

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

7/12/2024

Region ID: 02

Site Name: Historic Potteries

CERCLIS: NJN000203535

OUID: 00

SSID: A29V

Action: Removal Action Administrative Record

Region ID: 02

Doc ID: **501113**

Bates: NA

Date: 7/12/2024

Pages: 3

Title: Historic Potteries, Administrative Record Index of Documents

Doc Type: Index

	Name	Organization
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Region ID: 02

Doc ID: **501114**

Bates: R2-000001

Date: 1/23/2024

Pages: 1

Title: HP002 P019 Validated Analytical Results

Doc Type: Sampling Locations

	Name	Organization
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	Name	Organization
Addressee:	Jonathan Byk, On-Scene Coordinator Superfund and Emergency Management Division	EPA, REGION 2

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

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Region ID: 02

Site Name: Historic Potteries

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Action: Removal Action Administrative Record

Region ID: 02

Doc ID: [501115](#)

Bates: R2-000002

To: R2-000003

Date: 12/7/2023

Pages: 1

Title: Summary Table: TAL Metals

Doc Type: Analytical Results

	Name	Organization
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	Name	Organization
Addressee:	NA	NA

Region ID: 02

Doc ID: [501116](#)

Bates: R2-000004

To: R2-000058

Date: 1/9/2024

Pages: 55

Title: Removal Site Evaluation for Historic Potteries Site

Doc Type: Removal Site Evaluation

	Name	Organization
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7/12/2024

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

7/12/2024

Region ID: 02

Site Name: Historic Potteries

CERCLIS: NJN000203535

OUID: 00

SSID: A29V

Action: Removal Action Administrative Record

Region ID: 02

Doc ID: [501117](#)

Bates: R2-000059

To: R2-000061

Date: 2/15/2024

Pages: 3

Title: Confirmation of Verbal Authorization for a CERCLA Emergency Removal Action at the Historic Potteries Site

Doc Type: Confirmation of Verbal Authorization

	Name	Organization
Author:	Jonathan Byk, On-Scene Coordinator Superfund and Emergency Management Division	EPA, REGION 2
	Name	Organization
Addressee:	Pat Evangelista, Director Superfund and Emergency Management Division	EPA, REGION 2



SCALE

1:840

LEGEND

- Composite Sample Location
- Drip Line Composite Sample Location
- Tax Parcel Boundaries
- Sample Quadrants

Notes:
1. mg/kg - milligrams per kilogram
2. Red text indicates exceedance of EPA Action Level of 200 mg/kg for that sample depth interval.
3. In cases where more than one sample result is listed for a depth interval a duplicate sample was collected.



HP002-P019 Validated Analytical Results

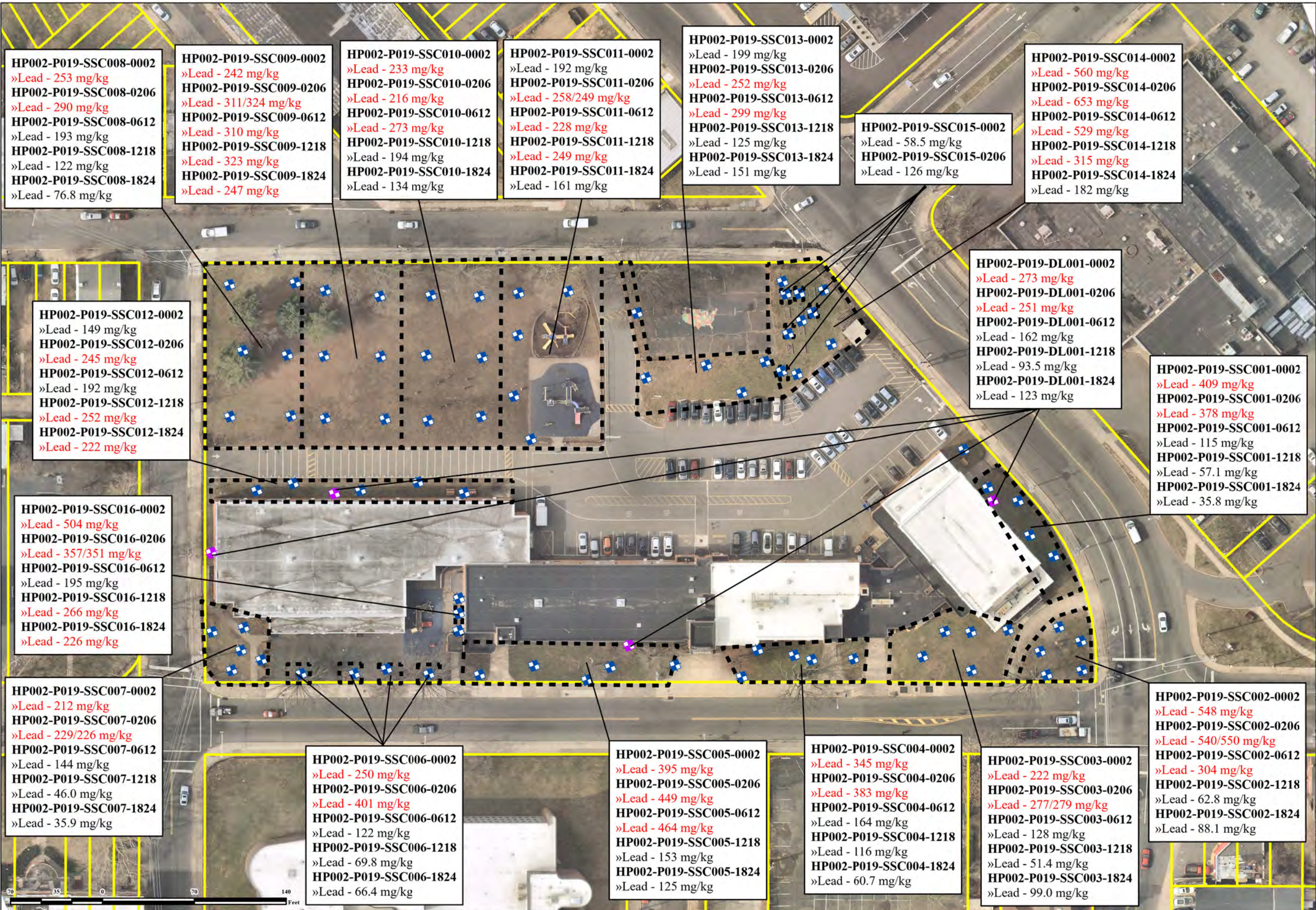
Historic Potteries
Trenton, New Jersey

UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY
SUPERFUND TECHNICAL ASSESSMENT
& RESPONSE TEAM V
CONTRACT # 68HE0319D0004

Weston Solutions, Inc.
Federal East Division

In Association With
Eco-Risk, Avatar Environmental, LLC,
Pro-West & Associates, Inc.,
On-Site Environmental, Inc.,
Sovereign Consulting, Inc.,
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Preliminary Soil Analytical Results Summary Table - TAL Metals
Historic Potteries Site
HP001-P138
Trenton, Mercer County, New Jersey
December 27, 2023

R2-000002

START V Sample Number	EPA RMLs for Residential Soil ¹	HP001-P138-SSC001-0002-01	HP001-P138-SSC001-0206-01	HP001-P138-SSC001-0612-01	HP001-P138-SSC001-1218-01	HP001-P138-SSC001-1824-01	HP001-P138-SSC002-0002-01	HP001-P138-SSC002-0206-01	HP001-P138-SSC002-0612-01	HP001-P138-SSC002-1218-01	HP001-P138-SSC002-1824-01
Sampling Date		12/27/2023	12/27/2023	12/27/2023	12/27/2023	12/27/2023	12/27/2023	12/27/2023	12/27/2023	12/27/2023	12/27/2023
Sample Depth		0-2	2-6	6-12	12-18	18-24	0-2	2-6	6-12	12-18	18-24
Sample Matrix		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
TAL Metal (mg/kg)											
Aluminum	230,000	8,680	8,720	9,450	10,700	10,100	7,550	8,330	7,580	7,340	8,770
Antimony	94	2.01 U	1.95 U	1.99 U	1.92 U	2.01 U	2.00 U	2.07 U	2.04 U	1.96 U	1.93 U
Arsenic	68	7.04	6.76	6.95	5.98	5.80	8.00	8.24	7.50	7.32	7.73
Barium	46,000	86.5	86.5	87.3	91.0	85.3	85.6	73.9	68.3	67.2	79.0
Beryllium	470	0.600	0.641	0.655	0.608	0.576	0.442	0.487	0.473	0.484	0.560
Boron	47,000	3.81	2.26	1.94	1.91	1.82	12.3	9.73	9.95	8.21	7.09
Cadmium	21	0.661	0.528	0.464	0.561	0.497	0.426	0.349	0.451	0.443	0.497
Calcium	NS	2,410	1,880	1,690	1,930	1,710	11,600	6,970	7,730	7,550	6,840
Chromium	NS	17.4	15.3	13.8	14.1	14.4	15.5	15.6	18.6	18.1	18.2
Cobalt	70	5.67	5.63	5.79	6.07	6.06	4.72	4.48	4.26	4.22	5.30
Copper	9,400	35.4	29.4	34.4	57.4	55.6	43.7	34.5	35.3	32.5	43.7
Iron	160,000	13,900	13,500	14,200	16,500	15,800	12,000	12,500	12,700	12,500	14,500
Lead	400	162	128	120	149	142	31.9	33.7	70.6	72.6	99.5
Magnesium	NS	1,880	1,770	1,810	2,040	2,030	2,400	1,870	1,770	1,660	2,000
Manganese	5,500	356	393	371	273	292	478	342	299	294	331
Nickel	4,300	13.6	12.6	12.2	13.1	12.8	8.82	8.67	9.47	9.42	11.6
Potassium	NS	694	514	490	510	534	769	670	716	683	708
Selenium	1,200	2.01 U	1.95 U	1.99 U	1.92 U	2.01 U	2.00 U	2.07 U	2.04 U	1.96 U	1.93 U
Silicon	NS	1,110 J	1,040	1,230	1,320	1,350	1,160	1,280	1,090	1,020	1,130
Silver	1,200	0.502 U	0.487 U	0.496 U	0.479 U	0.504 U	0.501 U	0.518 U	0.510 U	0.489 U	0.481 U
Sodium	NS	100 U	97.4 U	99.3 U	95.9 U	101 U	100 U	104 U	102 U	97.8 U	96.3 U
Thallium	2.3	2.01 U	1.95 U	1.99 U	1.92 U	2.01 U	2.00 U	2.07 U	2.04 U	1.96 U	1.93 U
Tin	140,000	3.77	2.71	4.24	8.15	5.27	1.21	1.27	1.87	2.08	4.12
Titanium	NS	121	104	100	86.5	86.6	128	118	116	110	117
Vanadium	1,200	26.2	24.1	23.2	21.8	20.7	24.8	21.6	21.9	20.6	23.2
Zinc	70,000	267	198	155	165	153	99.7	79.8	125	115	134

Notes:

START V - Superfund Technical Assessment & Response Team V

TAL - Target Analyte List

mg/kg - milligrams per kilogram

U - The analyte was not detected at or above the Reporting Limit

J - The identification of the analyte is acceptable; the reported value is an estimate

NS - Not Specified

¹U.S. Environmental Protection Agency (EPA) Removal Management Levels (RMLs)

for Residential Soil for 10⁻⁴ Risk Level for Carcinogens or a Hazard Quotient (HQ)

of 3 for Non-Carcinogens, November 2023

Bold result values are detections

Preliminary Soil Analytical Results Summary Table - TAL Metals
Historic Potteries Site
HP001-P138
Trenton, Mercer County, New Jersey
December 27, 2023

R2-000003

START V Sample Number	EPA RMLs for Residential Soil ¹	HP001-P138-SSC003-0004-01
Sampling Date		12/27/2023
Sample Depth		0-4
Sample Matrix		Soil
TAL Metal (mg/kg)		
Aluminum	230,000	6,940
Antimony	94	1.96 U
Arsenic	68	5.80
Barium	46,000	98.9
Beryllium	470	0.453
Boron	47,000	0.979 U
Cadmium	21	0.459
Calcium	NS	92,000
Chromium	NS	16.9
Cobalt	70	7.96
Copper	9,400	60.5
Iron	160,000	15,400
Lead	400	114
Magnesium	NS	25,700
Manganese	5,500	743
Nickel	4,300	13.4
Potassium	NS	886
Selenium	1,200	1.96 U
Silicon	NS	49.0 U
Silver	1,200	0.490 U
Sodium	NS	97.9 U
Thallium	2.3	1.96 U
Tin	140,000	0.979 U
Titanium	NS	0.979 U
Vanadium	1,200	30.7
Zinc	70,000	176

Notes:

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for Residential Soil for 10⁻⁴ Risk Level for Carcinogens or a Hazard Quotient (HQ)

of 3 for Non-Carcinogens, November 2023

Bold result values are detections



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
 REGION 2
 2890 WOODBRIDGE AVENUE
 EDISON, NEW JERSEY 08837-3679

DATE: January 9, 2024

SUBJECT: Removal Site Evaluation for the Historic Potteries Site, Trenton, Mercer County, New Jersey
 08638 (CERCLIS ID: NJN000203535)

FROM: Joel Petty, Acting On-Scene Coordinator/Remedial Project Manager
 Removal Action Branch

TO: Joseph D. Rotola, Branch Manager
 Removal Action Branch

JOEL PETTY Digitally signed by JOEL
 PETTY
 Date: 2024.01.09
 11:58:45 -05'00'

Introduction

The United States Environmental Protection Agency ("EPA") Region II Removal Action Branch ("RAB") has been requested to conduct a Removal Site Evaluation ("RSE") at the Historic Potteries Site ("Site") by the New Jersey Department of Environmental Protection ("NJDEP"). The Site was discovered during an RSE of the L.H. Mitchell Site where a small solder manufacturer historically operated and elevated levels of lead were found in soil on residential properties near the Site. The lead was unattributable to the L.H. Mitchell facility, but numerous potteries that operated in East Trenton were thought to be a potential source of the lead. On January 9, 2020, EPA received a referral from the NJDEP to conduct an integrated assessment by RAB and the EPA Special Projects Branch ("SPB") Pre-remedial Section. RAB and SPB began an investigation of the Site in January 2020 to determine if the Site qualifies for a Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA") removal action and/or placement on the National Priorities List ("NPL").

Site Description and Background

For purposes of this RSE, the current Site boundaries include a portion of the East Trenton neighborhood and areas upwind of it in the Top Road neighborhood where potteries historically operated, all of which are in Trenton, Mercer County, New Jersey. This includes the residential properties within East Trenton to the north of North Clinton Avenue, east of North Olden Avenue, and west of Plum Street as well as the locations of historic potteries that operated throughout the East Trenton and Top Road neighborhoods described within this RSE (Attachment 1, Figure 2). The Site boundaries may expand as more assessment activities are conducted pursuant to the NJDEP referral and the conclusions herein.

The Site is located in a mixed residential, commercial, and light industrial urban area with residential being the predominant use. There are over 600 housing units with a population greater than 1,800 people within the current Site boundaries. Most of the residences are single- or multi-family rowhomes with back yards, and a large portion of the community are renters. Many of the homes were constructed in the late 1800s and early 1900s. Most of the residential properties include bare soil and/or vegetated areas. In addition, there are many abandoned houses and vacant lots. A large portion of the population is Spanish-speaking and the area has been identified as a community with environmental justice concerns. Within the current site boundaries, using EPA's Environmental Justice Screening and Mapping Tool ("EJ Screen"), 10 of 13 environmental justice ("EJ") indexes and 8 of 13 supplemental EJ indexes exceed the 90th percentile.

The Assunpink Creek ("Assunpink") is located 800 feet to the southeast of the Site. Hamilton Township begins on the other side of the creek. Available wind rose charts indicate that prevailing winds were from the north-northwest, northwest, west-northwest, west-southwest, and southwest while potteries were historically operating. The United States Department of Agriculture's Natural Resources Conservation Service has classified the soil in the area as udorthents which indicates that the soils have been altered by excavating or filling. Due to its proximity to water, a likely scenario is that the area was filled and graded prior to development in the mid-1800s. Topographic maps are only available from year 1888 onward, so this could not be confirmed.

According to the Trenton Historical Society, the area was first improved in the mid-1700s when it was used as an apple orchard (prior to the use of lead-arsenate pesticides) and grist mill. In the early 1800s, mills were built along the Assunpink. Beginning in the 1850s, the pottery industry began to emerge with most of the potteries locating along the Delaware and Raritan Canal ("D&R Canal") which separates East Trenton and Top Road. At the same time, rubber companies began to locate near and along the Assunpink. The residential neighborhood between the canal and creek was developed over the next 50 years to support the industries.

Trenton was a major ceramic manufacturing center in the United States and was only rivaled by that in East Liverpool, Ohio. Potteries began to develop on an industrial scale in Trenton during the 1850s. The industry grew considerably throughout the remainder of the century and was at its peak between 1880 and 1920. The industry shrank during the Great Depression in the 1930s. Potteries in Trenton manufactured several products including Rockingham (fine wares, earthenware, and ornamental pottery), art ceramics, sanitary ware, and electrical porcelain, but the principal manufacturing was of the whitewares and yellowwares that made up much of the tableware used in American households. The industry flourished due to its central location between New York and Philadelphia, allowing for easy export of finished goods and import of central New Jersey clays and eastern Pennsylvania coals along the canals and railroads that went through the city.

According to historic resources, including the Potteries of Trenton Society ("POTS") online database and Sanborn Fire Insurance Maps ("Sanborns"), at least 78 locations existed

throughout the City of Trenton where ceramics manufacturing occurred (Attachment 1, Figure 1). At least 15 locations that manufactured ceramics operated within the current Site boundaries and at least another 12 operated to the southwest, within East Trenton. Of the 15 identified locations within the current Site boundaries, at least five of these were large-scale operations with more than five kilns.

As noted above, the genesis for NJDEP's referral was the finding of elevated soil lead levels throughout the East Trenton neighborhood which were not attributable to the L.H. Mitchell facility, as documented in an RSE dated April 6, 2022 (Attachment 2), but appeared to potentially coincide with the presence of ceramic chips or pottery sherds within the soil samples and/or were located in areas surrounding and/or downwind of large-scale potteries. Research on the historic pottery industry indicated that lead was a common component of glazes used by historic potteries such as those in Trenton and could have been released via air emissions during the firing of lead glaze in kilns, in addition to the kiln waste deposition evidenced by pottery fragments in soil. These observations and NJDEP's referral led to the current, extensive attribution study to determine whether the historically pervasive pottery operations in the area could be a unique source of lead deposition and loading within the East Trenton neighborhood and similar areas.

Data from the L.H. Mitchell RSE was used as a starting point for the Historic Potteries assessment. The L.H. Mitchell assessment had been conducted between October 2018 and April 2019 and covered approximately six mostly residential blocks in the central to northern part of the East Trenton neighborhood, as well as an upwind church and several properties to the northwest for background/comparison locations, and Mulberry Street Park (also known as Red Oak Park) adjacent to the southeast of the residential blocks. Composite soil sampling results had indicated the presence of lead at concentrations above its applicable EPA Removal Management Level ("RML") using a hazard quotient of 3 ("HQ3") for residential soil of 400 milligrams per kilogram ("mg/kg") at varying depths in most of the locations sampled. RMLs are generic, chemical-specific concentrations for individual contaminants that may be used to support the decision for EPA to undertake a removal action. Although they are not necessarily health-protective concentrations in terms of chronic exposure, an exceedance of an RML does not imply that adverse health effects will occur. Lead levels exceeded the EPA RML in 291 of 408 samples collected from intervals within the upper two feet of soil, at all downwind properties and across varying depth intervals. Elevated lead levels ranged from 400 to 7,500 mg/kg. Lead levels did not exceed its EPA RML at any of the background locations. Lead levels exceeded 1,200 mg/kg within the upper two feet of soil at 26 of 33 identified sampling units across 40 properties. Refer to Table 1 for a Quadrant Composite Sampling Lead Results Summary Table. Additional analyses indicated that the elevated lead levels in soil could not be largely attributed to either lead-based paint or the historic L.H. Mitchell solder manufacturing facility, and a CERCLA removal action was not warranted.

Given the existing soil lead dataset for the East Trenton neighborhood, the Historic Potteries investigation focused on two of the large-scale potteries that were located directly upwind of the initial East Trenton sampling area and were adjacent to each other and to the former

railroad tracks along the southern border of the Top Road neighborhood. One of the former potteries, identified during the current assessment as HP001-P056, was located at 457 Mulberry Street and is currently operated as a paper products distributor called Crest Paper Products Inc. Several potteries, including Moore Pottery, East Trenton Pottery, and Imperial Porcelain Work, operated at the location from the 1860s through the 1940s. The other former pottery, identified during the current assessment as HP001-P057, was located at 900-930 New York Avenue and is currently operated as a stone distributor and fabricator called Stone Tech Fabrication. Several potteries, including East Trenton Porcelain Company, Anchor Pottery, Stangl Pottery, and Deluxe Designs Inc. operated at this location from the 1860s through the 1990s.

