Air Dispersion Modeling Analysis

Reading Lead Site

SEPTEMBER 10, 2021

EPA CONTRACT NO: 68HE0320D0003

PRESENTED TO

EPA R3 START VI

SUBMITTED BY

Tetra Tech
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REPORT CERTIFICATION

The material and data in this report were prepared under the supervision and direction of the undersigned.

Scott D Miller Project Manager	September 10, 2021 Date
Jeff Harrington Senior Engineer	September 10, 2021 Date

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APPENDIX A – 2016 SAMPLING RESULTS

ACRONYMS, ABBREVIATIONS, AND LETTER SYMBOLS

Acronyms/Abbreviations	Definition
ac	acres
AERMAP	AERMOD's terrain pre-processor algorithm
AERMET	AERMOD's meteorological data processing algorithm
AERMOD	AMS/EPA Regulatory Model
BPIP-PRIME	Building Profile Input Program – Plume Rise Model Enhancements (EPA)
EPA	United States Environmental Protection Agency
ft	feet
ft/s	feet per second
ft-agl	feet above ground level
g/cm^3	grams per cubic centimeter
GEP	Good Engineering Practice
in.	Inch(es)
km	kilometer(s)
m	meter(s)
mi	mile(s)
°, °F	degrees, degrees Fahrenheit
OSC	On-Scene Coordinator
PM	particulate matter
ppm	parts per million
PSU	Pennsylvania State University
START	Superfund Technical Assessment and Response Team
UTM	Universal Transverse Mercator
XRF	X-Ray Fluorescence
$\mu g/m^3$	microgram(s) per cubic meter
µm	micrometer
USGS	United States Geological Survey

1.0 PROJECT

1.1 INTRODUCTION

1.1.1 Purpose

EPA Region III contracted Tetra Tech to perform an air dispersion and deposition modeling analysis in support of the consideration of a lead soil-sampling program in Reading, Pennsylvania (PA). Soil sampling conducted in 2016 in Reading indicates the former Reading Iron Works site may have been a lead emissions source that contributed to the measured lead soil concentrations. The purpose of the modeling study is to evaluate the potential of aerial deposition of lead contamination--not to quantitatively predict soil concentrations--from what was likely the largest historical industrial source in the South Reading area. In addition, the study will help to determine whether additional sample location(s) should be considered. The purpose of the modeling is.

Reading Iron Works was selected as the subject of this modeling study, based on the fact that it was the largest likely source of lead emissions in the South Reading area. Reading Iron Works was an iron foundry that operated from approximately 1836 to 1939, and this study considers the foundry as it existed circa 1922. Tetra Tech selected the time period based on readily available public photographic documentation that shows the facility to be operating at considerable capacity and with few air emissions controls.

The site is currently occupied by United Corrstack, LLC/DS Smith and the address is listed as 720 Laurel St, Reading, PA 19602. The facility manufactures corrugated packaging products and is not engaged in metallurgical production. This report in no way should be interpreted to address current facility operations.

1.1.2 Site History and Operations

In the 19th and early 20th centuries, industries in Reading engaged in the manufacture of iron, brass, and other metal products. Metallurgical production facilities were the most prominent industry in Reading and exceeded other manufacturing establishments in furnishing dependable employment to the greatest number of working people. The Philadelphia & Reading Railroad (P&R) Company Works and the Reading Iron Company Works were early establishments in the development of the city.

In 1836, Keim, Whitaker & Co. built a rolling mill and nail factory, known as Reading Iron & Nail Works. It was located at the foot of 7th street, between the Schuylkill River and the Philadelphia & Reading railroad (which had just been constructed). It was here that the first large stationary engine in Berks county was introduced for driving machinery. Bar-iron and cut nails were made in large quantities. In 1846 the firm name was changed to Seyfert, McManus & Co. and it so remained up to 1878, when the Reading Iron Works was incorporated. The first pipe-mill was built in 1848. Here, butt-weld pipe was made and charcoal iron tubes were made a few years later.

In 1889, the company merged with P&R and in 1923, it reorganized to Philadelphia & Reading Coal and Iron Co. to comply with the Sherman/Clayton Antitrust Act. By 1936, 100 years after it was founded as a maker of iron nails, the company manufactured 90 percent of the world's supply of puddled wrought iron pipe at its facilities in Reading. It produced 90,000 tons of iron pipe and 52,000 kegs of nails and had sales of $3.7 million. Reading pipe and wrought iron was used in the White House, the Library of Congress, and the gates at Arlington National Cemetery. The mechanism controlling the gates at Hoover Dam is made of Reading wrought iron. Resistant to corrosion, it was used in the ocean liner Mariposa and the Pulaski Skyway viaduct in northern New Jersey.

In 1942, the site became the home of Reading Tube Corporation, which manufactured copper tubing. The site changed hands again in the late 20th century and is now occupied by United Corrstack, LLC and DS Smith Recycling (United Corrstack operates under the name DS Smith Recycling). The enterprises currently produce corrugated packaging products.

1.1.3 Site Description

A review of the extent of the site suggests the subject site's footprint was approximately 40 acres. The current site's footprint appears to have not changed appreciably since 1922. The site is bounded to west by 7th St, to the north by Laurel St, to the east by a railroad, and to the south by the Schuylkill River. The site is predominantly flat. A circa 1922 site photo shows approximately 23 tiered buildings. Roof and tier heights are estimated to range from 20 ft-agl to 70 ft-agl. Exhaust stacks are located throughout the site.

Figures 1, 2, and 3 (Figures Section) are a site location map, present-day aerial, and circa 1922 site photo respectively.

1.1.4 Background

In July 2016 Debora Hoag (City of Reading Engineer), contacted Todd Richardson (EPA Region III OSC), requesting assistance in evaluating potential lead contamination in a Reading neighborhood. Mrs. Hoag indicated that she had been made aware of a local senior center (the Family First Center) which had been planning to start a community garden. Soil samples were collected from the proposed garden area by PSU's Agriculture Extension.

Analytical results showed a lead concentration of approximately 1017 ppm in one of the samples. In response, EPA mobilized under its START program to the Family First Center in September 2016 to conduct in-situ soil screening in the area where the garden was to be located. EPA returned later that same month to screen and sample the nearby Reading Iron Playground which included an active community produce garden.

For completeness, we include the results of the above sampling in Appendix A. The mapped results generally indicate the highest soil concentrations of lead are located in the vicinity of the former Reading Iron Works site, which provided the basis for performing the dispersion modeling analysis of the historic facility operations.

2.0 MODELING ANALYSIS

2.1 AIR QUALITY MODEL

AERMOD is an EPA-preferred, steady-state, Gaussian air dispersion model that is designed to estimate downwind ground-level concentrations and deposition fluxes from single or multiple emissions sources using detailed meteorological data.

Major features of AERMOD include:

- Plume rise, in stable conditions, is calculated using Briggs equations that consider wind and temperature gradients at stack top and half the distance to plume rise; in unstable conditions, plume rise is superimposed on the displacements by random convective velocities, accounting for updrafts and downdrafts due to momentum and buoyancy as a function of downwind distance for stack emissions;
- Plume dispersion receives Gaussian treatment in horizontal and vertical directions for stable conditions and non-Gaussian probability density function in vertical direction only for unstable conditions;
- AERMOD creates profiles of wind, temperature, and turbulence, using all available measurement levels and accounts for meteorological data throughout the plume depth;
- Surface characteristics, such as Bowen ratio, albedo, and surface roughness length, may be specified to better simulate the modeling domain;
- Planetary boundary layer (PBL) parameters such as friction velocity, Monin-Obukhov length, convective velocity scale, mechanical and convective height, and sensible heat flux may be specified;
- AERMOD uses convective (based upon hourly accumulation of sensible heat flux) and mechanical mixed layer heights;
- AERMAP, AERMOD’s terrain processor, provides information for AERMOD’s advanced critical dividing streamline height algorithms and uses U.S. Geological Survey (USGS) National Elevation Data (NED) to obtain elevations;
- AERMOD uses vertical and horizontal turbulence-based plume growth (from measurements and/or PBL theory) that varies with height and uses continuous growth functions;
- AERMOD uses convective updrafts and downdrafts in a probability density function to predict plume interaction with the mixing lid in convective conditions while using a mechanically mixed layer near the ground;
- Plume reflection above the lid is considered;
- AERMOD models impacts that occur within the cavity regions of building downwash via the use of the PRIME algorithm and uses the standard AERMOD algorithms for areas without downwash.

