABSd = Dermal Absorption Fraction to Skin (unitless)
SA = Skin Surface Area Available for Contact (cm2)
BW = Body Weight (kg),
ABSGI = Gastrointestinal Absorption Factor (unitless)

Bioavailability refers to how much of a contaminant is absorbed into the body after ingestion (swallowing) of soil. A contaminant is not absorbed (i.e., not bioavailable) will leave the body. DSHS assumed 100 percent bioavailability for copper, nickel, benzo(a)pyrene and dibenz(a,h)anthracene. DSHS also assumed that recreational receptors and on-site trespassers visit the area 7 days per week for 52 weeks. This is a worst-case assumption, which was made in absence of any site-specific information. Age-specific ingestion rates in milligrams per day (mg/day) for reasonable maximum exposure (RME) and central tendency exposure (CTE), and body weights in kilograms (kg) are based on data presented in the Environmental Protection Agency (EPA) 2011 Exposure Factors Handbook (USEPA 2011). See Tables B1 and B2 for exposure concentrations and default exposure factors.

RME: referring to persons who are at the upper end of the exposure distribution (about the 95%). The RME assesses exposures that are higher than average but still within a realistic exposure range. In this case, this would refer to individuals who have a very high soil intake rate.

CTE: referring to individuals who have an average or typical soil intake rate.

Hazard quotients (HQs) were calculated to compare estimated exposure doses to health guidelines, which are considered to be safe doses at which adverse health effects are not expected. The hazard quotient is calculated by dividing the estimated exposure dose by the health guideline, such as the minimal risk level (MRL) or reference dose (RfD).

$$HQ = \text{Exposure Dose} / \text{Health Guideline}$$

For example, the CTE non-cancer copper HQ for children 11 years old to less than 16 years old is:

$$HQ = 0.00042 / 0.01 = 0.04$$

Table B 1 Concentrations and factors for each contaminant used to calculate dose for soil

Contaminant Name	Maximum Concentration (mg/kg)	Dermal Absorption Fraction	GI Absorption Factor	Bioavailability Factor
Benzo(a)pyrene	0.420	0.13	1	1
Dibenz(a,h)anthracene	0.048	0.13	1	1
Copper	650	0.01	0.57	1
Nickel	3200	0.01	0.04	1

Abbreviations: mg/kg = milligram per kilogram; GI = gastrointestinal.

Table B 2 Default exposure factors (body weight, exposure duration intake rate CTE and RME, adherence factor and surface skin area) by age group

Exposure Group	Body Weight (kg)	Age Specific Exposure Duration (years)	Intake Rate (mg/day) CTE	Intake Rate (mg/day) RME	Adherence Factor to Skin (mg/cm^2 event)	Combined Skin Surface Area (cm^2)
11 to < 16 years	56.8	5	30	100	0.2	5,454
16 to < 21 years	71.6	5	30	100	0.2	6,083
Adult	80	33	30	100	0.07	6,030

Abbreviation: CTE = central tendency exposure; RME = reasonable maximum exposure; kg = kilogram; mg/day = milligram per day; mg/cm^2 = milligram per square centimeter; cm^2 = square centimeter.

Table B 3 Concentrations and factors for each contaminant used to calculate dose for drinking water

Contaminant Name	Maximum Concentration (µg/L)
Antimony	6.1
Arsenic	3
Cadmium	1.1
Copper	161
Chromium	1.8
Hexavalent chromium	0.19
Lead	16
Thallium	4.2
Zinc	2950

Abbreviation: µg/L = micrograms per liter.