Three other known or potential former pottery locations within East Trenton were also sampled during this investigation. A small pottery that was only known to have one kiln operated within the residential sampling area between 224-238 Breunig Avenue between 1890 and 1903 as Ricketts and Hellyer's Pottery, American Art China Company, American Porcelain, and Acme Porcelain Works and is thought to be located at, or adjacent to, sampled property HP001-P003. Another property that appears to have contained a pottery prior to the 1890s but remained commercial/industrial in its use, identified as HP001-P053, is located within the sampling area at 325 Mulberry Street. A final location at 356 Enterprise Avenue where Elite Pottery and Cordey China Company ("Cordey China") operated, identified as HP001-P051, was located 1,000 feet downwind of any residential receptors.

Other industrial and commercial properties that were viewed as potential sources were also included in the attribution study. The L.H. Mitchell facility, identified as HP001-P001, which manufactured solder at 216 Klagg Avenue and a former rail- and coal-yard that is currently the City of Trenton Water Works, identified as HP001-P054, located at the adjacent properties of 351 Mulberry Street and 201 Cortland Street were located within the residential sampling area. A two-acre secondary zinc smelter operated by ASARCO/Federated Metals, identified as HP001-P050, and located at 300 Enterprise Avenue adjacent to Cordey China was 700 feet downwind of the closest residential receptor.

Site assessment activities/observations

Historic Sanborn maps, historic aerial photographs, and the POTS database were reviewed as part of this RSE. Internet searches were conducted for scientific journal articles, historic articles, photographs, and other references on the pottery industry in Trenton and the likelihood of lead releases during ceramics manufacturing. The POTS database was used extensively for both the history of the industry in Trenton and to determine how long each location operated and what they produced. An expert in the pottery industry was also consulted with to determine the likelihood of lead glaze usage and the potential for a lead release in the firing process.

On October 3, 2018, RAB conducted an initial reconnaissance of the area during the L.H. Mitchell site assessment. Buildings in East Trenton are commercial/industrial and residential in all directions. Most of the residential properties in the Site vicinity have exposed soil in their

backyards with varying levels of grass coverage. Abandoned buildings and vacant lots are common in this area. A review of tax records shows that the City of Trenton owns many of the vacant lots.

On August 14 and 27, 2019, following review of historic resources which revealed the historic presence of several nearby pottery manufacturers, EPA conducted a site reconnaissance of all the known pottery locations throughout Trenton to determine the current status of the locations. Many of the former pottery buildings are still present but most appear to have undergone extensive changes since they operated as potteries. Several exhaust stacks and chimneys were identified on many of the buildings, but no remnants of kilns were observed. Roof windows were observed on some of the roofs where kilns most likely once stood. Potential residential receptors existed downwind of many of the potteries and one former pottery appears to be a public housing complex with exposed soil. These areas will need further investigation in the future.

In July 2019, EPA initially conducted soil sampling at properties located upwind to the northwest and southwest of the L.H. Mitchell facility, within East Trenton, to determine if lead contamination is present outside of the original sampling area and could be attributed to an historic release from these potteries. EPA collected 35 composite soil samples, including field duplicates, from five city-owned properties to the northwest of the facility, in an upwind direction: four rights-of-way and one vacant property. Results indicate lead levels exceed its EPA RML in nine samples from two of the five properties, ranging from 400 to 1,000 mg/kg. In September 2019, EPA collected 42 composite soil samples, including field duplicates, from city-owned properties to the southwest of the facility which included vacant residential properties, two parks (one active and one vacant), and a former library. Results indicate lead levels exceed its EPA RML in 28 samples from six of the seven properties, ranging from 420 to 2,300 mg/kg. Pottery sherds were identified at five of these sampled locations and were screened for lead with a handheld x-ray fluorescence analyzer (XRF) and analyzed for metals at a laboratory. Lead was detected as high as 2,610 mg/kg in these pottery sherds.

Following receipt of NJDEP's referral in early 2020, EPA began an extensive attribution study of the elevated lead levels found during the L.H. Mitchell RSE and the potteries that operated nearby. Sampling was conducted between October 2020 and July 2022. As discussed in detail below, properties sampled for the attribution study include occupied and vacant residential properties previously sampled during the L.H. Mitchell RSE located throughout the East Trenton neighborhood, three large-scale (HP001-P051, HP001-P056, and HP001-P057) and two smaller-scale (HP001-P003 and HP001-P053) former potteries noted above, the ASARCO/Federated Metals secondary zinc smelter (HP001-P050), a rail and coal yard (HP001-P054), and additional city-owned properties in other sections of the city, including those both nearby other former potteries and others away from former potteries to be used as background locations. The former potteries that were sampled were chosen based upon their location, the likelihood of high use of lead glazes, and the ability to gain access expeditiously. Samples located in the vicinity of differing groups of large-scale known potteries within Trenton were split into six areas, denoted HP001 through HP006, as shown on Attachment 1, Figure 1, and background

samples were located outside the potential areas of influence from potteries via air deposition, based on the known predominant wind directions. HP001 is the area containing portions of the East Trenton and Top Road neighborhoods and was the main focus of this RSE, while HP002 contains the rest of East Trenton.

The attribution study conducted for the Site has included several specialized laboratory analyses and data analysis with assistance from the EPA Office of Research and Development (“ORD”) as well as the EPA Environmental Response Team. Laboratory analyses included Target Analyte List (“TAL”) metals and isotopic lead on soils, ceramic sherds, and tree cores, Scanning Electron Microscopy with Backscatter Electron Imaging and Energy Dispersive X-ray Spectroscopy (“SEM/BSE/EDS”) on soils and ceramic sherds, and Synthetic Precipitation Leaching Procedure (“SPLP”) on ceramic sherds. Analyses of the data included statistical analysis using a commercial software (Pirouette®), vertical and horizontal distribution of lead, and age dating. Air modeling was also conducted to determine where airborne releases would have had the greatest impact. A Technical Memorandum was prepared by ORD and is included as Attachment 3.

Discrete soil samples were collected from all properties in the attribution study at the surface (0-2” below ground surface [bgs]), from 2-6” bgs, and then from 6-inch intervals to a depth ranging from two to eight feet bgs, totaling 1,239 samples collected, including QA/QC samples. All of the soil samples were screened with an XRF. The XRF data was reviewed, and subsequent intervals with similar lead levels and soil characteristics from the same soil borings were combined for TAL metals analysis. This was done to reduce the overall number of samples for both TAL metals and isotopic lead analyses. The TAL metals data from a total of 901 samples was then reviewed, and 459 samples from 76 locations were selected and analyzed for isotopic lead which ensured representation across all sampled properties. Generally, this included samples from the entire soil column of the sample(s) selected for isotopic analysis.

Analytical lead results for the discrete soil samples from the attribution study ranged from 3.52 to 50,900 mg/kg, within a median of 152 mg/kg. Results indicate lead levels exceed the EPA RML of 400 mg/kg in 104 of 298 soil samples collected on residential properties or parks and analyzed for TAL metals, including 100 of 204 samples collected from the upper two feet of soil. Results indicate lead levels exceed the EPA RML of 800 mg/kg in 84 of 603 soil samples collected on industrial properties and analyzed for TAL metals, including 17 of 155 samples collected from the upper foot of soil. No other metals exceeded their respective RMLs on either residential or industrial properties, except for one exceedance of iron at 234,000 mg/kg, compared to its RML of 160,000 mg/kg, from 6-18 inches bgs at a former metal chain works facility (HP006-P004). Refer to Attachment 1, Figure 2 for the locations of the sampled properties within HP001 and HP002.

Additionally, 5-point composite samples were collected using the risk-based sample collection methodology employed for the L.H. Mitchell RSE at 12 city-owned properties throughout Trenton. Seven were located downwind of other pottery areas in the city and five were outside of areas that would be subject to deposition from the known locations of former potteries. A

total of 84 composite soil samples were analyzed for TAL metals and ten of those were analyzed for isotopic lead. Analytical lead results for the composite soil samples from the attribution study ranged from 23.1 to 2,390 mg/kg. Results indicate lead levels exceed its EPA RML of 400 mg/kg in 34 of 84 composite soil samples.

Table 1: Quadrant Composite Sampling Lead Results Summary

Area	Depth (inches below ground surface)	# of Samples	# of Samples Exceeding 400 mg/kg for Lead	Maximum Lead Result (mg/kg)	Average Lead Result (mg/kg)
HP001	0-2	76	58 (76 %)	4,600	936
	2-6	76	60 (79 %)	7,500	1,090
	6-12	76	59 (78 %)	4,200	919
	12-18	76	53 (70 %)	2,200	625
	18-24	76	31 (41 %)	1,900	431
HP002 – HP006	0-2	10	7 (70 %)	1,350	551
	2-6	10	7 (70 %)	1,540	616
	6-12	10	5 (50 %)	1,230	509
	12-18	10	5 (50 %)	1,660	505
	18-24	10	2 (20 %)	1,070	334
HP007	0-2	4	1 (25 %)	510	300
	2-6	4	1 (25 %)	542	320
	6-12	4	1 (25 %)	431	177
	12-18	4	0 (0 %)	370	126
	18-24	4	0 (0 %)	377	135

* Table includes all locations, except dripline, collected throughout L.H. Mitchell Site and Historic Potteries Site assessments.

Pottery sherds were found in the soils at most properties sampled during the attribution study. All sherds were separated from the soils, cleaned, and logged as individual samples. The sherds were then analyzed with the XRF for lead and other metals. Based upon the XRF results, the characteristics of the sherd, and the location where it was found, a variety of sherds were selected for further analysis for TAL metals and isotopic lead. Additionally, a slag-like material was found at Property HP001-P051 and was handled in the same manner as the pottery sherds. Hunter Research, Inc., a historical resource consulting firm, also provided ten pottery sherd samples that had been collected from pottery waste dumps identified during numerous construction projects and located in different areas of Trenton. These ten samples are linked to specific potteries. A total of 308 pottery sherd and four slag samples were screened with the XRF and 66 of the pottery sherds and three of the slag samples were analyzed for TAL metals and isotopic lead. Lead levels in the glaze measured with the XRF were as high as 254,708 parts per million (ppm). Lead levels in the pottery sherd samples analyzed for TAL metals ranged

from non-detect to 14,916 mg/kg. Lead levels in the slag samples analyzed for TAL metals ranged from 1,112 to 50,156 mg/kg.

Because lead concentrations alone cannot determine sources of lead contamination, isotopic lead analysis was conducted on 469 soil samples (459 discrete and ten composite), 66 pottery sherd samples, and three slag samples in order to determine if an isotopic signature could be found from the lead used in the ceramic glazes. The isotopic analysis is based on the premise that the four stable lead isotopes, Pb^{204} , Pb^{206} , Pb^{207} and Pb^{208} , add together to comprise the total amount of lead in a sample. Therefore, the ratios of different lead isotopes can serve to define a lead fingerprint. The concentration of Pb^{204} is customarily used in the denominator for defining lead isotope ratios. The following presents the ranges of isotopic lead ratios for each media type:

Table 2: Ranges of Isotopic Lead Ratios per Media Type

	Pb^{206}/Pb^{204}	Pb^{207}/Pb^{204}	Pb^{208}/Pb^{204}
Soil	17.391 to 20.830	15.453 to 15.901	37.340 to 41.902
Pottery Sherds	17.014 to 19.739	15.417 to 15.812	36.727 to 39.243
Slag	18.549 to 18.968	15.597 to 15.707	38.307 to 38.697

The pottery sherd ratios formed two clusters denoted Cluster 1 and Cluster 2 (Attachment 3).. Cluster 1 was the least radiogenic of all samples. Cluster 2 and soil samples containing lead above 2,000 mg/kg for lead at all properties besides the smelter fell within the same range. Soil samples with lower lead levels were the most radiogenic, which is indicative of natural lead in soils.

In an attempt to determine time frames for when the lead contamination occurred and therefore whether significant amounts of lead were deposited during potteries' operations, core samples were collected from trees within the sampling area. All of the properties sampled for the attribution study were surveyed for tree species. Sycamore was determined to be the most common tree throughout the area and included some of the largest and oldest trees. Cores were collected from 11 sycamore trees and one oak tree of varying ages throughout the study area. Upon collection, the cores were split into samples representing time intervals that coincided with important markers for the pottery industry and other lead sources. These date ranges were before 1910, 1910-1935, 1935-1955, 1955-1980, and 1980-2020. The samples were then analyzed for total and isotopic lead. Lead concentrations ranged from non-detect to 2.93 mg/kg. The data was then compared to associated soils data and analyzed to determine if any patterns were evident that may have indicated when the contamination occurred.

The results of the tree core sampling were inconclusive and sometimes contradictory. The isotopic lead ratios found in the tree core samples were similar to nearby soil samples. However, no consistent temporal pattern emerged. Some of the tree cores did show an increase in lead over time, but others did not show a significant difference, and some decreased. A higher lead loading was found to be present in trees in areas downwind of known large-scale potteries than those within background areas. Within HP001, the lead results from

tree core samples from ranged from 1.9 to 29.3 micrograms per liter ($\mu\text{g/L}$), while the background tree core samples ranged from 1.2 to 6.3 $\mu\text{g/L}$. Uncertainty with the data resulted from the lack of pre-operational (pre-1850s) data, the small sample set, and significant results differences between duplicate samples. Additionally, trees can uptake lead via both the roots and leaves, and therefore higher results in later time periods do not necessarily equate to higher levels of lead in the soils at that time.

An SEM/BSE/EDS analysis was performed on ceramic sherds and three associated soil samples in which the sherds were present. This was an attempt to determine if larger sherds would eventually weather into smaller fragments within the soil and to see if there was evidence of smaller sherds that would not be seen by the unaided eye which may be present in a pottery fill material. Evidence of small pottery fragments which could not be seen with the unaided eye were found in one of the three soil samples.

SPLP analysis was performed on 20 ceramic sherd samples to determine if lead or other metals would readily leach from the sample. Samples were chosen based on the size needed for the analysis, the XRF lead result and the characteristic of the glazed portion of the ceramic sherd to ensure a large sampling variety. Samples were chosen from a range of lead levels including five samples containing lead ranging from 100 to 1,000 ppm, four samples from 1,000 to 10,000 ppm, eight samples from 10,000 to 100,000 ppm, and three samples over 100,000 ppm. The ceramic sherds were pulverized and analyzed for TAL metals, isotopic lead and SPLP analyses. The SPLP analysis included antimony, arsenic, barium, beryllium, cadmium, cobalt, copper, chromium, lead, manganese, molybdenum, nickel, silver, thallium, tin, uranium, vanadium, and zinc. Of these metals, lead, barium, zinc, vanadium, and copper (presented in order of highest leachate concentration) were the most leachable. Lead results for the SPLP analysis ranged from less than 1 to 124 $\mu\text{g/L}$ of total lead extracted, indicating leaching from intact ceramic sherds in the soil is a probable source of soil lead and other metals.

Radiation monitoring and sampling was conducted at some properties within HP001. Uranium and some other radioactive elements were often used historically in glazes to provide vibrant colors on ceramics. A Ludlum Model 19 microR survey meter was used to detect gamma radiation and a Ludlum Model 2241 digital ratemeter was used to detect alpha and beta radiation. Elevated alpha and beta readings were measured on three of the properties up to three times the background which prompted the decision to collect soil samples for radiation analysis. Nine soil samples were analyzed for gamma-ray spectrometry, isotopic thorium, and isotopic uranium. All of the results were similar to background for the area. The elevated readings with the Ludlum Model 2241 were attributed to operator error or interference.

Pirouette® is a commercial statistical software that was used to compare the metals data collected both during the attribution study and the L.H. Mitchell assessment. The results of metals that were detected within more than 90% of all soil samples were uploaded into the program. This included aluminum, arsenic, barium, calcium, chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, silicon, titanium, vanadium, and zinc. All sample depths were entered for each location and the data was log-transformed prior to the statistical

analysis. The software compares all the metals concentration data using statistical tests to assess similarities and differences across all sample locations. Two primary analyses are implemented: hierarchical cluster analysis (“HCA”) and principal component analysis (“PCA”). HCA assigns subsets of sample data into clusters (or groups) based on maximizing the similarities in metal concentrations within each cluster and the dissimilarities in metal concentrations between clusters; relative location and depth are not considered when establishing groups of samples with chemical similarity. PCA identifies what metals explain most of the variation driving cluster assignments. Each cluster identified with HCA represents a population of soil samples that appear to be from a common source. Thus, a cluster that includes samples from residential properties and samples from properties formally occupied by potteries indicates that the historical pottery was a potential source. The data was viewed in multiple formats, but for the purposes of this report, the discussion will revolve around the entire data set.

The number of statistical clusters identified in the analysis is dependent on the level of restriction the user applies for maximizing similarity within clusters. The level of restriction is applied by selection of a value between zero and one for a criterion called the “similarity index”, with zero being least stringent and one being most stringent. When all of the data was viewed together in Pirouette® using a similarity index of 0.7, eight distinct clusters were identified. Cluster 1 is comprised of samples containing lower levels of lead (all, besides two, containing lead concentrations below 300 mg/kg) originating from varying depths at both residential and commercial/industrial properties both inside and outside of HP001. Cluster 2 is comprised of samples containing varying levels of lead ranging from 4 to 4,050 mg/kg originating almost entirely from depths below two feet bgs at the two large potteries (HP001-P056 and HP001-P057) and the former railroad properties (HP001-P054 and HP001-P055). Cluster 3 is comprised of samples with very low levels of lead (below 40 mg/kg) originating from varying depths below two feet at Properties HP001-P055, HP001-P056, and HP001-P057. Cluster 4 is comprised of samples containing varying levels of lead ranging from 121 to 8,640 mg/kg, originating from mostly surface to two feet bgs at a variety of properties throughout the study area including both residential and former potteries. Cluster 5 is comprised of samples with varying levels of lead ranging from 13 to 3,630 mg/kg originating from varying depths throughout the study area, including both residential and former potteries. Cluster 6 is comprised of samples with lead concentrations at 4,600 mg/kg or above originating solely from the smelter property (HP001-P050) and the adjacent former pottery (HP001-P051). Cluster 7 is comprised of samples with lead concentrations below 163 mg/kg originating from HP001-P054, HP001-P055, HP001-P056, and HP001-P057. Cluster 8 is comprised of samples with lead concentrations ranging from 18 to 3,870 mg/kg originating from commercial/industrial properties, including former potteries.

Release or threatened release into the environment of a hazardous substance, or pollutant or contaminant

Findings of the removal assessment field work indicate that there are elevated levels of CERCLA-designated hazardous substances as defined in Section 101(14) of CERCLA, 42 U.S.C. §

9601(14), in several locations near historic potteries at the Site, which are facilities as defined under Section 101(9) of CERCLA. Lead levels above the EPA RML for residential soil were found to be present at all properties sampled, except for properties that were sampled to establish background levels and one vacant lot towards the southwest of the current Site boundaries. As discussed below, the elevated lead levels can be attributed to both airborne releases that occurred from the kilns during the firing process and from leaching over time from the ceramic sherds found to be present within the residential site soils.

Airborne releases of lead that would have impacted the residential sampling area would be anticipated from the pottery industry based upon research and air modeling that was conducted. Lead emissions from ceramics manufacturing is currently regulated under the National Emission Standards for Hazardous Air Pollutants (“NESHAP”). There were likely minimal, if any, controls for air emissions when these potteries were operating. EPA’s AP-42: Compilation of Air Emissions Factors show that releases of lead are likely to occur if no controls are in place^a. Studies have shown that significant releases of lead particles occur from uncontrolled kiln operations, including particles as small as 10 nanometers^b. Other studies have shown elevated blood lead levels in those living nearby ceramics facilities^c and lead-contaminated soil nearby ceramic facilities with levels decreasing as distance from the facility increases^d. A study on metals contamination in soils in a historically heavily industrialized city in the United Kingdom attributed high lead levels in soils to the pottery industry^e. Air modeling of the two larger potteries within the Top Road neighborhood was conducted using historic information to estimate maximum kiln heights and diameters to establish where potential airborne releases of lead would have had the highest impact. The model showed that the East Trenton residential area sampled during the initial L.H. Mitchell assessment had a high likelihood of being impacted by airborne releases from these facilities (Attachment 1, Figures 3 and 4).

Both the vertical and horizontal distribution of lead in soil follow a depositional pattern that would be expected from an airborne release from the potteries that operated nearby and upwind. The vertical distribution of lead follows a pattern of airborne deposition, in which contaminant concentrations are generally highest at the surface and decrease with depth. This indicates that most properties may be impacted from airborne deposition and not from historic fill, or that an airborne release occurred after fill was installed, which would align with the

^a U.S. Environmental Protection Agency Office of Air Quality Planning and Standards (June 1996). *Section 11.7: Ceramic Products Manufacturing: Compilation of Air Pollutant Emission Factors*.