2.1.1 Source Parameters

As stated above, the analysis is based on the foundry as it existed circa 1922. Source parameters for the era were not available. Therefore, Tetra Tech performed professional assumptions as follows that are believed to adequately represent the site exhaust characteristics circa 1922.

- Exhaust heights and diameters are estimated based on a derived scale of a present-day site structure that existed circa 1922[1].
- Exhaust velocities and temperatures are taken from Chapter VI-9[2] of *Exhaust Gases from Combustion and Industrial Processes,* Engineering Science Inc., Washington DC, 10/02/1971. The document suggests, for air dispersion purposes, to assume an exhaust velocity and temperature of 40 ft/s and 200°F respectively[3]. Therefore, these values are used for all stacks at the site.
- Base elevations (i.e., for stacks) are derived using digitized terrain data and the AERMAP terrain-processing program (see Section 2.5).
- Emission rates are assumed to be 1 g/s for each stack, because no actual emissions information was available. Because the purpose of the modeling is to assess soil sampling locations and not to quantitatively predict soil concentrations, the magnitude of the emissions is not relevant to the purpose of the study.

Table 1 (Tables Section) lists the source parameters used in the analysis.

2.1.2 Deposition

The site's PM emissions are assumed to both disperse downwind and deposit on the ground. Therefore, we incorporate particle deposition in the analysis to reflect downwind impacts to soil. AERMOD requires a particle diameter, mass fraction, and density for particle size distribution fractions. Below are the values we determined to be representative of the site[4]:

Particle Diameter (μm)	Mass Fraction	Density (g/cm^3)
30	0.17	3.0
10	0.23	3.0
2.5	0.60	3.0

[1] Google Earth Pro was used to measure
[2] Gray Iron Foundry
[3] If no representative or site-specific information is identified
[4] EPA. *AP-42: Compilation of Emission Factors.* Table 12.5-2 (Oct 1986)

2.2 PROJECT SITE CHARACTERISTICS

2.2.1 Land Use Analysis

Appendix W in the *Guideline on Air Quality Models* specifies a procedure to determine whether land usage surrounding the modeled source is primarily urban or rural. These classifications are used by the model for its dispersion calculations and results typically differ depending on whether rural or urban dispersion coefficients are used.

EPA's preferred land use procedure (Auer, 1978) classifies land use within an area circumscribed by a circle, centered on the source, with a radius of 3 km. If land use types "industrial" (I-1, I-2), "commercial" (C-1), or "compact residential" (R-2, and R-3) account for 50 percent or more of the land use within 3 km radius of the subject site, then the modeling regime is considered urban.[5]

The land use (circa 1922) for a 3-km area surrounding the site was difficult to determine, based on the Auer scheme. Based on the information available to us, we were not able to definitively determine the appropriate circa 1922 land use and therefore we opted to perform the analysis using both rural and urban dispersion coefficients for completeness.

2.3 GEP STACK HEIGHT ANALYSIS

A GEP analysis was performed for each stack included in the analysis. The purpose of this evaluation is to determine if the discharge from a stack will become caught in the turbulent wake of a nearby (defined as a distance up to 5L [L defined below] from the stacks) building or other structure, resulting in downwash of the plume (downwash of a plume can result in elevated ground-level concentrations). The procedure is based on EPA's *Guideline for Determination of Good Engineering Practice Stack Height* (EPA 1985), the Stack Height Regulations (40 CFR § 51), and current Model Clearinghouse guidance. GEP stack height, measured from the base of the stack, is defined as the greater of 65 meters or stack height calculated from the following formula:

H_g (GEP stack height) = H + 1.5L,

H = the height of the nearby structure

L = the lesser of the building height or the greatest crosswind distance of the building ("maximum projected width")

2.3.1 Site Specific GEP Analysis

The complex building regime (i.e., multi-tiered structures), distances to stacks, and heights relative to stack heights potentially influence dispersion. Therefore, we developed building dimensions and locations to determine direction-specific downwash parameters using the current version of EPA's BPIP-PRIME downwash algorithm. The BPIP-PRIME algorithm provides direction-specific building dimensions to evaluate downwash conditions.[6] **Figures 4 and 5** (Figures Section) show the buildings and sources input to BPIP-PRIME.

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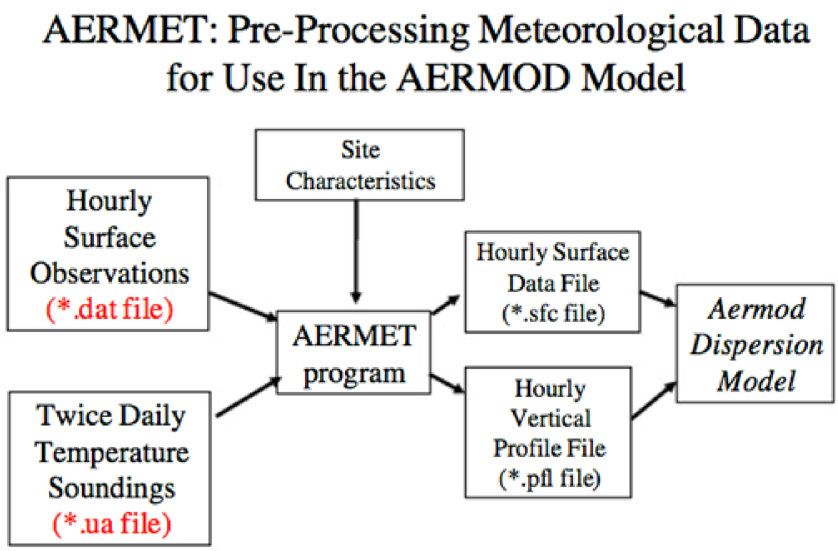
[5] Compact residential and industrial areas are often the pink and purple-colored areas identified on USGS 7.5-minute topographic maps.
[6] Building locations, tiers, and dimensions were developed using Google Earth Pro

2.4 METEOROLOGICAL DATA

AERMET is a meteorological preprocessor that produces meteorological data files that can be read by AERMOD. Data used as input to AERMET should ensure that the wind, temperature and turbulence profiles derived by AERMOD are both laterally and vertically representative of the source area. The primary atmospheric input variables including wind speed and direction, ambient temperature, cloud cover, and a morning upper air sounding should also be adequately representative of the source area. The diagram below is a depiction of inputs and outputs of the AERMET program:



AERMET requires input of the following information:

- Surface roughness
- Bowen ratio
- Albedo by sector and season or month
- Hourly observations of wind speed
- Wind direction
- Cloud cover
- Temperature
- Morning sounding from a representative upper air station
- Latitude and longitude
- Time zone
- Wind speed threshold

Additionally, measured profiles of wind, temperature, vertical and lateral turbulence may be required in certain applications (e.g., in complex terrain) to adequately represent the meteorology affecting plume transport and dispersion. Optionally, measurements of solar, or net radiation may be input to AERMET. Two files are produced by the AERMET meteorological preprocessor for input to the model. The surface file contains observed and calculated surface variables, one record per hour. The profile file contains the observations made at each level of a meteorological tower (or remote sensor), or the one-level observations taken from other representative data (e.g., National Weather Service surface observations), one record per level per hour.

The surface file contains the following parameters (in this order):

1. Year
2. Month
3. Day
4. Julian Day
5. Hour
6. Sensible heat flux
7. Surface friction velocity (Ustar)
8. Convective velocity scale (Wstar)
9. Vertical potential temperature gradient above PBL (VPTG)
10. Convective mixing height (PBL)
11. Mechanical mixing height (SBL)
12. Monin-Obukhov length(MOL)
13. Surface roughness (Z0)
14. Bowen ratio (BRatio)
15. Albedo
16. Wind speed (WS)
17. Wind direction (WD)
18. Reference height for winds (WRef=10m)
19. Surface temperature (KTEMP)
20. Reference height for surface temp (TRef=2m)
21. Precipitation code
22. Precipitation rate (RPPTN)
23. Relative humidity (RH)

The profile file contains the following parameters (in this order):

1. Year
2. Month
3. Day
4. Hour
5. Height
6. Top (1, if this is the last (highest) level for this hour, or 0 otherwise)
7. WDnn - wind direction at the current level (degrees)
8. WSnn - wind speed at the current level (m/s)
9. TTnn - temperature at the current level (°C)
10. SAnn - Sigmatheta (degrees)
11. SWnn - SigmaW (m/s)

The 5-year concatenated meteorological dataset, provided by the Pennsylvania Department of Environmental Protection (PADEP), is composed of sequential hourly meteorological data (output of AERMET) that is read by AERMOD and used for calculating downwind concentrations and deposition of pollutants.