Table B 4 Default drinking water exposure factors (body weight, exposure duration and intake rate CTE and RME) by age group

Exposure Group	Body Weight (kg)	Age Specific Exposure Duration (years)	Intake Rate (L/day) CTE	Intake Rate (L/day) RME
Birth to <1 year	7.8	1	0.504	1.113
1 to < 2 years	11.4	1	0.308	0.893
2 to < 6 years	17.4	4	0.376	0.977
6 to < 11 years	31.8	5	0.511	1.404
11 to < 16 years	56.8	5	0.637	1.976
16 to < 21 years	71.6	5	0.770	2.444

Exposure Group	Body Weight (kg)	Age Specific Exposure Duration (years)	Intake Rate (L/day) CTE	Intake Rate (L/day) RME
Adult	80	33	1.227	3.092

Abbreviation: CTE = central tendency exposure; RME = reasonable maximum exposure; kg = kilogram; L/day = liters per day.

Table B 5 Essential elements and dietary reference intake calculations for residential private water wells

Sampling Event	Analyte	Maximum Concentration (mg/L)	Water Intake Rate (L/Day)	Analyte Intake Rate (mg/Day)	Dietary Reference Intake Levels (mg/Day) Infant	Dietary Reference Intake Levels (mg/Day) Children	Dietary Reference Intake Levels (mg/Day) Adults
EAA 2018	Calcium	76.7	1.227	94.1	1000 – 1500	2500	2000 – 2500
EAA 2018	Copper	0.003	1.227	0.004	ND	1000 – 3000	10,000
EAA 2018	Fluoride	0.18	1.227	0.221	0.7 – 0.9	1.3 – 2.2	10
EAA 2018	Iron	-	1.227	-	40	40	45
EAA 2018	Magnesium	17.2	1.227	21.1	ND	65 – 110	350
EAA 2018	Manganese	0.0119	1.227	0.015	ND	2 -3	11
EAA 2018	Nickel	-	1.227	-	ND	0.2 – 0.3	1
EAA 2018	Potassium	1.36	1.227	1.669	400 – 860	2000 – 3000	2600 – 3400
EAA 2018	Selenium	-	1.227	-	45 – 60	90 – 150	400
EAA 2018	Sodium	13.1	1.227	16.07	110 – 370	1000-2000	1500
EAA 2018	Vanadium	0.004	1.227	0.005	ND	ND	1.8
EAA 2018	Zinc	0.454	1.227	0.557	4 -5	7 – 12	40
EPA/TCEQ 2016	Calcium	91.3	1.227	112	1000 – 1500	2500	2000 – 2500

Sampling Event	Analyte	Maximum Concentration (mg/L)	Water Intake Rate (L/Day)	Analyte Intake Rate (mg/Day)	Dietary Reference Intake Levels (mg/Day) Infant	Dietary Reference Intake Levels (mg/Day) Children	Dietary Reference Intake Levels (mg/Day) Adults
EAA 2018	Copper	0.161	1.227	0.198	ND	1000 – 3000	10,000
EAA 2018	Fluoride	-	1.227	-	0.7 – 0.9	1.3 – 2.2	10
EAA 2018	Iron	0.110	1.227	0.135	40	40	45
EAA 2018	Magnesium	27.3	1.227	33.5	ND	65 – 110	350
EAA 2018	Manganese	-	1.227	-	ND	2 -3	11
EAA 2018	Nickel	-	1.227	-	ND	0.2 – 0.3	1
EAA 2018	Potassium	1.69	1.227	2.07	400 – 860	2000 – 3000	2600 – 3400
EAA 2018	Selenium	-	1.227	-	45 – 60	90 – 150	400
EAA 2018	Sodium	14.1	1.227	16.07	110 – 370	1000-2000	1500
EAA 2018	Vanadium	-	1.227	-	ND	ND	1.8
EAA 2018	Zinc	0.155	1.227	0.557	4 -5	7 – 12	40
EPA/TCEQ 2019	Calcium	121	1.227	148.5	1000 – 1500	2500	2000 – 2500
EPA/TCEQ 2019	Copper	-	1.227	-	ND	1000 – 3000	10,000
EPA/TCEQ 2019	Fluoride	-	1.227	-	0.7 – 0.9	1.3 – 2.2	10
EPA/TCEQ 2019	Iron	45.2	1.227	**55.46**	40	40	45
EPA/TCEQ 2019	Magnesium	23.4	1.227	28.7	ND	65 – 110	350
EPA/TCEQ 2019	Manganese	0.136	1.227	0.167	ND	2 -3	11
EPA/TCEQ 2019	Nickel	-	1.227	-	ND	0.2 – 0.3	1
EPA/TCEQ 2019	Potassium	4.38	1.227	5.374	400 – 860	2000 – 3000	2600 – 3400
EPA/TCEQ 2019	Selenium	-	1.227	-	45 – 60	90 – 150	400