^b Voliotis, Aristeidis, et al. “Nanoparticle Emission from Traditional Pottery Manufacturing.” *Environmental Science: Processes & Impacts* 16 (2014): 1489-1494. DOI: 10.1039/c3em00709j

^c Bah, Homegnon A. F., et al. “Environmental Exposure to Lead and Hematological Parameters in Afro-Brazilian Children Living Near Artisanal Glazed Pottery Workshops.” *Journal of Environmental Science and Health* 55:8 (2020): 964-974. DOI: 10.1080/10934529.2020.1761738

^d Counter, S. Allen, et al. “Environmental Lead Contamination and Pediatric Lead Intoxication in an Andean Ecuadorian Village.” *International Journal of Occupational and Environmental Health* 6:3 (2000): 169-176. DOI: 10.1179/oeh.2000.6.3.169

^e Wragg, Joanna and Cave, Mark. “Modelling and Mapping Total and Bioaccessible Arsenic and Lead in Stoke-on-Trent and Their Relationships with Industry.” *Geosciences* 11:515 (2021). DOI: 10.3390/geosciences11120515

development of the East Trenton neighborhood during the early growth of the local pottery and rubber industries. Although a horizontal boundary to the lead contamination has not yet been established, the samples collected to date follow a pattern that would be expected from contamination from the numerous potteries that operated in the area. Samples that were collected upwind of the pottery operations and from background locations expected to be unaffected by pottery influence generally had lower levels of lead.

Elevated lead concentrations were found on all of the potteries that were sampled. At the three large potteries, HP001-P051, HP001-P056, and HP001-P057, the highest lead concentrations were 17,000, 4,050, and 8,640 mg/kg, respectively. It is important to note the HP001-P051 and HP001-P057 have both undergone soil remediation. Sample locations were chosen to avoid areas of known remediation, but the highest lead concentrations may have been previously removed. Additionally, some of the elevated lead concentrations found at HP001-P051 were likely influenced by the adjacent smelter (HP001-P050). On the former railroad that ran adjacent to HP001-P056 and HP001-P057, the highest lead concentration was 2,880 mg/kg. More than ten large-scale potteries operated within East Trenton and Top Road, and sampling efforts included less than one-third of the large potteries that may have contributed to the airborne deposition of lead.

The isotopic analysis performed on the pottery sherds showed that the lead used in the glazes likely originated from mines in the western United States. There were two clusters that were formed from the isotopic ratios, which included the following ratios:

Table 3: Ranges of Isotopic Lead Ratios per Cluster – Pottery Sherds

	Pb^{206}/Pb^{207}	Pb^{206}/Pb^{204}
Cluster 1	1.10 to 1.16	17.0 to 18.0
Cluster 2	1.17 to 1.25	18.1 to 19.7

Pottery sherds from Cluster 1 share lead isotopic signatures with North American ore bodies from Montana, Utah, and Colorado. Cluster 2 pottery sherds are distinctive of ores from southwest Colorado mines. This coincides with information found in historic trade publications that stated that the lead used in glazes originated from mines in the western United States, including Colorado and Utah^f.

The isotopic analysis performed on the impacted residential soils shows significant overlap with Cluster 2 of the pottery sherds, although they also overlap with other potential sources. For the residential soils within the top foot of soil, the isotopic lead ratios of Pb^{206}/Pb^{207} and Pb^{206}/Pb^{204} ranged from 1.17 to 1.22 and 18.2 to 19.1, respectively. Soils with lead levels above 2,000 mg/kg, not including those collected from the former smelter, also shared similar isotopic ratios with Cluster 2 pottery sherds (SW Colorado signature) and the residential properties, indicating that the lead contamination from both may have been from the same source or sources, or that

^f Mayer, Ernest. "Notes on the Grinding of Materials Used in Earthenware Bodies." *Glass and Pottery World* (May 1903): 23-24.

the properties with the higher lead concentrations are the source. Many of the locations with lead levels above 2,000 mg/kg were the former pottery properties. However, it is important to note that additional sources of lead could not be ruled out with the data obtained from the isotopic lead analysis including paint, gasoline, coal, and slag.

The isotopic lead ratios for the pottery sherds and their respective surrounding soils were often very similar. The best example of this is from property HP001-P004. Four pottery sherds that were located at the 2-6" and 6-12" intervals were analyzed for isotopic lead, generating lead ratios of Pb^{206}/Pb^{204} ranging from 18.282 to 18.506 and Pb^{207}/Pb^{204} from 15.519 to 15.619. The soil samples from the same intervals and quadrants for that property had lead isotope ratios of 18.233 and 18.548 for Pb^{206}/Pb^{204} and 15.557 and 15.649 for Pb^{207}/Pb^{204} . The lead isotope ratios of the pottery sherds are within the narrow range of the two soil samples which provides evidence of a relationship between the lead in the pottery sherds and soils, and therefore, possible evidence of a release. Additionally, of seven separate property soil profiles ORD examined for relationships between lead isotope ratios in soil and in co-located ceramic chips, all profiles exhibited the highest soil lead concentrations within in the depth intervals containing the ceramic chips, generally within the upper 12 inches of the soil column. While other sources of lead contribute to lead concentrations and the seven soil profiles represent only a small portion of the sampled locations, this nonetheless suggests a possible correlation between pottery sherds and elevated lead levels.

The SEM/BSE/EDS analysis performed during the L.H. Mitchell assessment provides evidence that a release from an industrial facility has occurred. Historically relevant particles such as lead, zinc, and copper associated with slag-like material were detected in all of the samples analyzed by SEM/BSE/EDS, and trace loadings of lead-based paint were only detected in two of the samples. This provides evidence that the majority of the elevated lead levels detected in the soil were from an industrial source rather than lead-based paint or leaded gasoline. The specific industrial source, however, was unable to be determined from this analysis.

The SEM/BSE/EDS analysis performed during the attribution study did not find widespread evidence of smaller pottery sherds being present in the soil samples. Evidence of pottery sherds was found in one of the three soil samples. This analysis was limited; the laboratory was only comparing a small sample number of pottery sherds to the soil samples so it is not necessarily representative of all of the pottery sherds that would be found throughout the study area. Additionally, the lack of smaller pottery sherds identified during this analysis does not rule out any airborne deposition of lead or leaching of lead from the pottery sherds.

When using the similarity index of 0.7, Pirouette® analysis of isotopic lead ratios typically grouped residential properties into two different clusters, Clusters 4 and 5. Both of these clusters also contained many samples found on former potteries, which shows that the soils found on the residential properties are related to some of the soils found on the former potteries. This provides a line of evidence that the numerous potteries that operated in East Trenton contributed to the elevated lead levels found on the residential properties. Samples from other former commercial/industrial properties often were placed in these clusters as well,

which could either indicate that these other properties were a contributing source or, more likely, due to their locations in relationship to the potteries and/or the presence of pottery sherds that these properties were impacted from airborne deposition and/or fill from the potteries.

Additionally, Pirouette® found a relationship between numerous metals found within the attribution study soil samples, and the groupings were created based upon these relationships. Lead, zinc, barium, and copper were the metals that had the strongest influence on creating the clusters. Lead and zinc, and to a lesser extent copper and barium, would all have been used in glazes. Similar to lead, these metals were used in other industries as well; however, when looked at as a whole, ceramics is an industry where all could have commonly been used in the glazes depending on the types of ceramics being produced.

The metals that had the highest leachate concentrations from the SPLP analysis were also the same metals that were found to be the most closely correlated using the Pirouette® software. The metals found to be the most leachable were lead, barium, zinc, vanadium, and copper. The four of these metals besides vanadium were found to have the closest relationship in the soils using Pirouette®. This shows a strong relationship between the soil samples and pottery sherds and is strong evidence that the pottery industry is a large contributor to the lead contamination found within the residential soils.

The pottery sherds that were found at all properties at varying quantities have likely leached over time, especially during periods of acidic rain. During a study conducted in the 1984 by the Association of New Jersey Environmental Commissions, the pH of rainwater in New Jersey was found to have a mean below 4.2 and was measured as low as 3.61, which would represent conditions in which lead and other metals could leach from the ceramic glaze from the pottery sherds found in the soils[§]. Of all of the metals tested for during the SPLP analysis, lead had the highest leachate concentrations, indicating it was readily leachable under acidic conditions. The initial pH established for the SPLP test is 4.20 ± 0.05 (i.e., near the mean pH value during periods of acidic rain). The pH of the SPLP solution typically increases through the 18-hour leach test as acidity is consumed in dissolution reactions. Thus, the SPLP test is considered to be a representative test for metals leaching from solutions typical of acidic rain. Although in conditions of rainfall with a near-neutral pH, metals would not be expected to readily leach from ceramic sherds, during periods of time where the rainfall was extremely acidic, conditions would have been favorable to the lead leaching from the sherds.

Analysis of the majority of the data collected during the attribution study, forming multiple lines of evidence through the various methods discussed above, provides a compelling indication that the pottery industry was a significant contributor to the elevated lead levels found in residential soils within East Trenton. As a whole, and in combination with the lack of sufficient evidence of other point or non-point sources of lead, the attribution study indicates

[§] Cooper, Gregory. "Precipitation Acidity in New Jersey: Levels and Patterns." *Association of New Jersey Environmental Commissions*, May 1985.

the pottery industry appears to be the largest contributor to the lead contamination. The data indicate the elevated lead levels are a direct result of airborne releases during firing of ceramics in kilns located upwind and/or leaching of lead from pottery sherds located in the soils which originated from pottery sherd-containing fill within the residential neighborhood. Although other sources have likely also contributed over time, including lead paint, leaded gasoline, coal combustion, and other localized industry (smelters, foundries, rubber facilities), the potteries appear to be the largest contributor to the elevated lead levels.

Threats to Public Health or Welfare

There is a potential exposure to nearby populations from hazardous substances, pollutants or contaminants that have been detected in the soil samples collected in the vicinity of the Site. Exposed soil was observed with varying levels of grass coverage at every sampled property. Occupants of the residential buildings may be currently exposed to soil containing a CERCLA-designated hazardous substance at levels above the respective EPA RMLs.

Direct contact with the elevated levels of lead within the upper six inches of soil may occur through common residential activities. Contaminated soil could adhere to pets' paws when accessing the backyards and could readily be tracked inside the home. Children playing in the yard could be exposed to high levels of lead which could be ingested, adhere to their hands or shoes, and be tracked inside the home. Other common activities such as gardening or yard maintenance could result in lead exposure.

Contact with the contaminated soil, or inhalation of contaminated soil particles, may present a health risk to those utilizing the backyards, particularly young children, and women of child-bearing age. The relationship between soil-lead concentrations and the consequent impact on blood levels in children has been studied through numerous epidemiological studies. Based on epidemiological studies, it is generally believed that persistent exposure to soil-borne lead results in an increase in blood lead levels in children. The effects of exposure to lead are the same whether it enters the body through breathing or swallowing. The main target for lead toxicity is the nervous system, both in adults and children. Lead is a cumulative poison where increasing amounts can build up in the body, eventually reaching a point where symptoms and disability occur. Particularly sensitive populations are women of child-bearing age, because of the fetal transfer of lead, and children. Cognitive deficits are associated with fetal and childhood exposure to lead. An increase in blood pressure is the most sensitive, adverse health effect from lead exposure in adults. The Department of Health and Human Services has determined that lead and lead compounds are reasonably anticipated to be human carcinogens based on limited evidence from studies in humans and sufficient evidence from animal studies, and the EPA has determined that lead is a probable human carcinogen.

All residents and owners of sampled properties were provided with their property-specific results and a list of recommended measures to reduce exposures to elevated levels of lead. Additionally, EPA has notified both local and state partners of the potential threat to human health present in the neighborhood surrounding the facility. Specifically, EPA has collaborated

with the NJDEP, the City of Trenton's Division of Health Promotion and Housing & Economic Development Department, and two local non-profit organizations, the East Trenton Collaborative ("ETC") and Isles, Inc., to promote education of the public regarding lead exposure and explore different avenues for potential remediation. On November 14, 2019, EPA co-hosted a public meeting with the NJDEP, the City of Trenton's Division of Health Promotion and Housing & Economic Development Department, and the ETC for residents who have or may have elevated lead levels in their soil, to answer questions and provide further education on steps that can be taken to reduce exposure to lead in soil. Several of these organizations remain available to further advise residents on measures they can take to reduce lead exposures at their properties. Additional virtual meetings to provide education on Site conditions and lead safety have been hosted by ETC and attended by residents since 2019. On September 6, 2022, EPA conducted a virtual meeting with the NJDEP, City of Trenton, Rutgers University, and many non-profits including ETC, New Jersey Future, Isles, and Green and Healthy Homes Initiative, in which the attribution study was discussed.

Although the cobalt level in one sample at a depth interval of 6 to 12 inches bgs was 150 mg/kg which exceeded the EPA RML for residential soil of 70 mg/kg, this appears to be an isolated incidence of cobalt from an unidentifiable source, which may have been a pottery. All other cobalt levels at all depths were below at the EPA RML for residential soil. Based on this information and its presence at a depth beneath the surface where exposure is less likely, the presence of elevated levels of cobalt in the subsurface of property LM003 at the Site does not represent a significant threat to public health or welfare.

In addition, the arsenic level in one sample was 84 mg/kg which is above the EPA RML for residential soil of 68 mg/kg. This elevated arsenic level is at the 0 to 2 inch depth in the backyard of an occupied residential property and represents an exposure threat to those that come in contact with it. Although all other arsenic levels at all depths were below the EPA RML for residential soil, 69 of the soil samples were equal to or exceeded the NJDEP Residential Direct Contact Soil Remediation Standard of 19 mg/kg.

Although the iron level in one sample at a depth interval of 6 to 18 inches bgs was 234,000 mg/kg which exceeded the EPA RML for residential soil of 160,000 mg/kg, all other iron levels at all depths were below at the EPA RML for residential soil. The property is currently a city-owned park and was formerly the Woodhouse Chain Works facility. The city placed a foot of clean fill on this property prior to the construction of the park so the elevated iron result is likely below 12 inches. Based on this information and its presence at a depth beneath the surface where exposure is less likely, the presence of elevated levels of cobalt in the subsurface of property HP006-P004 does not represent a significant threat to public health or welfare.

Threats to the Environment

At this time there is no information to indicate that the Site is currently having an acute impact to the surrounding environment and areas of exposed soil near the Site.

Conclusions

The Historic Potteries Site includes groupings of numerous potteries which are facilities as defined under Section 101(9) of CERCLA, 42 U.S.C. § 9601(9). Based on the available information, a release of CERCLA hazardous substances, as defined in Section 101(22) of CERCLA, 42 U.S.C. Section § 9601(22), has occurred at the Site in the areas near the historic potteries. Lead exists in surface and subsurface soils in these areas at levels which exceed the respective EPA RMLs. Lead is frequently found in these areas above 1,200 mg/kg in the upper foot of soil. There is a current exposure pathway existing that may present an imminent and substantial endangerment to the public health and welfare. A CERCLA removal action is warranted to mitigate the threat to public health or welfare posed by the presence of these contaminants at the Site where the lead can be attributed to the nearby potteries. It is recommended that a CERCLA removal action be undertaken to address the uncontrolled release of these hazardous substances at properties that represent the highest threat to public health while the Site is considered for inclusion on the NPL.

ATTACHMENTS

1. Figures 1: Trenton Boundary, Pottery Locations, and Sampled Properties Outside HP001; 2: HP001 and HP002 Sampled Properties; 3 & 4: Stack/Air Modeling Worst Case Scenarios
2. Removal Site Evaluation for L.H. Mitchell Co.
3. EPA ORD Technical Memorandum for the Historic Potteries Site

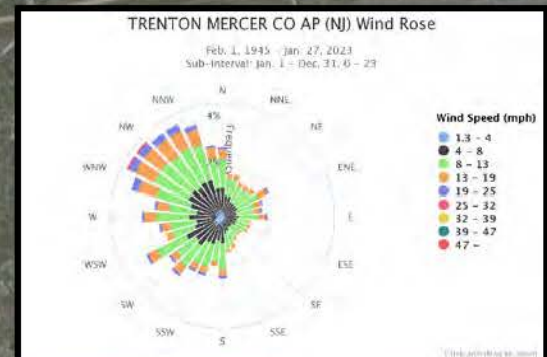
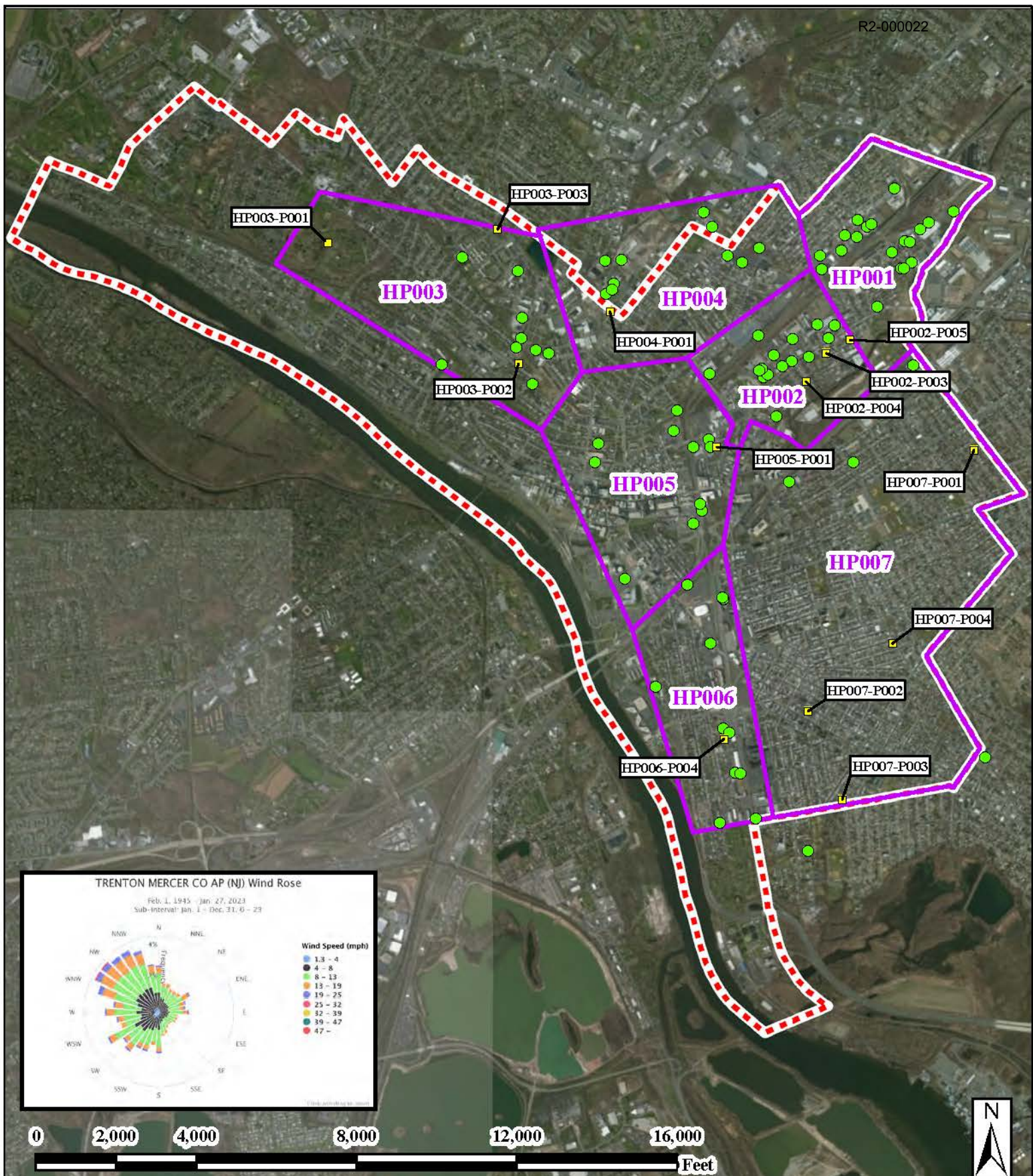
cc: M. Gregor, SEMD-RAB
D. Gaughan, SEMD-RAB
J. Desir, SEMD-SPB
B. Grealish, SEMD-RAB
EPA Region II Removal Records Center

ATTACHMENT A

Figure 1: Trenton Boundary, Pottery Locations, and Sampled Properties Outside HP001

Figure 2: HP001 and HP002 Sampled Properties

Figures 3 & 4: Stack/Air Modeling Worst Case Scenarios



Legend

- Property Sampled for Attribution Study
- Historic Potteries
- Historic Pottery Areas
- Trenton Boundary



