HRS DOCUMENTATION RECORD COVER SHEET

Name of Site: Billings PCE
EPA ID No. MTD986073252

Contact Person
Site Investigation and
Documentation Record: Victor Ketellapper (303) 312-6578
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U.S. Environmental Protection Agency, Region 8
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The Billings PCE (Tetrachloroethylene) site is located in Yellowstone County, Montana.

Pathways, Components or Threats Not Scored

Ground Water Migration Pathway

Data indicate that a release to groundwater has occurred and, although it would not contribute significantly to the overall site score, the ground water pathway is of concern. Therefore, the ground water pathway will not be scored as part of this Hazard Ranking System (HRS) package.

Surface Water Migration Pathway

There are no data to satisfy HRS requirements for establishing an observed release to the surface water migration pathway. As such, the surface water migration pathway will not be scored as part of this HRS package.

Soil Exposure and Subsurface Intrusion Pathway

Although there is sampling data to show a release has occurred to shallow soils, the site score would not change as a result of evaluation of the soil exposure portion of the pathway. Additional investigation of this pathway, if warranted, will be performed during further Remedial Investigation (RI) work.

Air Migration Pathway

The listing of this site would not be affected by evaluating the air migration pathway due to the relatively minor impact that it would have on the site score. Additional investigation of this pathway, if warranted, will be performed during a RI.

HRS DOCUMENTATION RECORD

Name of Site:	Billings PCE	Date Prepared: September 2020
EPA Region:	8	
Street Address of Site*:	715 Central Avenue	
City, County, State:	Billings, Yellowstone County, Montana 59102	
General Location in the State:	The site is located in the city of Billings on the Yellowstone River, Yellowstone County, Montana (Figure 1).	

Latitude*: 45° 46’ 12.7543” North

Longitude*: -108° 32’ 03.853” West

Latitude and Longitude coordinates were measured at the approximate location of the former Big Sky Linen site and were determined using a scaled aerial photograph and Bing Maps Aerial imagery software by ESRI.

* The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area the site is located. They represent one or more locations the United States Environmental Protection Agency (EPA) considers to be part of the site based on the screening information EPA used to evaluate the site for NPL listing. EPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, not precisely delineated boundaries. A site is defined as where a hazardous substance has been "deposited, stored, disposed, or placed, or has otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under CERCLA. Accordingly, EPA contemplates that the preliminary description of site boundaries at the time of scoring will be refined as more information is developed as to where the contamination has come to be located.

Scores

Ground Water Migration Pathway[1]	NS
Surface Water Migration Pathway	NS
Soil Exposure and Subsurface Intrusion Pathway	100.00
Air Migration Pathway	NS
HRS Site Score	**50.00**

NS – Not Scored

[1] “Ground water” and “groundwater” are synonymous; the spelling is different due to “ground water” being codified as part of the HRS, while “groundwater” is the modern spelling.

WORKSHEET FOR COMPUTING HRS SITE SCORE

	S	**S^2**
1. (S_{gw}) Ground Water Migration Pathway Score (from Table 3-1, line 13)	NS	NS
2a. Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	NS	NS
2b. Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	NS	NS
2c. Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.	NS	NS
3a. Soil Exposure Component Score (S_{se}) (from Table 5-1, line 22)	NS	NS
3b. Subsurface Intrusion Component Score (S_{ssi}) (from Table 5-11, line 12)	100	10,000
3c. Soil Exposure and Subsurface Intrusion Pathway Score (S_{sessi}) (from Table 5-11, line 13)	100	10,000
4. Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	NS	NS
5. Total of $S_{gw}^2 + S_{sw}^2 + S_{sessi}^2 + S_a^2$		10,000
6. **HRS Site Score** Divide the value on line 5 by 4 and take the square root	50.00	

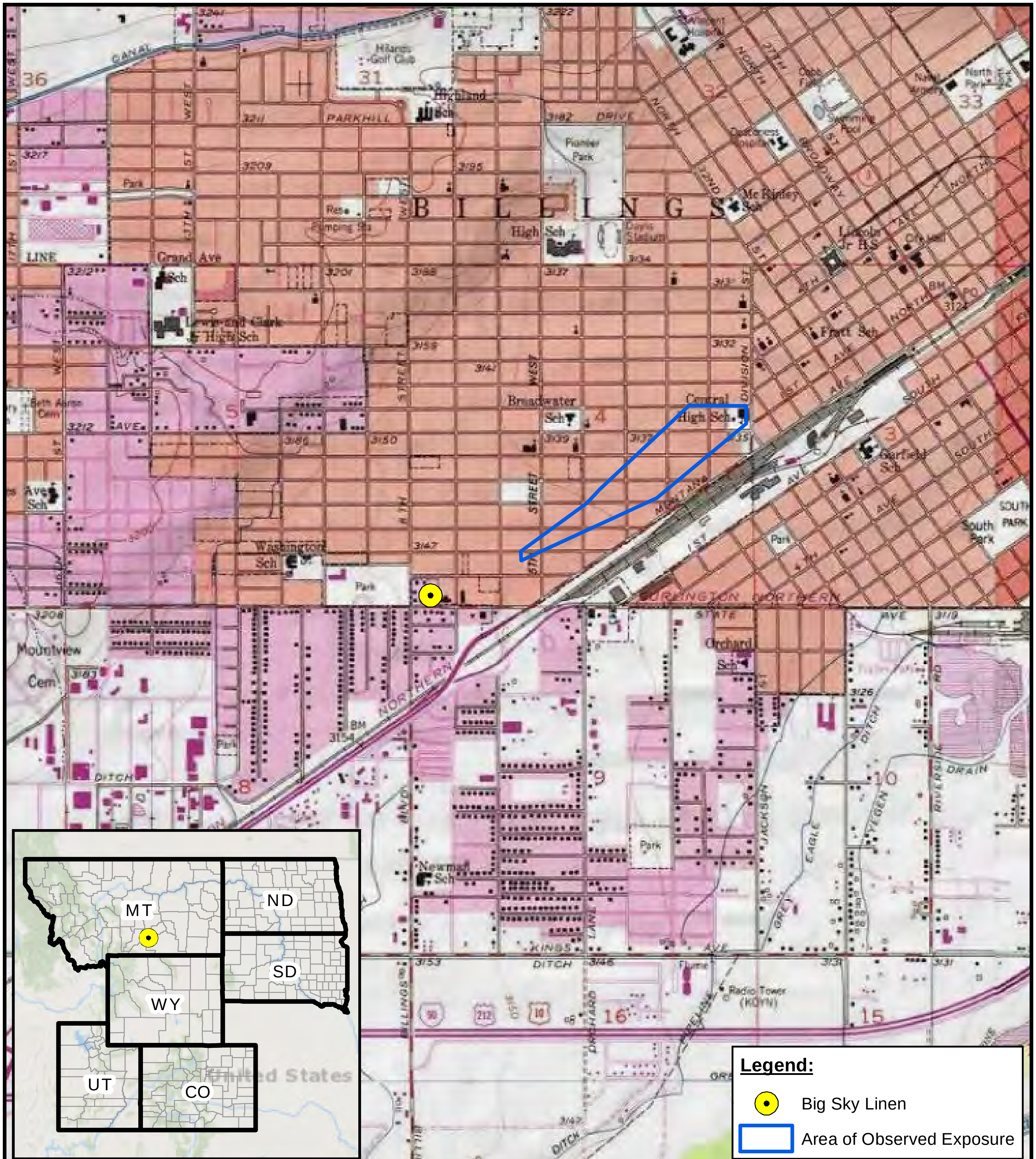
Notes:
S Score
S_2 Score squared
NS Not scored

Table 5-11, refers to score sheets presented in the HRS. Table 5-11 is reproduced on the following page of this HRS documentation record for the convenience of the reader.

HRS Table 5-11
Subsurface Intrusion Component Scoresheet

Factor Categories and Factors	Maximum Value	Value Assigned
Subsurface Intrusion Component		
Likelihood of Exposure:		
1. Observed Exposure	550	**550**
2. Potential for Exposure		
2a. Structure Containment	10	**NS**
2b. Depth to contamination	10	**NS**
2c. Vertical Migration	15	**NS**
2d. Vapor Migration Potential	25	**NS**
3. Potential for Exposure (lines 2a * (2b+2c+2d), subject to a maximum of 500)	500	
4. Likelihood of Exposure (higher of lines 1 or 3)	550	**550**
Waste Characteristics:		
5. Toxicity/Degradation	(a)	**1,000**
6. Hazardous Waste Quantity	(a)	**10,000**
7. Waste Characteristics (subject to a maximum of 100)	100	**56**
Targets:		
8. Exposed Individual	50	**50**
9. Population:		
9a. Level I Concentrations	(b)	**73.7**
9b. Level II Concentrations	(b)	**666.43**
9c. Population within an Area of Subsurface Contamination	(b)	**0**
9d. Total Population (lines 9a + 9b + 9c)	(b)	**740.13**
10. Resources	5	**0**
11. Targets (lines 8 + 9d + 10)	(b)	**790.13**
Subsurface Intrusion Component Score		
12. Subsurface Intrusion Component (lines 4 x 7 x 11)/82,500[c] (subject to a maximum of 100)	100.00	**100.00**
Soil Exposure and Subsurface Intrusion Pathway Score		
13. Soil Exposure Component + Subsurface Intrusion Component (subject to a maximum of 100)	100.00	**100.00**

[a] Maximum value applies to waste characteristics category.
[b] Maximum value not applicable.
[c] Do not round to the nearest integer.
NS – Not Scored



Path: Q:\R8START\Billings PCE HRS\BillingsPCE\Maps\Figure 1 - Site Location Map.mxd

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Projection: Mercator Auxiliary Sphere
Datum: WGS 1984

Source:
Background: ESRI USA Topo Maps (2019)
The source of this map image is ESRI,
used by the EPA with ESRI's permission.
Area of Observed Exposure: Trihydro (Ref. 4 pp. 456-457)

0 0.6 1.2 Miles

N

Prepared for:
U.S. EPA - Region 8

Contract: EP-S8-13-01
TO/TDD: 0004/1905-05

Prepared By:
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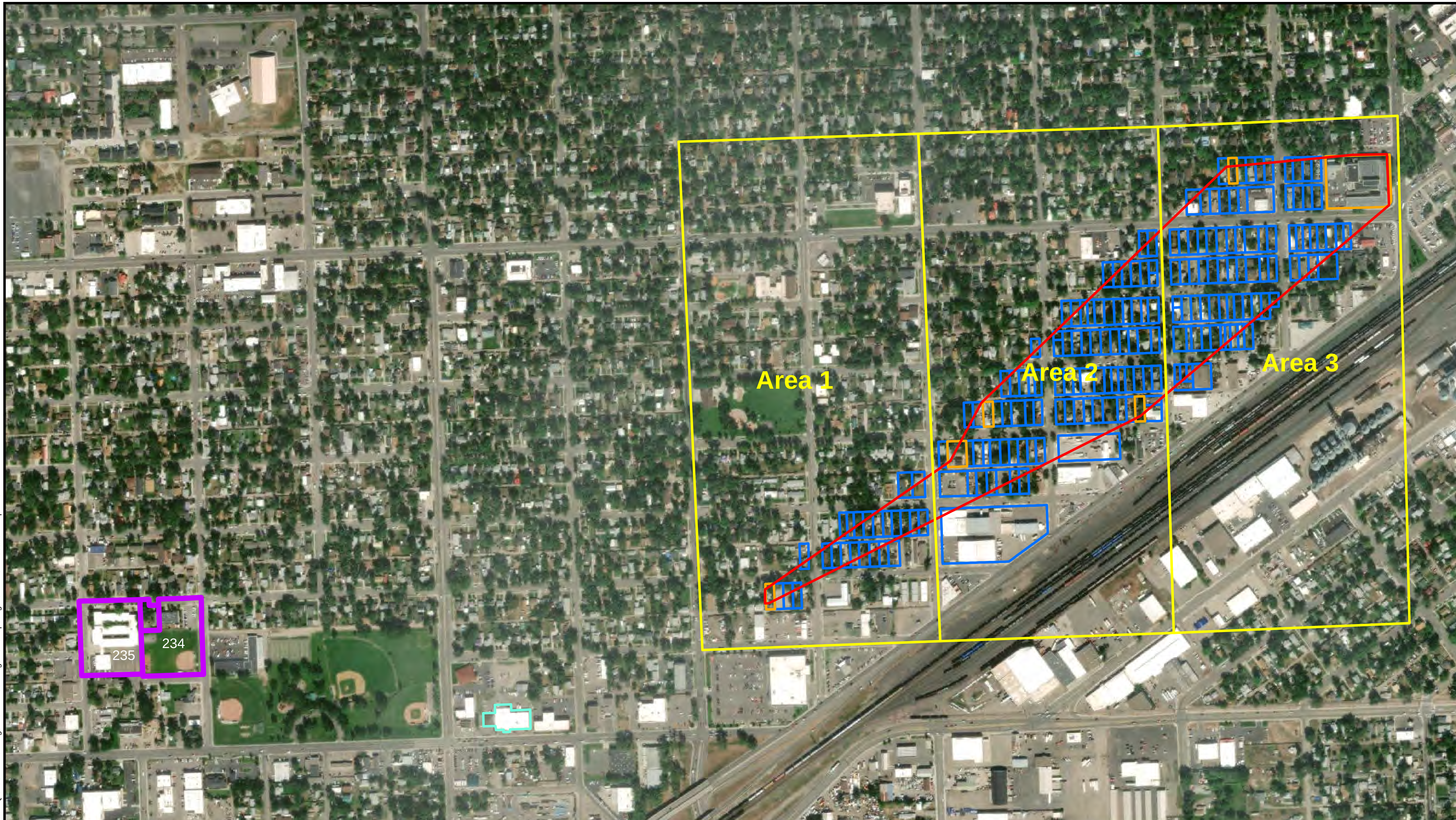
FIGURE 1
SITE LOCATION MAP
BILLINGS PCE
BILLINGS, YELLOWSTONE COUNTY
MONTANA

Date: 8/14/2020



Path: Q:\R8START\Billings PCE HRS\BillingsPCE\Maps\Figure 2 - AOE Location Map.mxd

Coordinate System: NAD 1983 UTM Zone 12N
Projection: Transverse Mercator
Datum: North American 1983