The surface data input to AERMET were obtained from the National Weather Service (NWS) site located at Carl A. Spaatz Field (RDG). The airport is located northwest (328°) and 6.8 km (4.2 mi) from the former Reading Iron Works site. Upper air data input to AERMET were obtained from the NWS site located at Sterling, VA (LWX), which is southwest (221°) and 199 km (124 mi) from the former Reading Iron Works site. These NWS sites are recommended by PADEP as representative of the surface and upper air meteorology of Reading.

2.5 RECEPTORS

Terrain close to the site is generally flat to undulating. Terrain farther out is hilly, especially to the east. Tetra Tech developed a comprehensive receptor grid (5,093 receptors), with 25-meter spacing out to approximately 600 meters in all quadrants. Additional receptors are placed beyond 600 meters, extending to over 3,200 meters in all quadrants. This grid assures that resulting spatial concentration and deposition gradients are adequately identified.

The appropriate USGS NED terrain files are used to obtain the necessary receptor elevations. AERMAP uses gridded terrain data for the modeling domain to calculate not only an XYZ coordinate, but also a representative terrain-influence height associated with each receptor location selected. This terrain-influenced height, called the *height scale*, is separate for each individual receptor. AERMAP uses the electronic NED terrain data to populate the model with receptor elevations.

Figure 6 (Figures Section) shows the receptor grid as input to AERMOD.

3.0 MODELING RESULTS

The model was run using urban and rural dispersion parameters. **Figures 7 through 10** (Figures Section) show the concentration and deposition gradients for each case. As shown in each figure, the areas of predicted maxima occur proximate to the former facility and on the western slope of Neversink Mountain to the east of the former facility. These locations generally coincide with the soil sample locations shown in Appendix A.

Based on these results, we believe the 2016 sampling program adequately covers the areas where expected soil concentration maxima would likely occur. Therefore, we conclude additional sampling would not likely provide any substantial benefit.

4.0 REFERENCES

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TABLES

Table 1 Source Parameters

Model ID	UTM[1] Easting (m)	UTM[1] Northing (m)	Base Elevation[2] (ft)	Exhaust Parameters Height[1] (ft)	Temp[3] (°F)	Velocity[3] (fps)	Diameter[1] (ft)
1	421,575	4,464,359	214	162	200	40	8
2	421,577	4,464,412	214	162	200	40	8
3	421,577	4,464,424	214	129	200	40	8
4	421,583	4,464,507	222	162	200	40	8
5	421,621	4,464,484	221	85	200	40	6
6	421,618	4,464,359	226	150	200	40	9
7	421,613	4,464,355	225	150	200	40	9
8	421,685	4,464,372	248	150	200	40	6
9	421,626	4,464,325	227	65	200	40	4
10	421,629	4,464,320	227	65	200	40	4
11	421,633	4,464,314	227	65	200	40	4
12	421,661	4,464,326	234	65	200	40	4
13	421,614	4,464,295	227	65	200	40	4
14	421,607	4,464,290	227	65	200	40	4
15	421,621	4,464,284	228	65	200	40	4
16	421,613	4,464,279	227	65	200	40	4
17	421,636	4,464,208	224	100	200	40	8
18	421,640	4,464,200	222	100	200	40	8
19	421,617	4,464,198	221	100	200	40	8
20	421,619	4,464,173	219	155	200	40	8
21	421,607	4,464,166	218	145	200	40	8
22	421,554	4,464,234	215	150	200	40	8
23	421,583	4,464,126	213	150	200	40	8
24	421,564	4,464,168	213	135	200	40	8
25	421,553	4,464,160	212	150	200	40	8
26	421,537	4,464,198	212	150	200	40	8
27	421,496	4,464,183	207	150	200	40	8
28	421,460	4,464,138	207	100	200	40	8
29	421,465	4,464,136	207	100	200	40	8
30	421,470	4,464,134	208	100	200	40	8
31	421,476	4,464,131	208	100	200	40	8
32	421,482	4,464,128	208	100	200	40	8
33	421,488	4,464,126	208	100	200	40	8
34	421,493	4,464,124	208	100	200	40	8
35	421,500	4,464,121	208	100	200	40	8
36	421,505	4,464,119	208	100	200	40	8
37	421,511	4,464,117	209	100	200	40	8
38	421,516	4,464,115	209	100	200	40	8
39	421,522	4,464,113	209	100	200	40	8
40	421,527	4,464,111	209	100	200	40	8
41	421,531	4,464,108	209	100	200	40	8

[1] Derived using Google Earth Pro
[2] Derived using AERMAP
[3] Source: Engineering-Science Inc, *Exhaust Gases from Combustion and Industrial Processes*, Oct 2, 1971

TETRA TECH

FIGURES

Source: Google Earth

N

0 580 1160

Feet

SCALE IS APPROXIMATE

Reading Lead Site
Reading, Berks County, PA

Figure 1

Site Location Map

TETRA TECH

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Prepared By: Scott Miller

Date Saved: 08/11/21

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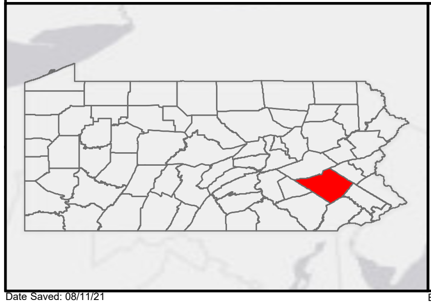
TD No: T601-20-11-001



Source: Google Earth

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Feet

SCALE IS APPROXIMATE

Reading Lead Site
Reading, Berks County, PA

Figure 2

Present Day Aerial

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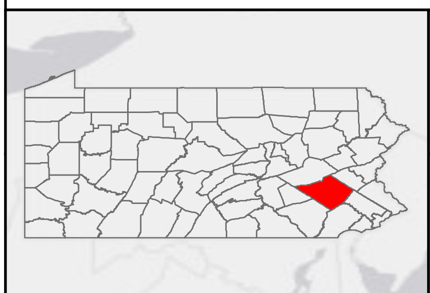
TD No: T601-20-11-001



Source: Google Earth

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Feet

SCALE IS APPROXIMATE

Reading Lead Site
Reading, Berks County, PA

Figure 3

Site Photo (circa 1922)