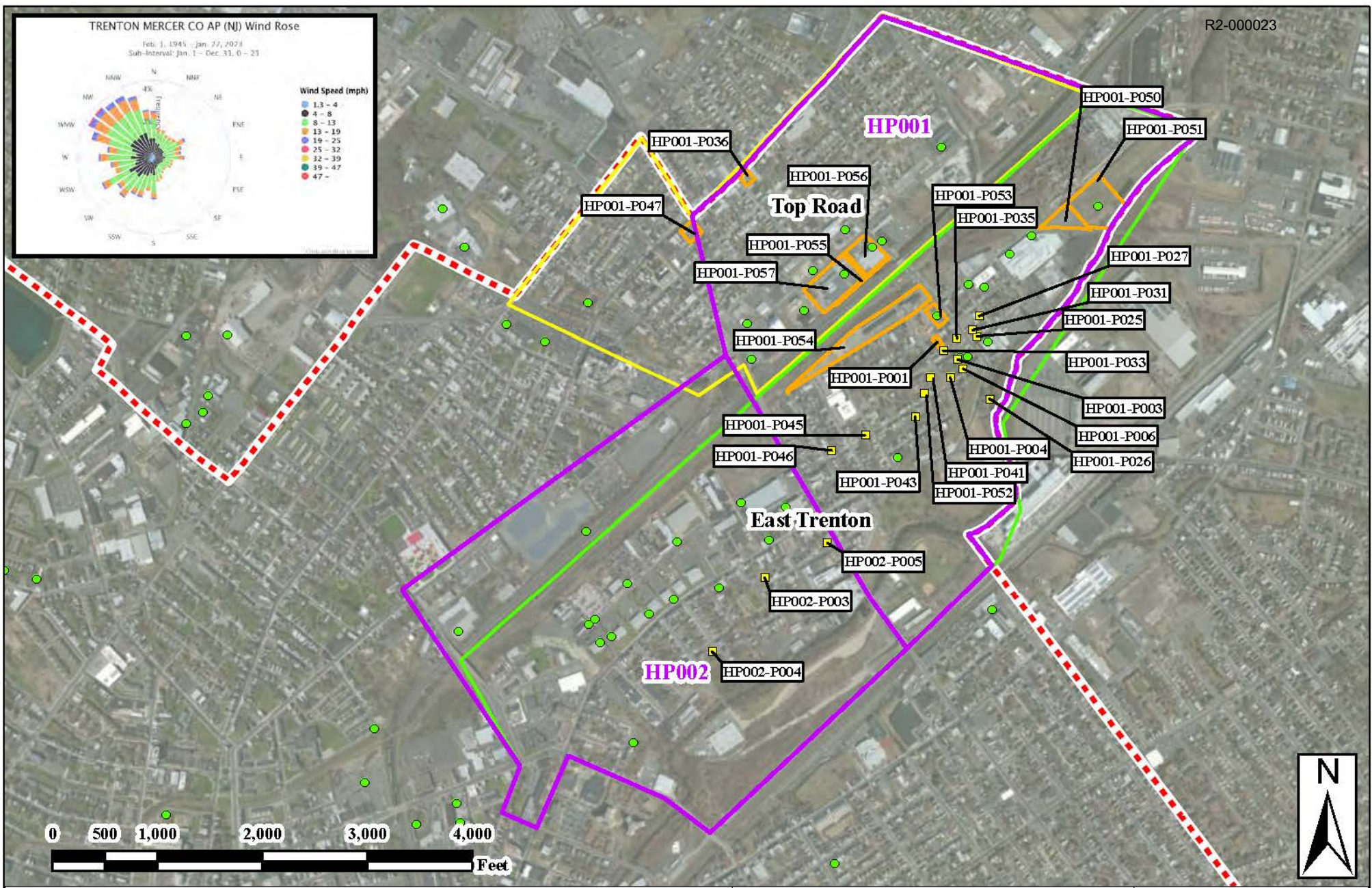
Weston Solutions, Inc.
 Federal East Division

In Association With
 Eco-Risk; Avatar Environmental, LLC;
 Pro-West & Associates, Inc.; On-Site Environmental, Inc.;
 Sovereign Consulting, Inc.; and TechLaw Consultants, Inc.

Figure 1: Trenton Boundary, Pottery Locations, and Sampled Properties Outside HP001

Historic Potteries Site Trenton, New Jersey	
U.S. ENVIRONMENTAL PROTECTION AGENCY SUPERFUND TECHNICAL ASSESSMENT & RESPONSE TEAM V CONTRACT #68HED3 BD0004	
GIS ANALYST:	K. HEULITT
EPA OSC:	J. PETTY
START V SPM:	M. LANG
CHARGE #:	40200.051930.5045

DATE MODIFIED: 11/22/2023



Legend

- East Trenton Sampled Residential Property
- East Trenton Sampled Industrial Property
- Historic Potteries
- Historic Pottery Areas
- Top Road
- East Trenton
- Trenton Boundary

WESTON SOLUTIONS **Weston Solutions, Inc.**
Federal East Division

In Association With
 Eco-Risk; Avatar Environmental, LLC;
 Pro-West & Associates, Inc.; On-Site Environmental, Inc.;
 Sovereign Consulting, Inc.; and TechLaw Consultants, Inc.

Figure 2: HP001 and HP002 Sampled Properties	
Historic Potteries Site Trenton, New Jersey	
U.S. ENVIRONMENTAL PROTECTION AGENCY SUPERFUND TECHNICAL ASSESSMENT & RESPONSE TEAM V CONTRACT #68H0319D0004	
GE ANALYST:	K. HEULITT
EPA OSC:	J. PETTY
START YSPM:	M. LANG
CHARGE #:	402000519305045



<p>Legend</p> <p> Footprint of Former Facility</p> <p>Lead (Percent of Maximum Concentration)</p> <ul style="list-style-type: none">  0-20%  20-40%  40-60%  60-80%  80-100% 	<p>WESTON SOLUTIONS Weston Solutions, Inc. Federal East Division</p> <p>In Association With Eco-Risk; Avatar Environmental, LLC; Pro-West & Associates, Inc.; On-Site Environmental, Inc.; Sovereign Consulting, Inc.; and TechLaw Consulting, Inc.</p>	<p>Stack/Air Modeling Worst Case Scenario Moore Pottery / East Trenton Pottery / Imperial Porcelain Works</p> <p>Historic Potteries Site Trenton, New Jersey</p> <p>U.S. ENVIRONMENTAL PROTECTION AGENCY SUPERFUND TECHNICAL ASSESSMENT & RESPONSE TEAM V CONTRACT # 458WB919D0004</p> <p>DATE MODIFIED: 11/22/2021</p> <p>GES ANALYST: K. HEULITT EPA OSC: J. PETTY START VSPM: M. LANG CHARGE#: 40200.031043 3025</p>
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R2-000025



<p>Legend</p> <p> Footprint of Former Facility</p> <p>Lead (Percent of Maximum Concentration)</p> <ul style="list-style-type: none">● 0-20%● 20-40%● 40-60%● 60-80%● 80-100%	<p>WESTON SOLUTIONS Weston Solutions, Inc. Federal East Division</p> <p>In Association With Eco-Risk; Avatar Environmental, LLC; Pro-West & Associates, Inc.; On-Site Environmental, Inc.; Sovereign Consulting, Inc.; and TechLaw Consulting, Inc.</p>	<p>Stack/Air Modeling Worst Case Scenario East Trenton Pottery Company/Anchor Pottery/Stangl Pottery</p> <p>Historic Potteries Site Trenton, New Jersey</p> <p>U.S. ENVIRONMENTAL PROTECTION AGENCY SUPERFUND TECHNICAL ASSESSMENT & RESPONSE TEAM V CONTRACT # 465WB0319D0004</p> <p>DATE MODIFIED: 11/22/2021</p> <table border="1"><tr><td>GE ANALYST:</td><td>K. HEULITT</td></tr><tr><td>EPA OSC:</td><td>J. PETTY</td></tr><tr><td>START VSPM:</td><td>M. LANG</td></tr><tr><td>CHARGE#:</td><td>40200.031043.3025</td></tr></table>	GE ANALYST:	K. HEULITT	EPA OSC:	J. PETTY	START VSPM:	M. LANG	CHARGE#:	40200.031043.3025
GE ANALYST:	K. HEULITT									
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CHARGE#:	40200.031043.3025									

ATTACHMENT B

Removal Site Evaluation for L.H. Mitchell Co.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
2890 WOODBRIDGE AVENUE
EDISON, NEW JERSEY 08837-3679

DATE: April 6, 2022

SUBJECT: Removal Site Evaluation for L.H. Mitchell Co., 216 Klagg Avenue, Trenton, Mercer County, New Jersey 08638 (CERCLIS ID: NJN000206554)

FROM: Joel Petty, On-Scene Coordinator
Removal Action Branch

TO: Joseph D. Rotola, Chief
Removal Action Branch

Introduction

The United States Environmental Protection Agency ("EPA") Region II Removal Action Branch ("RAB") has been requested to conduct a Removal Site Evaluation ("RSE") at the L.H. Mitchell Co. Site ("Site") by the New Jersey Department of Environmental Protection ("NJDEP"). The Site was included on a list of hundreds of locations nationwide where secondary lead smelting or alloying may have been conducted between 1931 and 1964, according to entries in historical trade publications. The list was originally compiled by William P. Eckel in a doctoral dissertation for George Mason University, and the research was summarized in the article "Discovering Unrecognized Lead-Smelting Sites by Historical Methods" (Eckel et al, 2001). The NJDEP assessed many of the sites and ultimately referred a number of these sites to EPA for further assessment.

On May 11, 2012, the Site received a No Further Remedial Action Planned ("NFRAP") from the EPA Pre-Remedial Section meaning that the Site does not qualify for the National Priorities List ("NPL") based on existing information available for the Site. RAB began an investigation of the Site in March 2018 to determine if the Site qualifies for a Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA") removal action.

Site Description and Background

The Site includes an historic solder manufacturing facility formerly operated by L.H. Mitchell Co. ("L.H. Mitchell") located at 216 Klagg Avenue in Trenton, Mercer County, New Jersey. The on-site building is 24 by 45 feet in size and was erected in 1951. The size of the lot is approximately 1/10th of an acre, measuring 50 by 101 feet. Current tax maps indicate that the property is located on Block 22801, Lots 16 and 17. The former tax map identifies the property as 216-218 Klagg Ave, Block 207, Lots 1100 and 1102. The property is currently being utilized as an autobody repair shop named Alarcon Auto Repair.

According to historic resources, including city directories and Sanborn Fire Insurance Maps ("Sanborns"), L.H. Mitchell manufactured solder on-site from the early 1950s until at least the

late 1970s, possibly through the 1980s. The building first appears in the 1955 Sanborn map and is identified as “MFG of Solders.” Prior to that, it appears that the property was undeveloped. Available city directories list “Mitchell L H & Co solder” at 216 Klagg Ave. in Trenton dating back to 1952. L.H. Mitchell is listed in the city directory through 1977 but is no longer listed in the 1982 city directory. However, Sanborn maps through 1991 continue to identify the building as “MFG of Solders.” Therefore, there is conflicting evidence as to when operations ceased. The property was later occupied by boat and automobile shops. The 1987 city directory lists David’s Performance Boats; 1992 lists Challenger Performance Boats; 2000 and 2005 list Carlos Towing. The building present on the property appears to be the original from 1951.

An historic photograph of the building accompanying the tax map indicates there was a block chimney likely used for heating and a visible stack on the roof line likely for solder manufacturing operations. The Occupational Safety and Health Administration identifies solder manufacturing as an activity under Industry Group 334: Secondary Smelting and Refining of Nonferrous Metals. The process involves the melting of varying concentrations of metals to create a filler product with a lower melting point than its anticipated adjoining metal. Historically, nearly all solders contained lead. The most common type of solder contains a mixture of lead and tin. Other common metals used in solder include silver, zinc, cadmium, aluminum, and bismuth.

The Site is located in a mixed residential, commercial, and light industrial urban area. Residential properties are adjacent to the northeast along Klagg Avenue and to the southeast along Breunig Avenue. A marble and granite supplier is adjacent to the southwest and across Klagg Avenue to the northwest is a commercial contractor. There are over 100 residential properties which currently include bare soil and/or vegetated areas within 600 feet of the on-site former solder facility. The majority of the residences are single- or multi-family rowhomes with back yards, located to the west, southwest, south, southeast, east, and northeast of the facility. In addition, there are many abandoned houses and vacant lots. Most of the residential buildings were constructed prior to the 1950s so were present during the time that the manufacturing of solder occurred on-site. The Assunpink Creek is located 800 feet to the southeast of the Site. Hamilton Township begins on the other side of the creek. Available wind rose charts indicate that prevailing winds were from the north-northwest, northwest, west-northwest, west-southwest, and southwest.

EPA also obtained evidence that L.H. Mitchell operated at a different location prior to 1955. In 1950, L.H. Mitchell appears in the city directory at the address 236 John Fitch Way, Trenton, NJ, and as a “manufacturer of bar and wire acid and rosin core solder, automobile body tin, babbitt and lead.” This address is no longer a valid address. Two potential locations were identified which could have been historically addressed as 236 John Fitch Way. Part of New Jersey State Highway 29 (“Hwy 29”) is also known as John Fitch Way and spans of it were historically industrial areas. The historic road was redeveloped and expanded upon over time and any labeled properties along it were incorporated into the current highway; none appeared to house this historic L.H. Mitchell facility. Currently, there is another street called John Fitch Way that is only 350 feet long and there are no labeled facilities along it. Sanborn maps for this location as well as the current portion of part of Hwy 29 known as John Fitch Way do not indicate any buildings that were engaged in solder or smelter operations during this timeframe.

Site assessment activities/observations

The Pre-Remedial site files, which included a Pre-Comprehensive Environmental Response, Compensation and Liability Information System Screening Form for the Site as well as historic Sanborn maps, historic aerial photographs and city directories were reviewed as part of this RSE. Internet searches were conducted for historic articles, photographs, ads and other references, but were unsuccessful. It appears that L.H. Mitchell was a small company, without much documentation in the East Trenton community.

On October 3, 2018, RAB conducted a Site reconnaissance. The property is currently occupied by an autobody shop and was identified by signage stating “Alarcon Auto Repair” during the Site visit. The property was completely paved over. The block chimney and stack shown on the roof of the building in the historic tax map photo did not appear to be present. Several vehicles were parked on the property. Surrounding buildings are commercial/industrial and residential in all directions. Most of the residential properties surrounding the Site have exposed soil in their backyards with varying levels of grass coverage. Abandoned buildings and vacant lots are common in this area. A review of tax records shows that the City of Trenton owns many of the vacant lots.

EPA conducted assessment sampling activities at the Site between October 2018 and April 2019 to determine whether operations at the former solder manufacturing facility resulted in a release of CERCLA-designated hazardous substances to the surrounding areas at concentrations above EPA screening levels. Soil was sampled from approximately 40 properties in the vicinity of the Site, including some city-owned abandoned lots. These include properties along Klagg Avenue, Breunig Avenue, St. Joes Avenue, East Trenton Avenue, and Mulberry Street. All properties were either currently occupied or vacant residential lots except for a church that was sampled as a background location and Mulberry Street Park (also known as Red Oak Park). The unpaved portion of the majority of the properties was limited to the backyard. At this time, paved areas were not sampled, including the parcel with the on-site historic solder facility. Approximate upwind and downwind soil sampling locations were chosen using averaged annual wind rose charts from the Trenton-Mercer Airport averaged from 1950-1995, overlapping the time period in which L.H. Mitchell was operating (the early 1950s to at least the late 1970s). A church located an estimated 1,600 feet northwest of the facility in the upwind direction was sampled to help establish background levels of lead and other metals in the area. All sampled properties except the background location are located in the predominant downwind directions from the on-site facility. In addition, Mulberry Street Park, located more than 600 feet away from L.H. Mitchell in a downwind southwesterly direction, was also sampled. Suspected fill was encountered at Mulberry Street Park and the church background location. Mulberry Street Park is located within an NJDEP-identified known historic fill area. A total of 34 property identifiers (IDs) were established. Most of these property IDs consist of one lot, although several consist of multiple adjacent lots owned by the same individual or the city. The Site and Sampling Locations Map is included as Figure 1.

EPA collected a total of 408 composite soil samples, including field duplicates, from 69 sampling locations throughout the sampling area. Quadrants were established at each property based upon both location of the unpaved areas and size of the property. Most of the properties

consisted of one or two quadrants with a maximum of four quadrants, except at the park which consisted of seven quadrants. Soil samples along the dripline of the house were collected when at least two distinct sampling locations could be identified. At all locations, EPA collected samples at the following five intervals in the upper two feet of soil within each boring: 0 to 2 inches, 2 to 6-inches, 6- to 12-inches, 12- to 18-inches and 18- to 24-inches below the ground surface (“bgs”). Two- to five-point composite samples were collected at each location, with five-point composite samples as the default and majority of the samples. Less than five-point composite samples were collected when availability of sampling locations was limited. All samples were sieved to remove particles greater than 150 micrometers and analyzed for Target Analyte List (“TAL”) metals plus tin and titanium but not including calcium, iron, magnesium, potassium, and sodium. Ten percent of the samples were also analyzed unsieved for comparison purposes.

An x-ray fluorescence (“XRF”) analyzer was used to screen for lead-based paint at nine of the sampled residential properties. Exterior paint at seven of the properties tested positive for lead-based paint (lead result greater than or equal to 1.0 milligrams per square centimeter [mg/cm^2]). Positive results ranged from 1.21 mg/cm^2 to 10.15 mg/cm^2 .

The analytical results indicate that lead is present at levels above the applicable EPA Removal Management Level (“RML”) using a hazard quotient of 3 (“HQ3”) for residential soil of 400 milligrams per kilogram (“ mg/kg ”) at varying depths in multiple locations. RMLs are generic, chemical-specific concentrations for individual contaminants that may be used to support the decision for EPA to undertake a removal action. Although they are not necessarily health-protective concentrations in terms of chronic exposure, an exceedance of an RML does not imply that adverse health effects will occur. All sampling results were compared to the respective EPA RMLs using an HQ3 for residential soil.

Results indicate lead levels exceed its EPA RML in 291 of 408 samples, at all downwind properties and across varying depth intervals, ranging from 400 to 7,500 mg/kg . Lead levels did not exceed its EPA RML at any of the background location samples. Lead levels exceed 1,200 mg/kg within the upper two feet of soil at 26 of the 33 sampled property IDs. Soil at one residential property (LM003) also contains cobalt at one location with a concentration of 150 mg/kg , exceeding its EPA RML for residential soil of 70 mg/kg . Soil at one residential property (LM020) also contains arsenic at one location with a concentration of 84 mg/kg , exceeding its EPA RML for residential soil of 68 mg/kg . No other metals were present at any properties above the EPA RMLs for residential soil.

Seven unsieved samples from 0 to 12 inches bgs were sent for further analysis by Scanning Electron Microscopy with Backscatter Electron Imaging and Energy Dispersive X-ray Spectroscopy (“SEM/BSE/EDS”). Samples were selected for analysis based on the TAL metals results and their location with respect to L.H. Mitchell. The objective of the analysis was to document the presence of any fly ash, paint, solder, brass, or any other particles bearing historically relevant industrial metals, including copper, zinc, tin, and lead. The results of the SEM/BSE/EDS analysis were used to help determine if the elevated lead levels could be attributed to the historic on-site solder manufacturing operations. Although evidence of slag particles was found in all of the samples, only one single particle in the fine soils was found that was consistent with solder. Historically relevant metals (copper, zinc, and lead) were readily

detected in the samples but their specific source was found to be ambiguous. Trace loadings of lead paint were detected in two of the samples.

In 2019, following additional review of historic resources which revealed the historic presence of several nearby pottery manufacturers, EPA conducted additional soil sampling at properties located upwind to the northwest and southwest of the L.H. Mitchell facility to determine if lead contamination is present outside of the original sampling area and could be attributed to an historic release in the area from these potteries. In July 2019, EPA collected 35 composite soil samples, including field duplicates, from city-owned properties to the northwest of the facility, in an upwind direction, which included four right-of-ways and one vacant property. Results indicate lead levels exceed its EPA RML in nine samples from two of the five properties, ranging from 400 to 1,000 mg/kg. In September 2019, EPA collected 42 composite soil samples, including field duplicates, from city-owned properties to the southwest of the facility which included vacant residential properties, two parks (one active and one vacant), and a former library. Results indicate lead levels exceed its EPA RML in 28 samples from six of the seven properties, ranging from 420 to 2,300 mg/kg. Pottery sherds were identified at five of these sampled locations and were screened for lead with an XRF and analyzed for metals at a laboratory. Lead was detected as high as 2,610 mg/kg in these pottery sherds.

On January 9, 2020, following discussions of the L.H. Mitchell analytical results with NJDEP, EPA received a referral from NJDEP to perform an Integrated Assessment between RAB and the Pre-Remedial Section, focused on potential soil contamination in additional areas of Trenton which could be related to the historically prevalent pottery industry in the area. Discussions had stemmed from the discovery of numerous, large historical potteries upwind of the sampling area, research into potential airborne emissions of lead from the firing of lead glaze in kilns and the discovery of pottery sherds found within the soil during EPA's sampling events. In response to the referral, EPA began an extensive attribution study of the elevated lead levels found during the L.H. Mitchell RSE and the potteries that operated nearby, which included an isotopic analysis of lead at many of the previously sampled properties as well as additional residential, commercial, and industrial properties. The RSE for the Historic Potteries Site is ongoing and a separate report will be prepared with the findings.