Source:
Background: ESRI World Imagery (2019)
The source of this map image is ESRI, used by the EPA with ESRI's permission.
Parcels: Montana Department of Revenue's ORION database
and Yellowstone County, MT (12/10/2019)
Area of Observed Exposure: Trihydro (Ref. 4 pp. 456-457)

0 600 1,200 Feet

N

Legend

- Big Sky Linen
- Sub-Areas
- Area of Observed Exposure
- Observed Exposure Samples
- Inferred Level II Contamination
- Background Location

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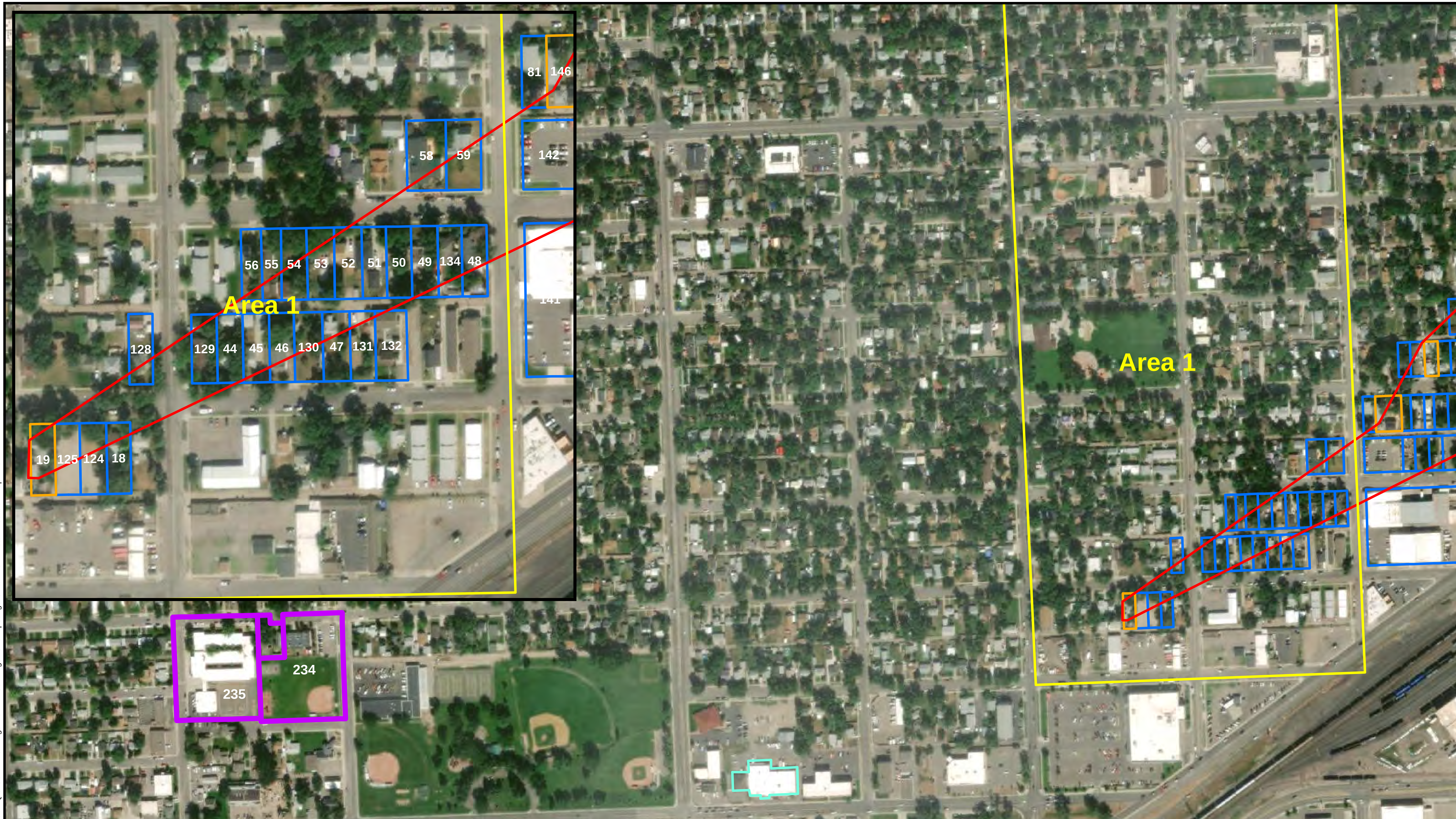
FIGURE 2
AREA OF OBSERVED EXPOSURE (AOE) MAP
BILLINGS PCE
BILLINGS, YELLOWSTONE COUNTY
MONTANA

Date: 8/12/2020



Path: Q:\R8START\Billings PCE HRS\BillingsPCE\Maps\Figure 2a - AOE Area 1-Location Map.mxd

Coordinate System: NAD 1983 UTM Zone 12N
Projection: Transverse Mercator
Datum: North American 1983

Source:
Background: ESRI World Imagery (2019)
The source of this map image is ESRI, used by the EPA with ESRI's permission.
Parcels: Montana Department of Revenue's ORION database
and Yellowstone County, MT (12/10/2019)
Area of Observed Exposure: Trihydro (Ref. 4 pp. 456-457)

0 500 1,000 Feet

N

Legend

- Big Sky Linen
- Sub-Areas
- Area of Observed Exposure
- Observed Exposure Samples
- Inferred Level II Contamination
- Background Location

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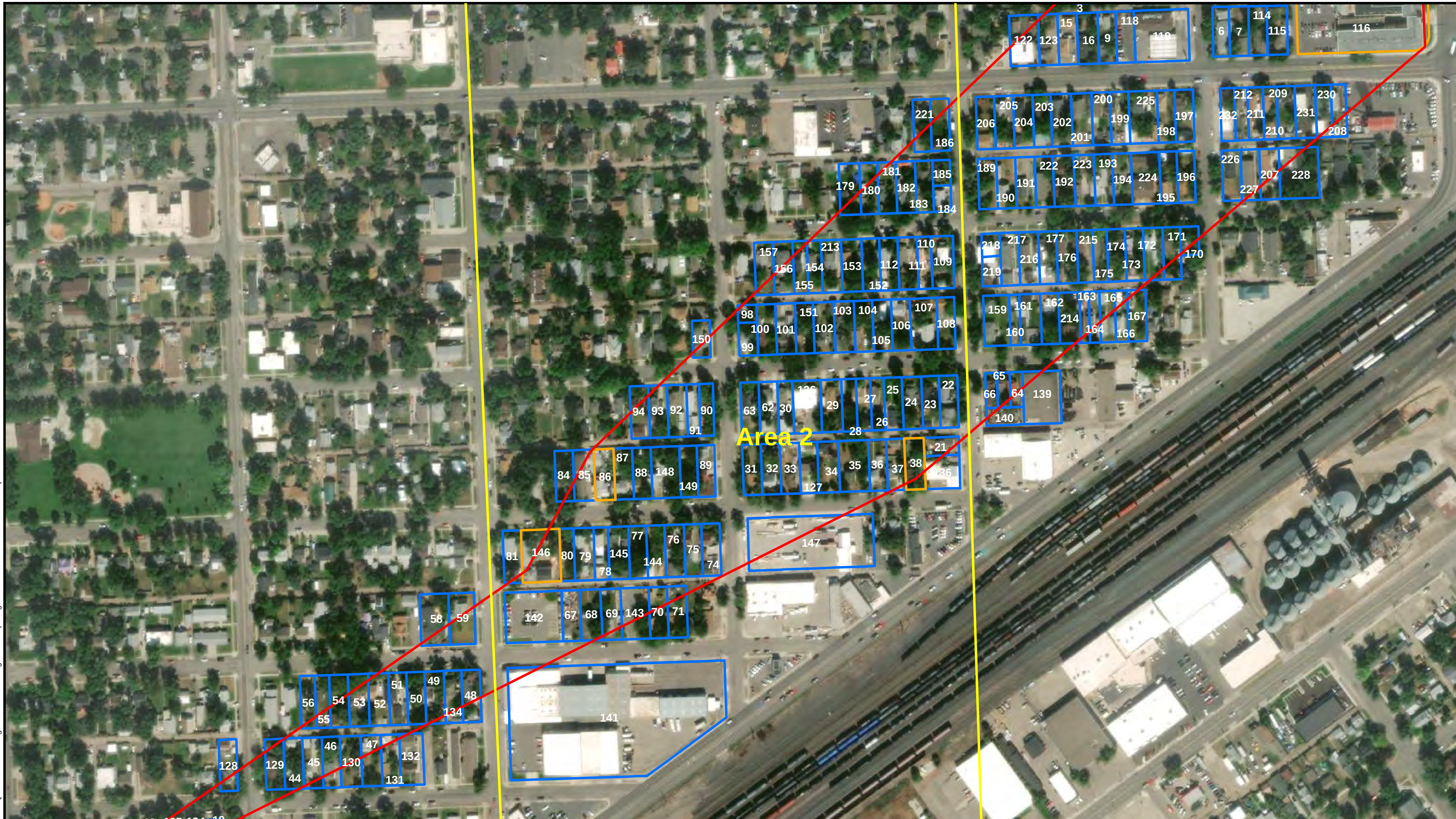
FIGURE 2A
AREA OF OBSERVED EXPOSURE (AOE) MAP
SUB-AREA 1 AND BACKGROUND LOCATIONS
BILLINGS PCE
BILLINGS, YELLOWSTONE COUNTY
MONTANA

Date: 8/12/2020

Path: Q:\R8START\Billings PCE HRS\BillingsPCE\Maps\Figure 2b - AOE Area 2-Location Map.mxd



Coordinate System: NAD 1983 UTM Zone 12N
Projection: Transverse Mercator
Datum: North American 1983

Source:
Background: ESRI World Imagery (2019)
The source of this map image is ESRI, used by the EPA with ESRI's permission.
Parcels: Montana Department of Revenue's ORION database
and Yellowstone County, MT (12/10/2019)
Area of Observed Exposure: Trihydro (Ref. 4 pp. 456-457)

0 300 600 Feet

N

Legend

- Sub-Areas
- Area of Observed Exposure
- Observed Exposure Samples
- Inferred Level II Contamination

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Contract: EP-S8-13-01
TO/TDD: 0004/1905-05

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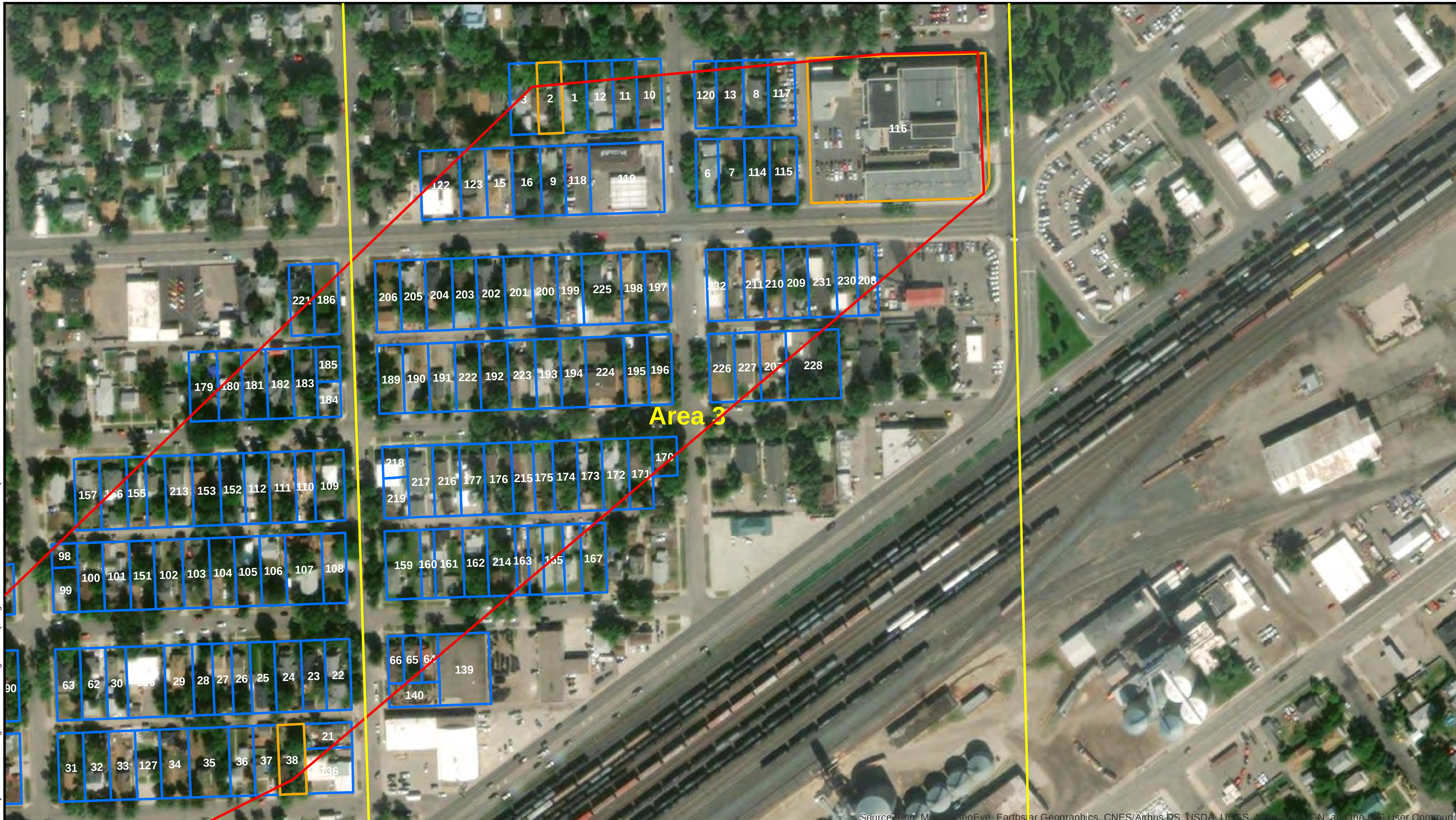
FIGURE 2B
AREA OF OBSERVED EXPOSURE (AOE) MAP
SUB-AREA 2
BILLINGS PCE
BILLINGS, YELLOWSTONE COUNTY
MONTANA

Date: 8/12/2020



Path: Q:\R8START\Billings PCE HRS\BillingsPCE\Maps\Figure 2c - AOE Area 3-Location Map.mxd

Coordinate System: NAD 1983 UTM Zone 12N
Projection: Transverse Mercator
Datum: North American 1983