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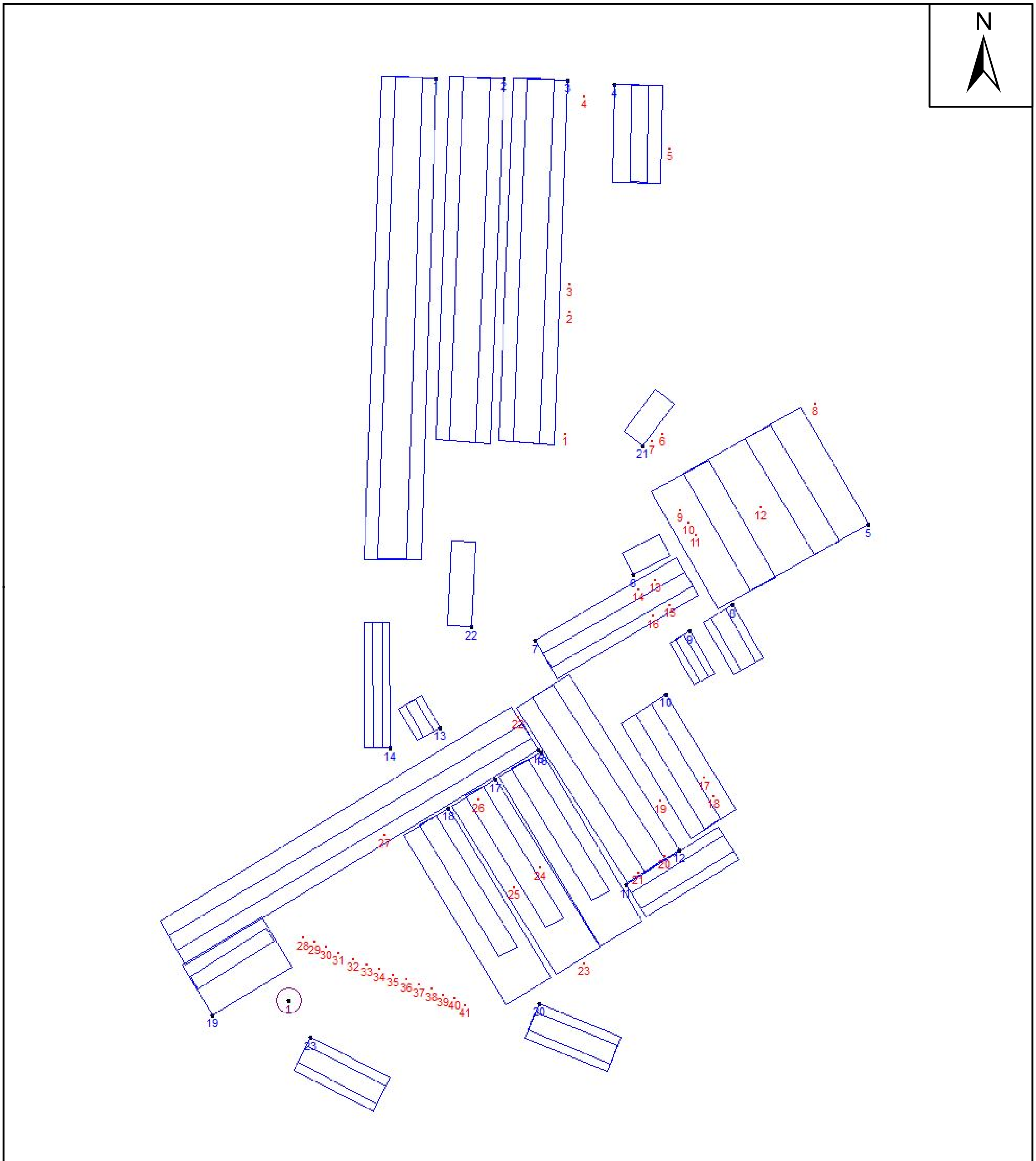
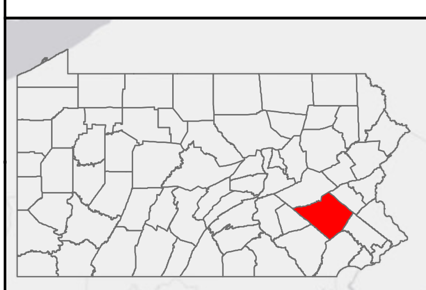
EPA Contract No: 68-HE-0320-D003

TD No: T601-20-11-001





Reading Lead Site
Reading, Berks County, PA

Figure 4

Model Depiction of
Buildings & Source Locations

TETRA TECH

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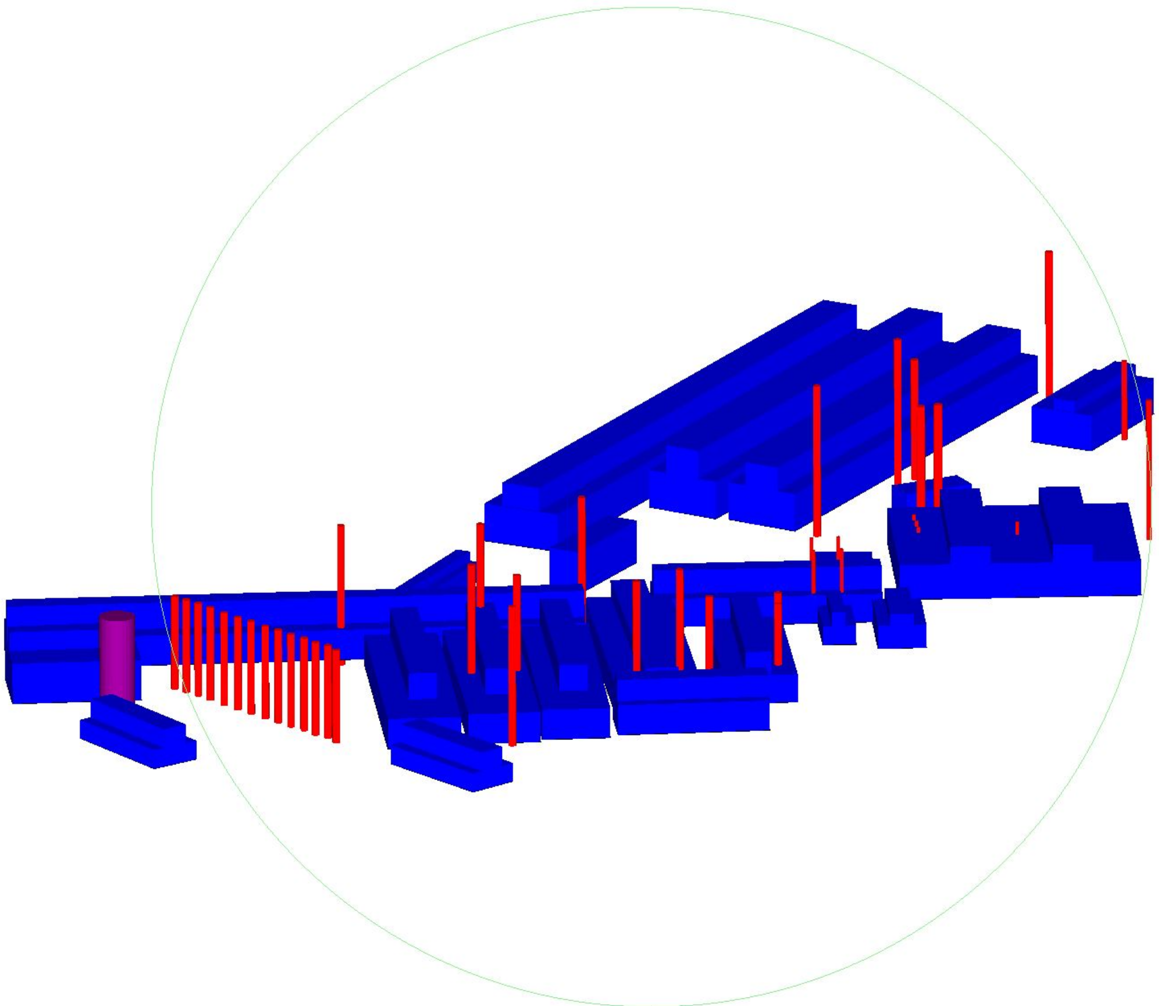

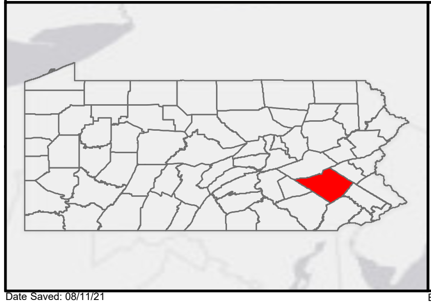

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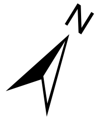