As part of the attribution study, in April 2021, EPA collected 15 discrete soil samples, including a field duplicate, from three locations to a depth of four feet at the former L.H. Mitchell property. The samples were analyzed for TAL metals and lead isotopes. Results indicate lead levels exceed its EPA RML of 800 mg/kg for commercial/industrial properties in three samples from one of the three locations, ranging from 831 to 1,690 mg/kg. No other metals were present at this property above the EPA RMLs for commercial/industrial soil.

Release or threatened release into the environment of a hazardous substance, or pollutant or contaminant

Findings of the removal assessment field work indicate that there are elevated levels of CERCLA-designated hazardous substances as defined in Section 101(14) of CERCLA, 42 U.S.C. § 9601(14), in several locations near the Site, which is a facility as defined under Section 101(9) of CERCLA. Lead levels above the EPA RML for residential soil were found to be

present at all properties sampled, except for the church located upwind that was sampled to establish background levels.

Elemental correlation analysis was completed for the TAL metals sampling data. Levels of lead and other smelter-related metals were not found in consistent ratios or correlated closely in a way that indicates the elevated lead levels are attributable to smelter operations. Analysis of the composition of the samples does not indicate a correlation between lead and tin which could be expected if the lead originated from solder manufacturing or smelting operations. Overall, low levels of tin were found in the samples whereas higher levels of tin would be expected if the contamination were from solder manufacturing. In addition, there was not a correlation between lead and other solder- or smelter-related metals, such as antimony, arsenic, cadmium, copper, or zinc. This information indicates the lack of a pattern indicative of an impact from the historic on-site solder manufacturing to surrounding properties.

Similarly, the single particle characteristic of solder detected through the SEM/BSE/EDS analysis does not provide evidence that a release from the L.H. Mitchell facility has occurred. Although historically relevant particles such as lead, zinc, and copper were detected in all of the samples analyzed by SEM/BSE/EDS, there was not enough evidence to substantiate that these metals were from Site-related operations.

The lead concentrations found on the L.H. Mitchell property were either similar to or less than those found at downwind properties. The analysis of the isotopic data collected from the L.H. Mitchell facility and other nearby properties did not show any compelling evidence that the Site facility could have been a source of nearby elevated lead concentrations. Ratios of lead isotopes ($^{206}\text{Pb}/^{204}\text{Pb}$ to $^{207}\text{Pb}/^{204}\text{Pb}$ and $^{206}\text{Pb}/^{204}\text{Pb}$ to $^{208}\text{Pb}/^{204}\text{Pb}$) from the L.H. Mitchell property were compared to downwind properties that could have been impacted by a potential historic airborne release from L.H. Mitchell and properties upwind of L.H. Mitchell. Most of the sample data from the L.H. Mitchell property was distinct from both the downwind and upwind properties, indicating that it is likely not the source of contamination.

Additionally, the horizontal distribution of lead does not follow a pattern of deposition from an airborne release from the Site. Properties located up to 1,400 feet southwest and upwind of the Site contained similar levels of lead to properties nearby and downwind. Air modeling that was conducted suggests that operations at the facility would not have contaminated properties more than 700 feet away. The vertical distribution of lead does follow a pattern of airborne deposition, in which contaminant concentrations are generally highest at the surface and decrease with depth. This indicates that most properties may be impacted from airborne deposition and not from historic fill, or that an airborne release occurred after fill was installed. However, based on the horizontal distribution of elevated lead detections, the source of this potential airborne deposition is unknown and is unlikely to be the former L.H. Mitchell facility.

Based on this information and a lack of evidence indicating that the Site is a source of contamination, a release from historic operations at the Site has not been documented. Lead detected at residential properties in the vicinity of the Site may be from other historic anthropogenic sources including, but not limited to, historic fill, leaded gasoline, lead-based

paint, coal combustion, and potentially the pottery industry that was prevalent in this section of Trenton.

Threats to Public Health or Welfare

There is a potential exposure to nearby populations from hazardous substances, pollutants or contaminants that have been detected in the soil samples collected in the vicinity of the Site. Exposed soil was observed with varying levels of grass coverage at every sampled property. Occupants of the residential buildings may be currently exposed to soil containing CERCLA-designated hazardous substances at levels above the respective EPA RMLs.

Direct contact with the elevated levels of lead within the upper six inches of soil may occur through common residential activities. Contaminated soil could adhere to pets' paws when accessing the backyards and could readily be tracked inside the home. Children playing in the yard could be exposed to high levels of lead which could be ingested, adhere to their hands or shoes and be tracked inside the home. Other common activities such as gardening or yard maintenance could result in lead exposure. Contact with the contaminated soil, or inhalation of contaminated soil particles, may present a health risk to those utilizing the backyards, particularly young children and women of child-bearing age. Based on epidemiological studies, it is generally believed that persistent exposure to soil-borne lead results in an increase in blood lead levels in children.

All residents and owners of sampled properties were provided with their property-specific results and a list of recommended measures to reduce exposures to elevated levels of lead. Additionally, EPA has notified both local and state partners of the potential threat to human health present in the neighborhood surrounding the facility. Specifically, EPA has collaborated with the NJDEP, the City of Trenton's Division of Health Promotion and Housing & Economic Development Department, and two local non-profit organizations, the East Trenton Collaborative and Isles, Inc., to promote education of the public to protect themselves from lead exposure and explore different avenues for potential remediation. On November 14, 2019, EPA co-hosted a public meeting with the NJDEP, the City of Trenton's Division of Health Promotion and Housing & Economic Development Department, and the East Trenton Collaborative for residents who have or may have elevated lead levels in their soil, to answer questions and provide further education on steps that can be taken to reduce exposure to lead in soil. Several of these organizations remain available to further advise residents on measures they can take to reduce lead exposures at their properties.

Although the cobalt level in one sample at a depth interval of 6 to 12 inches bgs exceeded the EPA RML for residential soil, this appears to be an isolated incidence of cobalt from an unidentifiable source. All other cobalt levels at all depths were below at the EPA RML for residential soil. Based on this information and its presence at a depth beneath the surface where exposure is less likely, the presence of elevated levels of cobalt in the subsurface of property LM003 at the Site does not represent a significant threat to public health or welfare.

In addition, the arsenic level in one sample was above the EPA RML for residential soil. This elevated arsenic level is at 0 to 2 inch depth in the backyard of an occupied residential property

and represents an exposure threat to those that come in contact with it. Although all other arsenic levels at all depths were below the EPA RML for residential soil, 69 of the soil samples were equal to or exceeded the NJDEP Residential Direct Contact Soil Remediation Standard of 19 mg/kg. As such, this may warrant further investigation under NJDEP regulations.

The former L.H. Mitchell property is currently used as an auto repair business. Lead levels at this property exceed its EPA RML for commercial/industrial soils at one of the three locations from 6 to 24 inches bgs. The entirety of this property, including the location with elevated lead levels, is covered by asphalt. The asphalt is in good condition and no bare soil was observed to be present on the property. Therefore, an employee or customer of the auto repair business would not come in contact with any exposed soil during routine daily activities and the elevated lead levels on this property do not represent a significant threat to public health or welfare.

Threats to the Environment

At this time there is no information to indicate that the Site is currently having an acute impact to the surrounding environment and areas of exposed soil near the Site.

Conclusions

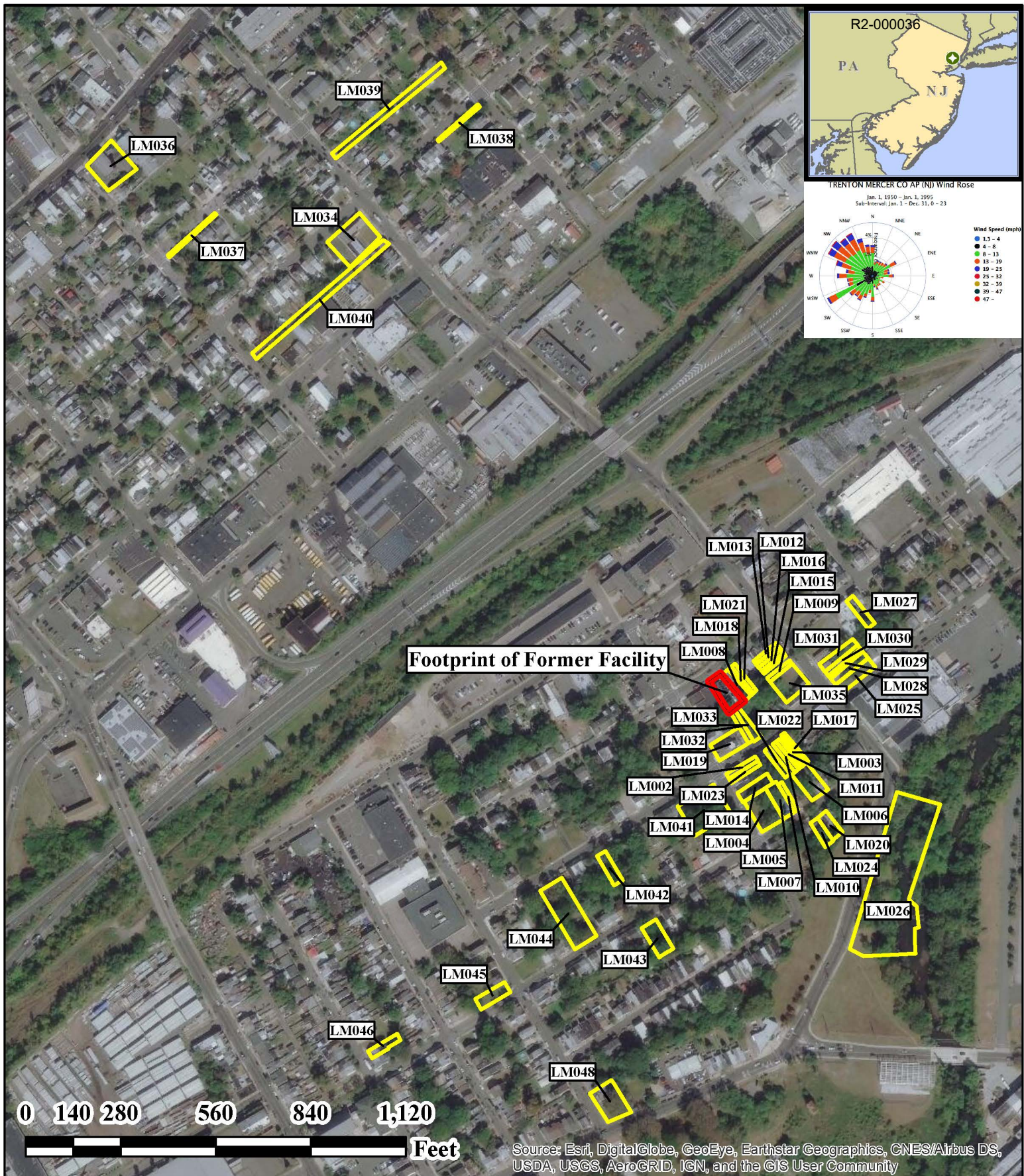
Despite the presence of hazardous substances identified in the soil at residential properties near the Site, the available information does not indicate that a release of CERCLA-designated hazardous substances (as defined in section 101(14) of CERCLA, 42 U.S.C. § 9601) can be attributed to the Site. Although the lead levels are elevated above the EPA RML, lead detected at residential properties near the Site may be from other historic anthropogenic sources. Conditions at the Site do not meet the requirements of Section 300.425 (b) of the National Contingency Plan for the undertaking of a CERCLA removal action at this time.

Although the Site is not eligible for a CERCLA removal action, EPA recommends that appropriate action be taken to mitigate the potential health threat associated with direct contact with the lead-contaminated soil. EPA has discussed this recommendation with NJDEP and local entities including the City of Trenton's Division of Health Promotion and Housing & Economic Development Department. EPA is conducting an extensive attribution study of the elevated lead levels found during the L.H. Mitchell RSE and the potteries that operated nearby. The RSE for the Historic Potteries Site is ongoing and a separate report will be prepared with the findings.

cc: M. Gregor, SEMD-RAB
J. Desir, SEMD-SPB
B. Grealish, SEMD-RAB
EPA Region II Removal Records Center

ATTACHMENT A

Site & Soil Sampling Locations Map



Legend

- Footprint of Former Facility
- Sampling Locations



Weston Solutions, Inc.
Federal East Division

In Association With
Eco-Risk; Avatar Environmental, LLC;
Pro-West & Associates, Inc.; On-Site Environmental, Inc.;
Sovereign Consulting, Inc.; and TechLaw Consulting, Inc.

Figure 1: Site & Soil Sampling Locations Map

L.H. Mitchell Site
Trenton, New Jersey

U.S. ENVIRONMENTAL PROTECTION AGENCY
SUPERFUND TECHNICAL ASSESSMENT
& RESPONSE TEAM V
CONTRACT # 68HE0319D0004

GIS ANALYST: M. LANG
EPA OSC: J. PETTY
START V SPM: M. LANG
CHARGE #: 40200.031.043.3025

DATE MODIFIED: 11/2/2021

ATTACHMENT C

EPA ORD Technical Memorandum for the Historic Potteries Site



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CENTER FOR ENVIRONMENTAL SOLUTIONS AND EMERGENCY RESPONSE
GROUNDWATER CHARACTERIZATION AND REMEDIATION DIVISION
919 KERR RESEARCH DRIVE • ADA, OK 74820

November 29, 2023

OFFICE OF
RESEARCH AND DEVELOPMENT

MEMORANDUM

SUBJECT: Historic Potteries Site, East Trenton, NJ (**24-R02-03**)

FROM: Richard Wilkin, Ph.D.
ORD/CESER/GCRD

Robert Ford, Ph.D.
ORD/CESER/LRTD

Matt Rovero
ORD/CESER/GCRD

Lisa Costantino
ORD/CESER/GCRD

Ronald Herrmann
ORD/CESER/LRTD

TO: Joel Petty, SEMD, EPA Region 2
James Desir, SEMD, EPA Region 2

Since the fall of 2020, EPA/ORD has provided support to Region 2 at the Historic Potteries site in East Trenton, New Jersey. The technical support effort focused on the development and implementation of a multi-phased plan to determine if Pb-contaminated soils on properties sampled could be attributed to historical industrial operations in the surrounding area. ORD provided Pb isotopic characterization of soils, ceramic chips, slags, and tree ring digestates. A total of 64 ceramic chips were analyzed for Pb isotope ratios and a total of 469 soil digestates were delivered to ORD from the Region 2 laboratory for Pb isotope analysis and comparative evaluation starting in September 2020. Subsequent batches of samples were delivered to ORD for sample analysis in December 2020, May 2021, October 2021, March 2022, June 2022, August 2022, and October 2022. Pb isotopic characterization was identified as a line of evidence that could support source apportionment and site conceptual model development. In addition, selected ceramic chips were analyzed using the Synthetic Precipitation Leaching Procedure (SPLP, EPA Method 1312). This method was used to evaluate whether the ceramic chips encountered in soils could potentially leach and release Pb and other metals during

weathering and environmental exposure. ORD conducted multivariate statistical analysis of the large soil data set collected in this project. The analysis utilized Principal Components Analysis (PCA) and Hierarchical Cluster Analysis (HCA) to identify groupings of samples based on selected metals (e.g., Al, Ca, Cu, Pb, Mn, Ni, V, and Zn). This Technical Memorandum is divided into several sections: Background, Pb Isotope Measurements, Overview of Pb isotope findings, SPLP results, and Multivariate Statistical analysis. The memo provides additional context and detail behind ORD input to the presentation titled “Historic Potteries Site Attribution Study Findings & Conclusions” given by the project manager to Region 2 technical staff and management on May 15, 2023.

Background. Common anthropogenic lead (Pb) sources in urban environments include manufacturing processes using Pb, vehicles (past combustion of leaded gasoline), coal-fired power plant and domestic emissions, Pb-based paint manufacturing and use, Pb ore processing (smelting), petroleum refining, and municipal waste incineration [1]. Natural Pb concentrations vary with geology, with a national median value of about 18 mg/kg for uncontaminated surface soils in the United States [2-3]. The median background soil Pb concentration in New Jersey is 23 mg/kg according to the USGS’s Background Soil-Lead Survey: State Data [4]. Total Pb concentrations are important in characterizing contaminated media, however, they are generally inadequate to determine Pb pollution source attribution among multiple pollution sources unless one source has produced contamination far in excess of other sources. Because of this, fingerprinting methods are applied to trace the influence of sources in contaminated media. National Academy of Sciences [5] described four approaches for defining fingerprints of Pb: multielement fingerprints (e.g., combinations of metals), physical/mineralogical characteristics of the soils, lead speciation, and Pb stable isotopes. Stable Pb isotope systematics are advantageous because the isotopic signal for a particular source is maintained as Pb moves through the environment.

Four stable Pb isotopes occur in geologic materials (i.e., ore bodies, coals, and uncontaminated background rocks and soils). ^{204}Pb is “primordial,” or original, in geologic materials, ^{206}Pb and ^{207}Pb are the end points in the decay chains of ^{238}U and ^{235}U , respectively, and ^{208}Pb is the end of the decay chain for ^{232}Th [1]. The ratios of Pb isotopes do not change from the original ore or coal through mining, refining, manufacturing, and release to the environment. Thus, isotopic signatures can be effective tracers [6,7]. Products and pollution from an anthropogenic source, such as industry, will carry the isotopic signature of the Pb source initially purchased.

A graphical approach is often used to evaluate likely sources. The isotopic ratios of samples may be plotted against the inverse Pb concentration (e.g., $^{206}\text{Pb}/^{204}\text{Pb}$ vs. $1/\text{Pb}$). Three-isotope graphs plot two ratios (e.g., $^{206}\text{Pb}/^{207}\text{Pb}$ vs. $^{206}\text{Pb}/^{204}\text{Pb}$), producing a more useful graph when the Pb concentrations are heterogeneous. In a simple binary system, samples will plot along a mixing line connecting two sources with known isotopic signatures [8]. Examples of these approaches using data from the Historic Potteries site are provided below.

Pb Isotope Measurements. Concentrations of Pb and other metals in soil samples were determined by the Region 2 laboratory (LSASD). Digestates and laboratory blanks were provided to ORD for analysis. Based on the measured Pb concentrations in the digested soil samples, dilutions were prepared to yield an adequate volume (~10 mL) of solution with a final

Pb concentration of approximately 3 µg/L in 2% nitric acid. High Resolution-Inductively Coupled Plasma-Mass Spectrometry (HR-ICP-MS) analyses were conducted at the EPA Office of Research and Development Laboratory in Ada, Oklahoma using a Thermo Element XR HR-ICP-MS [9]. Daily instrument tuning utilized ^{238}U and ^{115}In in low resolution mode to optimize signal stability and minimize oxide production. Each analysis sequence involved 10 samples bracketed by the NIST SRM 981 Pb isotope standard to correct for mass bias and instrument drift. Instrument performance, mass bias, and analytical reproducibility were assessed by analyzing NIST SRM 981 Pb isotope standard (5 analyses per batch of 10 samples), NIST SRM 2711 soil standard as a second source verification sample (1 per batch of 10 samples), and sample duplicates (1 per batch of 10 samples). Solution blanks were monitored for Pb and were routinely at the low parts per trillion level. ^{201}Hg was used to monitor Hg levels and to correct for the isobaric interference on ^{204}Pb according to the natural abundance ratio. Ceramic chips (fragments of pottery products produced in Trenton) collected from soil core samples were ground, homogenized, and digested using microwave-assisted acid dissolution [10]. Lead was a common component of glazes that were used during production of ceramic products produced by the pottery industry in Trenton, NJ. The ceramic chip digestates were diluted and analyzed for Pb isotope ratios. In addition, tree core samples were collected across a subset of Trenton residential yards and subsections of each core were digested in acid to support analysis of trace metals and Pb isotopes [11-12]. The isotope ratios measured were $^{206}\text{Pb}/^{204}\text{Pb}$, $^{207}\text{Pb}/^{204}\text{Pb}$, and $^{208}\text{Pb}/^{204}\text{Pb}$; other isotopic ratios of interest were calculated from the three measured ratios.

Overview of Findings: Pb Isotopes. The first set of 9 ceramic chips were analyzed in September 2020. This initial testing indicated that the selected sherds contained levels of Pb that could be characterized for Pb isotope ratios. Additional sets of ceramic chips were prepared and analyzed for a total of 64 measurements. Figure 1 summarizes all ceramic chip Pb isotope data using a $^{206}\text{Pb}/^{204}\text{Pb}$ versus $^{206}\text{Pb}/^{207}\text{Pb}$ plot.