Sampling Event	Analyte	Maximum Concentration (mg/L)	Water Intake Rate (L/Day)	Analyte Intake Rate (mg/Day)	Dietary Reference Intake Levels (mg/Day) Infant	Dietary Reference Intake Levels (mg/Day) Children	Dietary Reference Intake Levels (mg/Day) Adults
EPA/TCEQ 2019	Sodium	23.7	1.227	29.1	110 – 370	1000-2000	1500
EPA/TCEQ 2019	Vanadium	0.0103	1.227	0.013	ND	ND	1.8
EPA/TCEQ 2019	Zinc	2.95	1.227	3.62	4 -5	7 – 12	40

Abbreviation: EPA = Environmental Protection Agency; TCEQ = Texas Commission on Environmental Quality; mg/L = milligram per liter; mg/day = milligram per day; mg/kg = milligram per kilogram. Bolded value exceeds a dietary intake level.

Appendix C: Cancer Risk Evaluation

Studies in animals and humans have shown that contaminants including PAHs are associated with cancer at target sites. EPA developed cancer slope factors (CSFs) for each target site. CSFs are quantitative indications of the carcinogenicity of a substance. CSFs estimate the increase in cancer risk per mg/kg/day of exposure to a carcinogenic substance.

DSHS estimated total excess cancer risk for ingestion and dermal exposure to chemicals that can cause cancer. DSHS multiplied the combined dermal, ingestion, and inhalation dose by the CSF. DSHS assumed 33 years of exposure for adults and 10 years for children, and averaged exposures over a lifetime of 78 years. To estimate total lifetime excess cancer risks, DSHS summed excess cancer risks for children (ages 11 to less than 21 years) and adults (Table 9).

Contaminant total exposure dose cancer risk equations

For contaminants considered to be carcinogens, the estimated cancer risk was calculated using the following formula:

Risk = (Dose (mg/kg/day) x cancer slope factor $(\text{mg/kg/day})^{-1}$ x exposure duration (years)) / Lifetime (years)

DSHS used ATSDR's default assumption for exposure duration to calculate the cancer risks. These exposures were averaged over a lifetime of 78 years.

For example, the estimated RME cancer risks for adults and children (11 years old to less than 21 years old) exposed to PAHs in soil (mg/kg) by ingestion was calculated as:

Adults:

Risk = ($8.1\text{x}10^{-7}$ (mg/kg/day) x 1 $(\text{mg/kg/day})^{-1}$ x 33 years)/78 years = 3×10^{-7}

Children:

<u>11 years to less than 16 years</u>

Risk = ($1.8\text{x}10^{-6}$ (mg/kg/day) x 1 $(\text{mg/kg/day})^{-1}$ x 5 years) / 78 years = 1.15×10^{-7}

<u>16 years to less than 21 years</u>

Risk = ($1.5\text{x}10^{-6}$ (mg/kg/day) x 1 $(\text{mg/kg/day})^{-1}$ x 5 years) / 78 years = 9.62×10^{-8}

The cancer risks for each age group from 11 years old to less than 21 years old were then summed to obtain the cumulative cancer risk estimate for children.

Total Cancer Risk = $(1.15x10^{-7}) + (9.62x10^{-8}) = 2x10^{-7}$