Reading Lead Site
Reading, Berks County, PA

Figure 5

Model Depiction (3D) of Buildings & Source Locations

TETRA TECH

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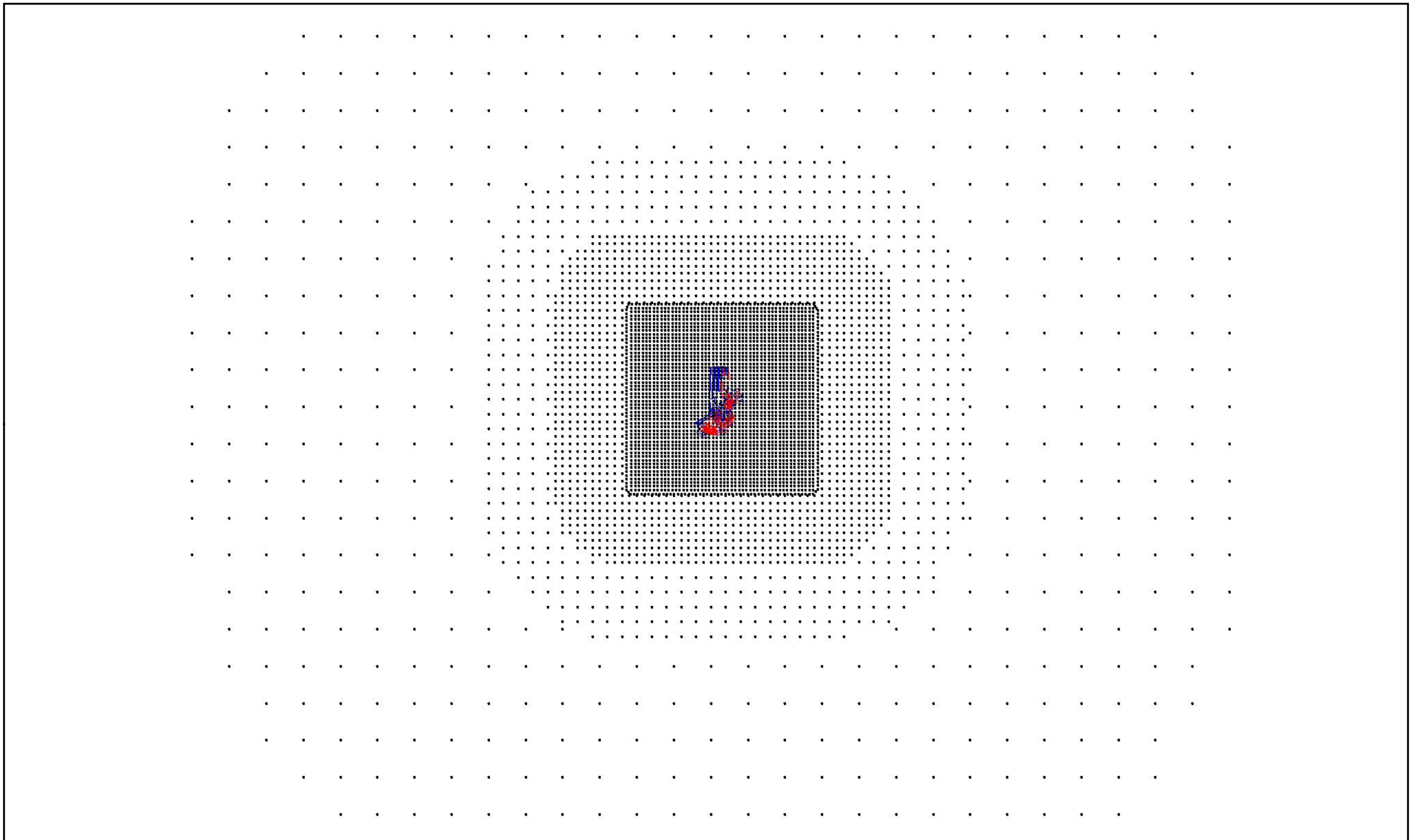

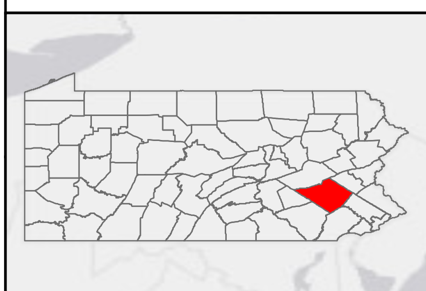

Source: BEEST

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Reading Lead Site
Reading, Berks County, PA

Figure 6
Receptor Grid

TETRA TECH

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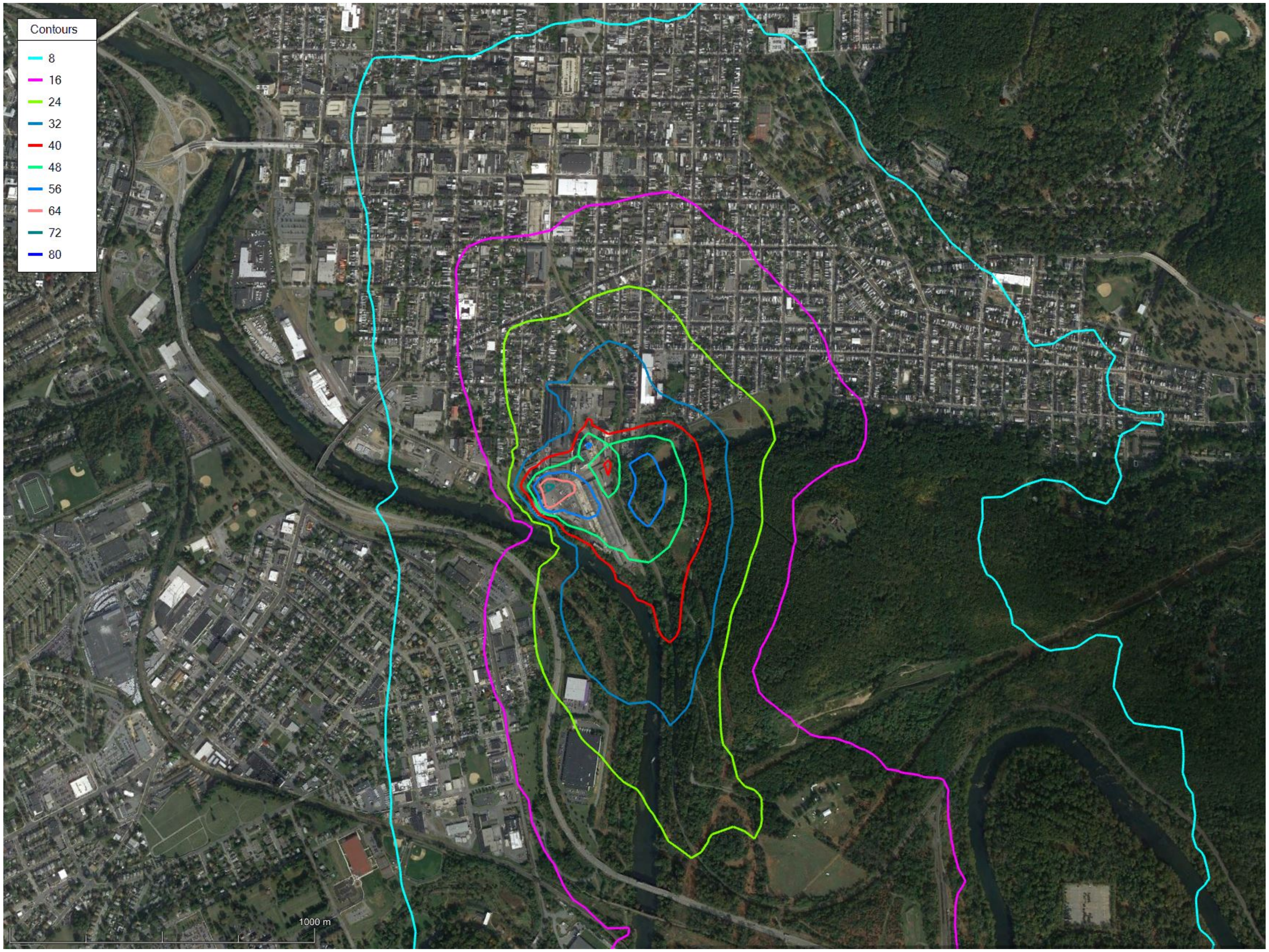
Prepared By: Scott Miller