Pb isotope ratios of ceramic chips fall within two separate clusters, labeled Cluster 1 and Cluster 2 on Figure 1. These separate clusters indicate that multiple sources of Pb were used to produce ceramic glaze in the historic Trenton potteries industry. Chip Cluster 2 Pb isotope ratios match with lead ores from SW Colorado, consistent with historical reports and literature references [13-15]. Chip Cluster 1 Pb isotope ratios overlap with ores from Colorado, Utah, and Montana. Cluster 1 chips are less radiogenic (i.e., lower $^{206}\text{Pb}/^{204}\text{Pb}$) compared to Cluster 2 chips. The Pb isotopic compositions of the ceramic chips serve as a point of reference to compare with the Pb isotope signature determined in soils and other potential Pb sources.

Figure 2 summarizes soil Pb isotope data, again using a $^{206}\text{Pb}/^{204}\text{Pb}$ versus $^{206}\text{Pb}/^{207}\text{Pb}$ plot. The plot also groups the isotopic data into 5 concentration ranges. Soils with $\text{Pb} > 2,000$ mg/kg show a range of Pb isotope ratios, e.g., $^{206}\text{Pb}/^{204}\text{Pb}$ from ~18.1 – 19.1. This indicates that there is heterogeneity in Pb sources to the sampled properties, i.e., the high Pb concentrations are made up from multiple sources, or from a single product that had an isotope signature that changed over time, for example, a changing isotopic signature of a product could result from a switch in the raw ore material used in a manufacturing process. The highest Pb concentrations ($\text{Pb} > 2,000$ mg/kg) are mainly from properties P041 (yard soil), P043 (park soil; high ceramic chip count), P046 (yard soil), P055 (railway), P056, and P057 (former potteries).

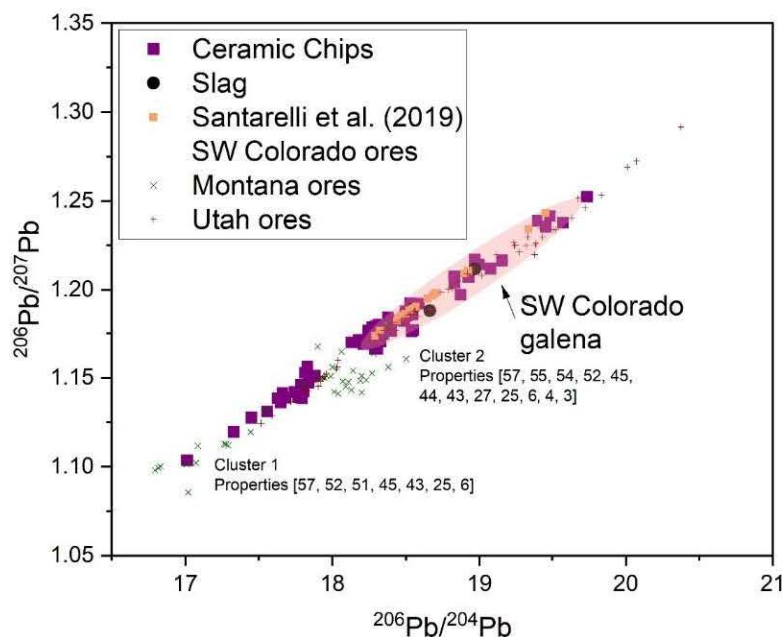


Figure 1. Pb isotope data for ceramic chips collected from the Historic Potteries site (East Trenton, NJ; purple squares). Pb isotope data for ores in Colorado, Montana, and Utah are taken from the literature.

Note that properties P050 and P051 are excluded from this analysis. The former smelter (P050) and adjacent property (P051) have high soil Pb concentrations with distinctive Pb isotope signatures that are unrelated to the isotopic signatures observed in the residential soils of East Trenton. Residential soils with lower Pb concentrations tend to be more radiogenic, i.e., higher ratios of $^{206}\text{Pb}/^{204}\text{Pb}$, $^{207}\text{Pb}/^{204}\text{Pb}$, and $^{208}\text{Pb}/^{204}\text{Pb}$. These lower concentration soils tend to plot on the upper righthand portion of the data trend shown in Figure 2 and they can be considered to represent a dilute endmember composition and isotopic signature. Similarly, soils collected at deeper intervals (>1-2 ft) tend to have lower Pb concentrations with more radiogenic isotopic signatures; thus, radiogenic composition and low Pb concentration are diagnostic of the natural (geogenic) Pb signature in this area. As a point of reference, Ma et al. [16] reported low concentration soils with radiogenic isotopic signatures as being representative of pre-industrial soils from central Pennsylvania. Ault et al. [17] made a similar observation in a region of New Jersey just to the northeast of East Trenton; low concentration soils reflective of native conditions ($\text{Pb} < 20 \text{ mg/kg}$) were noted to have a radiogenic isotopic signature ($^{206}\text{Pb}/^{204}\text{Pb}$ values up to 19.6).

Figure 3 shows Pb isotope data for multiple sample types, including soils, ceramic chips, and tree ring digestates. The plot also shows the ranges of $^{206}\text{Pb}/^{204}\text{Pb}$ in potential urban sources of Pb. The data trends indicate that leaded gasoline, coal combustion products, industrial products,

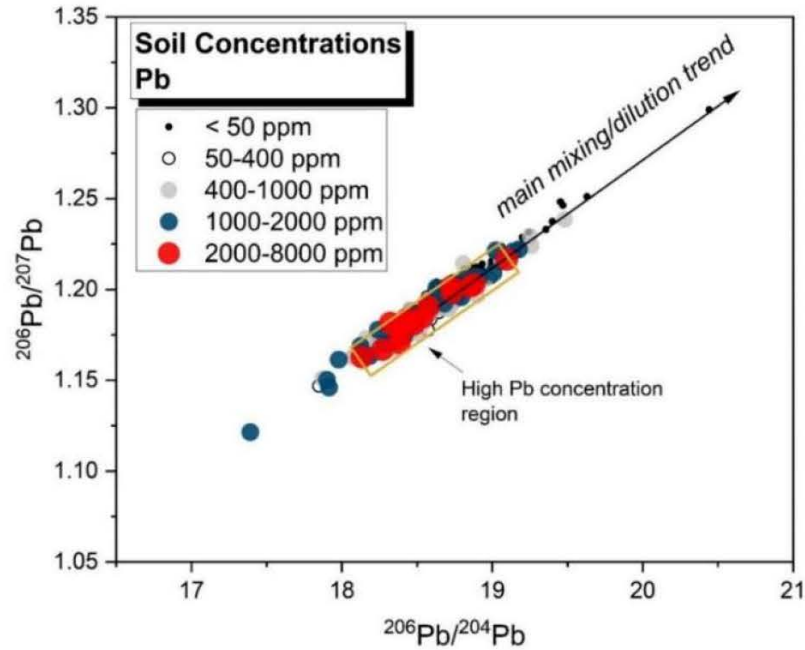


Figure 2. Pb isotope data for soils collected from the Historic Potteries site; plotting symbols represent the Pb concentration.

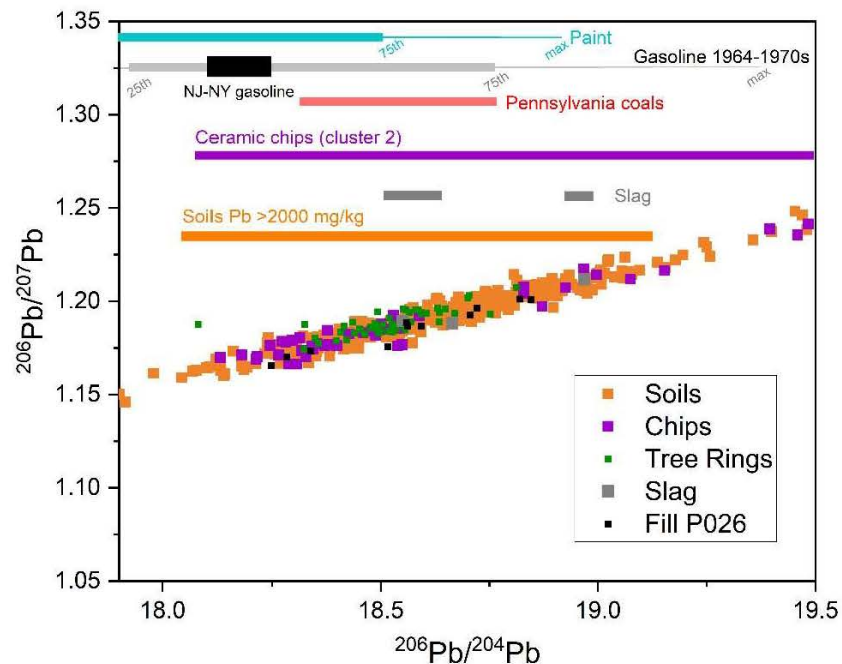


Figure 3. Pb isotope data for a focused isotopic region including >95% of the soil data. The plot shows the overlap between the soil Pb data and ceramic chip Pb as well as Pb from gasoline, coal and paint.

paint, aerosols, historic pottery kiln emissions, and ceramic chips are all possible sources of Pb in the urban environment of Trenton, NJ. Isotope signatures in high concentration soils from the study, e.g., Pb > 2,000 mg/kg, overlap with the isotopic signatures of leaded gasoline, Pb in Pennsylvania coals, Pb in industrial slag, and Pb in ceramic chips (mainly Cluster 2). Historical use of coal from Pennsylvania for powering industry and for domestic use in Trenton NJ is indicated in literature references [18]. The Pennsylvania coal database includes four data points and may not encompass the full range of isotopic heterogeneity of this potential source of Pb [19]. The leaded gasoline isotopic signature includes 24 data points (some represent an average) from gasoline samples collected around the world from 1964 to 1974. Eleven of the points are from samples collected in the United States (our comparison used the US data set as a comparative reference; min/max and 25th – 75th percentiles shown, ref. 20). Perhaps a better estimate of the leaded gasoline signature representative of New Jersey comes from a study published in 1970 [17]. Ault et al. [17] determined the mean $^{206}\text{Pb}/^{204}\text{Pb}$ value of leaded gasoline used in the New York-New Jersey region to be 18.2 (Figure 3). This value was also measured in surface soils collected adjacent to the New Jersey turnpike within a transect of sampling points conducted about 20 miles to the northeast of East Trenton. Leaded paint isotopic values are from a compilation of data [21] developed by Wang et al. (2019) (min/max and 25th - 75th percentile shown). The Pb isotope composition of tree ring digestates indicated that the Pb isotope composition of tree cores overlapped with the isotopic composition of soils with >2,000 mg/kg Pb. Similar to the tree ring data, Pb isotope data for residential properties in HP001: P003, P004, P006, P026, P027, P031, and P033, particularly in soil samples collected at shallow depths (<12 inches), overlap with the Pb isotope signature encountered in the high Pb concentration soils representative of potential sources. Samples collected at depth intervals >12 inches tended to have lower Pb concentrations and higher $^{206}\text{Pb}/^{204}\text{Pb}$ and $^{206}\text{Pb}/^{207}\text{Pb}$, consistent with the geogenic background.

Figure 4 shows depth resolved Pb concentrations and isotopic ratios in multiple soil cores from HP001-P043. At this location soil core data were obtained from shallow depths (~1-4 inches) to up to 93 inches below ground surface. The highest Pb concentrations (1,000 to ~4,000 mg/kg) were located near land surface to ~20 inches below ground surface. Ceramic chips (n=8) were also collected over the same depth interval, but they were not observed in soils collected at deeper levels (>20 inches). High concentration/near-surface soil samples have distinctive Pb isotope values that match the high concentration isotopic signature identified in Figure 1. With increasing depth, soil Pb isotope ratios become more radiogenic (e.g., increasing $^{206}\text{Pb}/^{204}\text{Pb}$) and correlate with decreasing Pb concentration.

The main conclusion is that the Pb isotopic signature in the residential properties overlaps with the high-concentration Pb signature observed at other locations in East Trenton. The isotopic analysis performed on the impacted residential soils shows significant overlap with Cluster 2 of the ceramic chips, although they also overlap with other potential Pb sources. Soils with lead levels above 2,000 mg/kg also shared similar isotopic ratios indicating that the Pb contamination from both may have been from the same source or sources, or that the properties with the higher lead concentrations contain the dominant source of urban Pb from this site.

A common method for using Pb isotope data for source attribution utilizes the equation: $(^{206}\text{Pb}/^{204}\text{Pb})_{\text{mixture}} = (a/\text{Pb}_{\text{mixture}}) + b$, where a and b are constants that specify concentrations of Pb and $^{206}\text{Pb}/^{204}\text{Pb}$ of end member components in a binary mix. Thus, plotting $1/\text{Pb}$ versus $^{206}\text{Pb}/^{204}\text{Pb}$ (or any other Pb isotope ratio) can be useful in fitting Pb isotope data. Figure 5 shows plots of $1/\text{Pb}$ versus different isotopic ratios of Pb. In all cases, with increasing $1/\text{Pb}$ (decreasing Pb concentration), Pb isotope ratios become more radiogenic, i.e., ratios shift to higher levels of ^{206}Pb , ^{207}Pb , and ^{208}Pb relative to ^{204}Pb . Notice that the green shaded field shows Pb concentrations <50 mg/kg; this concentration range would normally be viewed as representing unimpacted soils. However, the data trend indicates continuous mixing to the lowest Pb concentrations observed. The other key observation from Figure 5 is that as $1/\text{Pb}$ approaches 0 (the highest Pb concentrations, typically representative of Pb contamination sources), isotopically variability is wide. In the simplest case where a single source of Pb was

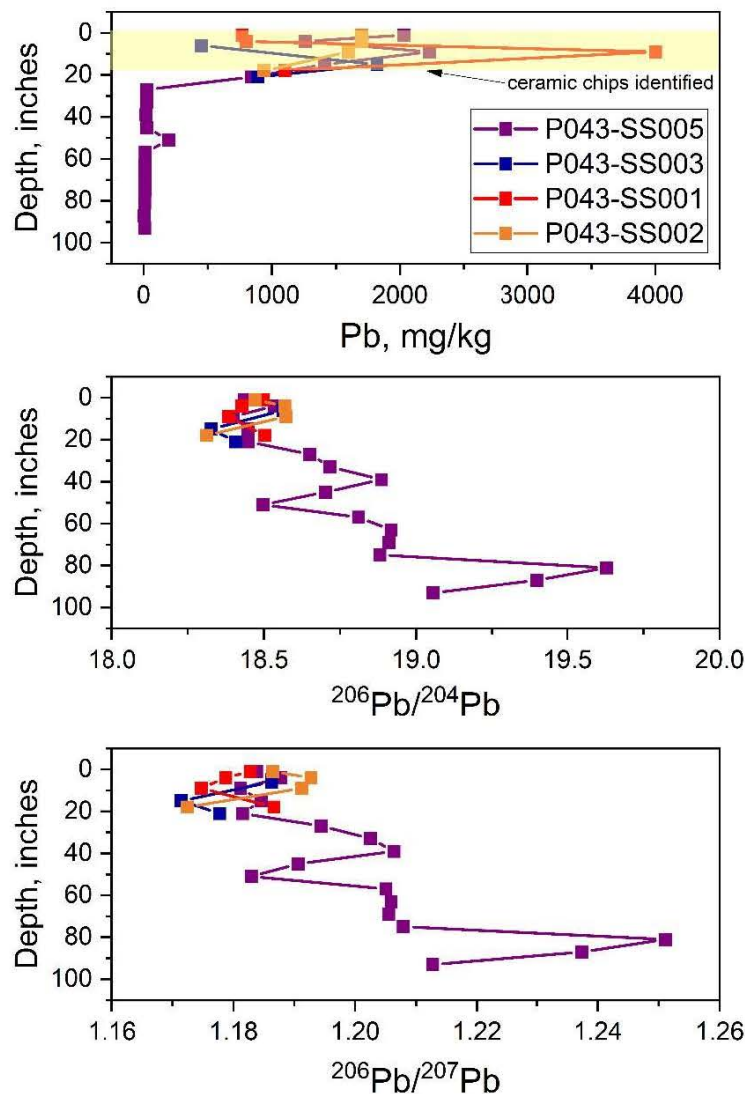


Figure 4. Soil Pb concentrations and isotopic compositions ($^{206}\text{Pb}/^{204}\text{Pb}$ and $^{206}\text{Pb}/^{207}\text{Pb}$) with depth for property HP001-P043 (park located amongst residential properties).

released to the environment, the isotopic ratio on the y-axis intercept would represent the isotopic ratio in the source material. The isotopic variability (pink oval) along the y-axis at $1/\text{Pb} < 0.0025$ indicates that multiple Pb sources were present or that the main contributing source of Pb was isotopically heterogeneous.

Seven separate property soil profiles were examined for relationships between Pb isotope ratios in soil and in co-located ceramic chips. In all cases the highest soil Pb concentrations were present in the depth intervals containing the ceramic chips, generally within the upper 12 inches of the soil column. Six of seven of the properties had at least one recovered and characterized ceramic chip with an isotopic composition that correlated with the isotopic ratios of Pb in soil. As noted above, other potential sources of Pb are possible (e.g., coal, leaded gasoline, industrial products); however, the ceramic chips or kiln emissions cannot be excluded as potential sources of soil Pb. Four soil samples with Pb in the 1,000-2,000 mg/kg concentration range (from P054 and P057) have isotopic compositions that are only consistent with Pb in Cluster 1 ceramic chips based on the known understanding of possible Pb sources.

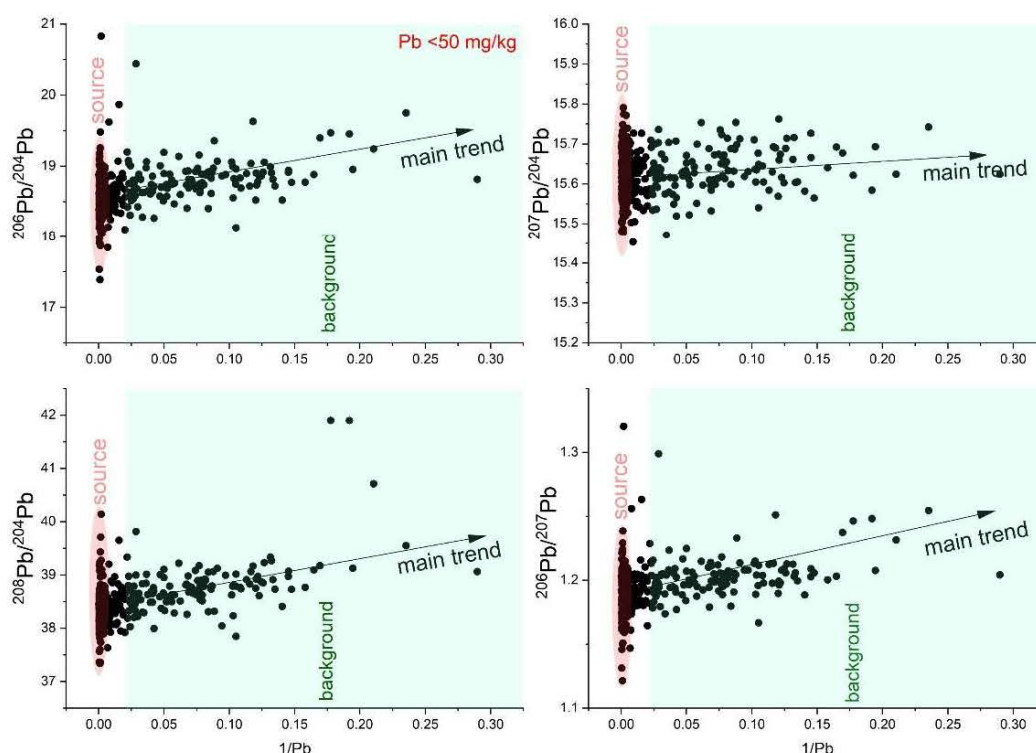
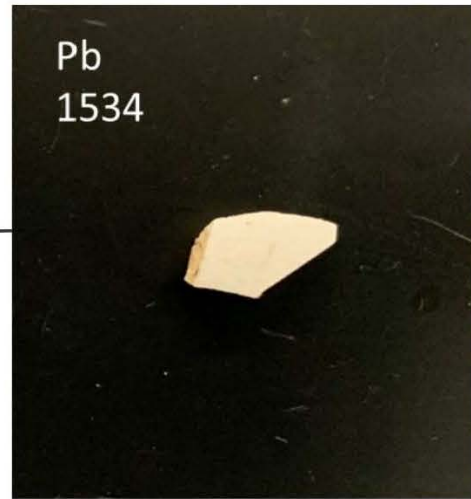
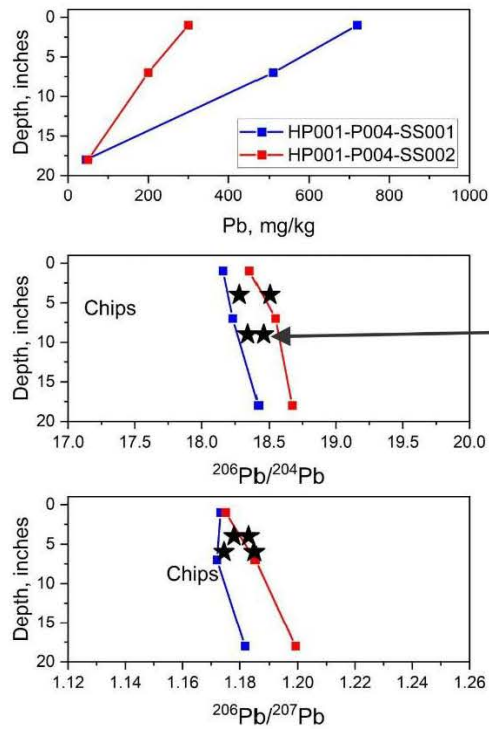


Figure 5. Isotopic ratio of Pb vs $1/\text{Pb}$ in soil samples. The green shaded region represents soil Pb concentrations $< 50 \text{ mg/kg}$. The pink-shaded ovals represent the isotopic variability at the highest levels of soil Pb.

Property 4 example soil data and pottery



Property 6 example soil data and pottery

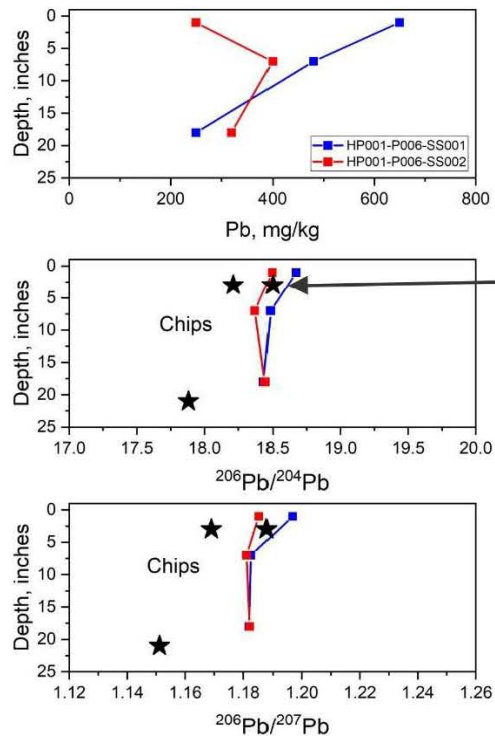


Figure 6. Co-located ceramic chip and soil isotopic compositions in residential soils P004 and P006.

One example of the comparison between the Pb isotopic composition of soil and co-located ceramic chips is property HP001-P004 (Figure 5a). Four pottery chips that were collected from the 2-6" and 6-12" intervals were analyzed for isotopic lead and the lead ratios of $^{206}\text{Pb}/^{204}\text{Pb}$ ranged from 18.28 to 18.51. The lead isotope ratios of the ceramic chips are within the narrow range of the two soil samples which provides evidence of a relationship between the lead in the ceramic chips and soils. Figure 5b shows data for HP001 property P006. In this case, one of three ceramic chips had an isotopic composition that matched soil data for Pb. Six of seven of the properties where co-located soil and ceramic chips were collected had at least one ceramic chip with an isotopic composition that correlated with the isotopic ratios of Pb in soil.

Synthetic Precipitation Leaching Procedure (SPLP EPA Method 1312): SPLP analysis was performed on 20 ceramic chip samples to determine if Pb or other metals would readily leach from the samples tested. Samples were selected based on XRF-determined Pb concentrations and the characteristics of the glazed portion of the ceramic chips. Samples were chosen from a range of Pb levels including five samples from 100 to 1,000 mg/kg, four samples from 1,000 to 10,000 mg/kg, eight samples from 10,000 to 100,000 mg/kg, and three samples over 100,000 mg/kg. The SPLP analysis included antimony, arsenic, barium, beryllium, cadmium, cobalt, copper, chromium, lead, manganese, molybdenum, nickel, silver, thallium, tin, uranium, vanadium, and zinc. Of these metals, lead, barium, zinc, vanadium, and copper (presented in order of highest leachate concentration) were the most leachable (Figure 7). Lead results for the SPLP analysis ranged from less than 1 to 124 $\mu\text{g/L}$ and was the most leached metal in the SPLP analysis. The ceramic chips that were found at all properties at varying quantities have likely leached over time, especially during periods of acidic rain. Thus, it is possible that higher concentrations of metals could have been leached to the environment prior to the ceramic chips being collected. On the other hand, in order to provide a consistent testing of materials the SPLP was performed on crushed ceramic chips, which increased surface area and the potential for metals leaching.

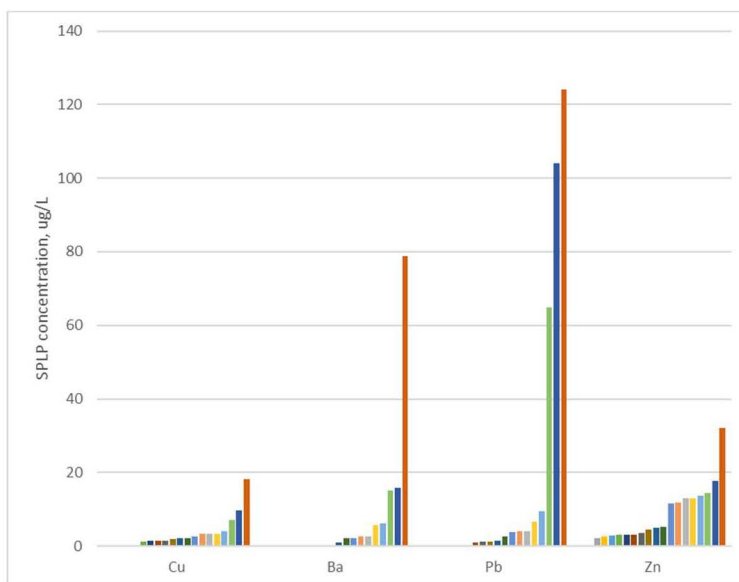
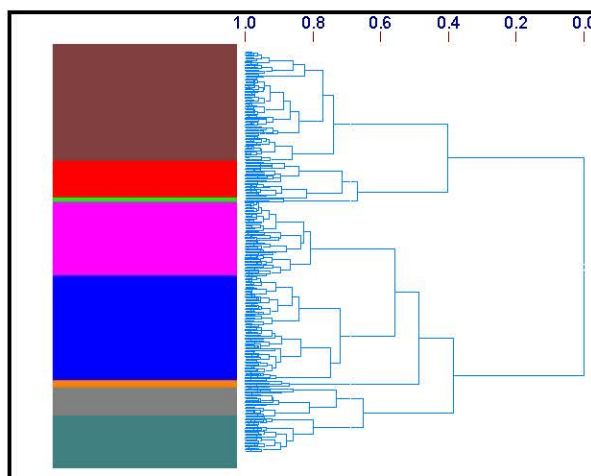


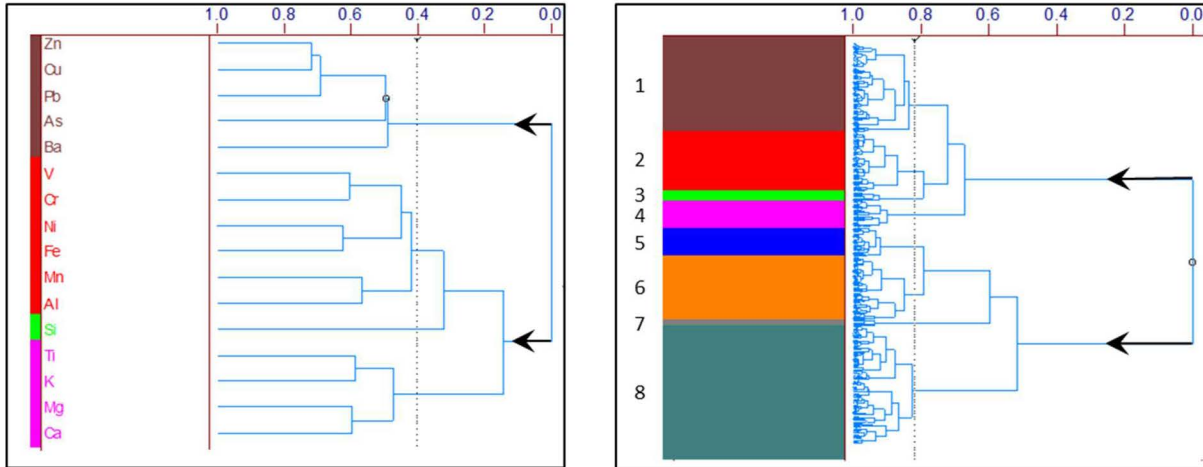
Figure 7. SPLP results for selected metals: Cu, Ba, Pb, and Zn. For each metal the samples are ranked from lowest to highest leaching potential.

Multivariate Statistics: Multivariate statistical analysis was conducted using the commercial software Pirouette (Version 4.5). Total extractable metals concentrations from discrete soil samples for residential, recreational, municipal, and commercial properties were compiled and processed to include only those metals which had a detection rate >90% for all sampled properties. The metals that satisfied this criterion included aluminum (Al), arsenic (As), barium (Ba), calcium (Ca), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), nickel (Ni), potassium (K), silicon (Si), titanium (Ti), vanadium (V), and zinc (Zn). For this subset of metals, the laboratory quantitation limit value for each metal was used for the non-detect results. Prior to analysis, metal concentrations were transformed to logarithmic (Log10) values. Program settings for the HCA analysis included autoscale preprocessing, Euclidean distance metric, and incremental linkage method.

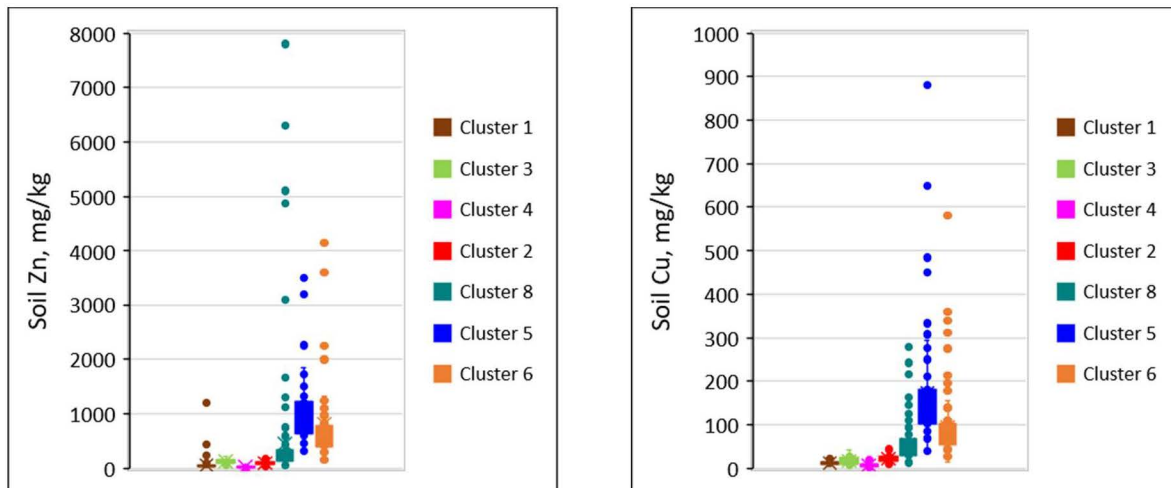
For this analysis, the compositional variables (i.e., metal concentrations) can be viewed as the fixed set of ingredients of a recipe for each soil sample. Samples with statistically similar compositions are assigned to subsets (i.e., clusters) of the entire set of samples. Samples within a cluster have similar compositions when compared to other samples in the entire population. The Pirouette software allows the user to assess changes in the populations of each cluster with greater restrictions on compositional variability for each cluster. The metric that defines within cluster similarity is referred to as the “similarity index” which varies from a value of zero to one. A similarity index of zero is the least restrictive with all samples being classified as similar. A similarity index of one is the most restrictive where samples within a cluster must have identical composition. The initial HCA analysis using all metal concentration data resulted in eight statistical clusters when the similarity index was set to 0.7 (Figure 8, upper panel). The statistical analysis can also be implemented to assess what subsets of metals are interacting to influence the groupings of individual samples. Assessment of the HCA output with respect to the metal concentrations revealed that As, Ba, Cu, Pb, and Zn grouped as a branch separate from the other metals (Figure 8, lower left panel). This set of metals includes four of the metals (Ba, Cu, Pb, Zn) that showed the highest leaching potential for ceramic chips subjected to the SPLP. Subsequent statistical analysis of all samples using only this subset of metals as the variables resulted in eight statistical clusters differentiated at a similarity index greater than 0.82 (Figure 8, lower right panel). These clusters initially grouped separately into two primary branches that were subsequently distributed among clusters 1-4 and 5-8 at the higher similarity index.

Figure 8. Statistical dendrograms that illustrate the differentiated clusters of samples across the entire data set. Right: sample dendrogram shows the outcome using all metals and 0.7 similarity index. Lower left: parameter dendrogram shows the interacting groups of metals that influence the clusters. Lower right: sample dendrogram shows the outcome using just the metals from the upper branch of the parameter dendrogram (As, Ba, Cu, Pb, Zn).





The distribution of concentrations for a subset of metals for seven of the eight clusters is shown in Figure 9 to illustrate distinctions across statistical clusters. Clusters with the lowest Pb concentrations had similar or higher concentrations of other metals (e.g., Ni and Ti, not shown), which were not observed to leach significantly from ceramic chips. The statistical groups can be classified as: 1) no impact from Pb contamination (Clusters 1, 2, 3, 4), 2) significant impact from Pb contamination (Clusters 5, 6 and 7), and 3) a transitional group with varying level of potential impact (Group 8). Metal concentration distributions are not shown for Group 7 since this constituted a small group with only 14 samples from properties HP001-P050 and HP001-P051. This cluster had anomalously high metal concentrations and Pb isotope ratios that were inconsistent with the other soil samples.



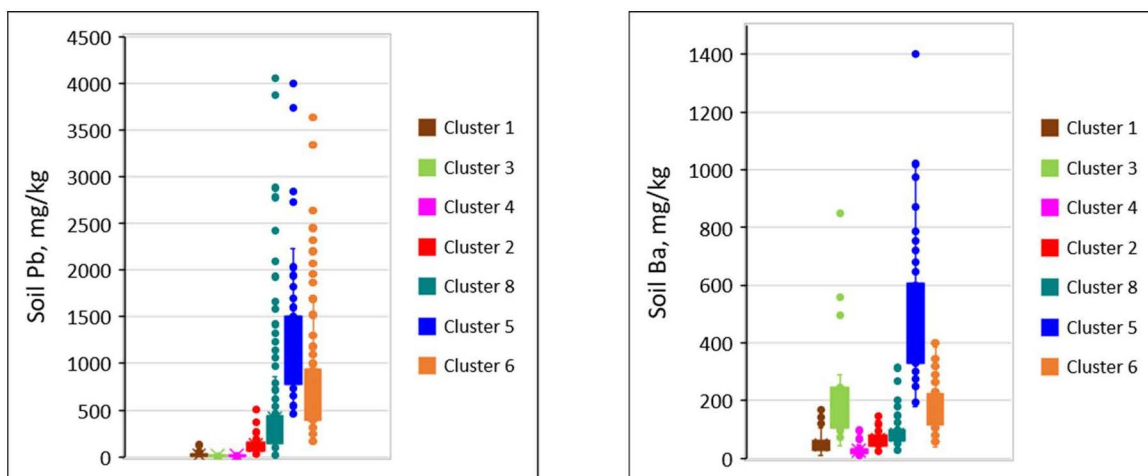


Figure 9. Distribution of metal concentrations for the statistical groups identified at a similarity index of 0.82 when only As, Ba, Cu, Pb, and Zn were used as variables. Metal concentrations that are shown correspond to those that were observed to leach from ceramic chips to greatest extent in the SPLP procedure.

A common pattern observed for many of the residential and recreational properties within sampling area HP001 was higher concentration of Pb at shallow depths (<30 inches) that rapidly decreased for depth >30 inches (Figure 10, left panel). At depths >30 inches, both Pb concentrations and isotope ratios transitioned to those anticipated for geogenic background. This vertical pattern was also reflected in the statistical clusters that were assigned as a function of depth. Shallow depths were assigned to statistical clusters associated with contamination impact (Clusters 5 and 6), while deeper depths were assigned to Clusters 1 and 2 (not labeled). For soil core location P043-SS005, the depth interval at about 50-inches is assigned to Cluster 8, which is consistent with the less radiogenic Pb isotope ratio for this sample. The presence of elevated Pb concentrations at shallow depths is consistent with the presence of ceramic chips at similar depths and/or aerial deposition of kiln emissions from upwind historical pottery operations. The pattern in Pb concentration at depth differs for multiple sampling locations within Property P057, which is the former location of a large pottery facility north-northwest of residential properties (Figure 10, right panel). For this property the distribution of Pb concentration with depth is erratic. For the two sampling locations, all depths were assigned to either statistical clusters indicative of contamination (Clusters 5 and 6) or a transitional condition represented by Cluster 8. The depth heterogeneity observed at property P057 is more consistent with a property where Pb-bearing materials have been processed and entrained within the soil profile over years of property transition and redevelopment.

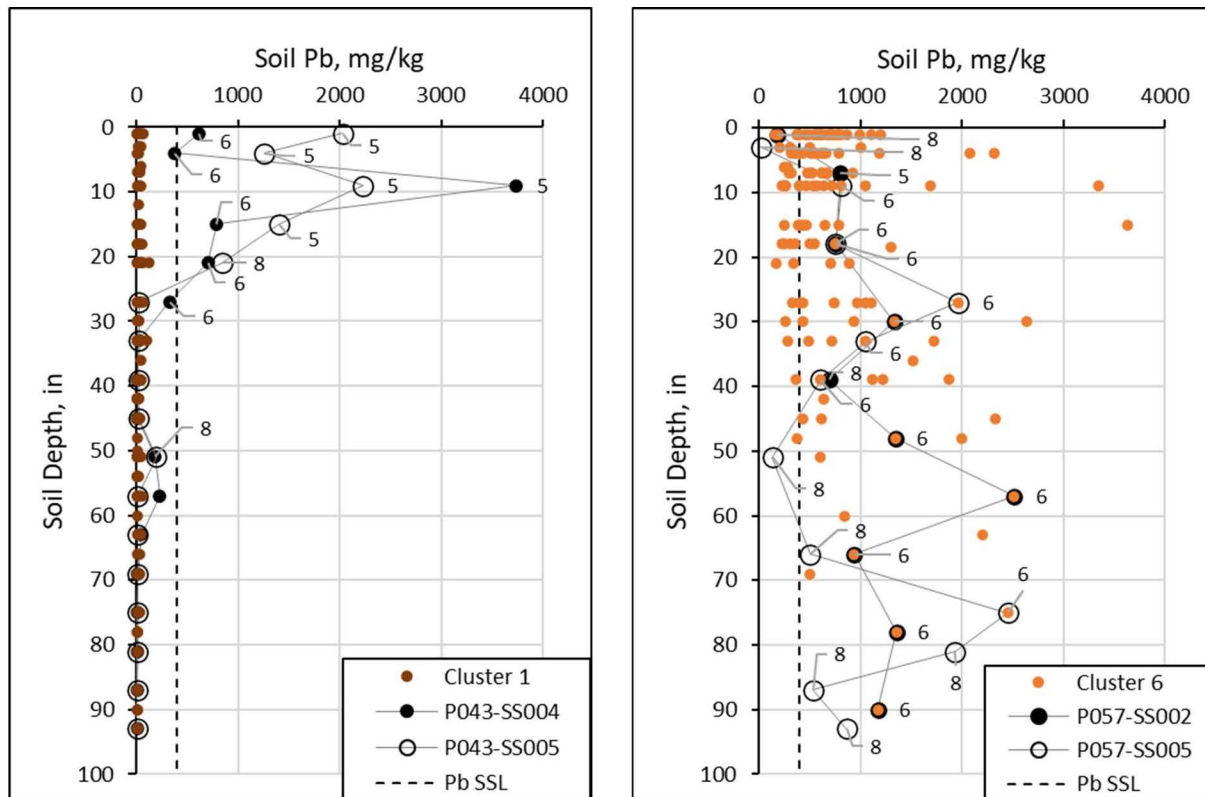


Figure 10. Soil Pb concentrations with depth for two locations sampled within area HP001. Left panel: Property P043 is a park (recreational) nestled amongst residential properties. Right panel: Property P057 is the location of a large former pottery facility that was north-northwest of the residential properties within area HP001.

Intervening commercial/municipal properties between the large historic pottery facilities (P056, P057) and residential/recreational properties also had elevated Pb concentrations indicative of contamination. Property P055 was the location of a railway area that was used for transporting materials to and from the historic potteries. Soil Pb concentration data are shown in Figure 11 (left panel) for two sampling locations within property P055. The depth distribution of elevated Pb is consistent with what was observed for property P057, indicating potential contribution from fill. Property P054 was the location of a coal yard that has been redeveloped for municipal use. Much of this property is currently paved, so soil samples start at depths >10 inches. Elevated Pb concentrations primarily occur at depths <40 inches (Figure 11, right panel). Both properties have soil samples indicative of contamination based on statistical cluster assignments (Clusters 5, 6, and 8). The remaining deep intervals were assigned to Clusters 2, 3, or 4, indicative of background conditions.