Source:
Background: ESRI World Imagery (2019)
The source of this map image is ESRI, used by the EPA with ESRI's permission.
Parcels: Montana Department of Revenue's ORION database
and Yellowstone County, MT (12/10/2019)
Area of Observed Exposure: Trihydro (Ref. 4 pp. 456-457)

0 250 500 Feet

N

Legend

- Sub-Areas
- Area of Observed Exposure
- Observed Exposure Samples
- Inferred Level II Contamination

Prepared for:
U.S. EPA - Region 8

Contract: EP-S8-13-01
TO/TDD: 0004/1905-05

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FIGURE 2C
AREA OF OBSERVED EXPOSURE (AOE) MAP
SUB-AREA 3
BILLINGS PCE
BILLINGS, YELLOWSTONE COUNTY
MONTANA

Date: 8/12/2020

Path: Q:\R8START\Billings PCE HRS\BillingsPCE\Maps\Figure 3 Groundwater Sample Location Map.mxd

Coordinate System: NAD 1983 UTM Zone 12N
Projection: Transverse Mercator
Datum: North American 1983

Source:
Background: ESRI World Imagery (2019)
The source of this map image is ESRI, used by the EPA with ESRI's permission.
TCE Groundwater Plume: Trihydro (Ref. 4 pp. 447)

0 1,000 2,000 Feet

N

Legend

Groundwater Sample Locations

Trichloroethene Groundwater Plume - September 2018

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TO/TDD: 0004/1905-05

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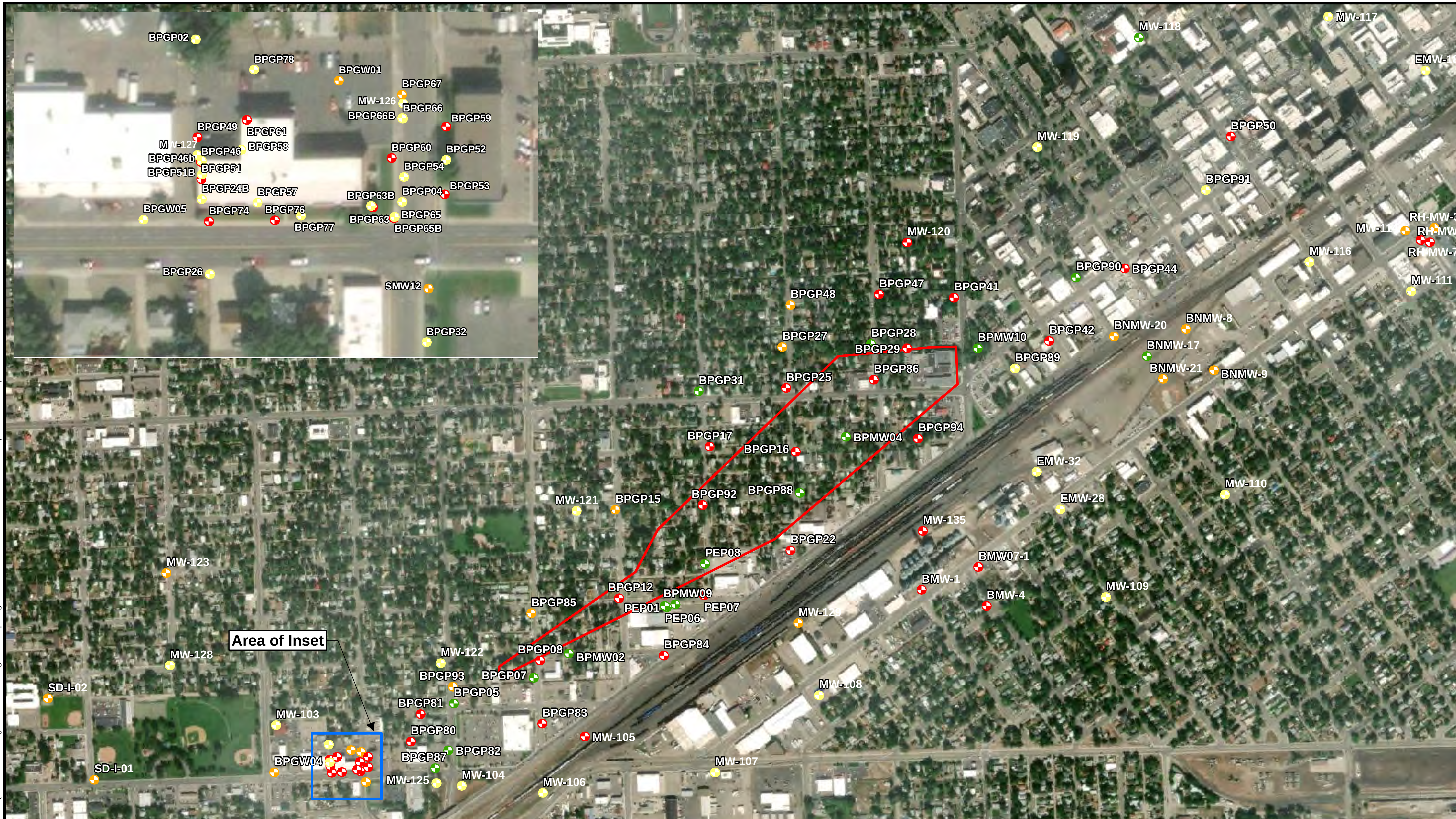
FIGURE 3
GROUNDWATER SAMPLE LOCATIONS
BILLINGS PCE
BILLINGS, YELLOWSTONE COUNTY
MONTANA

Date: 1/22/2020



Path: Q:\R8START\Billings PCE HRS\BillingsPCE\Maps\Figure 3a PCE Concetrations Groundwater Sample Location Map.mxd

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Projection: Mercator Auxiliary Sphere
Datum: WGS 1984

Source:
Background: ESRI World Imagery (2019)
The source of this map image is ESRI, used by the EPA with ESRI's permission.
TCE Groundwater Concentrations: Trihydro (Ref. 4 pp. 447)

0 1,100 2,200 Feet

Legend

Groundwater Sample Locations

- Undetected
- 1 - 5 ug/L
- 5 - 50 ug/L
- > 50 ug/L
- Area of Observed Exposure

Prepared for:
U.S. EPA - Region 8

Contract: EP-S8-13-01
TO/TDD: 0004/1905-05

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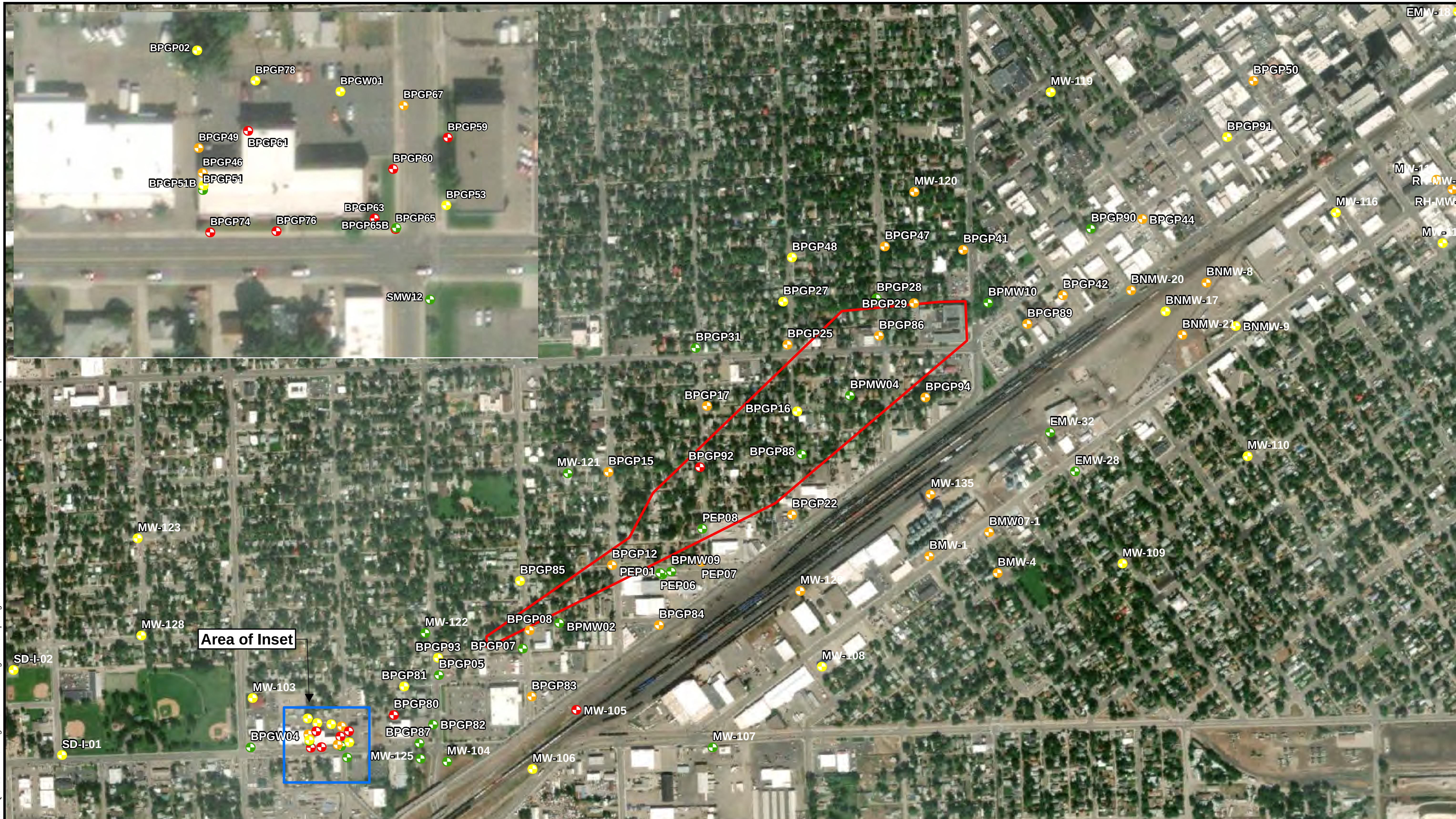
FIGURE 3A
GROUNDWATER SAMPLE LOCATIONS (MAY 2018)
PCE - TETRACHLOROETHANE (ug/L)
BILLINGS PCE
BILLINGS, YELLOWSTONE COUNTY
MONTANA

Date: 8/12/2020



Path: Q:\R8START\Billings PCE HRS\BillingsPCE\Maps\Figure 3b TCE Concetrations Groundwater Sample Location Map.mxd

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Projection: Mercator Auxiliary Sphere
Datum: WGS 1984

Source:
Background: ESRI World Imagery (2019)
The source of this map image is ESRI, used by the EPA with ESRI's permission.
TCE Groundwater Concentrations: Trihydro (Ref. 4 pp. 447)

0 1,000 2,000 Feet

Legend

Groundwater Sample Locations

- Undetected
- 1 - 5 ug/L
- 5 - 50 ug/L
- > 50 ug/L
- Area of Observed Exposure

Prepared for:
U.S. EPA - Region 8

Contract: EP-S8-13-01
TO/TDD: 0004/1905-05

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FIGURE 3B
GROUNDWATER SAMPLE LOCATIONS (May 2018)
TCE - TRICHLOROETHANE (ug/L)
BILLINGS PCE
BILLINGS, YELLOWSTONE COUNTY
MONTANA

Date: 8/12/2020

REFERENCES

Ref. No. Description of the Reference

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SITE SUMMARY

Site Description

The site includes releases from the Big Sky Linen (BSL) operations, the approximate 355 acres of the city of Billings overlying contaminated groundwater resulting from the release of tetrachloroethylene (PCE) from BSL, and the 145 regularly occupied structures within the area of observed exposure evaluated over the contaminated groundwater PCE and daughter product plume[2]. Beginning in 1965, BSL was responsible for releasing PCE to soils and groundwater, creating a plume of PCE and daughter products that reached 1.6 miles to the east-northeast based upon groundwater sampling (Ref. 4, pp. 190, 425, Figure 5-1). Structures found over this plume have documented releases of PCE and trichloroethylene (TCE) via subsurface intrusion into regularly occupied spaces (Ref. 4, p. 207, Table 10-1, pp. 368-381; Figure 2 of this HRS documentation record).

According to the Montana Secretary of State and property ownership records, BSL has operated at 715 Central Avenue in Billings since 1965 (Refs. 4, p. 40; 6, p. 1). The Billings Laundry Company operates BSL in a 14,040 square foot commercial building on the property and provides commercial cleaning services. Although chlorinated solvent use was documented at the BSL facility, the actual duration of their use is unknown and may have started as early as 1967 and extended to as late as 1994. A floor drain in the building reportedly discharged to a French drain east of the building, that was modified to connect to the city storm sewer in 1970 and was closed permanently in 1975 (Ref. 4, p. 40). BSL offered dry cleaning services using PCE as a dry cleaning solvent until as late as 1994. Since the early 1990s, BSL has provided commercial wet laundry services. Site contamination is known to be related to the release of PCE to the subsurface during commercial operations at BSL that were detailed by EPA during the interim emergency action. While contaminant releases initially occurred at the place of business and associated utilities adjacent to BSL, the chlorinated solvent releases resulted in widespread contamination extending for more than 1.6 miles to the northeast of the property. The following subsections describe the known primary releases discovered during EPA's interim emergency actions, and also detail the current source and release mechanisms evaluated based on the 2019 RI results (Ref. 4, p. 190, 425, Figure 5-1).

Facility History

A variety of dry cleaning equipment was used at the facility, and was located in the northeastern corner of the BSL building. Three separate styles of dry cleaning apparatus were reported to operate between 1967 and 1993, including 35-pound and 65-pound transfer units, as well as a 55-pound "dry-to-dry" system. Both types of systems typically used solvent recovery processes via a "still" or "cooker unit" as part of the dry cleaning operation. The overflow discharge from the PCE recovery systems was reported to discharge to the floor drain. The Montana Department of Environmental Quality (DEQ) Hazardous Waste program records contained no information for BSL, and it does not appear to have been registered as a chlorinated solvent user (Ref. 4, p. 40).