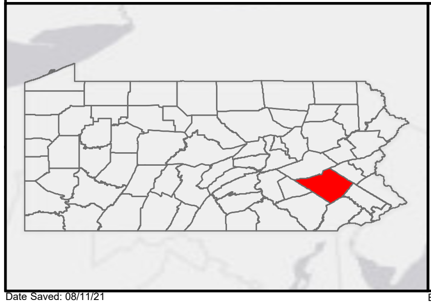
Date Saved: 08/11/21

EPA Contract No: 68-HE-0320-D003

TD No: T601-20-11-001

Contour values shown below are in units of µg/m³





Land Use: Rural

Source: Google Earth

N

0 670 1340

Feet

SCALE IS APPROXIMATE

Reading Lead Site
Reading, Berks County, PA

Figure 7

Concentration Contours

TETRA TECH

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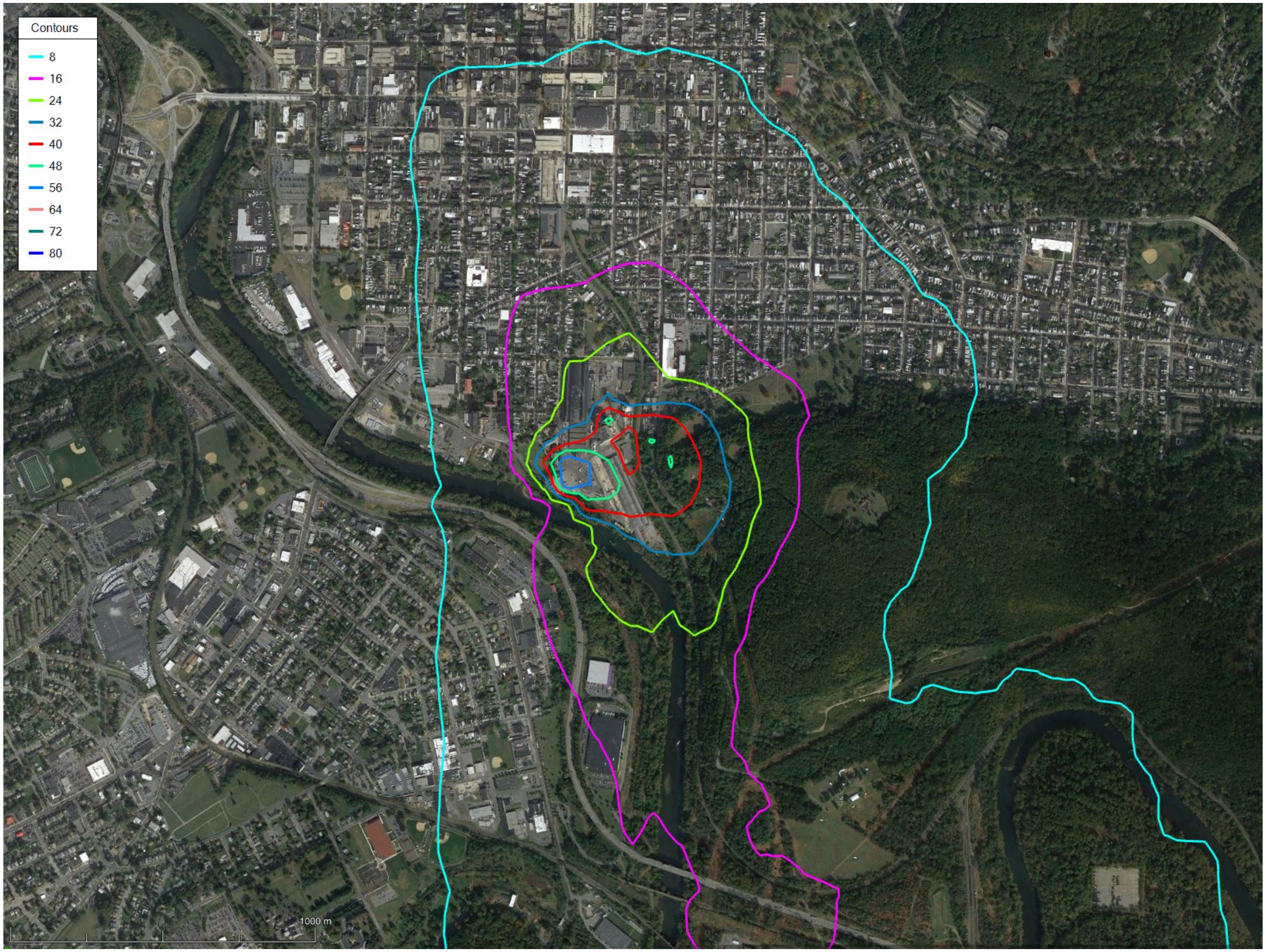
TD No: T601-20-11-001