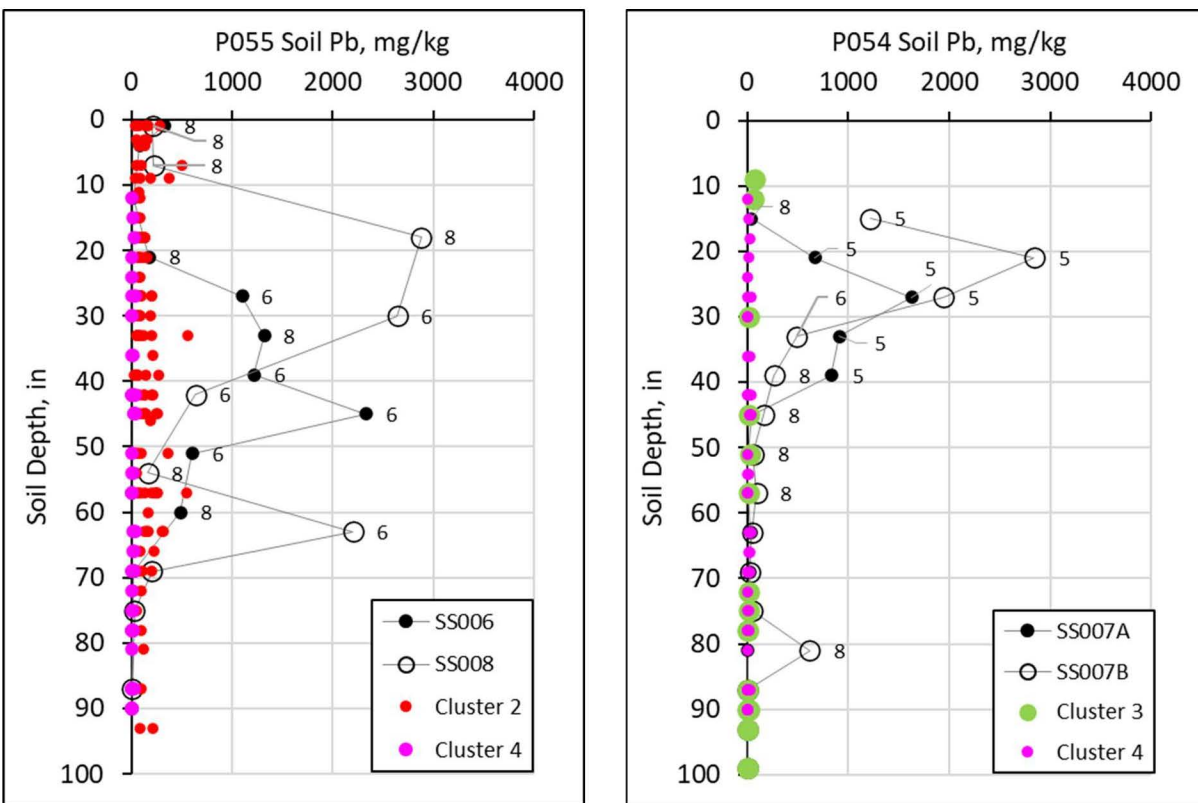


Figure 11. Soil Pb concentrations with depth for two locations sampled within area HP001. Left panel: Property P055 is the former location of a railway area adjacent to the locations of large historic pottery facilities (P056, P057). Right panel: Property P054 is the former location of a coal yard located between property P055 and the residential/recreational properties (including P043).

The following figure shows soil data for two other properties within HP001 that are further away from the two large historical properties. Property P026 is in Mulberry Street Park adjacent to Assunpink Creek. This property is known to have received fill; confirmed by observations of rubble (including ceramic materials) at multiple depths during sampling. For the two locations shown in Figure 12 (left panel), all soil samples appear to be contaminated to varying extent and were assigned to statistical Clusters 5, 6, or 8. Property P046 (Figure 12, right panel) is a vacant residential property south of property P054 (municipal) and west of property P043 (recreational). In contrast to property P026, elevated Pb concentrations were primarily observed at depths <20 inches. The samples from the shallow depth interval were assigned to statistical Clusters 5, 6, or 8. At greater depth, the soil samples were assigned to Clusters 1 or 2, indicative of a transition to background. Ceramic chips observed in soil samples from property P046 had elevated concentrations of Pb. These properties highlight potential sources of Pb beyond aerial deposition of stack emissions from historical pottery manufacturing.

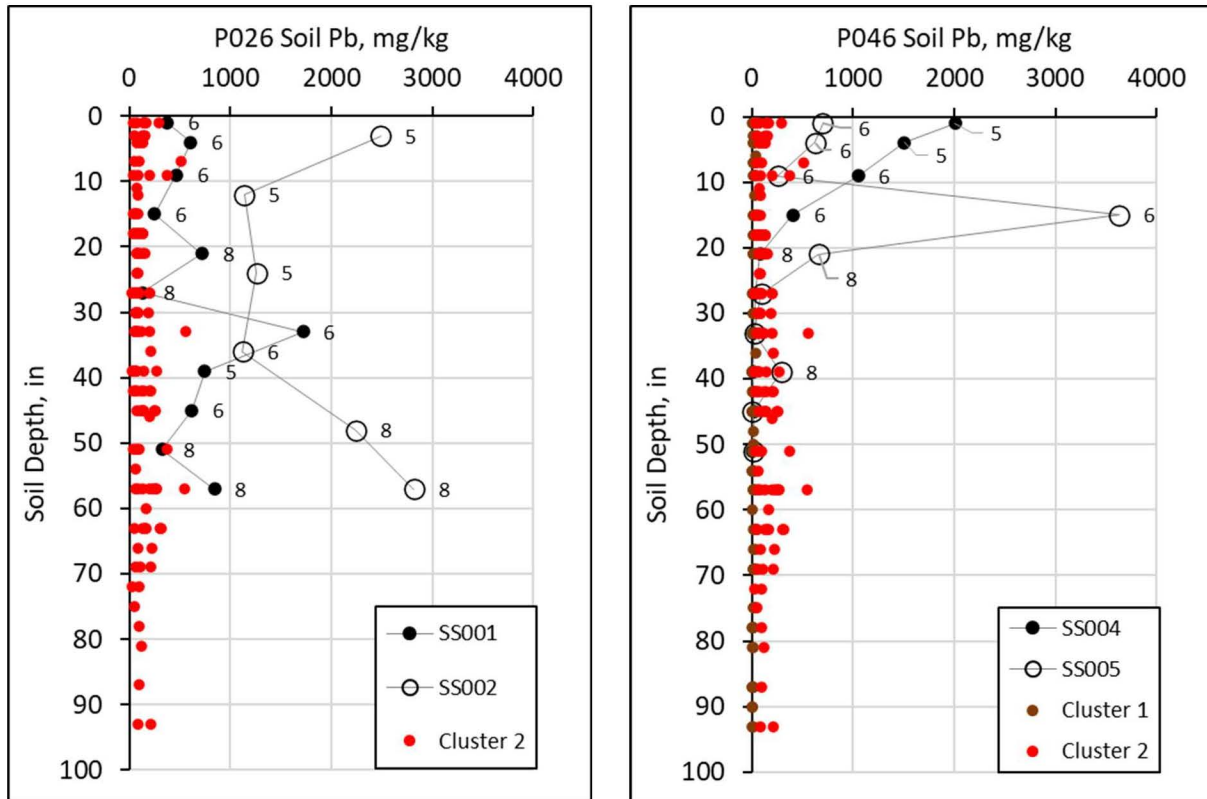


Figure 12. Soil Pb concentrations with depth for two locations sampled within area HP001. Left panel: Property P026 is in Mulberry Street Park; an area known to have received fill. Right panel: Property P046 is a vacant residential property south of property P054 (municipal) and west of property P043 (recreational).

The locations of all soil samples assigned to Clusters 5 and 6 are shown in Figure 13. For these samples, at least one depth interval was assigned to Cluster 5 or 6 with the majority occurring at depths <24-inches. The top panel shows the locations of historic potteries along with soil sample locations within sampling areas HP001 and HP002. This view highlights the spatial correspondence between historic pottery operations and the properties displaying evidence of Pb contamination. The bottom panel highlights the HP001 sampling area along with identification of property locations for which soil Pb concentration data were presented in Figures 10-12. The apparent spatial correlation between historic pottery locations and potentially contaminated properties indicates that historic pottery operations were a potential source for elevated soil Pb concentrations. This is supported by the correspondence between Pb isotope and soil chemistry data between soils sampled directly from former pottery facilities and residential/recreational properties.

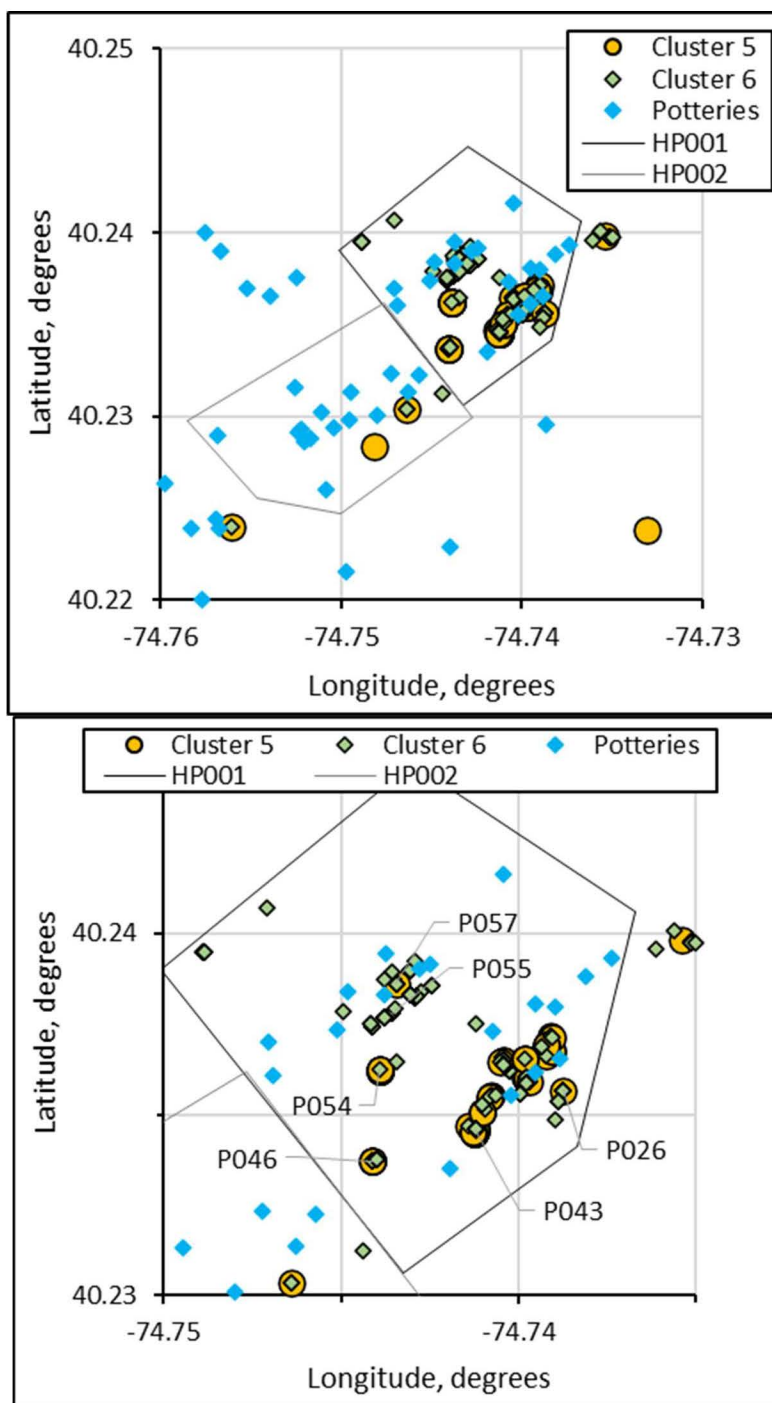


Figure 13. Summary of soil sample locations that were assigned to statistical Clusters 5 and 6. Top panel: Aerial view showing the distribution of potentially contaminated properties within sampling areas HP001 and HP002. Bottom panel: Aerial view of sampling area HP001 with identification of properties for which soil Pb concentration data were highlighted in previous figures. The former locations of historical pottery facilities are also shown.

Finally, a summary of key findings and high-level observations is provided below.

- Analysis described here utilized: 1) Pb concentration and isotope data for soils, ceramic chips, and tree ring digestates, 2) spatial evaluation of soil metals concentrations, 3) Synthetic Precipitation Leaching Procedure test results of ceramic chips, and 4) Principal Components Analysis (PCA) and Hierarchical Cluster Analysis (HCA) to identify groupings of samples based on selected metals.
- Soils with Pb > 2,000 mg/kg reflect a range of isotope ratios indicating multiple sources of Pb to the environment. Soils with the lowest Pb concentrations tend to have distinctive isotopic ratios that shift to higher levels of ^{206}Pb , ^{207}Pb , and ^{208}Pb relative to ^{204}Pb . High concentration soils are typically encountered at depths within ~24 inches of ground surface. The low concentration soils are typically found at greater depths and are likely representative of pre-industrial conditions.
- Ceramic chips were collected over the same soil depth intervals in which high soil Pb concentrations were observed. In many cases, the isotopic composition of soil Pb can be correlated to the isotopic composition of co-located ceramic chips; however, leaded gasoline, coal combustion products, industrial products, paint, aerosols, kiln emissions, and ceramic chips are all possible sources of Pb in the urban environment of Trenton, NJ.
- Synthetic Precipitation Leaching Procedure results indicated that Pb, Ba, Zn, V, and Cu were the most leachable metals from the ceramic chips. Pb concentrations from the SPLP analysis ranged from less than 1 to 124 $\mu\text{g/L}$ and Pb was the most leached metal in the analysis. The ceramic chips that were found at properties have likely leached over time, especially during periods of acidic rain (SPLP initial pH was 4.2).
- The presence of elevated Pb concentrations at shallow depths is consistent with the presence of pottery chips at similar depths and/or aerial deposition of kiln emissions from upwind historical pottery operations.
- Hierarchical Cluster Analysis output revealed that As, Ba, Cu, Pb, and Zn grouped as a statistical branch separate from other metals. This set of metals includes four of the metals (Ba, Cu, Pb, Zn) that showed the highest leaching potential for pottery chips subjected to the SPLP. Statistical analysis of all samples using only this subset of metals as the independent variables resulted in eight statistical clusters or groupings.
- The statistical groups can be classified as: 1) no impact from Pb contamination (Clusters 1, 2, 3, 4), 2) significant impact from Pb contamination (Clusters 5, 6 and 7), and 3) a transitional group with varying level of potential impact (Group 8). Shallow depth intervals with higher Pb concentrations were typically grouped within statistical clusters associated with contamination impact (Clusters 5 and 6), while deeper depths with lower Pb concentrations were typically associated with Clusters 1 and 2, indicative of a transition with depth to natural pre-industrial background.

- Soil samples assigned to Clusters 5 and 6 are near locations proximal to historic potteries within sampling areas HP001 and HP002. This finding highlights the spatial correspondence between historic pottery operations and the properties displaying evidence of Pb contamination.

If you have any questions concerning the information and analysis described in this memorandum, please do not hesitate to contact us at your convenience via phone, email, or MS Teams.

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DATE: February 15, 2024

SUBJECT: Confirmation of Verbal Authorization for a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Emergency Removal Action at the Historic Potteries Site, Trenton, Mercer County, New Jersey

FROM: Jonathan Byk, On-Scene Coordinator
Removal Action Branch
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Date: 2024.02.15 10:20:58 -05'00'

THRU: Joseph D. Rotola, Supervisor
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TO: Pat Evangelista, Director
Superfund and Emergency Management Division
Pat Evangelista
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Date: 2024.02.15 16:47:02 -05'00'

Site ID: A29V

The purpose of this memorandum is to confirm and document the Superfund and Emergency Management Division (SEMD) Director's February 14, 2024, verbal authorization for a CERCLA emergency removal action (RV1) at the Historic Potteries Site (Site) located in the City of Trenton, Mercer County, New Jersey. The total funding authorized for this emergency removal action is \$1,300,000, of which \$1,200,00 is for mitigation contracting and \$100,000 is for the Superfund Technical Assessment and Response Team (START). This is the first removal (RV1) at this Site.

The Site is situated in a mixed-use urban area comprised predominately of residential properties, along with some commercial and light industrial buildings. The current Site boundaries encompass part of the East Trenton neighborhood and areas upwind along Top Road neighborhood where potteries historically operated. These neighborhoods are within Trenton city limits, Mercer County, New Jersey. The Site encompasses approximately 0.38 square miles of occupied residential properties and communal spaces such as schools and parks in East Trenton, north of North Clinton Avenue, south of the Assunpink Creek, east of Lincoln Avenue, and west of Plum Street. This emergency action focuses on actions to be taken at the Ulysses S. Grant (Grant) Intermediate School located at 159 North Clinton Avenue, Trenton, NJ

bound by Perry Street to the north, North Clinton Avenue to the east, Monmouth Street to the south, and Southard Street to the west. The Ulysses S. Grant Intermediate School serves 550 students in grade 4-6, ranging in age from 8-12-year-olds, as well as 60 staff and facility members. An additional removal action is anticipated to address residential properties and parks in East Trenton following receipt and review of the validated analytical data.

The Site was discovered during a removal site evaluation (RSE) for the L.H. Mitchell Site where a small solder manufacturer historically operated and elevated levels of lead were found in soil on residential properties near the Site. The lead was unattributable to the L.H. Mitchell facility, but numerous potteries that operated in East Trenton were thought to be a potential source of the lead. On January 9, 2020, EPA received a referral from the NJDEP to conduct an integrated assessment to determine if the Site qualifies for a removal action and/or placement on the National Priorities List. EPA's Removal Action Branch and the Pre-remedial Section began an integrated investigation of the Site in January 2020 which included an extensive attribution study to assess the pottery industry's contribution to lead contamination discovered in area soil. This attribution study, completed in 2022, concluded that the pottery industry was a major source of the lead contamination found in soil. EPA is evaluating the investigation through the Hazard Ranking System to determine if the Site meets the criteria for placement on the National Priorities List. Assessment of residential properties, parks, and schools within the Top Road and East Trenton neighborhoods, as part of the HRS scoring evaluation, had been conducted in fall and early winter of 2023/2024 and is ongoing.

Sampling and analysis conducted at the Site in December 2023 identified the presence of elevated concentrations of lead and arsenic above the removal management level (RML)¹ in surficial soil at the Grant Intermediate School, along with significantly elevated concentrations in an area where students garden and the presence of bare soil. Lead was detected exceeding the RMLs in surficial soil samples from all fifteen quadrants sampled on the property, while arsenic was detected above the RML in only one quadrant adjacent to the building and the drip-line composite sample (potentially linked to historic use of arsenic based rodenticide).

Lead was identified in surface soil at the school at concentrations as high as 653 mg/kg, posing a direct contact risk for students and staff. Exposure to lead is likely through routine outdoor play and outdoor maintenance activities such as landscaping, and grass cutting. The potential for increased exposure to lead exists and is a health concern when children place their hands or other objects covered with lead-contaminated dust and/or soil into their mouth. The threat is increased when bare soil is present, which is a condition observed widely across the school property. The potential for contamination of indoor areas may result after foot traffic on and through the lead contaminated soils as well.

¹ On January 17, 2024, EPA released new guidance for lead in residential soils: "Updated Residential Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities," which establishes an RML of 200 mg/kg. It can be found at https://www.epa.gov/system/files/documents/2024-01/olem-residential-lead-soil-guidance-2024_signed_508.pdf.

The objective of the removal action is to mitigate lead exposure through appropriate temporary dissociation measures. This action will contribute effectively to any long-term remedial action with respect to the release or threatened release of hazardous substances and is consistent with any future long-term remedial action that may be undertaken at the Site.

The scope of the work for this emergency removal action will include installation of temporary controls to dissociate the students and staff from the lead impacted soil. Proposed interim controls to be implemented may include fencing to restrict access to impacted areas, as well as placement of artificial turf, soil, wood chips, sand, sod and/or comparable clean cover material over high use play areas so that normal school operations like recess and gym class may resume. The appropriate action will be selected in coordination with school administration so that selected measures are best for use-specific requirements.

The Site meets the criteria for a removal action under CERCLA, as amended, 42 U.S.C. § 9601-9675, and as described in Section 300.415(b) of the National Contingency Plan, 40 C.F.R. § 300.415(b).

A complete Action Memorandum providing further documentation of this funding request and more detailed Site information, including the potential for additional mitigation actions at numerous residential properties in East Trenton, will be submitted for approval in the near future.

Should you have any questions or require additional information, please feel free to contact the On-Scene Coordinator assigned to the Site, Jonathan Byk at 347-899-6210.

Cc:

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