BSL's primary source of chlorinated solvents was PCE from dry cleaning activities prior to 1995. The PCE at BSL was collected in the building in a floor drain connected to a French drain system and dry well located in the alley east of BSL that discharged directly to the subsurface prior to 1970. In 1970, the French drain was connected to the city storm sewer system; however, in 1975 BSL was directed to abandon all drains and properly dispose of PCE waste and wastewater. Additional primary releases likely occurred after 1975 since EPA observed and replaced degraded sanitary sewer system piping during EPA interim remedial actions in 2008. Releases appeared to have

[2] The original Billings PCE Remedial Investigation (RI) facility included approximately 855 acres where groundwater is impacted by chlorinated volatile organic compounds (CVOCs) emanating from sources of CVOCs in and around downtown Billings (Ref. 4, p. 400). This RI facility boundary is inclusive of chlorinated solvent sampling results for subsurface soil, indoor air, and subslab/basement/crawlspace air. The site for RI purposes covers a larger area and is more inclusive than the site for HRS scoring purposes.

occurred from sanitary and storm sewer service lines as well as main lines in Central Avenue, based on heavily contaminated soil excavated from underneath these lines by EPA during the interim emergency actions. Although carbon tetrachloride was only detected in subslab vapor and indoor air during the RI, it appears to have been released along with PCE (carbon tetrachloride is a known contaminant associated with PCE). Separate from the chlorinated solvent source identification, a gasoline UST was formerly located on the north side of BSL property, which was found in 1998 to have released petroleum to the subsurface. The underground storage tank (UST) was removed, and subsurface soil excavated in 1998. Low levels of trihalomethane compounds are ubiquitous at the site. These releases have resulted in sources of PCE and volatile petroleum hydrocarbons (VPH) contamination of subsurface soil, groundwater, and soil vapor at BSL (Ref. 4, p. 191).

As primary chlorinated solvent sources and releases were identified by DEQ and EPA prior to 2008, interim removal actions were taken beginning in 2008 to excavate impacted subsurface soil from the alley between BSL and the building at 711 Central Avenue, as well as along the storm water and sanitary sewer utility corridor in Central Avenue. Additional removal actions including vapor mitigation at select locations, in situ chemical oxidation along utility corridors, and sheet pile wall installation were employed near BSL. Dry cleaning is no longer conducted at the BSL facility, and no other USTs are known to be present in the immediate area (Ref. 4, pp. 191-192).

Soil investigations were primarily conducted at known or suspected chlorinated solvent source areas at the BSL facility. Surface and subsurface soil samples were collected outside the building footprints in locations where chlorinated solvents were known or suspected to be used. Observations of other contaminants exceeding DEQ direct- contact or leaching to groundwater screening levels in surface soil were limited. In subsurface soil, PCE was observed above the DEQ direct-contact screening level at one location at BSL. PCE concentrations in subsurface soil exceeding DEQ leaching to groundwater screening levels were observed at BSL. The highest PCE concentrations in subsurface soil observed at BSL were around 90 mg/kg. Evidence of dense, non-aqueous phase liquid (DNAPL) on bedrock was not identified during the RI; however, there may be small areas where DNAPL is present in fine-grained soils at or above the smear zone at BSL as well as beneath the BSL and 711 Central Avenue, which act as a continuing secondary source to groundwater and soil vapor (Ref. 4, pp. 205-206).

Site Investigation History

Previous investigations and interim actions have been conducted at the site, including both DEQ and EPA led actions. Several investigations were conducted specifically to address the chlorinated solvent plume originating from BSL and other solvent source sites. Additional analytical and geological data are available for the site due to the prevalence of Leaking Underground Storage Tank (LUST) sites in the area. Many of the investigations or interim actions within or near the site included chlorinated solvents and/or petroleum constituent evaluations. The site investigation and interim activities are summarized in the bulleted list below. Additional details regarding historical investigations are presented in Reference 4. The following bullet point summary is from the Trihydro Remedial Investigation (Ref. 4, pp. 26-29)

- **1993 – Montana Department of Health and Environmental Services (MDHES):** Preliminary Assessment by DEQ's predecessor, MDHES, to evaluate hazards posed by chlorinated solvents in groundwater along Central Avenue. During the course of investigating nearby LUST releases, chlorinated solvents were found in the subsurface.
- **1998 – Maxim:** As part of an UST release investigation, groundwater sampling was conducted at the former Tom's Conoco service station located directly upgradient from BSL.
- **1999 – Pioneer:** Near BSL, Pioneer conducted a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Site Inspection to evaluate volatile organic compound (VOC) contamination in groundwater, soil and soil vapor.
- **2001 – Pioneer:** Near BSL an expanded site investigation was initiated based upon the results of the 1999 Site Inspection. The expanded investigation focused on evaluating whether PCE contamination in the

subsurface was affecting public water supplies in the contaminant plume, as well as conducting sampling to evaluate the nature and extent of Vapor Intrusion (VI) impacts to buildings located within the plume.

- **2002 – Tetratech** (formerly Maxim): Former Rex soil and groundwater investigation.
- **2006 – URS:** Near BSL a site investigation was conducted on behalf of EPA with the primary objective to define the extent and magnitude of groundwater contamination.
- **2006 – URS:** Near BSL and in conjunction with the field investigations of contamination in groundwater, soil, and indoor air, a range of removal alternatives was explored to address chlorinated solvent impacts, with a primary objective of rapid and permanent PCE reduction in groundwater (i.e. investigation to look at interim action alternatives).
- **2008 – URS:** At BSL from June to December 2008, URS conducted an interim removal action near BSL and adjacent properties to address possible chlorinated solvent source areas. Interim actions included excavating and disposing of 6,600 tons of contaminated soil, sheet piling was installed to allow for deeper contamination excavation in areas along Central Avenue, and in situ chemical oxidation was implemented in four injection events to reduce contaminant concentrations in the east of the sheet pile in utility corridor source area in Central Avenue.
- **2009 – Olympus:** At the Riverstone Health Clinic (formerly the Deering Community Health Clinic), Phase I and Phase II LUST RIs were conducted to evaluate petroleum hydrocarbon impacts, but also indicated issues with CVOCs in analytical results.
- **2009 – Lockheed Martin:** Supporting EPA BSL investigations, a flow and transport model was prepared by Lockheed Martin's Information Systems and Global Services group. The results of a flow and transport model were presented to aid EPA in "developing an appropriate removal action that would minimize/eliminate the potential risk of indoor air vapor intrusion."
- **2010 – 2012 URS:** Supporting BSL investigation and interim actions, five rounds of groundwater sampling were conducted in May 2009, April 2010, June 2010, 2011, and 2012 to evaluate the chlorinated solvent groundwater plume magnitude and extent following the EPA 2008 interim removal action. In 2011, eleven air samples were collected to further evaluate impacts to indoor air due to the solvent plume.
- **2014 – Weston:** Supporting BSL investigation and interim actions, a sixth round of groundwater sampling was conducted on behalf of EPA after the 2008 interim removal action.
- **2015 – Olympus:** Near the Riverstone Health Clinic at 27th Street and 1st Avenue South groundwater was sampled from September 2015 through August 2016. The objective of the investigation was to assess the state of chlorinated solvent concentrations near the Clinic, as well as further define the extent and magnitude of the CVOC plume.
- **2015 – Weston:** Supporting BSL investigation and interim actions, EPA conducted the seventh round of post- removal groundwater sampling at the site.
- **2017 – EPA/DEQ Meeting:** On February 24, 2017, DEQ, its consultant Trihydro, EPA, and its consultant Leidos, met in Helena to discuss the BPCE Groundwater Site, recent rounds of EPA groundwater analytical sampling, and the development and updates to the groundwater model that EPA is using to evaluate site progress.
- **2017 – Trihydro**: Supporting CVOC investigation near potential identified sources in and around Billings, (including BSL, former CAL, and former Rex/Riverstone Health Clinic), Trihydro compiled the DSR, summarizing known site information and the nature and extent of known contamination based on historic investigations, and identified data gaps in the understanding of data gaps in spatial and media examined (Trihydro 2017a).
- **2017 – Trihydro:** Supporting CVOC investigation near potential identified sources in and around Billings, preliminary groundwater monitoring event conducted in July and August, 2017. Groundwater monitoring event conducted to focus on extents of contamination near potential sources at BSL, former CAL, and former Rex, and to evaluate locations that need further step-out samples to establish edges of the groundwater plume(s). Measurement of groundwater hydraulic gradients to evaluate contaminant transport,

changes in plume shape and orientation, and the effects of interim remedial actions approximately 10-years after implementation.

- **2019 -** Trihydro Corporation. Remedial Investigation Report, Billings PCE Groundwater Site, Billings, Montana. May 15, 2019.

5.0 SOIL EXPOSURE AND SUBSURFACE INTRUSION PATHWAY

5.2 SUBSURFACE INTRUSION COMPONENT

The origin of the evaluated contamination at the site is the BSL facility based on past operations. The most recent investigations conducted from 2017 to 2018 by Trihydro, Inc. indicated that PCE and TCE were released into the ground at the dry cleaners. The subsurface vapors emanate from the contaminated groundwater, and enter the pore space around and between the subsurface soil particles and soil column above the groundwater table. From there the hazardous vapors in the vadose zone (the soil between the surface and the groundwater table) have entered into buildings by migrating through cracks, seams, interstices, and gaps in walls or foundations (Ref. 4, pp. 40, 156, 157)

Geology

The Billings PCE site is located in the Great Plains geologic province adjacent to the Yellowstone River Valley. The Site lies on deposits that are Quaternary (1.5 million years to present) in age and are primarily alluvial in nature. The alluvial deposits underlying the site are terraces as thick as 120 feet (ft.) and usually overlie the Eagle Sandstone and Telegraph Creek Formations (Ref. 4, p. 32). The Eagle Sandstone Formation is a light brownish gray to pale yellow-orange, fine-grained sandstone and it can be up to 210 ft. thick (Ref. 7). This sandstone can be a low-yield water-bearing unit, and typically yields less than 10 gallons per minute (gpm) (Ref. 4, p. 34). The Telegraph Creek Formation is predominantly a shale, with some sandy shale, and grading into a sandstone when underlying the Eagle Sandstone Formation. This formation varies in color from brownish-gray medium dark-gray, and it can be up to 150 ft. thick from the top of contact, which was observed to occur at just over 25 ft below ground surface (bgs) at the BSL area. The Telegraph Creek Formation is not considered a water-bearing unit since it typically yields less than 10 gpm, which indicates that the bedrock is likely an aquitard and barrier to downward groundwater or contaminant migration (Ref. 4, pp. 34-35).

The alluvial materials underlying the site can generally be divided into an upper alluvial layer and a lower alluvial layer. The upper alluvial material within the AOE is between 5 ft. thick in the vicinity of MW-119 to 20 ft. thick in the vicinity of MW-127 and is comprised of heterogeneous sandy clay, sandy silt, clayey sand, silt, or clay that is approximately 10 to 15 ft. thick, interspersed with smaller sand layers (Ref. 4, p. 424, Ref.15, p. 17). The upper alluvial material is present in smaller, disconnected alluvial lenses rather than continuous layers, and the water table is typically present near the bottom of this zone, approximately 13-15 ft. bgs. Beneath the topsoil, the lithology of the unsaturated vadose zone was comprised of intermittent layers of silty clays, silty sands, and clayey sands. There is discontinuity at depth between these layers in the unsaturated zone that indicates no continuous layering of clays or aquitard type materials, but instead, the lithology is comprised of small, localized lenses of alluvial materials throughout the unsaturated zone (Ref. 4, p. 31). Beneath that layer of finer alluvium is a coarser, more homogenous sand or gravel for approximately 10 to 80 ft. This lower alluvium layer is typically a medium brown gravely sand or a brown to gray sand or a brown to gray sandy gravel (Ref. 4, pp. 33-34). The coarse sand and gravel formation is primarily saturated and likely accounts for the majority of the groundwater flow in the alluvial aquifer (Ref. 4, p. 35).

Shallow Groundwater

Shallow groundwater is present in the alluvial terrace material including silts, sands, and gravels overlying shale bedrock (Ref. 15, p.18).

Historically, groundwater in the alluvial aquifer is encountered at depths 12-19 ft. bgs. During sampling events in July 2017 and May 2018 depths were found to range from 7 and 16 ft. bgs and between 6 and 17 ft. bgs, respectively, in the vicinity of the site (Ref. 4, pp. 112, 119, 591). The groundwater flow direction at the site is primarily to the northeast with a slightly more easterly flow west of BSL. The alluvial aquifer groundwater hydraulic conductivity (K), is estimated to be around 109 to 299 feet per day (ft./day) in the lower alluvial material, but only 0.2 to 1.1 ft./day in the upper alluvial material. Vertical hydraulic conductivity was reported to be 40.8 ft/day and horizontal hydraulic conductivity was reported to be 408 ft/day in 2008-2010 (Ref. 4, p. 37).

Groundwater analytical results from bedrock monitoring wells did not have evidence of dense, non-aqueous phase liquid (DNAPL) in the alluvial materials above the bedrock and DNAPL was not observed migrating into bedrock adjacent to or immediately downgradient of BSL. PCE concentrations in bedrock wells were less than Montana DEQ groundwater standards of 5 micrograms per liter (µg/L). Since nearby wells screened at the top and bottom of the alluvial aquifer had PCE concentrations exceeding the screening levels by 3-4 orders of magnitude, groundwater concentrations suggest that the bedrock acts as an effective vertical barrier to PCE migration. Additional evaluation of hydraulic conductivity in the bedrock wells noted hydraulic conductivities 8 to 9 orders of magnitude lower than measured in the alluvial aquifer, confirming that the bedrock appears to be minimally hydraulically connected to the alluvial aquifer and is functioning as an aquitard (Ref. 4, p. 206).

BSL surface soil samples were evaluated for VOCs, which included chlorinated solvents (e.g., PCE, TCE, cis-1,2-dichloroethene (DCE), and trans-1,2-DCE). Surface soil exceedances only occurred for PCE in samples BSL-MIP09 and 18 based on MDEQ and EPA screening levels (Ref. 4, pp. 89, 11921, Figure 8-5). Detected PCE concentrations exceeded a leaching to groundwater screening level, calculated using DEQ's soil screening flow chart part 2 (23 µg/kg) at two BSL surface soil locations; in addition to the detected values, Reporting Limits (RLs) for PCE in surface soil samples also exceeded the leaching screening levels (Ref. 4, p. 99). Subsurface soil sample locations were evaluated for VOCs, which included chlorinated solvents (e.g., PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and VC) Detected PCE concentrations exceeded the leaching to groundwater screening level in six samples from three BSL subsurface soil locations (Ref. 4, p. 100).

Samples from two wells located immediately adjacent to the BSL facility have had elevated PCE concentrations from 2009 to 2018, with one well showing a slight increase over time. These two wells consistently contain some of the highest groundwater PCE concentrations at the site. Elevated PCE concentrations, which have ranged from 7,020 to 47,400 µg/L over the reporting period, may be indicative of residual contamination in the immediate vicinity of the BSL building, and may fluctuate based on enhanced dissolution of residual, immobile PCE in the immediate vicinity of the BSL building during higher water elevation periods (Ref. 4, pp. 134, 309, 310, 600).

The largest and most well-mapped groundwater chlorinated solvent plume associated with the RI is the BSL plume that extends from the cleaners to the northeast for more than 1.6 miles to approximately North 27th Street and encompasses roughly 350 acres along the Montana Avenue corridor (Ref. 4, pp. 436, 437). The plume appears to expand laterally as it extends from the BSL building, and appears to be more than 3,100 feet wide at its widest point during the September 2018 RI sampling event. The highest PCE groundwater concentrations are found in the immediate vicinity of the BSL building within approximately 600 feet of the building. The BSL plume consists of a central core of high concentration (greater than 500 µg/L) PCE contamination that extends from the immediate vicinity of the BSL building to the northeast along the groundwater gradient for approximately 0.6 miles. North of the Burlington Northern Santa Fe (BNSF) railroad, groundwater gradients appear to run roughly parallel to the rail line, towards the northeast. However, south of the rail line, groundwater may have a more easterly flow from Underpass Avenue to approximately South 32nd Street (Ref. 4, p. 142). Downgradient of the BSL building, the PCE groundwater plume ranges in concentration from roughly 100 to 1,000 µg/L, with some exceptions (Ref. 4, p. 136).

5.2.0 GENERAL CONSIDERATIONS

There is one identified area of observed exposure (AOE), an area containing structures with indoor air contamination due to subsurface intrusion, at the site as shown in Figure 2. The structures present within the AOE are described in Table 1.

TABLE 1
REGULARLY OCCUPIED STRUCTURES SUMMARY

AOE Number/ ASC Letter	Type of Structure	Number(s) of Specific Type of Structure*	References
1	High School (116)	1	Figure 2B of this HRS documentation record; Ref. 8 p. 6 Object ID 116
1	Residential (all others)	144	Figure 2B of this HRS documentation record; Ref. 8, pp. 1-5

* There are an additional 59 structures located within the delineated AOE that may be businesses or some other sort of non-residential structure, but will not be evaluated for this HRS documentation record. These were not evaluated due to the difficulty in collecting information regarding these structures and the number of full and part time employees, as applicable.

Area(s) of Observed Exposure

AOE 1 – Area of Observed Exposure 1

Location, description and delineation of AOE (with reference to a map of the site):

The AOE was identified based on groundwater sampling and five residential structures and a high school which had observed exposure concentrations of PCE and/or TCE obtained through indoor air sampling (see observed exposure below). An additional 139 occupied residential structures had inferred contamination based on their location between the structures with observed Level II contamination, for a total of 145 structures evaluated for this documentation record (see Figure 2). These residential structures are located between 1,500 ft. and 4,200 ft. east and northeast of the BSL facility, and are located above the PCE and TCE shallow groundwater plume (see Figures 1, and 2 of this HRS documentation record; Ref. 8, pp. 1-5).

Identification of all regularly occupied structures in the AOE:

TABLE 2
REGULARLY OCCUPIED STRUCTURES WITHIN AOE 1

Type of Structure	Regularly Occupied Structure ID	Area (ft^2) (Regularly Occupied Structures)**	References
Residential*	2	1997	Ref. 8, p. 1
Residential*	19	923	Ref. 8, p. 1
Residential*	38	1044	Ref. 8, p. 1
Residential*	86	920	Ref. 8, p. 2
High School*	116	59,438	Ref. 8, p. 6
Residential*	146	1,740	Refs. 1, Table 5-19; 8, p. 4
Residential	114	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	44	1,126	Ref. 8, p. 1
Residential	125	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	48	1,019	Ref. 8, p. 2
Residential	77	673	Ref. 8, p. 2
Residential	173	770	Ref. 8, p. 4
Residential	56	522	Ref. 8, p. 2
Residential	11	2,184	Ref. 8, p. 1
Residential	172	576	Ref. 8, p. 4
Residential	12	2,058	Ref. 8, p. 1
Residential	166	975	Ref. 8, p. 4
Residential	164	920	Ref. 8, p. 4
Residential	91	855	Ref. 8, p. 2
Residential	47	280	Ref. 8, p. 1
Residential	147	1,740	Refs. 1, Table 5-19; 8, p. 4
Residential	128	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	171	600	Ref. 8, p. 4
Residential	150	1,740	Refs. 1, Table 5-19; 8, p. 4
Residential	152	1,008	Ref. 8, p. 4
Residential	74	1,404	Ref. 8, p. 2
Residential	119	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	59	1,313	Ref. 8, p. 2
Residential	156	1,281	Ref. 8, p. 4
Residential	66	680	Ref. 8, p. 2
Residential	174	1,183	Ref. 8, p. 4
Residential	71	1,112	Ref. 8, p. 2
Residential	26	1092	Ref. 8, p. 1
Residential	62	240	Ref. 8, p. 2
Residential	165	792	Ref. 8, p. 4
Residential	127	1,740	Refs. 1, Table 5-19; 8, p. 3

Type of Structure	Regularly Occupied Structure ID	Area (ft^2) (Regularly Occupied Structures)**	References
Residential	80	946	Ref. 8, p. 2
Residential	10	1,157	Ref. 8, p. 1
Residential	54	728	Ref. 8, p. 2
Residential	87	1,562	Ref. 8, p. 2
Residential	69	1,052	Ref. 8, p. 2
Residential	93	776	Ref. 8, p. 2
Residential	34	528	Ref. 8, p. 1
Residential	25	988	Ref. 8, p. 1
Residential	24	1,112	Ref. 8, p. 1
Residential	78	1,525	Ref. 8, p. 2
Residential	13	1,156	Ref. 8, p. 1
Residential	9	448	Ref. 8, p. 1
Residential	110	1,536	Ref. 8, p. 3
Residential	120	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	162	705	Ref. 8, p. 4
Residential	154	762	Ref. 8, p. 4
Residential	105	862	Ref. 8, p. 3
Residential	143	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	70	948	Ref. 8, p. 2
Residential	136	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	112	1,164	Ref. 8, p. 3
Residential	145	1,740	Refs. 1, Table 5-19; 8, p. 4
Residential	126	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	94	664	Ref. 8, p. 2
Residential	89	932	Ref. 8, p. 2
Residential	16	1,396	Ref. 8, p. 1
Residential	15	456	Ref. 8, p. 1
Residential	29	1,104	Ref. 8, p. 1
Residential	63	1,214	Ref. 8, p. 2
Residential	108	1,472	Ref. 8, p. 3
Residential	18	1,280	Ref. 8, p. 1
Residential	99	1,016	Ref. 8, p. 3
Residential	130	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	30	768	Ref. 8, p. 1
Residential	65	760	Ref. 8, p. 2
Residential	31	774	Ref. 8, p. 1
Residential	153	1,199	Ref. 8, p. 4
Residential	68	1,366	Ref. 8, p. 2
Residential	8	1,120	Ref. 8, p. 1

Type of Structure	Regularly Occupied Structure ID	Area (ft^2) (Regularly Occupied Structures)**	References
Residential	111	1,253	Ref. 8, p. 3
Residential	90	990	Ref. 8, p. 2
Residential	36	736	Ref. 8, p. 1
Residential	140	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	142	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	141	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	37	624	Ref. 8, p. 1
Residential	51	1,020	Ref. 8, p. 2
Residential	100	807	Ref. 8, p. 3
Residential	160	569	Ref. 8, p. 4
Residential	101	1,275	Ref. 8, p. 3
Residential	132	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	107	1,102	Ref. 8, p. 3
Residential	151	1,740	Refs. 1, Table 5-19; 8, p. 4
Residential	50	940	Ref. 8, p. 2
Residential	155	1,288	Ref. 8, p. 4
Residential	144	1,740	Refs. 1, Table 5-19; 8, p. 4
Residential	21	1,152	Ref. 8, p. 1
Residential	85	792	Ref. 8, p. 2
Residential	88	1,008	Ref. 8, p. 2
Residential	122	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	98	752	Ref. 8, p. 3
Residential	23	1,452	Ref. 8, p. 1
Residential	115	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	163	848	Ref. 8, p. 4
Residential	161	1,180	Ref. 8, p. 4
Residential	106	912	Ref. 8, p. 3
Residential	149	1,740	Refs. 1, Table 5-19; 8, p. 4
Residential	148	1,740	Refs. 1, Table 5-19; 8, p. 4
Residential	27	744	Ref. 8, p. 1
Residential	46	1,200	Ref. 8, p. 1
Residential	84	490	Ref. 8, p. 2
Residential	6	1,250	Ref. 8, p. 1
Residential	76	960	Ref. 8, p. 2
Residential	167	578	Ref. 8, p. 4
Residential	92	672	Ref. 8, p. 2
Residential	64	912	Ref. 8, p. 2
Residential	124	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	102	962	Ref. 8, p. 3

Type of Structure	Regularly Occupied Structure ID	Area (ft^2) (Regularly Occupied Structures)**	References
Residential	49	768	Ref. 8, p. 2
Residential	52	776	Ref. 8, p. 2
Residential	170	780	Ref. 8, p. 4
Residential	123	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	38	1,044	Ref. 8, p. 1
Residential	79	1,380	Ref. 8, p. 2
Residential	159	672	Ref. 8, p. 4
Residential	81	1,144	Ref. 8, p. 2
Residential	45	856	Ref. 8, p. 1
Residential	109	588	Ref. 8, p. 3
Residential	103	746	Ref. 8, p. 3
Residential	3	1,784	Ref. 8, p. 1
Residential	134	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	67	988	Ref. 8, p. 2
Residential	131	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	28	1,429	Ref. 8, p. 1
Residential	32	1,497	Ref. 8, p. 1
Residential	7	1,008	Ref. 8, p. 1
Residential	117	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	118	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	22	536	Ref. 8, p. 1
Residential	55	748	Ref. 8, p. 2
Residential	139	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	33	1,280	Ref. 8, p. 1
Residential	129	1,740	Refs. 1, Table 5-19; 8, p. 3
Residential	157	1,008	Ref. 8, p. 4
Residential	75	624	Ref. 8, p. 2
Residential	104	630	Ref. 8, p. 3
Residential	58	1,841	Ref. 8, p. 2
Residential	53	885	Ref. 8, p. 2
Residential	35	1482	Ref. 8, p. 1

* Observed Exposure location
****** Where the footprint area of a regularly occupied structure is unknown, an area of 1,740 square ft. is used (Refs. 1, Table 5-19; 8).

Observed Exposure by Chemical Analysis

Multiple residences at this site have been identified as having indoor air contamination levels meeting observed exposure criteria (collected for the Trihydro RI), as documented below in Tables 3 through 7 (Ref. 4, Table 10-1, pp. 368-381). In 2019, Trihydro prepared a RI Report for the Billings PCE (BPCE) Groundwater Comprehensive Environmental Cleanup and Responsibility Act (CECRA) Site for the Montana DEQ. DEQ ranked the site as a high priority site on its CECRA priority list. This was performed under contract to the Montana DEQ. PCE and TCE contamination was historically observed in soil, soil vapor, and groundwater at various locations across the site in previous investigations and interim remedial actions (Ref. 4, pp. 156, 157). The previous investigations and interim actions were performed from 1993 through 2016 by various contractors and government agencies (Ref. 4, p. 23).

Establishment of Background Levels

To document that indoor air contamination levels are significantly above background levels, indoor air samples were chosen to establish background concentrations for the residential properties. These samples were collected during the extended winter sampling event of 2017/2018 (Ref. 4, pp. 2480, 2492, 8951, 9028, 9223, 9267, 11187-11207, 11230-11248). The concentrations of TCE and PCE in the background samples (selected from samples located upgradient of the BSL site, since there were no background samples specified in the RI) collected during this event were compared to concentrations in the observed release samples collected during the same timeframe. The background sample locations are located hydro-geologically upgradient of the contamination. No TCE contamination was detected in indoor air samples collected within the background structures. PCE was detected at a maximum concentration of 0.21 $\mu g/m^3$ (Ref. 4, pp. 2480, 2492, 8951, 9028, 9223, 9267, 11187-11207, 11230-11248).

Indoor and crawlspace air samples at residential locations were collected in individually clean-certified 6-liter (L) with corresponding individually clean certified 24-hour flow controllers. Indoor air samples at commercial locations were also collected in individually certified 6-L evacuated air canister but with corresponding individually clean certified 8-hour flow controllers. Subslab air samples at both residential and commercial locations were collected in individually clean-certified 6-L evacuated air canister with corresponding individually clean certified 30-minute flow controllers. Ambient air samples were collected on the same days that Vapor Intrusion (VI) samples were collected. Ambient air samples were collected in individually clean-certified 6-liter (L) evacuated air canister with corresponding individually clean certified 24-hour flow controllers. The starting and completion times, initial and final vacuum for each evacuated air canister, sample IDs, and readings were recorded in the field documentation (VI sampling field forms and photos are found in Reference 4, Appendix E-5). VI field documentation forms were also filled out (Ref. 4, p. 71). Samples were analyzed using EPA method TO-15 in single ion monitoring mode (Ref. 4, pp. 153, 11165). The two upgradient locations are within approximately 1,600 feet (as measured on Figure 2) of the BSL location: one is a daycare (structure 234), one is a school building (structure 235) (See Figures 2, 2A of this HRS documentation record; Ref. 4, p. 434).

TABLE 3
AOE 1 BACKGROUND LOCATIONS

Sample ID	Sample Location/Regularly Occupied Structure ID	Start Date and Time	End Date and Time	Basis for Sample as Background	References
10420606033	234: main floor hall	2/8/18, 1017	2/9/18, 1003	Outside Plume, Daycare	4, pp. 2480, 2481, 8951, 9028
10420606017	234: main floor hall	2/8/18, 1015	2/9/18, 1005	Outside Plume, Daycare	4, pp. 2480, 2481, 8951, 8996
10420912019	235; annex hall, main floor	2/11/18, 1229	2/12/18, 1226	Outside Plume, School building	4, pp. 2492, 2494, 2514, 9223, 9267

The background sample locations were chosen from the total sampled locations because they are located hydraulically upgradient of BSL (See Figures 2, 2A of this HRS documentation record; Ref. 4, p. 33).

TABLE 4
AOE 1 BACKGROUND SAMPLE CONCENTRATIONS

Sample ID	**Eligible Hazardous Substance**	**Concentration ($\mu g/m^3$)**	**Reporting Limit ($\mu g/m^3$)**	**References**
10420606033	PCE	0.14	0.14	4, pp. 2480, 8951, 9028
10420606033	TCE	ND	0.11	
10420606017	PCE	0.13	0.11	4, pp. 2480, 8951, 8996
10420606017	TCE	ND	0.088	
10420912019	PCE	0.21	0.12	4, pp. 2492, 9223, 9267
10420912019	TCE	ND	0.092	

ND – Not detected
$\mu g/m^3$ – micrograms per cubic meter

Background Levels

The background level for TCE for establishing an observed exposure has been selected to be below detection at the highest reporting limit of 0.11 micrograms per cubic meter ($\mu g/m^3$). This level was selected because background concentrations of TCE were non- detect for the 2017/2018 winter sampling event. The highest background concentration of PCE, 0.21 $\mu g/m^3$, was selected as the background level for establishing an observed exposure of PCE.

PCE and TCE also were not found in outdoor air samples collected in the vicinity of the AOE. In addition, residents were requested to remove anthropogenic sources that could interfere with the air sample results. Anthropogenic sources within residential structures can include common cleaning supplies (Ref. 4, p.149).

The detection limit for these background samples is identified as the reporting limit, which is defined for these analyses as the lowest concentration at which an analyte can be reliably measured and reported without qualification. This definition is the same as the HRS definition for Sample Quantitation Limit, which is the quantity of a substance that can be reasonably quantified given the limits of detection for the methods of analysis and sample characteristics that may affect quantitation (for example, dilution, concentration) (Refs. 1, Section 1.1: 4, p. 9364). So, for these samples, the terms can be used interchangeably.

The background samples and observed exposure samples were each collected during the same sampling event, by the same sampling team, using the same sampling technique and over a similar time period.

TABLE 5
AOE 1 BACKGROUND LEVELS

Eligible Hazardous Substance	**Background Level ($\mu g/m^3$)**	**Concentrations used for Establishing an Observed Exposure (µg/m3)**	**References**
PCE	0.21	0.63	4, pp. 2492, 9223, 9267, 11230-11248
TCE	ND	0.11	

ND – Not detected
$\mu g/m^3$ – micrograms per cubic meter

Exposure Samples

TCE and PCE indoor air concentrations greater than or equal to 0.11 μg/m^3 and 0.63 μg/m^3 (three times 0.21 μg/m^3), respectively, and attributable to the subsurface contamination were used to establish an observed exposure (Ref. 1, Table 2-3: Figure 2).

During the sampling events, both background and exposure indoor air samples were collected over a 24- hour period, using individually certified evacuated canisters equipped with flow controllers and analyzed using EPA method TO-15 in single ion monitoring mode (Ref. 4, pp. 71, 153, 11165).

TABLE 6
AOE 1 INDOOR AIR OBSERVED EXPOSURE SAMPLE LOCATIONS

Regularly Occupied Structure ID	Sample ID	Sample Location	Start Date and Time	End Date and Time	References
2	10423364003	Main floor, single family home	3/6/18, 1806	3/7/18, 1806	4, pp. 2018-2027, 9957, 9958, 9961, 9962, 11410-11424; Figure 10-3, p. 457
	10423364005	Second floor, single family home	3/6/18, 1808	3/7/18, 1804	
19	10420606001	Main, kitchen, single family home	2/7/18, 1314	2/8/18, 1258	4, pp. 2288-2299, 8963, 8964, 11187-11207; Figure 10-3, p. 457
38	10420651027	Basement	2/9/18, 1028	2/10/18, 0938	4, pp. 2113-2135, 9147, 11208-11229; Figure 10-3, p. 457
86	10422527023	Main, living, single family home	2/27/18, 1138	2/28/18, 1135	4, pp. 2247-2257, 9490, 11268-11290; Figure 10-3, p. 457
116	10422523007	Main, gym, school	2/22/18, 0841	2/23/18, 0754	4, pp. 1821-1837, 9390, 9394, 11249-11267; Figure 10-3, p. 457
146	10422614011	Basement	3/1/18, 1404	3/2/18, 1409	4, pp. 2258-2265, 9816, 11374-11391; Figure 10-3, p. 457

TABLE 7
AOE 1 INDOOR AIR OBSERVED EXPOSURE SAMPLE CONCENTRATIONS

Sample ID	Eligible Hazardous Substance	Concentration (μg/m^3)	Observed Exposure Concentration (μg/m^3)	References
10423364003	TCE	1.4	0.11	4, pp. 2018-2027, 9957, 9958, 9961, 9962, 11410-11424; Figures 10-2, 10-3 pp. 456-457
	PCE	12.3	0.63	
10423364005	TCE	1.3	0.11	
	PCE	12.4	0.63	
10420606001	TCE	0.43	0.11	4, pp. 2288-2299, 8963, 8964, 11187-11207; Figures 10-2, 10-3, pp. 456-457
	PCE	1.5	0.63	
10420651027	TCE	0.71	0.11	4, pp. 2113-2135, 9147, 11208-11229; Figures 10-2, 10-3, pp. 456-457
	PCE	2.5	0.63	
10422527023	TCE	0.41	0.11	4, pp. 2247-2257, 9489, 9490, 11268-11290; Figures 10-2, 10-3, p. 456-457
	PCE	9.2	0.63	
10422523007	TCE	0.11	0.11	4, pp. 1821-1837, 9391, 9395, 11249-11267; Figures 10-2, 10-3, pp. 456-457
10422614011	TCE	2.4	0.11	4, pp. 2258-2265, 9816, 11374-11391; Figures 10-2, 10-3, pp. 456-457
	PCE	17.1	0.63	

ND – Not detected
μg/m^3 – micrograms per cubic meter

Attribution to Subsurface and Facility

Association of TCE and PCE with the BSL Facility

The BSL facility has been in operation since 1965 (Ref. 6, p. 40). Although chlorinated solvent use was documented at the facility, the actual duration of its use is unknown and may have started as early as 1967 and extended to as late as 1994. A variety of dry cleaning equipment was used at BSL, and was located in the northeastern corner of the BSL building. Three separate styles of dry cleaning apparatus were reported to operate between 1967 and 1993, including 35-pound and 65-pound transfer units, as well as a 55-pound "dry-to-dry" system. Both types of systems typically used solvent recovery processes via a "still" or "cooker unit" as part of the dry cleaning operation. (Ref. 4, p. 40).

The overflow discharge from the PCE recovery systems at the BLS facility were reported to discharge to the floor drain (Ref. 4, p. 40). The PCE collected in the floor drain, which connected to a French drain system and dry well that discharged to the subsurface prior to 1970 (Ref. 4, p. 191). The dry well was modified to connect to the city storm sewer in 1970, and was then closed permanently in 1975 (Ref. 4, pp. 40, 172). Additional releases likely occurred after 1975 since EPA observed and replaced degraded sanitary sewer system piping during EPA interim remedial actions in 2008, and heavily contaminated soil was excavated from underneath those lines during the interim emergency actions (Ref. 4, p. 191). While contaminant releases initially occurred at BSL, and then through associated utility lines adjacent to BSL, the PCE releases resulted in widespread soil and groundwater contamination extending to the northeast of the facility (Ref. 4, p. 190).

Surface and subsurface soil samples were collected outside the BSL building footprint as part of the 2019 RI (Ref 4, p. 205). PCE was detected in soil samples collected from the BSL property. The highest concentration of PCE in surface soil samples was 1.10 mg/kg collected at a depth of 0-0.5 feet and located east of the BSL building. (Ref. 4, pp. 430, 2790) The highest concentrations of PCE in subsurface soil samples was found in BSL-MIP-09 at 89.7 mg/kg and a depth of 16-16.5 feet at the same location. PCE was also detected in surface soils just north of the BSL building, and in subsurface soils to the northeast and south of the building (Ref 4, pp. 430, 2790, 2819, 3433).

The highest PCE concentrations in groundwater at the site were detected near BSL (Ref. 4, p. 142). Groundwater PCE and TCE concentrations in monitoring wells were highest near the eastern end of the BSL building, where historical dry cleaning operations occurred and where the French drain and sewer lines were located. Four wells in this area consistently contained PCE concentrations greater than 10,000 µg/L (Ref. 4, p. 193). In July 2017 groundwater samples collected in the vicinity of BSL detected concentrations of PCE as high as 47,400 µg/L, and TCE concentrations as high as 444 µg/L (Ref. 4, pp. 436-437, 4357, 4371). In May 2018 groundwater samples collected in the vicinity of BSL detected concentrations of PCE as high as 29,300 µg/L, and TCE concentration as high as 246 µg/L (Ref. 4, pp. 441-442, 6823, 8166). In September 2018 groundwater samples collected in the vicinity of BSL detected concentrations of PCE as high as 41,100 µg/L, and TCE concentrations as high as 308 µg/L (Ref. 4, pp. 446-447, 8170). Monitoring Well BPGW04 is located upgradient of BSL to the west, approximately 400 feet, and monitoring well BPGP02 is located upgradient of BSL to the north, approximately 100 feet (Ref. 4, p. 436). Sampling events in July 2017 and May 2018 identified PCE at a maximum concentration of 5.6 µg/L, and TCE at a maximum concentration of 1.7 µg/L in these two wells. These concentrations in the two wells just upgradient of the BSL facility are significantly lower than the concentrations identified in wells at and downgradient of BSL, indicating an upgradient source, if one is present, is not contributing significantly to the contamination in the subsurface at BSL.

PCE and TCE are the most frequently encountered contaminants in groundwater at the site. The extent of the TCE contamination in groundwater appears to mirror that of the PCE groundwater plume (Ref 4, p. 138). Use of TCE is not known to be associated with operations at BSL, however, PCE can degrade into TCE (Ref. 13, p. 23). Therefore, the presence of TCE in groundwater at the site is likely due to the degradation of the PCE in the groundwater. Two upgradient monitoring wells located on the west (BPGW04) and north (BPGP02) of BSL contained concentrations of PCE (4.1 µg/L and 2.3 µg/L) and TCE (not detected at or above the reporting limits of 0.4 µg/L and 1.7 µg/L) at levels significantly below the levels detected in wells just downgradient of the BSL property during the sampling events in 2017 and 2018. PCE concentrations ranged from 0.9 µg/L to 7 µg/L in these two wells, and TCE concentrations ranged from not detected to 2.4 µg/L. Comparatively, samples collected from two wells next to the BSL building on the west (BPGP51) and north (BPGP61) contained concentrations for PCE ranging from 7,020 µg/L to 39,300 µg/L, and for TCE ranging from <1 µg/L to 251 µg/L (Ref. 4, pp. 436-437, 441-442, 446-447, 4369, 4371, 6821, 6825, 8166, 8085). Therefore, releases from BSL have contributed to the elevated PCE and TCE levels in groundwater that is beneath and downgradient of BSL.

<u>Evidence of PCE and TCE Migration from the BSL Facility to the Subsurface Below the Contaminated Structures</u>

The upper alluvial zone at the site, approximately the top 13 to 20 ft., is comprised of heterogeneous sandy clay, sandy silt, clayey sand, silt, or clay interspersed with smaller sand layers. The upper alluvial material is present in smaller, disconnected alluvial lenses rather than continuous layers, and the water table is typically present near the bottom of this zone, approximately 13-15 ft. bgs (Ref. 4, p. 192). Shallower water bearing zones tend to be 15-20 ft. bgs with a transition to the deeper water bearing zone occurring near the water table at locations where hydraulic profile tool investigations were performed. The underlying deeper water bearing zone (transition depths of 15-120 ft bgs) tends to be more homogenous, and has a conductivity of 60 to 80 ft. per day (Ref 4, pp. 98-99). The alluvial aquifer appears be relatively high-velocity and homogenous in the saturated zone, leading to large-scale plume migration (Ref 4, p. 206).

VOCs in groundwater have migrated through the deeper water bearing zone of the alluvium an extended distance from the BSL facility to an area downgradient to the northeast. A VOC-contaminated groundwater plume extends from beneath the BSL building to the northeast along the predominant groundwater flow direction (Figures 3A and 3B). PCE concentrations in groundwater in May 2018 tended to be highest in the vicinity of the delineated AOE at the site, which is located downgradient of the BSL facility (Figure 3A). Generally, the distribution of TCE at the site tends to mirror that of the PCE (Figure 3B).

Lack of Structural Containment Permanently Preventing Vapor Intrusion

PCE and TCE have the ability to off-gas from contaminated groundwater and soil, migrate into air spaces beneath buildings, and enter the indoor air through cracks or perforations in the foundation of the building, and in some cases, basement floors or walls (Ref. 14, p. 305). Indoor air concentrations at six buildings at the site indicate the presence of TCE and PCE significantly above background levels, indicating these hazardous substances have migrated from the underlying groundwater into these structures (Table 7). Additionally, there is no presence of geologic layers that may serve to inhibit vertical migration of vapors between the water table and surface beneath the AOE (Ref. 4, pp. 420, 424).

In addition, every single-family residence found in the AOE was constructed before 1956, most have full basements and all of those were either concrete or concrete block construction (Ref. 8). According to the Occupied Dwelling Questionnaires filled out during VI sampling for the RI, almost every single-family residence sampled had a floor drain, floor cracks, a sump, an opening to bare ground, or a combination of these four conditions, thus, providing a pathway for subsurface vapors to enter the home (Ref. 4, Appendix E-5).

Consideration of Anthropogenic Sources

TCE and PCE have been found in indoor air samples within structures located on the contaminated groundwater plume. Other possible contributions of these PCE and TCE concentrations from anthropogenic sources within the residential structures were minimized during sampling activities by requesting that the residents remove such items before the scheduled sampling and the use of a photoionization detector (PID) (Ref. 4, pp. 71, 81).

Consideration of Ambient Air Contamination

Outdoor ambient air sampling was conducted to demonstrate that elevated levels of hazardous substances in the indoor air samples are the result of subsurface intrusion and not outdoor air that had migrated into the structures. Ambient (outdoor) air samples were collected during each day of indoor air sampling during the RI. Due to the large area covered, multiple ambient air samples were sometimes collected for adequate comparison to indoor air samples. In general, ambient air sample locations were selected to collect both upgradient and cross-gradient air samples during indoor air sample collection, based upon prevailing wind conditions during the time of sampling. (Ref. 4, p. 135). Where VI sampling results suggested a potentially complete pathway for a given contaminant, ambient air concentrations for that day were compared to indoor air concentrations to evaluate whether outdoor sources could potentially be contributing to indoor air concentrations. This evaluation was presented in Table 10-1 for each structure as part of the VI pathway evaluation in the RI (Ref. 4, Table 10-1, pp. 356-364).

Other Possible Offsite Sources of VOCs

There is one former operation that has been reviewed as part of the Billings PCE RI facility without being considered for this documentation record: the former Central Avenue Laundry and Cleaners (CAL).

The former CAL, located at 1246 Central Avenue, operated from 1982 to 1990 and is located west of the BSL site. According to the DEQ, solvents were disposed of onsite in a “sewer lagoon” and PCE was reclaimed with an onsite distillation system. Prior to housing a dry cleaning establishment, a coin-operated laundromat occupied the former CAL building from 1961 to 1981. Since CAL’s closure in 1990, the building has served as a pawnshop, an appliance repair business, a sign making shop, a bookkeeper’s office, and most recently, a cigarette store, which continues to operate on the premises. The building is located in a mixed residential/commercial area, adjacent to both residential structures and small businesses (Ref. 4, pp. 40, 41). Based on samples collected from well BPGW04 located west of BSL it does not appear that contamination associated with any releases from CAL has significantly contributed to PCE or TCE levels in groundwater at and downgradient of BSL.

Structure Containment

As presented above in the AOE characterization, there are 5 residential structures and a school which have a documented observed exposure and are therefore assigned a containment value of 10: the remaining structures are assigned a containment value of greater than zero (Ref. 1, Table 5-12).

TABLE 8
AOE 1 - STRUCTURE CONTAINMENT

Regularly Occupied Structure ID	Structure Containment Factor Value (Ref. 1, Table 5-12)	Rationale	References
2, 19, 38, 86, 116, 146	10	Evidence of subsurface intrusion with documented observed exposure	See AOE description above; Figure 2B
All other structures in AOE	Greater than 0	None of the remaining structures are constructed at least 6’ above ground on stilts.	Refs. 1 Section 5.2.1.1.2.1; 8, pp. 1-5

AOE Hazardous Waste Quantity

Tier A Hazardous Constituent Quantity:

The total Hazardous Constituent Quantity for AOE 1 could not be adequately determined according to the HRS requirements; that is, the total mass of all Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) hazardous substances to enter the structures is not known and cannot be estimated with reasonable confidence (Ref. 1, Section 2.4.2.1.1). Insufficient historical and current data (manifests, potentially responsible party [PRP] records, State records, permits, waste concentration data, etc.) are available to adequately calculate the total mass, or a partial estimate, of all CERCLA hazardous substances in the structures. Therefore, there is insufficient information to calculate a total or partial Hazardous Constituent Quantity estimate for AOE 1 with reasonable confidence.

Hazardous Constituent Quantity Assigned Value: Not Scored (Ref. 1, Table 5-19)

Hazardous Constituent Quantity Complete? No

Tier B Hazardous Wastestream Quantity:

The total Hazardous Wastestream Quantity for AOE 1 could not be adequately determined according to the HRS requirements; that is, the total mass, or a partial estimate, of all hazardous wastestreams and CERCLA pollutants and contaminants to enter the structures is not known and cannot be estimated with reasonable confidence (Ref. 1, Section 2.4.2.1.2). Insufficient historical and current data (manifests, PRP records, State records, permits, waste concentration data, annual reports, etc.) are available to adequately calculate the total mass, or a partial estimate, of all hazardous wastestreams and CERCLA pollutants and contaminants entering the structures. Therefore, there is insufficient information to adequately calculate or extrapolate a total or partial Hazardous Wastestream Quantity for AOE 1 with reasonable confidence.

Hazardous Wastestream Quantity Assigned Value: Not Scored

Tier C Volume:

There are 144 occupied residential structures and a school within the area of AOE 1 (Figure 2 of this HRS documentation record; Ref. 8, pp.1-5). The square footage for 113 of the structures in square ft. (ft^2) is shown in the tax database (Ref. 8, pp.1-5). Since the height of each structure is unknown and not readily available, according to Section 5.2.1.2.2 of the HRS, a ceiling height of 8 ft. was used to calculate volume. Calculations for AOE 1 are as follows:

TABLE 9
AOE 1 - VOLUME

Regularly Occupied Structure ID	**Area (ft^2) (Regularly Occupied Structures)**	**Volume(ft^3) (Section 5.2.1.2.2)**	**Volume(yd^3) (1 ft^3 x 0.03703704 = 1yd^3)**	**References**
2	1997	15,976	591.7	Ref. 8, p. 1
19	923	7,384	273.5	Ref. 8, p. 1
38	1044	8,352	309.3	Ref. 8, p. 1
86	920	7,360	272.6	Ref. 8, p. 2
116	59,438	475,504	17,611.3	Ref. 8, p. 6
44	1,126	9,008	334	Ref. 8, p. 1
48	1,019	8,152	302	Ref. 8, p. 2
77	673	5,384	199.4	Ref. 8, p. 2
173	770	6,160	228.1	Ref. 8, p. 4
56	522	4,176	155	Ref. 8, p. 2
11	2,184	17,472	647.1	Ref. 8, p. 1
172	576	4,608	171	Ref. 8, p. 4
12	2,058	16,464	610	Ref. 8, p. 1
166	975	7,800	289	Ref. 8, p. 4
164	920	7,360	273	Ref. 8, p. 4
91	855	6,840	253.3	Ref. 8, p. 2
47	280	2,240	83	Ref. 8, p. 1

Regularly Occupied Structure ID	Area (ft^2) (Regularly Occupied Structures)	Volume(ft^3) (Section 5.2.1.2.2)	Volume(yd^3) (1 ft^3 x 0.03703704 = 1yd^3)	References
171	600	4,800	178	Ref. 8, p. 4
152	1,008	8,064	299	Ref. 8, p. 4
74	1,404	11,232	416	Ref. 8, p. 2
59	1,313	10,504	389	Ref. 8, p. 2
156	1,281	10,248	380	Ref. 8, p. 4
66	680	5,440	201.5	Ref. 8, p. 2
174	1,183	9,464	351	Ref. 8, p. 4
71	1,112	8,896	329.5	Ref. 8, p. 2
26	1092	8,736	324	Ref. 8, p. 1
62	240	1,920	71.1	Ref. 8, p. 2
165	792	6,336	235	Ref. 8, p. 4
80	946	7,568	280.3	Ref. 8, p. 2
10	1,157	9,256	343	Ref. 8, p. 1
54	728	5,824	216	Ref. 8, p. 2
87	1,562	12,496	463	Ref. 8, p. 2
69	1,052	8,416	312	Ref. 8, p. 2
93	776	6,208	230	Ref. 8, p. 2
34	528	4,224	156.4	Ref. 8, p. 1
25	988	7,904	293	Ref. 8, p. 1
24	1,112	8,896	329.5	Ref. 8, p. 1
78	1,525	12,200	452	Ref. 8, p. 2
13	1,156	9,248	343	Ref. 8, p. 1
9	448	3,584	133	Ref. 8, p. 1
110	1,536	12,288	455.1	Ref. 8, p. 3
162	705	5,640	209	Ref. 8, p. 4
154	762	6,096	226	Ref. 8, p. 4
105	862	6,896	255.4	Ref. 8, p. 3
70	948	7,584	281	Ref. 8, p. 2
112	1,164	9,312	345.0	Ref. 8, p. 3
94	664	5,312	197	Ref. 8, p. 2
89	932	7,456	276.1	Ref. 8, p. 2
16	1,396	11,168	414	Ref. 8, p. 1
15	456	3,648	135.1	Ref. 8, p. 1
29	1,104	8,832	327.1	Ref. 8, p. 1
63	1,214	9,712	360	Ref. 8, p. 2
108	1,472	11,776	436.1	Ref. 8, p. 3
18	1,280	10,240	379.3	Ref. 8, p. 1
99	1,016	8,128	301	Ref. 8, p. 3
30	768	6,144	228	Ref. 8, p. 1

Regularly Occupied Structure ID	**Area (ft^2) (Regularly Occupied Structures)**	**Volume(ft^3) (Section 5.2.1.2.2)**	**Volume(yd^3) (1 ft^3 x 0.03703704 = 1yd^3)**	**References**
65	760	6,080	225.2	Ref. 8, p. 2
31	774	6,192	229.3	Ref. 8, p. 1
153	1,199	9,592	355.3	Ref. 8, p. 4
68	1,366	10,928	405	Ref. 8, p. 2
8	1,120	8,960	332	Ref. 8, p. 1
111	1,253	10,024	371.3	Ref. 8, p. 3
90	990	7,920	293.3	Ref. 8, p. 2
36	736	5,888	218.1	Ref. 8, p. 1
37	624	4,992	185	Ref. 8, p. 1
51	1,020	8,160	302.2	Ref. 8, p. 2
100	807	6,456	239.1	Ref. 8, p. 3
160	569	4,552	169	Ref. 8, p. 4
101	1,275	10,200	378	Ref. 8, p. 4
107	1,102	8,816	327	Ref. 8, p. 3
50	940	7,520	279	Ref. 8, p. 2
155	1,288	10,304	382	Ref. 8, p. 4
21	1,152	9,216	341.3	Ref. 8, p. 1
85	792	6,336	235	Ref. 8, p. 2
88	1,008	8,064	299	Ref. 8, p. 2
98	752	6,016	223	Ref. 8, p. 3
23	1,452	11,616	430.2	Ref. 8, p. 1
163	848	6,784	251.3	Ref. 8, p. 4
161	1,180	9,440	350	Ref. 8, p. 4
106	912	7,296	270.2	Ref. 8, p. 3
27	744	5,952	220.4	Ref. 8, p. 1
46	1,200	9,600	356	Ref. 8, p. 1
84	490	3,920	145.2	Ref. 8, p. 2
6	1,250	10,000	370.4	Ref. 8, p. 1
76	960	7,680	284.4	Ref. 8, p. 2
167	578	4,624	171.3	Ref. 8, p. 4
92	672	5,376	199.1	Ref. 8, p. 2
64	912	7,296	270.2	Ref. 8, p. 2
102	962	7,696	285	Ref. 8, p. 3
49	768	6,144	228	Ref. 8, p. 2
52	776	6,208	230	Ref. 8, p. 2
170	780	6,240	231.1	Ref. 8, p. 4
38	1,044	8,352	309.3	Ref. 8, p. 1
79	1,380	11,040	409	Ref. 8, p. 2
159	672	5,376	199.1	Ref. 8, p. 4

Regularly Occupied Structure ID	Area (ft^2) (Regularly Occupied Structures)	Volume(ft^3) (Section 5.2.1.2.2)	Volume(yd^3) ($1\ ft^3 \times 0.03703704 = 1yd^3$)	References
81	1,144	9,152	339	Ref. 8, p. 2
45	856	6,848	254	Ref. 8, p. 1
109	588	4,704	174.2	Ref. 8, p. 3
103	746	5,968	221	Ref. 8, p. 3
3	1,784	14,272	529	Ref. 8, p. 1
67	988	7,904	293	Ref. 8, p. 2
28	1,429	11,432	423	Ref. 8, p. 1
32	1,497	11,976	444	Ref. 8, p. 1
7	1,008	8,064	299	Ref. 8, p. 1
22	536	4,288	159	Ref. 8, p. 1
55	748	5,984	222	Ref. 8, p. 2
33	1,280	10,240	379.2	Ref. 8, p. 1
157	1,008	8,064	299	Ref. 8, p. 4
75	624	4,992	185	Ref. 8, p. 2
104	630	5,040	187	Ref. 8, p. 3
58	1,841	14,728	545.5	Ref. 8, p. 2
53	885	7,080	262.2	Ref. 8, p. 2
35	1482	11,856	439.1	Ref. 8, p. 1
			Total 50,807.3	

ft^2 – square feet
ft^3 – cubic feet
yd^3 – cubic yards

Sum of values: 50,807.3

Sum of values/2.5 (V/2.5): 20,322.92
Equation for Assigning Value (Ref. 1, Table 5-19)

Volume Assigned Value: 20,322.92

Tier D Area:

The square footage of the basal footprint for structures 114, 115, 117, 118, 119, 120, 122, 123, 124, 125, 126, 127, 128, 129, 130, 132, 131, 134, 136, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151 is unknown (Ref. 8, pp. 1-5). Therefore, a value of 1,740 square feet is assigned for each of these 32 structures (Ref. 1, Sec. 5.2.1.2.2).

Sum of values: 55,680

Sum of Values/13 (A/13): 4,283.07

Equation for Assigning Value (Ref. 1, Table 5-19)

Area Assigned Value: 4,283.07

AOE Hazardous Waste Quantity Value:

Per the HRS, the highest of the values assigned to each structure for hazardous constituent quantity (Tier A), hazardous wastestream quantity (Tier B), volume (Tier C), or area (Tier D) should be assigned as the structure hazardous waste quantity value (Ref. 1, Section 2.4.2.1.5). The total hazardous waste quantity value for AOE 1 is shown below.

TABLE 10
AOE 1 HAZARDOUS WASTE QUANTITY

Tier Evaluated	**Source 1 Values**
Tier A	Not Scored
Tier B	Not Scored
Tier C	20,322.92
Tier D	4,283.07
Total	**24,605.97**

AOE 1 Hazardous Waste Quantity Value: 24,605.97

5.2.1 SUBSURFACE INTRUSION COMPONENT

5.2.1.1 LIKELIHOOD OF EXPOSURE

5.2.1.1.1 Observed Exposure

Observed exposure of populations to PCE and TCE was documented in Section 5.2.0 and the AOE 1 discussion of this HRS documentation record. The AOE was identified based on five residential properties and a school which had observed exposure concentrations of PCE and TCE obtained through indoor air sampling. See Figure 2 of this HRS documentation record for the release sample locations and Tables 6 and 7 for observed exposure sample location descriptions and sample results.

TABLE 11
AOE OBSERVED EXPOSURE

AOE Number	Regularly Occupied Structure ID	Eligible Hazardous Substance(s)	Evidence *(e.g., sample ID)*	References
1	2	TCE	10423364003, 10423364005	4, pp. 2018-2027, 9957-9958, 9961-9962, 11410-11424
		PCE		
	19	TCE	10420606001	4, pp. 2288-2299, 8963, 8964, 11187-11207
		PCE		
	38	TCE	10420651027	4, pp. 2113-2135, 9147, 11208-11229
		PCE		
	86	TCE	10422527023	4, pp. 2247-2257, 9489-9490, 11268-11290
		PCE		
	116	TCE	10422523007	4, pp. 1821-1837, 9391, 9395, 11249-11267
	146	TCE	10422614011	4, pp. 2258-2265, 9816, 11374-11391
		PCE		

Chemical Analysis

The observed exposure samples that also had concentrations above the TCE and/or PCE cancer-risk benchmark are shown in Table 17. An additional structure had concentrations that met observed exposure criteria, but the concentrations were not above a health-based benchmark (Structure 116). It is evaluated as Level II actual contamination along with the inferred structures.

5.2.1.1.2 Potential for Exposure

Observed exposure was documented as stated above, therefore potential for exposure was not evaluated.

5.2.1.1.2.5 Calculation of Potential for Exposure Factor Value

Potential for Exposure Factor Value (Ref. 1, Sec. 5.2.1.1.2.5): Not Evaluated

Likelihood of Exposure Factor Category Value: 550 (Ref. 1, Sec. 5.2.1.1.3)

5.2.1.2 WASTE CHARACTERISTICS

The Contaminants of Concern (COCs) associated with the Site include PCE, TCE, and their daughter products: however, at this time only TCE and PCE are being used to score the site Ref. 4, pp. 186, 187, Table 10-1. pp. 368-381). The contaminants found and evaluated within the AOE are shown below.

5.2.1.2.1 Toxicity/Degradation

Toxicity Factor Value

TABLE 12
TOXICITY FACTOR VALUE

Eligible Hazardous Substance	AOE Number/ ASC Letter	Toxicity Factor Value	References
TCE	1	1000	2, p. 5
PCE	1	100	2, p. 1

Degradation Factor Value

TABLE 13
DEGRADATION FACTOR VALUE

Eligible Hazardous Substance	AOE Number/ ASC Letter	Substance Present in AOE or NAPL? (Y/N)	Depth to Contamination (Ref. 1, Sec. 5.2.1.1.2.2)	Half-life (Days)	Degradation Factor Value (Ref. 1, Table 5-18)	References
TCE	AOE 1	Y	N/A	N/A	1*	2, p. 5
PCE	AOE 1	Y	N/A	N/A	1*	2, p. 1

* Any hazardous substance that meets the criteria for an observed exposure (those substances present in the AOE) have an assigned degradation factor value of 1 (Ref. 1, Section 5.2.1.2.1.2).

Toxicity/Degradation Factor Value

TABLE 14
TOXICITY/DEGRADATION FACTOR VALUE

Eligible Hazardous Substance	AOE Number/ ASC Letter	Toxicity	Degradation Factor Value (Ref. 1, Table 5-18)	Toxicity/Degradation Factor Value
TCE	AOE 1	1000	1	1000
PCE	AOE 1	100	1	100

The substance(s) with the highest combined toxicity/degradation factor value: TCE

Toxicity/Degradation Factor Value: 1,000

5.2.1.2.2 Hazardous Waste Quantity [for component]

TABLE 15
HAZARDOUS WASTE QUANTITY

AOE Number/ASC Letter	AOE/ASC Hazardous Waste Quantity
AOE 1	24,605.97

Sum of AOE/ASC Values: 24,606 (rounded to the nearest integer)

Hazardous Waste Quantity Factor Value based on estimates (Ref. 1, Table 2-6): 10,000

Or

Minimum Waste Quantity Factor Value (If appropriate):

Hazardous Waste Quantity Factor Value: 10,000

5.2.1.2.3 Calculation of Waste Characteristics Factor Category Value

Toxicity/Degradation Factor Value: 1,000
Hazardous Waste Quantity Factor Value: 10,000

Toxicity Factor Value x Hazardous Waste Quantity Factor Value: 10,000,000

Waste Characteristics Factor Category Value: 56
(Ref. 1, Table 2-7)

5.2.1.3 TARGETS

The Site is comprised of 145 regularly occupied structures within AOE 1. Only single-family residences and one school were evaluated for the AOE due to the difficulty in collecting square footage and employee data for businesses and other non-residential structures (Figures 1 and 2 of this HRS documentation record).

TABLE 16
AOE STRUCTURES

AOE Number/ ASC Letter	Type of Structure	Number(s) of Specific Type of Structure	Type of Population	References
1	Residential (all others)	144	residents	Figure 2B; Refs. 8, pp.1-5;10; 11
1	High School (Structure #116)	1	students, workers	

TABLE 17
HAZARDOUS SUBSTANCES THAT EXCEED HEALTH-BASED BENCHMARKS

AOE Number	Sample ID	Eligible Hazardous Substance	Hazardous Substance Concentration (µg/m³)	Benchmark Concentration (µg/m³)	Benchmark (Ref. 1, Table 5-20)	References
1	10423364003	TCE	1.4	0.4	Cancer	Ref. 2, pp. 2, 5; 4, pp. 2018-2027, 9957-9958, 11410-11411
				2.0	Non-cancer	
		PCE	12.3	10.8	Cancer	
				41.7	Non-cancer	
	10423364005	TCE	1.3	0.4	Cancer	Ref. 2, pp. 2, 5; 4, pp. 2018-2027, 9961-9962, 11410-11411
				2.0	Non-cancer	
		PCE	12.4	10.8	Cancer	
				41.7	Non-cancer	
	10420606001	TCE	0.43	0.4	Cancer	Ref. 2, p. 5; 4, pp. 2288-2299, 8963-8964, 11187-11188
				2.0	Non-cancer	
	10420651027		0.71	0.4	Cancer	Ref. 2, p. 5; 4, pp. 2113-2135, 9147, 11208-11209
				2.0	Non-cancer	
	10422527023		0.41	0.4	Cancer	Ref. 2, p. 5; 4, pp. 2247-2257, 9489-9490, 11268-11269
				2.0	Non-cancer	
	10422523007		0.11	0.4	Cancer	Ref. 2, p. 5; 4, pp. 1821-1837, 9391, 11249-11250
				2.0	Non-cancer	
	10422614011		2.4	0.4	Cancer	Ref. 2, pp. 2, 5; 4, pp. 2258-2265, 9816, 11374-11375
				2.0	Non-cancer	
		PCE	17.1	10.8	Cancer	
				41.7	Non-cancer	

ND – Not detected
µg/m³ – micrograms per cubic meter

5.2.1.3.1 Exposed Individual

There are five regularly occupied residential structures within AOE 1 that had concentrations of TCE and/or PCE above health-based benchmarks as shown above and displayed on Figure 2 of this HRS documentation record.

AOE Number/ASC Letter: AOE 1
Regularly Occupied Structure ID: 146
Sample ID: 10422614011
Eligible Hazardous Substance: Trichloroethylene
Hazardous Substance Concentration: 2.4 $\mu g/m^3$
Benchmark Concentration: Cancer risk 0.4 $\mu g/m^3$
Level of Contamination (Level I/Level II/Potential): Level I
Reference: 2, p. 5; 4, pp. 2258-2265, 9808, 11374-11391

Exposed Individual Factor Value: 50

5.2.1.3.2 Population

The actual population count for every residence was not readily available, therefore the persons per residence for the county in which the residence is located, Yellowstone County, was used as necessary (Ref. 1, Section 5.2.1.3.2). Based on the United States Census Bureau estimate for 2018, there are 2.37 persons per household in Yellowstone County, for which the city of Billings is located. (Ref. 9, p. 1). For residences where number of inhabitants was collected, they are included.

5.2.1.3.2.1 Level I Concentrations

Level I concentrations are media-specific concentrations for the target that meet the criteria for an observed exposure for the pathway and are at or above media-specific benchmark values, as shown above (Ref. 1, Sec. 2.5). Information for AOE 1 can be found in Section 5.2.0 of this HRS documentation record. The structures that contain sampling data which meet observed exposure criteria are listed below.

Level I Population

TABLE 18
LEVEL I POPULATION

	Regularly Occupied Structure ID	**Sample ID**	**No. of Exposed Individuals (non-workers)**	**No. of Full-time Workers**		**No. of Part-time Workers**		**Regularly Occupied Structure’s Total Population Value**	**References**
				Actual #	**Adjusted (#/3)**	**Actual #**	**Adjusted (#/3)**		
AOE No.	2	10423364003 10423364005	1	N/A	N/A	N/A	N/A	1	Ref. 4, pp. 2018-2027
	19	10420606001	1	N/A	N/A	N/A	N/A	1	Ref. 4, pp. 2288-2299
	38	10420651027	1	N/A	N/A	N/A	N/A	1	Ref. 4, pp. 2113-2136
	86	10422527023	2	N/A	N/A	N/A	N/A	2	Ref. 4, pp. 2247-2265
	146	10422614011	2.37	N/A	N/A	N/A	N/A	2.37	Refs. 4, pp. 2258-2265; 9, p. 1

N/A – Not Applicable

Sum of regularly occupied structures’ total population values subject to Level I concentrations: 7.37
Sum of regularly occupied structures’ total population values subject to Level I concentrations x 10: 73.7
Level I Concentrations Factor Value: 73.7

5.2.1.3.2.2 Level II Concentrations

Level II concentrations are structures with one or more samples that meet observed exposure by chemical analysis, but are less than media-specific benchmarks, and structures inferred to be in an area of observed exposure based on samples meeting observed exposure (Ref. 1, Sec. 5.2.1.3.1). There is one structure, structure 116, with documented Level II contamination. Information for AOE 1 can be found in Section 5.2.0 of this HRS documentation record. The structures which contain either Level II sampling data or are inferred due to their locations are listed below:

Level II Population

TABLE 19
LEVEL II POPULATION

AOE No.	Regularly Occupied Structure ID	Sample ID/Inferred Indoor Air Contamination	No. of Exposed Individuals (non-workers)	No. of Full-time Workers		No. of Part-time Workers		Regularly Occupied Structure's Total Population Value	References
				Actual #	Adjusted (#/5)	Actual #	Adjusted (#/3)		
1	116	10422523011	326	33	11	N/A	N/A	337	4, pp. 9398-9399, 11250; 10, p. 1; 11, p. 1
	114	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	44	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	125	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	48	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	77	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	173	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	56	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	11	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	172	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	12	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	166	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	164	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	91	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	47	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	147	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	128	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	171	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	150	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	152	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	74	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1

AOE No.	Regularly Occupied Structure ID	Sample ID/Inferred Indoor Air Contamination	No. of Exposed Individuals (non-workers)	No. of Full-time Workers Actual #	No. of Full-time Workers Adjusted (#/5)	No. of Part-time Workers Actual #	No. of Part-time Workers Adjusted (#/3)	Regularly Occupied Structure's Total Population Value	References
	119	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	59	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	156	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	66	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	174	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	71	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	26	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	62	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	165	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	127	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	80	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	10	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	54	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	87	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	69	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	93	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	34	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	25	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	24	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	78	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	13	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	9	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	110	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	120	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	162	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	154	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	105	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	143	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	70	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	136	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	112	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	145	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	126	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	94	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	89	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	16	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	15	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1

AOE No.	Regularly Occupied Structure ID	Sample ID/Inferred Indoor Air Contamination	No. of Exposed Individuals (non-workers)	No. of Full-time Workers		No. of Part-time Workers		Regularly Occupied Structure's Total Population Value	References
				Actual #	Adjusted (#/5)	Actual #	Adjusted (#/3)		
	29	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	63	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	108	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	18	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	99	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	130	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	30	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	65	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	31	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	153	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	68	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	8	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	111	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	90	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	36	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	140	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	142	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	141	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	37	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	51	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	100	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	160	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	101	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	132	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	107	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	151	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	50	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	155	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	144	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	21	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	85	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	88	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	122	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	98	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	23	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	115	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	163	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1

AOE No.	Regularl y Occupied Structure ID	Sample ID/Inferred Indoor Air Contamination	No. of Exposed Individuals (non-workers)	No. of Full-time Workers		No. of Part-time Workers		Regularly Occupied Structure's Total Population Value	References
				Actual #	Adjusted (#/5)	Actual #	Adjusted (#/3)		
	161	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	106	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	149	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	148	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	27	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	46	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	84	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	6	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	76	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	167	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	92	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	64	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	124	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	102	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	49	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	52	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	170	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	123	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	38	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	79	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	159	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	81	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	45	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	109	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	103	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	3	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	134	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	67	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	131	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	28	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	32	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	7	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	117	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	118	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	22	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	55	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	139	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1

AOE No.	Regularly Occupied Structure ID	Sample ID/Inferred Indoor Air Contamination	No. of Exposed Individuals (non-workers)	No. of Full-time Workers		No. of Part-time Workers		Regularly Occupied Structure's Total Population Value	References
				Actual #	Adjusted (#/5)	Actual #	Adjusted (#/3)		
	33	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1
	129	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	157	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 4; 9, p. 1
	75	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	104	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 3; 9, p. 1
	58	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	53	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 2; 9, p. 1
	35	Inferred	2.37	N/A	N/A	N/A	N/A	2.37	8, p. 1; 9, p. 1

N/A – Not Applicable

Sum of regularly occupied structures' total population values subject to Level II concentrations: 666.43

Level II Concentrations Factor Value: 666.43

5.2.1.3.2.3 Population within Area(s) of Subsurface Contamination

An ASC was not evaluated for this site.

5.2.1.3.2.4 Calculation of Population Factor Value

Level I Concentrations Factor Value: 73.7
Level II Concentrations Factor Value: 666.43
Population within an Area of Subsurface Contamination Factor Value: 0

Level I Concentrations + Level II Concentrations + Population within an Area of Subsurface Contamination: 740.13

Population Factor Value: 740.13

5.2.1.3.3 Resources

Description of Resource(s):

No resources have been documented within the AOC.

Resources Factor Value: 0

5.2.1.3.4 Calculation of Targets Factor Category Value

Exposed Individual Factor Value: 50
Population Factor Value: 740.13
Resources Factor Value: 0

Exposed Individual + Population + Resources: 790.13

Targets Factor Category Value: 790.13