Contour values shown below are in units of g/m²/yr



Source: Google Earth

Land Use: Rural

N

0 670 1340

Feet

SCALE IS APPROXIMATE

Reading Lead Site
Reading, Berks County, PA

Figure 8

Deposition Contours

TETRA TECH

Prepared For: EPA R3 START VI

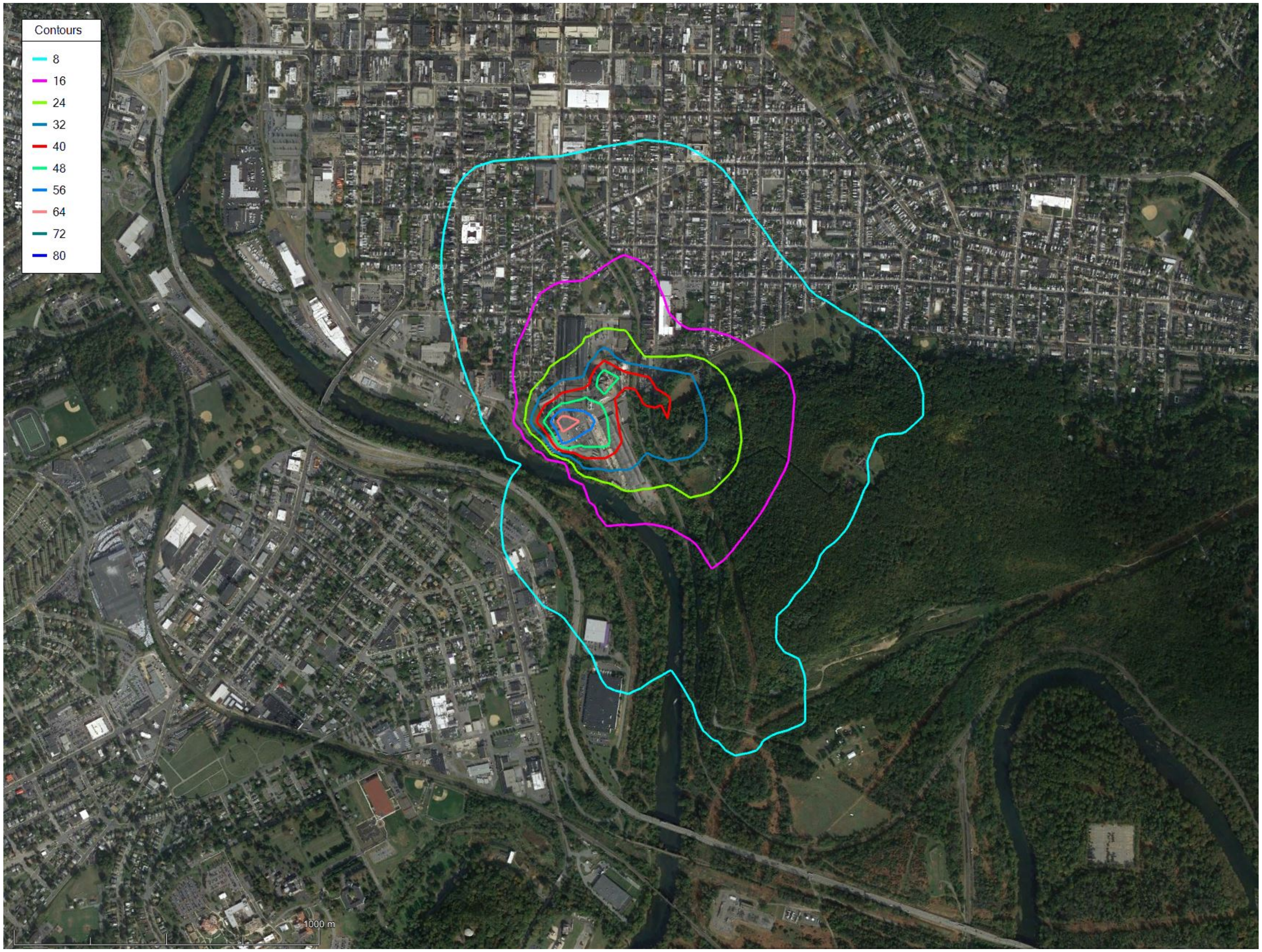
Prepared By: Scott Miller

Date Saved: 08/11/21

EPA Contract No: 68-HE-0320-D003

TD No: T601-20-11-001

Contour values shown below are in units of $\mu g/m^3$



Source: Google Earth

Land Use: Urban

N

0 670 1340

Feet

SCALE IS APPROXIMATE

Reading Lead Site
Reading, Berks County, PA

Figure 9
Concentration Contours

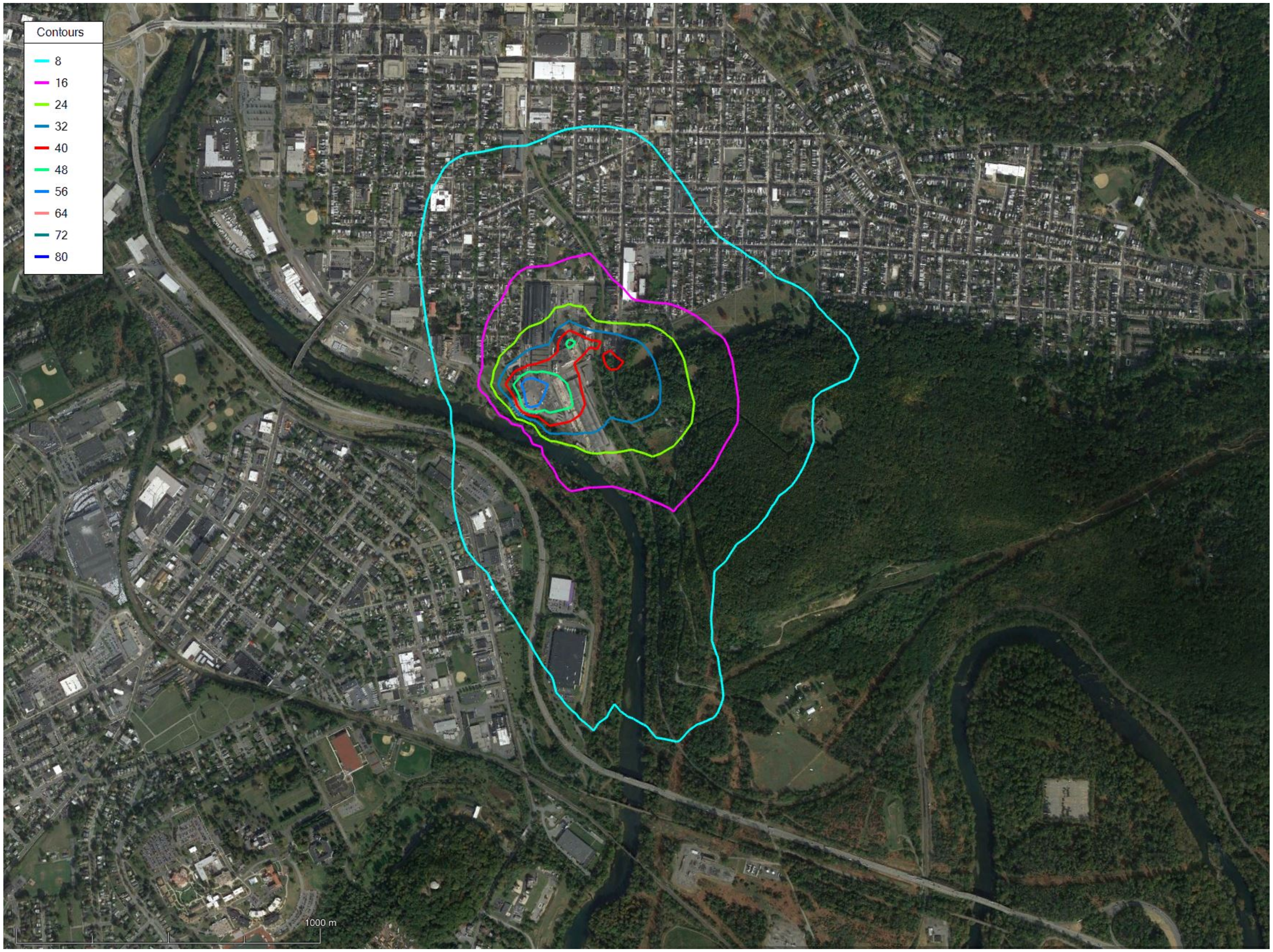
TETRA TECH

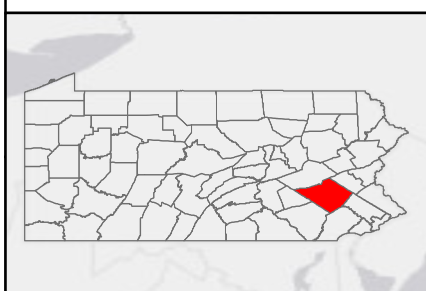
Prepared For: EPA R3 START VI | Prepared By: Scott Miller

Date Saved: 08/11/21

EPA Contract No: 68-HE-0320-D003 TD No: T601-20-11-001

Contour values shown below are in units of $g/m^2/yr$





Land Use: Urban

Source: Google Earth

N
0 670 1340
Feet
SCALE IS APPROXIMATE

Reading Lead Site
Reading, Berks County, PA

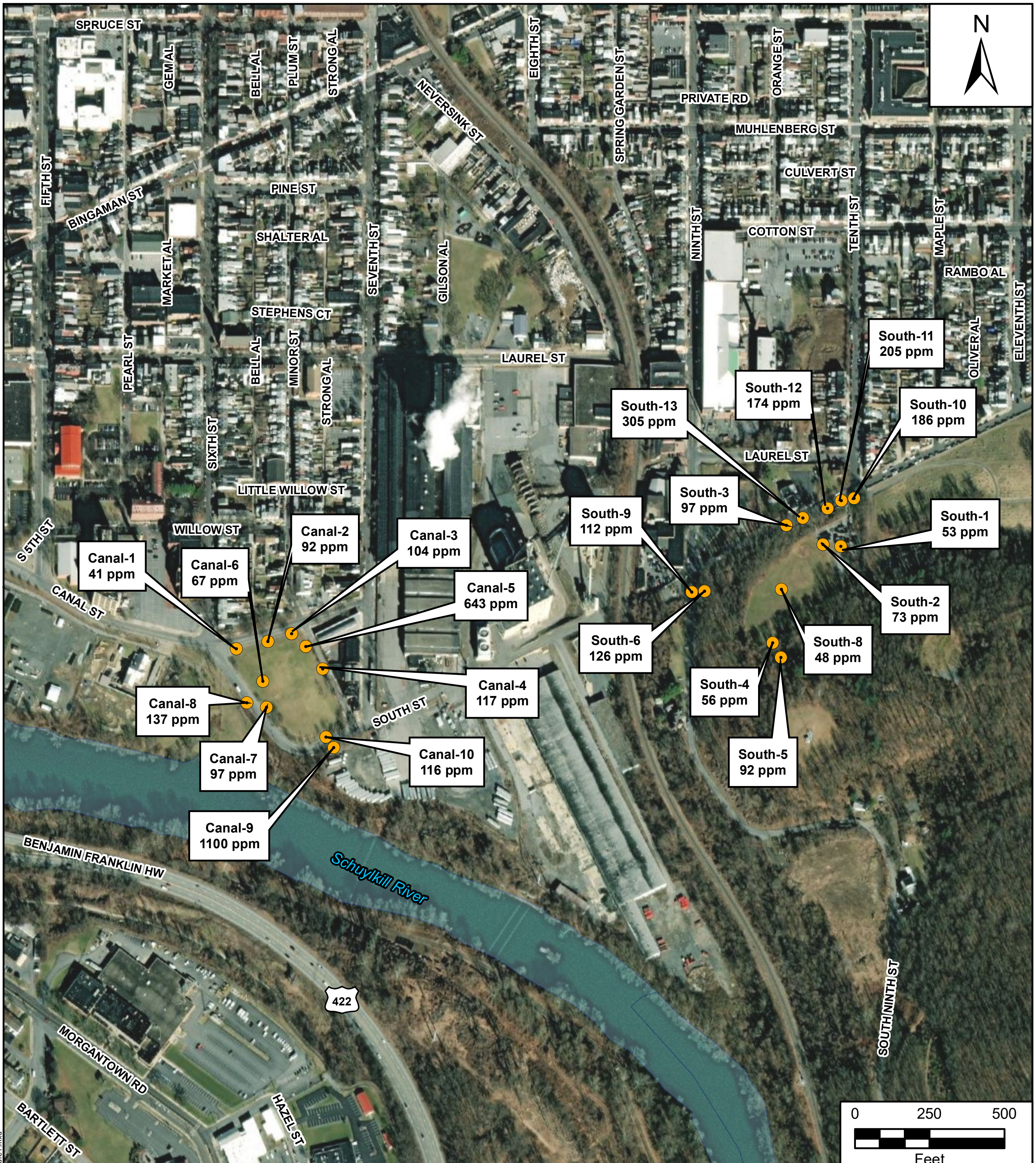
Figure 10
Deposition Contours

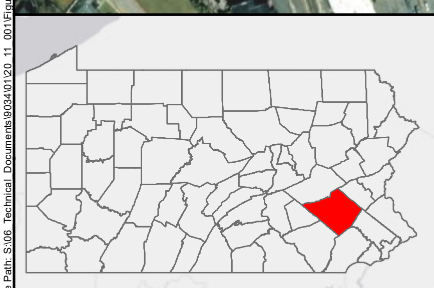
TETRA TECH

Prepared For: EPA R3 START VI
Prepared By: Scott Miller

Date Saved: 08/11/21
EPA Contract No: 68-HE-0320-D003
TD No: T601-20-11-001

APPENDIX A – 2016 SAMPLING RESULTS





Legend

XRF Sample Location

Note:
- ppm = parts per million

Source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Reading Lead
Reading, Berks County, PA

Figure 1

In-Situ XRF Lead Results

TETRA TECH

Prepared For: EPA R3 START VI | Prepared By: Megan Kelly

File Path: S:\06_Technical_Documents\9034\01\20_11_001\Figure1.mxd

Date Saved: 07/02/21 EPA Contract No: 68HE0320D0003 TD No: T601-20-11-001 Coordinate System: NAD 1983 2011 StatePlane Pennsylvania South FIPS 3702 Ft US

Legend

XRF Sample Location

Note:
- ppm = parts per million

N

0 500 1,000
Feet

Reading Lead
Reading, Berks County, PA

Figure 2
Ex-Situ XRF Lead Results

TETRA TECH

Source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

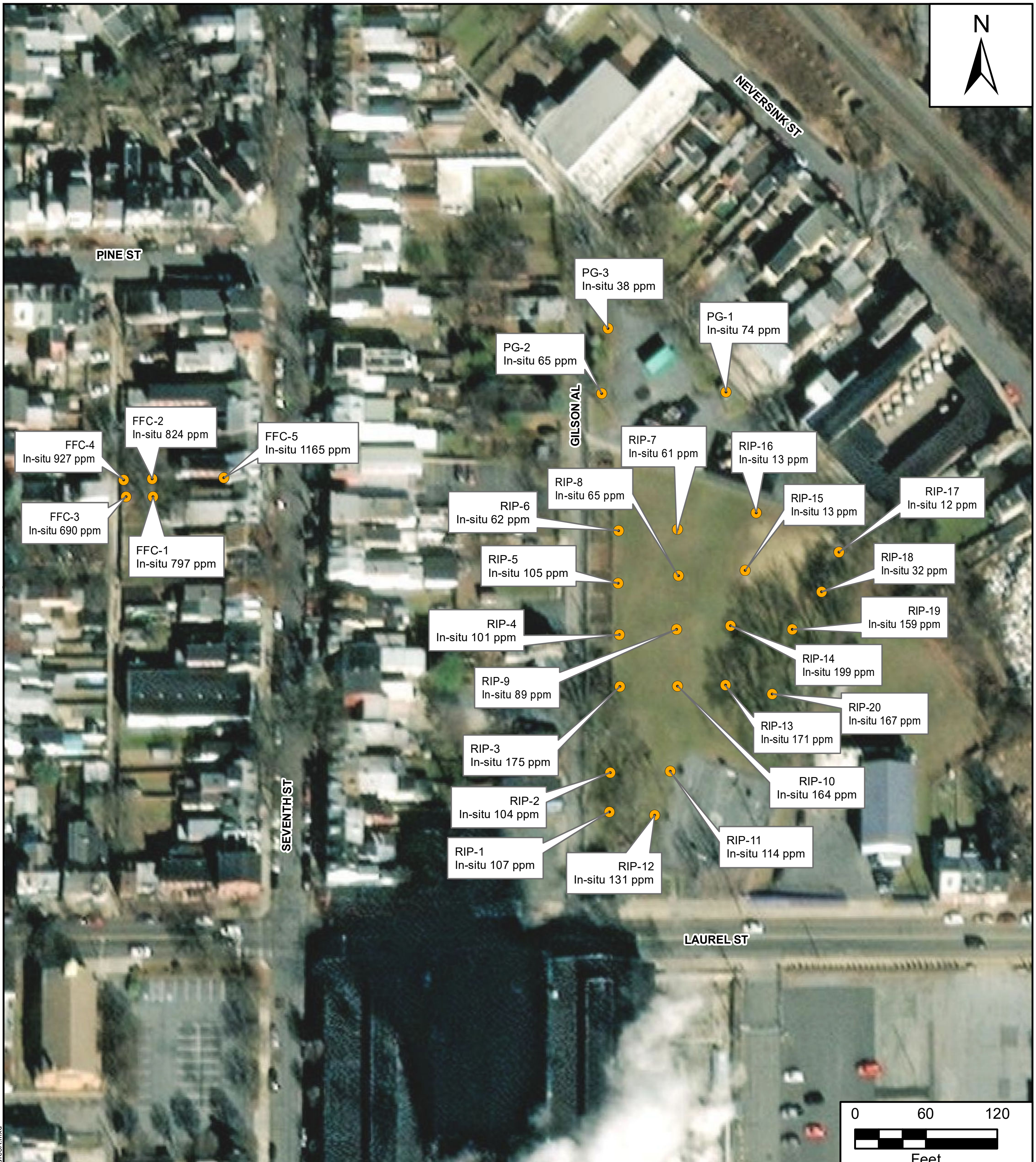
Prepared For: EPA R3 START VI | Prepared By: Aidan Tierney

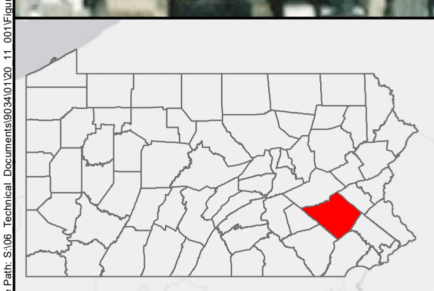
File Path: S:\06_Technical_Documents\9034\01120_11_001\Figure2L.mxd

Date Saved: 07/29/21

EPA Contract No: 68-HE-0320-D003   TD No: T601-20-11-001

Coordinate System: GCS North American 1983





Legend

XRF Sample Location

Note:
- ppm = parts per million

Source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Reading Lead
Reading, Berks County, PA

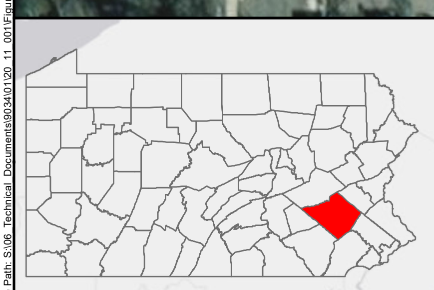
Figure 3A
Community Area In-Situ XRF Lead Results

TETRA TECH

Prepared For: EPA R3 START VI | Prepared By: Aidan Tierney

File Path: S:\06_Technical_Documents\9034\0120_11_001\Figure3A.mxd

Date Saved: 07/30/21 EPA Contract No: 68HE0320D0003 TD No: T601-20-11-001 Coordinate System: NAD 1983 2011 StatePlane Pennsylvania South FIPS 3702 Ft US



Legend

XRF Sample Location

Note:
- ppm = parts per million

Source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Reading Lead
Reading, Berks County, PA

Figure 3B
Community Area In-Situ XRF Lead Results

TETRA TECH

Prepared For: EPA R3 START VI | Prepared By: Aidan Tierney

File Path: S:\06 Technical Documents\9034\0120 11 001\Figure3A.mxd

Date Saved: 07/30/21 EPA Contract No: 68HE0320D0003 TD No: T601-20-11-001 Coordinate System: NAD 1983 2011 StatePlane Pennsylvania South FIPS 3702 Ft US

File Path: S:\06_Technical_Documents\9034\01120_11_001\Figure4.mxd

Legend

XRF Sample Location

Note:
- ppm = parts per million

Source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

N

0 250 500

Feet

Reading Lead
Reading, Berks County, PA

Figure 4

In-situ XRF Lead Results

TETRA TECH

Prepared For: EPA R3 START VI | Prepared By: Aidan Tierney

Date Saved: 07/30/21

EPA Contract No: 68-HE-0320-D003 TD No: T601-20-11-001

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere