FINAL

2019
ANNUAL SAMPLING AND MONITORING REPORT
REGARDING THE
MONTANA POLE AND TREATING PLANT
BUTTE-SILVER BOW, MONTANA

Revision 0

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CONTENTS

CONTENTS (Cont.)

TABLES

Table

FIGURES

Figure

CONTENTS (Cont.)

APPENDICES

ACRONYMS AND ABBREVIATIONS

ºF	Degrees Fahrenheit
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
ARCO	Atlantic Richfield Company
BSB	Butte-Silver Bow
CDM	Camp Dresser & McKee, Inc.
cfs	Cubic feet per second
COC	Chain of custody
Dioxin	Polychlorinated dibenzo-p-dioxins
DEQ	Montana Department of Environmental Quality
DSR	Daily Summary Report
EDD	Electronic data deliverable
EPA	U.S. Environmental Protection Agency
FS	Feasibility study
Furans	Polychlorinated dibenzofurans
GAC	Granulated activated carbon
gpm	Gallons per minute
GWMP	Groundwater and Surface Water Monitoring Plan
kg	Kilograms
kg/yr	Kilograms per year
LNAPL	Light non-aqueous phase liquid
LTU	Land treatment unit
MBMG	Montana Bureau of Mines and Geology
MDHES	Montana Department of Health and Environmental Sciences
MDL	Method detection limit
MDT	Montana Department of Transportation
mg/kg	Milligrams per kilogram
MPTP	Montana Pole and Treating Plant
NAPL	Non-aqueous phase liquid
NCRT	Near creek recovery trench
NHRT	Near highway recovery trench
NWS	National Weather Service
O&M	Operations and maintenance
OWS	Oil and water separator

ACRONYMS AND ABBREVIATIONS (Cont.)

PAH	Polycyclic aromatic hydrocarbon
PCP	Pentachlorophenol
pg/L	Picograms per liter
PRP	Potentially responsible party
QC	Quality control
RCRA	Resource Conservation and Recovery Act
RI	Remedial investigation
ROD	Record of decision
RPD	Relative percent difference
SD	Standard deviation
SDG	Sample delivery group
SSP	Soil staging and pretreatment pile
SVOC	Semivolatile organic compound
Tetra Tech	Tetra Tech, Inc. [EMI Unit]
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEF	Toxicity equivalency factor
TEQ	Toxicity equivalence quotient
USGS	U.S. Geological Survey
WTP	MPTP water treatment plant
WWTP	Wastewater treatment plant

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EXECUTIVE SUMMARY

This 2019 Montana Pole and Treating Plant (MPTP) annual report describes site monitoring activities, summarizes analytical data generated, and evaluates progress toward achievement of remedial objectives for MPTP. The report also discusses additional site operation and maintenance (O&M) activities during 2019, such as non-routine maintenance at the MPTP water treatment plant (WTP), use of the south-side infiltration system, operation of the land treatment unit (LTU), planning for the anticipated LTU offload, and other related projects completed at the site during the year.

Primary activities at the site in 2019 included: (1) O&M activities, (2) sampling, and (3) planning for the next and final offload of treated soil from the LTU. The LTU offload is addressed in reports prepared under separate contract task orders. WTP facilities are currently in good working order.

Important operational issues noted in 2019 are as follows:

- Throughout 2019 in the near highway recovery trench (NHRT), the sustainable pumping rate continued to decrease relative to historical rates—from 135 gallons per minute (gpm) in 2009 to about 70 gpm in 2019.
- On December 3, 2018, the site operator suspected a leak in the municipal water line supplying potable water to the treatment plant. The water line was shut off on December 3, 2018, to prevent further leaking. The leaking water line was repaired on October 3, 2019.

Other than the operational issues stated above, O&M of the MPTP WTP were routine in 2019.

Water Treatment Plant

WTP effluent (treated groundwater at WTP station EFF) was monitored weekly throughout 2019 for pentachlorophenol (PCP). Concentrations of PCP in effluent from both the NHRT and the near creek recovery trench (NCRT) were measured monthly.

During semi-annual monitoring in February 2019, plant water, groundwater, and surface water samples were analyzed for PCP. The annual monitoring event involving plant water, groundwater, and surface water was completed in August 2019. In addition to analysis of samples for PCP, some samples were analyzed for the “extended parameter list” analytes (semivolatile organic compounds [SVOC], polychlorinated dibenzo-p-dioxins [dioxins], and metals).

Concentrations of PCP in WTP effluent samples (station EFF) were below the 1 microgram per liter (µg/L) Record of Decision (ROD) discharge to surface water cleanup level in all 52 weekly samples collected during 2019. Average PCP concentration over 2019 in WTP effluent was 0.414 µg/L with a standard deviation (SD) of ±0.172 µg/L.

Concentrations of dioxin and polychlorinated dibenzofurans (furans), collectively referred to as “dioxins,” have varied over time. Low levels of dioxins (comparable to levels found in laboratory-grade distilled water blanks) have been detected in WTP effluent samples collected during monitoring events each year. Results from sampling in 2019 confirm that the concentration in WTP effluent of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxicity equivalence quotient (TEQ), referred to as “dioxin (TEQ),” met the ROD discharge to surface water cleanup level of 1.00E-5 μg/L (equivalent to 10 picograms per liter [pg/L]).

For the purposes of this report, concentrations of dioxin (TEQ) are calculated by application of two different methodologies, referred to as the “MPTP ROD Methodology” and the “Montana Department of Environmental Quality [DEQ]-7 Methodology,” as described below. (Calculations from application of both methods are in Appendix A [database] and Appendix B [table in section B-3].)

- **MPTP ROD Methodology**

  Calculation of dioxin (TEQ) includes assignment of 0 to values qualified as "U" (analyte not detected at concentration above the method detection limit [MDL]) when estimated maximum possible concentrations are reported, and use of ROD toxicity equivalency factors (TEF).

- **DEQ-7 Methodology**

  Calculation of dioxin (TEQ) includes application of 2005 World Health Organization methodology, assignment of one-half the project reporting limit to values qualified as “U”, assignment of one-half the estimated maximum possible concentration when estimated maximum possible concentrations are reported, and use of 2005 TEFs as specified in DEQ-7 (DEQ 2017).

In WTP effluent samples collected during August 2019, all metals, polycyclic aromatic hydrocarbons (PAH), chlorophenols, and anions for which ROD discharge to surface water cleanup levels had been specified were detected at concentrations below those ROD benchmarks.

No measurable volumes of light non-aqueous phase liquid (LNAPL) were detected in 2019. Coupled with lack of detection of LNAPL in any monitoring well during any sampling event over calendar years 2010 through 2019, these observations suggest that significant ongoing transport of LNAPL is not a major concern at MPTP. However, some residual non-aqueous phase liquid (NAPL) is likely still present near the NHRT, primarily below the interstate highway.

Land Treatment Unit

No soil tilling occurred at the LTU in 2019. Neither odors nor dust was observed at any time during the year. The irrigation system for the LTU has been removed in preparation for the final LTU offload.

Average concentration of PCP in all LTU zones sampled in 2012 was 26.7 milligrams per kilogram (mg/kg); in 2013, average concentration of PCP in LTU soils was 26.8 mg/kg. Thus, average concentration of PCP in LTU soils during the previous two monitoring events was less than the ROD soil cleanup level (34 mg/kg). LTU soils were not analyzed for PAH during the October 2013 round of sampling because all sections of the LTU previously had met the cleanup goal for PAH in two successive monitoring events. Average dioxin (TEQ) concentrations (calculated by application of the MPTP ROD Methodology) in all LTU zones sampled in 2012 (2.8 micrograms per kilogram [μg/kg]) and 2013 (2.6 μg/kg) were above the ROD soil cleanup level of 0.2 μg/kg. LTU soil was not sampled in 2019 as part of site operations.

Surface Water – Silver Bow Creek

During both 2019 monitoring events, concentrations of PCP at two surface water stations (SW-05 and SW-09) were below the laboratory detection limit (0.1 μg/L) and the ROD surface water cleanup level (1.0 μg/L). Concentrations of PCP detected at surface water station SS-06A were below laboratory detection limits in February and at 0.106 μg/L during the August 2019 sampling event.

In samples collected from Silver Bow Creek, all SVOCs and dioxins for which ROD cleanup levels had been specified were detected at concentrations below those ROD benchmarks.

Groundwater

During the 2019 semi-annual (February) and annual (August) monitoring events, 62 shallow monitoring wells, four intermediate wells, and eight deep wells were sampled for analysis of PCP via Environmental Protection Agency (EPA) Method 528.

During the August 2019 annual monitoring event, groundwater samples from three shallow monitoring wells (HCA-21, INF-04, and MW-11-04) and two deep wells (BMW-01A and BMW-01B) were analyzed for the “extended parameter list” of analytes, including SVOCs and dioxins, as per the Groundwater and Surface Water Monitoring Plan (GWMP), Revision 2 (Tetra Tech 2013b). As noted in the 2017 Annual Report, routine inspection of wells 10-12 and GW-14R-98 had revealed deficiencies (ineffective surface sealing) that compromised groundwater sample integrity at those locations. No sampling of those wells has occurred since.

Data from samples collected at shallow wells were plotted and contoured (Figures 4.5 and 4.6) to evaluate trends in concentration and the spatial distribution of PCP contamination. This analysis indicated presence of a plume of PCP, as defined by the 1.0 µg/L contour, approximately 1,000 feet wide by 1,700 feet long on the south side of Silver Bow Creek oriented along the principal direction of groundwater flow (southeast to northwest). In addition there were PCP "hot spots" at several locations on the site. The primary plume core is under the interstate highway and extends north under the WTP, as depicted on Figures 4.5 and 4.6.

This annual report was prepared to assess compliance with ROD groundwater cleanup requirements and evaluate progress of remediation. The groundwater cleanup level for PCP is 1.0 µg/L. Comparisons of 1.0 µg/L isocontours since 1993 indicated a decrease in the original area of the PCP plume by approximately 50 percent, and thus continuing effectiveness of the ongoing remediation.

1.0 INTRODUCTION AND PURPOSE

This 2019 Montana Pole and Treating Plant (MPTP) annual report describes site monitoring activities, summarizes analytical data generated, and evaluates progress toward achievement of remedial objectives for MPTP. The report also discusses additional site operation activities during 2019, such as non-routine operation and maintenance (O&M) activities at the MPTP water treatment plant (WTP), use of the south-side infiltration system, operation of the land treatment unit (LTU), planning for the anticipated LTU offload, and other related projects completed at the site during the year.

1.1 REPORT ORGANIZATION

Section 1.0 summarizes the site's operational and regulatory history. Section 2.0 discusses WTP operation and related activities. Section 3.0 describes LTU operations, soil treatment, and historical soil sampling. Section 4.0 provides results of surface water and groundwater monitoring, and assesses overall system performance and compliance with the requirements of the MPTP Record of Decision (ROD) (U.S. Environmental Protection Agency [EPA] and Montana Department of Environmental Quality [DEQ] 1993). Section 5.0 conveys historical residential well sampling results. Section 6.0 describes additional site activities. Section 7.0 overviews database management. Section 8.0 addresses climate and streamflow considerations. Section 9.0 offers recommendations. The following section lists sources referenced during preparation of this report, followed by tables and figures.

Appendix A (separate CD) includes an electronic copy of the Microsoft Access database pertaining to the MPTP site. Appendix B conveys sampling results and data. Appendix C summarizes 2019 pumping rates in the near highway recovery trench (NHRT) and near creek recovery trench (NCRT). Appendix D provides daily Summary Reports (DSR) regarding WTP-related incidents during 2019. Appendix E includes time series plots of water treatment plant field parameters programmed by use of R-Studio. Appendix F conveys results from Mann-Kendall statistical testing. Appendix G shows plume area maps. Appendix H summarizes quality control (QC) activities pertaining to electronic data deliverables (EDD). Appendices I and J provide climate and streamflow statistics.

1.2 SITE HISTORY

The site, in Butte, Montana, hosted operations of a wood treating facility from 1946 to 1984 (EPA and DEQ 1993) (Figure 1.1). During most of this period, the facility used a solution of about 5 percent pentachlorophenol (PCP), mixed with petroleum carrier oil similar to diesel, to preserve poles, posts, and bridge timbers. The PCP solution was applied to wood products in butt vats and pressure cylinders (retorts). The facility used creosote as a wood preservative for a brief period in 1969.

The plant initially included a pole peeling machine, two butt treating vats, on-site chemical storage tanks, and related ancillary facilities. Major modifications to the plant occurred between 1949 and 1951, and again around 1956. Sometime between 1949 and 1951, a 73-foot-long, 6-foot-diameter retort was installed to increase the efficiency of timber treatment production. A second retort, 66 feet long and 7 feet in diameter, was installed around 1956.

On May 5, 1969, an explosion occurred during treatment of a charge of poles in the east butt-treating vat. The explosion generated a fire that destroyed the east vat, boiler room, and retort building. Petroleum and PCP product reportedly spilled from the east butt-treating vat because of the explosion and fire. Additional seepage of product occurred from both retorts due to broken pipes and valves damaged by the fire. Reportedly, none of the on-site chemical storage tanks was ruptured during the fire. Although the boiler, retorts, and auxiliary equipment were damaged, the plant was rebuilt and functional by December 1969.

In response to implementation of the Resource Conservation and Recovery Act (RCRA), the facility constructed a closed-loop process water system in 1980. Operation of the closed-loop water recovery system involved collection of wastewater in storage tanks, recirculation of this water through the condensing system, and then evaporation of excess water by use of aeration sprays. On May 17, 1984, the MPTP ceased operations.

1.3 SITE INVESTIGATION

In March 1983, a local citizen filed a complaint concerning oil seepage into Silver Bow Creek near the MPTP facility. The Montana Department of Health and Environmental Sciences (MDHES) (now DEQ) investigated the complaint and discovered an oil seep on the south side of Silver Bow Creek directly downgradient of the MPTP facility. Further investigation of the site revealed oil-saturated soils adjacent to the creek and on MPTP property. Subsequent sampling confirmed presence in site soils and oil samples of PCP and polycyclic aromatic hydrocarbons (PAH), as well as polychlorinated dibenzo-p-dioxins (dioxin) and polychlorinated dibenzofurans (furans)—collectively referred to as “dioxins.” MDHES and EPA completed a preliminary assessment and site inspection, and subsequently a Hazard Ranking System score in July 1985.

In July 1985, the EPA Emergency Response Branch began a removal action on the site to minimize impacts on Silver Bow Creek and to stabilize the site. As part of the removal action, two groundwater interception and oil recovery systems were installed to minimize oil seepage into the creek. In October 1989, EPA granted MDHES the initial enforcement funding to conduct potentially responsible party (PRP) noticing and to negotiate and issue an administrative order. In April 1990, MDHES signed an administrative order on consent with Atlantic Richfield Company (ARCO) under which ARCO agreed to conduct a remedial investigation (RI) and feasibility study (FS) of the site. In June 1990, ARCO began the RI/FS following the MDHES- and EPA-approved RI/FS work plan.

In June 1992, EPA proposed an additional removal action to control and recover light non-aqueous phase liquid (LNAPL) (floating oils) in groundwater identified during the RI. The older remedial system installed in 1985 was shut down when the MPTP WTP began operation on January 22, 1993.

1.4 REMEDY IMPLEMENTATION AND STATUS

Implementation of the MPTP cleanup has proceeded in six phases. The design for Phase 1 of the remedial action was finalized in June 1996; construction occurred from May 1996 to November 1997. Primary components of the remedy completed during Phase 1 of the remedial action were constructions of the LTU and 13 soil staging and pretreatment piles (SSP), completion of an addition to the previous WTP, construction of two groundwater recovery trenches that form the current remedy extraction system (the NHRT and the NCRT), removal of the previous EPA groundwater recovery system, and excavation of the north-side contaminated soils.

Phase 2 involved removal and disposal of hazardous and nonhazardous waste debris remaining on site. The design for Phase 2 of the remedial action was finalized in December 1998; construction occurred from March 1999 to May 1999. Off-site disposal methods included incineration or placement in hazardous and nonhazardous waste landfills, as appropriate. Metal debris was pressure washed and recycled.

Phase 3 involved excavation of south-side contaminated soils, offload of Phase 1 treated soils from the LTU, placement of approximately 132,000 cubic yards of contaminated soil on the LTU, installation of the north- and south-side infiltration systems, and relocations of sewer and potable water lines. The design for Phase 3 of the remedial action was finalized in July 1999; construction occurred from October 1999 to December 2000. The infiltration system operated continuously through November 2002. Since that time, the south-side infiltration system has been used periodically to maintain adequate groundwater levels for operation of recovery trench pumps and aid in flushing contaminated soils remaining beneath the interstate highway embankment. The north side infiltration system has not been used since 2002.

Phase 4 is ongoing and involves continued capture and treatment of contaminated groundwater, and biological treatment of contaminated soils. This phase includes offloading the LTU as lifts of surface soil are remediated to below the action limits specified in the ROD for certain contaminants of concern at the site. Offload of remaining LTU soils is tentatively scheduled for 2020. Tetra Tech, Inc. (EMI Unit) (Tetra Tech) completed a data gaps investigation in mid-2017 that addressed site-wide concentrations of contaminants in soil, and presented results of this investigation in a final report issued in November 2017 (Tetra Tech 2017). Development of the 30 percent design for the final offload has begun. The design will include offload of all soil from the LTU, removal and disposal of the LTU liner and associated materials and equipment, and reclamation of the current LTU and retention pond areas.

Phase 5 addresses contaminated soils beneath the interstate that divides the site. In March 2009, Tetra Tech submitted a report titled Final Treatability Study Workplan, Montana Pole and Treating Plant Site – Phase 5 (Tetra Tech 2009) that evaluated areas of residual soil contamination and potential remedial technologies. The report incorporated a literature review of three in situ treatment technologies: in situ chemical oxidation, in situ soil flushing, and in situ bioremediation. Two of these technologies were retained at that time for further evaluation:

- In Situ Chemical Oxidation Via Application of Modified Fenton's Reagent
- In Situ Soil Flushing.

Tetra Tech revisited the 2009 treatability study in 2013. As part of this effort, Tetra Tech prepared a draft memorandum that considered and screened out the two previous potentially applicable technologies, and outlined a conceptual approach and approximate costs for full-scale implementation of three new potentially promising alternatives (Tetra Tech 2013a):

- Bioventing – Vertical Well Approach
- Bioventing – Horizontal Well Approach
- Chemical Oxidation – Horizontal Well Approach.

Evaluation of these technologies was put on hold temporarily because of complications associated with dewatering the construction site for the Butte-Silver Bow (BSB) Wastewater Treatment Plant (WWTP) in 2014, 2015, and 2016. These technologies will be evaluated again when conditions at the site have relatively stabilized from conditions there during WWTP construction dewatering, and after completion of offload of the LTU (see Section 9.0). In addition, as described on page 44 of the ROD (EPA and DEQ 1993), "After it has been determined by the lead agency, in consultation with the support agency, that recovery of hazardous substances from these areas is no longer effective or practical and contaminant levels have plateaued, these areas will be addressed by in situ bioremediation as outlined under Performance Standards for Groundwater."

Phase 6 involves removal and disposal of the soil treatment facilities on the south side of the site, implementation of final engineering controls (soil cover and stormwater management), revegetation of all disturbed areas, and imposition of appropriate institutional controls to maintain protectiveness of the remedy. Expectedly, designation of final land use at the site will occur via consultations with BSB County and interested citizens, with certain constraints on land use specified by EPA and DEQ (and consistent with the ROD) to ensure long-term protectiveness of the remedy.

2.0 WATER TREATMENT PLANT OPERATIONS AND ANALYTICAL RESULTS

The following sections provide information related to WTP operations and analytical results during 2019. Significant operational issues included the following (see Section 2.6 for details):

- Potable water line leak
- Replacement of the NHRT pump motor with a new motor
- Failure of the NCRT recover trench pump due to a power spike and brown-out, which required replacement of the pump. The pump was equipped with a variable frequency drive that had to be reprogrammed after replacement.

Otherwise, O&M of the MPTP WTP proceeded routinely over the remainder of 2019, and the WTP was generally in good working order. WTP operations are discussed below.

2.1 WTP OPERATIONS

The groundwater treatment system consists of a WTP, two groundwater recovery trenches (the NHRT and NCRT), and the south-side infiltration system consisting of eight infiltration cells (see Figure 1.1 and Figure 2.1). Inflow rates in 2019 were constant at 70 gallons per minute (gpm) from the NHRT and 200 gpm from the NCRT. The combined pumping rate into the WTP was 270 gpm over the reporting period of January 1 through December 31, 2019 (Figure 2.2, Table 2.1, and Appendix E). Short periods of time (hours) when WTP flow was temporarily halted to conduct maintenance and repairs are not factored into these daily flow estimates.

Water from the NHRT and NCRT is first pumped directly to groundwater holding tank T1C, and then through the granulated activated carbon (GAC) treatment system. The current (2019) WTP configuration and water quality monitoring points are shown on Figure 2.3.

Treated effluent is discharged to Silver Bow Creek. Except for backwashing, treated effluent was not pumped to the south-side infiltration system in 2019. During 2019, almost 142 million gallons of water were treated at the WTP. Since 1993, over 3.8 billion gallons of water have been treated at the WTP (Table 2.2).

2.2 WTP ANALYTICAL RESULTS

Table 2.3 summarizes sampling and analysis at the site per the Final Groundwater and Surface Water Monitoring Plan (GWMP), Revision 2 (Tetra Tech 2013b). Concentrations of PCP in effluent from both the NHRT and NCRT are measured monthly, and WTP samples are collected weekly. PCP analysis of all water samples collected for that purpose proceeds via EPA Method 528. Annual analyses involving a more comprehensive list of parameters (semivolatile organic compounds [SVOC], dioxins, metals, and anions) occur in August of each year (Tetra Tech 2013b). This list is referred to as the "extended parameter list" in the GWMP, as well as in this annual report. WTP station locations are shown on Figure 2.3.

Results of PCP analyses of samples collected in the NHRT (station NHRTEFF) and the NCRT (station NCRTEFF) over the 2001 to 2019 period of record are listed in Table 2.4; results from 2019 appear on Figure 2.4a, in Appendix A, and in Appendix B-1. Average concentration of PCP in the NHRT in 2019 was 274 micrograms per liter (µg/L) (standard deviation [SD] 68.5 µg/L). Average concentration of PCP in the NCRT was 5.8 µg/L (SD 1.9 µg/L). Following initiation of operations at the WTP, concentrations of PCP in the NCRT and NHRT decreased initially from 1998 to 2005. Since 2005, detected PCP concentrations in the NHRT and NCRT have trended slowly upward, but remain statistically lower than late-1990s and early-2000s concentrations (Figure 2.4b). The slowly increasing trend observed in PCP concentrations in the trenches likely has resulted from steadily increasing groundwater elevations over the same time-span (Figure 2.5). As groundwater elevation increases at the site, higher elevation layers of the smear zone not contacted by groundwater since the late 1990s reconnect with and contribute increased PCP to groundwater captured by the trenches (Figure 2.5). The strong correlation between groundwater elevation at monitoring well MW-H-95 and NHRT PCP concentration suggests that instituting controls on groundwater elevations could help stabilize WTP influent PCP concentrations to maximize PCP removal by the WTP.

Results from 2019 of sampling for PCP in plant influent (recovered groundwater – station IN), in treatment process water (between carbon units – station BABB), and in effluent (treated discharge from the plant – station EFF) are conveyed in Appendix A, Appendix B-1, and on Figure 2.6a. Long-term WTP PCP sampling results from 1998 to 2019 are indicated on Figure 2.6b, summarized in Table 2.4, and provided in Appendix E. WTP influent PCP concentrations decreased initially from 1998 to 2005, stabilized from 2005 to 2015, and slowly increased from 2015 to 2019 (Figure 2.6b). During 2019, PCP concentration in WTP influent ranged from 34.8 to 114 µg/L and averaged 68.5 µg/L (SD 19.5 µg/L). Sampling results throughout 2019 indicate that approximately 94 percent of the contaminant load and 26 percent of the water volume to the WTP come from the NHRT, and 6 percent of the contaminant load and 74 percent of the water volume come from the NCRT.

A WTP between-tanks sample (station BABB) is collected weekly to evaluate filter performance and service life. Concentrations of PCP in BABB samples during 2019 ranged from 0.165 to 2.96 µg/L, and averaged 0.608 µg/L (SD 0.421 µg/L). The plant operator estimates the remaining service life of the primary carbon train at approximately 3 years (personal communication with Tom Bowler, MPTP WTP operator, December 2019). Current estimates of remaining service life are based on historical filter performance and total PCP loading to the carbon filters. Carbon currently in the primary carbon train was last replaced on September 13, 2006, and carbon currently in the secondary carbon train was replaced on November 13, 2013. PCP concentrations in WTP influent water during 2019 were near average compared to the previous 13 years since the last carbon replacement (Figure 2.6b). Sustained increase in PCP concentration in influent water, precipitation of iron or manganese, or increase in system flow rate would likely result in additional decrease in remaining service life of the carbon trains.

In 2019, concentrations of PCP in WTP effluent samples (station EFF) never exceeded the 1 µg/L ROD discharge to surface water cleanup level (Figures 2.6a and 2.7a). Maximum and minimum recorded concentrations of PCP at station EFF during the 2019 monitoring period were 0.872 and 0.160 µg/L, respectively. Average PCP concentration in WTP effluent was 0.414 µg/L (SD 0.172 µg/L), slightly above the newly revised DEQ-7 human health standard for surface water (0.3 µg/L) (DEQ 2017). Historically, the WTP effluent has exceeded the ROD cleanup level 40 times since 1998, for an exceedance rate of 3.6 percent (Figure 2.7b). Most WTP effluent PCP concentrations (84.4 percent) were detected at or below 0.5 µg/L, half the ROD cleanup level.

Approximately 38 kilograms (kg) of dissolved PCP was removed from groundwater at the site in 2019, an estimate calculated by use of flow and concentration data associated with the WTP. Since the initial emergency response, the WTP has treated more than 3.8 billion gallons of contaminated water (Table 2.2), and has removed about 1,716 kg of PCP from groundwater at the site. Moreover, more than 48,000 kg of PCP-contaminated oil (from the oil and water separator [OWS] and from other locations) has been recovered and sent for disposal since January 1993. No measurable LNAPL has been recovered from the OWS (or other locations) since 2009, as shown on Figure 2.8.

Examination of the data on Figure 2.8 leads to the following observations:

- Most (80 percent) PCP mass removed by the system over the 22-year period from 1998 to 2019 was non-aqueous phase liquid (NAPL) (6,901 kg NAPL vs 1,716 kg dissolved phase).
- NAPL has not been recovered since 2009, and the OWS was removed during construction from December 2018 through March 2019. While the site has moved beyond the oil recovery phase, some residual oil may still be present on the site, as discussed in previous sections.

Neglecting the periods when emergency responses, excavations, etc., led to large mass removal, and focusing on total mass recovery (total of 8,575 kg of both NAPL and dissolved phase) from the system during 1998 to 2019, three periods are evident:

- During 1998-2002 when annual mass recoveries by the WTP exceeded 100 kg per year (kg/yr), and when NAPL recovery also occurred, combined recoveries exceeded 1,000 kg/yr.
    - Total mass recovered = 5,746 kg.
    - Annual average WTP recovery = 215 kg/yr.

- Annual average NAPL recovery (2000-2002) = 1557 kg/yr.
- Percent (%) of total mass recovered = 66%.
- % of total time = 22% .

- During 2003-2006, annual mass recovery exceeded 500 kg/yr.
  - Total mass recovered = 2,308 kg.
  - Annual average WTP recovery = 33.8 kg/yr.
  - Annual average NAPL recovery = 543.3 kg/yr.
  - % of total mass recovered = 27%.
  - % of total time = 19%.

- During 2007-2019, annual mass recovery was less than 100 kg/yr. OWS plant ceased operations in 2009.
  - Total mass recovered = 571 kg.
  - Annual average WTP recovery = 44 kg/yr.
  - Annual average NAPL recovery (2007-2019) = 19 kg/yr.
  - % of total mass recovered = 6%.
  - % of total time = 59%.

During the 12-year period from 2007-2019, approximately 31% of total recovery occurred during the 2 years 2008 and 2012 (15% of the time), during which annual mass recoveries were 86 and 78 kg, respectively (48 kg of NAPL was recovered in 2008; none in 2012). Without consideration of NAPL recovery during these 2 years, average annual mass recovery would have been approximately 37 kg/yr.

Ignoring NAPL recovery, only two periods stand out for recovery of dissolved PCP mass:

- During 1998-2002, annual dissolved mass recovery exceeded 100 kg/yr.
  - Total mass recovered = 1,075 kg.
  - Annual Average = 215 kg/yr.
  - % of total dissolved mass removed = 63%.
  - % of total time = 23%.

- During 2003-2019, annual dissolved mass recovery was less than 79 kg/yr.
  - Total mass recovered = 637 kg.
  - Annual average = 37 kg/yr.
  - % of total mass removed = 37%.
  - % of total time = 77 %.

The high dissolved mass recovery rate between 1998 and 2002 likely resulted from dissolution (and possibly emulsification) of NAPL in the recovery and treatment system. Regardless, the dissolved mass recovery rate from 2003 to present has been consistent, ranging between 78 and 20 kg/yr, with a mean of 37 kg/yr. The relatively high recovery in 2012 is responsible for the relatively large range. Ignoring recovery during that year, the range would be 52 to 20 kg/yr (a factor of 2.6). A linear trend fit to the data shows a slight upward trend that flattens considerably upon removal of the 2012 datum. Dissolved mass recovery in 2019 was near average.

The NHRT and NCRT, along with their associated pumps, continued to be reasonably effective in capturing site groundwater during 2019. Groundwater capture and plume containment are assessed by evaluating groundwater elevation data and verifying hydraulic gradients near the trenches. Performance monitoring, including an assessment of compliance with ROD cleanup levels, is discussed in Section 4.3.

For this report, concentrations of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxicity equivalence quotient (TEQ), referred to in this report as “dioxin (TEQ),” are calculated by application of two different methodologies, referred to as the “MPTP ROD Methodology” and the “DEQ-7 Methodology,” as described below. Calculations via application of both methodologies are in Appendix A, and are summarized in Appendix B-3.

- **MPTP ROD Methodology**

  Calculation of dioxin (TEQ) includes assignment of 0 to values qualified as "U" (analyte not detected at concentration above the MDL) when estimated maximum possible concentrations are reported, and use of ROD toxicity equivalency factors (TEF).

- **DEQ-7 Methodology**

  Calculation of dioxin (TEQ) includes application of 2005 World Health Organization methodology, assignment of one-half the project reporting limit to values qualified as “U”, assignment of one-half the estimated maximum possible concentration when estimated maximum possible concentrations are reported, and use of 2005 TEFs as specified in DEQ-7 (DEQ 2017).

Dioxin (TEQ) in WTP samples over the 2001 to 2019 period of record is conveyed in Appendix A, Appendix B-3, and Table 2.5. Dioxin levels have varied over time, and low levels of dioxins have been detected in the recovery trenches and WTP influent and effluent samples collected during monitoring events each year. Dioxin (TEQ) concentrations during 2019 are as follows:

Method of TEQ Calculation	**Sample Location Dioxin (TEQ) Concentration (picograms per liter)**			
	WTP Effluent	**WTP Influent**	**NCRT Effluent**	**NHRT Influent**
ROD Method	1.33	0.936	0.808	1.59
DEQ-7 Method	1.35	1.45	1.33	2.31

While dioxin (TEQ) concentrations have been detected in WTP effluent, a dioxin (TEQ) value (by application of DEQ-7 Methodology) of about 5 picograms per liter (pg/L) has been shown to be an appropriate “noise threshold” for dioxin (TEQ) using the currently lowest available detection limits, because laboratory-grade, distilled-deionized water has been shown to routinely exhibit dioxin (TEQ) up to about 5.0 pg/L (by application of the DEQ-7 Methodology) (Tetra Tech 2015). Therefore, it is unclear if dioxin results from the WTP effluent sample in 2019 indicate presence of dioxin in the effluent. Regardless, the results indicate that concentrations of dioxin (TEQ) in WTP effluent, if present, would have met the 1.00E-05 µg/L (equivalent to 10 pg/L) ROD discharge to surface water cleanup level.

The ROD requires analysis of treated discharge to surface water (station EFF) for six metals, including arsenic, cadmium, chromium, copper, lead, and zinc (EPA and DEQ 1993). Acute and chronic DEQ-7 aquatic life standards for cadmium, copper, lead, and zinc are hardness-dependent. A hardness of 125 milligrams per liter is representative of Silver Bow Creek. Table 2.6 lists analytical results for metals from 2019 samples collected from recovery trenches and WTP influent and effluent. In the WTP effluent sample, no concentration of an analyte metal exceeded acute and chronic DEQ-7 aquatic life standards.

Other contaminants of interest not specifically called out in the ROD, but historically included as analytes for various reasons, are the anions bromide, chloride, fluoride, nitrate, nitrite, and phosphate. Although not required by the ROD, samples from stations NHRTEFF, NCRTEFF, IN, and EFF continue to undergo annual analyses for anions (via EPA Method 300.0). Appendix A and Table 2.6 convey concentrations of metals, anions, PAH, and chlorophenols in WTP samples collected from NHRTEFF, NCRTEFF, IN, and EFF during the August 2019 annual monitoring event. All analyte concentrations in the MPTP WTP effluent sample (station EFF) were below ROD discharge to surface water cleanup levels, and below current acute and chronic Montana DEQ-7 aquatic life standards (adjusted for hardness). No ROD cleanup levels were specified for anions or for any analytes at the other three stations (NHRTEFF, NCRTEFF, and IN).

Floating Product Recovery and Treatment

No LNAPL was detected in monitoring wells or recovery trenches in 2019. LNAPL has not been detected in any monitoring well during any sampling in calendar years 2010 through 2019, suggesting that significant ongoing transport of LNAPL is no longer a major concern at MPTP. However, some residual LNAPL is likely still present near the NHRT, primarily below the interstate highway, based on the light oily sheen of LNAPL observed in the NHRT on January 25 and February 22, 2017.

2.3 QUALITY CONTROL

QC samples were collected and analyzed in 2019 as per the GWMP, Revision 2 (Tetra Tech 2013b). QC samples consisted of source water blanks and field duplicates of liquid matrix samples. Source water blanks (distilled-deionized water supplied by the laboratory) were prepared at a frequency of one per 20 samples per monitoring event to assess potential external sources of contamination. Field duplicates were also collected at a frequency of one per 20 water samples per monitoring event.

Source Water Blanks

Seventy-four source water blanks were prepared and analyzed in 2019 (Table 2.7). Concentrations of analytes in 70 of 74 (95 percent) source water blanks were below corresponding laboratory detection limits. All 30 samples analyzed for PCP (100 percent) yielded PCP concentrations below the detection limit (0.1 µg/L). However, dioxin (TEQ), chromium, dissolved zinc, and total recoverable zinc were detected in one source water blank sample (SW-07081119) submitted to the laboratory on August 11, 2019. Detectable concentrations of one or more analytes in a source water blank suggests high bias on that date of original sample concentrations of those analytes. Overall, the data from source water blanks are interpreted to indicate little or no cross contamination during sampling in 2019.

Field Duplicates

Seventy-five field duplicate samples were collected and analyzed in 2019 to evaluate precision. Precision is the degree of agreement between individual measurements of the same property under similar conditions. Field duplicate samples to undergo analyses for PCP and analytes on the “extended parameter list” were collected at the same time and from the same source at frequency of one per 20 liquid matrix samples per monitoring event. Variations between analytical results from original and duplicate samples were calculated as relative percent differences (RPD) according to the following formula:

$$RPD = \frac{|A - B|}{(A + B)/2} \; x \; 100$$

where: A = Concentration of analyte in original sample

B = Concentration of analyte in duplicate sample

The RPD goal for this project is 20 percent (or lower) (EPA 2014). Fifty-seven of 75 duplicate samples (76 percent) met the RPD goal (Table 2.8). Average RPD of results from all original-duplicate sample pairs in 2019 was 14.3 percent. Based on these results, the level of precision for sampling in 2019 is considered to have met the overall project goal.

2.4 WTP IMPROVEMENTS

No WTP improvements of significance occurred in 2019.

2.5 INJECTION ACTIVITIES

An estimated total of about 544,800 gallons of WTP backwash was directed to the south-side infiltration system, cells 2 and 3, in 2019. The WTP primary carbon tanks were backwashed 12 times: January 14, February 12, March 18, April 15, May 13, June 10, July 15, August 11, September 16, October 14, November 18, and December 16, 2019. The secondary carbon tanks were backwashed three times: April 1, July 30, and December 2, 2019.

2.6 OPERATIONAL ISSUES

Several non-routine operational issues arose in 2019. These issues are discussed below.

2.6.1 Pumping Rate in the NHRT

The decrease in sustainable pumping rate for the NHRT throughout 2018 stabilized in 2019 at a constant rate of 70 gpm. Historically, the sustainable pumping rate in the NHRT decreased from 135 gpm in 2009 to about 70 gpm in 2019 (see Appendix E, Figure 2.2). Possible explanations for this phenomenon include: (1) impact on aquifer hydraulic conductivity caused by loading of soils during construction of the interstate bridge embankment, and (2) partial clogging of perforated piping and gravels in the NHRT by iron and manganese precipitates, inhibiting flow from trench gravels to the recovery plumbing (Figure 2.9). If compaction during construction were the cause, one would expect a one-time reduction in rate rather than a progressive decrease continuing to at least 2018. Moreover, compaction of soils in a localized area would decrease flow nearby over the short term, but alternate flow paths around this zone would develop, and overall flow would rebound to rates close to those earlier. Alternatively, the NHRT pump was replaced in August 2015, also because of clogging associated with iron and manganese precipitation. Precipitation of these metals was also related to fouling of the NHRT pump in 2017 and changing of the NHRT pump motor on June 20, 2018. Figure 2.9 indicates an increase of iron concentration in the NHRT beginning in approximately 2005 and continuing through the present. That decrease in sustainable pumping rate in the NHRT and that increase in iron concentration affecting WTP operations should be investigated (see Section 9.0). To support this investigation, samples from the trenches should be analyzed for iron species more often than just annually.

While the pumping rate stabilized in 2019, the mass recovery rate was similar to the annual average between 2007 and 2019. Capture of the PCP plume in the NHRT area may or may not have been compromised by the decreased pumping rate, but if not, it is not clear that a higher volumetric pumping rate is needed for a higher mass recovery rate. For example, there have been periods with lower pumping rates but with average mass recovery rates. Pumping rates at NHRT were low from 1998 to 2001 (and comparable to those from 2014 to 2019) during the period of greatest mass recovery rates.

2.6.2 Municipal Water Line

On December 3, 2018, the site operator suspected a leak in the municipal water line supplying potable water to the treatment plant. To prevent further leaking, the water line was shut off on December 3, 2018. Repair of the leaking water line was completed on October 3, 2019.

2.7 MISCELLANEOUS REPAIRS AND ACTIVITIES

A few miscellaneous repairs and activities occurred at the MPTP site in 2019, as follows:

- On March 26, 2019, a T1-C level control failure occurred. On the same day, a new sensor was installed.
- On April 1, 2019, a new plant effluent sample port was installed.

No other repairs or activities of significance were required at the MPTP site in 2019.

3.0 LAND TREATMENT UNIT OPERATIONS

Historical LTU soil management, LTU operation in 2019, and results of LTU sampling are discussed in the following sections.

3.1 HISTORICAL LTU SOIL MANAGEMENT

Loading of soil into the LTU (Figure 1.1) began in fall 1996. By spring 1997, approximately 2 feet of soil from the north-side excavation had been placed on the LTU. During fall 1999, 18 of the 24 inches of treated soils (approximately 24,000 cubic yards) had been removed and backfilled on the north side. Six to 8 feet of contaminated soil that had been excavated from the south side was placed on the LTU during fall 1999 and summer 2000. During fall 2000, 18 inches of treated soils (approximately 24,000 cubic yards) was removed and used as backfill in the south-side excavation area. During spring 2001, contaminated soils from the north-side sewer main replacement project were placed on LTU zones 1 and 2.

In fall 2001, 18 to 24 inches of soil (approximately 27,000 cubic yards) was removed from LTU zones 2 to 10 and backfilled into the south-side excavation area. The LTU was tilled monthly during the 2001 treatment season. In response to complaints from residents in the nearby neighborhood regarding odors from the LTU, tilling frequency was reduced to annually beginning in 2002. The LTU was tilled to depth of approximately 8 inches in November 2002, and again in October 2003. In 2005, the top 30 inches of LTU soils was determined to have met the treatment standards for PCP and PAH. The top 24 inches of treated soils (approximately 29,000 cubic yards) was offloaded, leaving a 6-inch "buffer" of treated soils to minimize odor. The treated soils were backfilled into the south-side excavation areas on site.

The LTU was tilled in October 2005 after the summer offload. In 2007, 32,000 cubic yards of treated soil was offloaded from the LTU and backfilled on the southern portion of the site. The five remaining SSP piles were dismantled, and 8,000 cubic yards of contaminated soil was moved from the SSPs and placed on the LTU for final treatment. Work in 2009 associated with NHRT modifications and the sewer realignment project generated approximately 2,000 cubic yards of excavated soil, which was placed on the western portion of the LTU.

In 2010, approximately 3.2 million gallons of water was applied to the LTU through a center pivot unit at regular intervals from April to September to facilitate biologic degradation of the contaminants. Irrigation water was supplied from the retention pond, with make-up water added from the WTP as necessary. The LTU soil was tilled once in April 2010. A small volume of soil excavated during the interstate highway bridge replacement project was placed on the LTU in June 2010.

In 2011, the collection pipe between NHRT manhole #2 and the west-end cleanout was cleaned. A very small volume of solid material and an estimated 15,000 gallons of water removed during the cleanout were transferred into a vacuum collection truck and placed on the LTU for bioremediation. In addition, the Montana Department of Transportation (MDT) contractor removed approximately 200 cubic yards of soil from highway pier drilling and placed it on the LTU as part of the MDT bridge replacement project. Finally, 182 linear feet of drill cuttings (approximately 2.3 cubic yards) from five groundwater monitoring well borings was placed on the LTU. The LTU was irrigated on 14 separate days during the second and third quarters of 2011 (2,141,200 gallons applied). No soil was tilled at the LTU during 2011.

In 2012, five zones (2, 3, 4, 5, and 10) of the LTU were tilled during the second quarter, having not met the cleanup standard for PCP during the 2011 LTU soil monitoring event. In addition, the LTU was irrigated as necessary during the second and third quarters to control fugitive dust when conditions were dry (8 days, between May 14 and September 5, 2012). A total of 1,171,900 gallons of irrigation water was applied in 2012.

In 2013, the three sampling zones (LTU zones 2, 3, and 4) that had not met the cleanup standard for PCP during the 2012 LTU soil monitoring event were tilled two times in May and once in July. Soil moisture during the May and July 2013 tilling events was sufficiently high to preclude generation of dust.

The LTU was irrigated seven times during the third quarter of 2013 as necessary to control dust. A total of 884,700 gallons of irrigation water was applied. Neither odors nor dust was observed and no soil tilling or irrigation occurred at the LTU from 2014 through 2019.

3.2 LTU OPERATIONS IN 2019

Including the sand layer, the volume of soil that remains on the LTU is estimated at 53,000 cubic yards; the sand layer is approximately 6 to 12 inches thick (approximately 15 percent by volume).

No soil tilling occurred at the LTU in 2019. Neither odors nor dust was documented at any time during the year (the site is mostly covered by vegetation). Moreover, no irrigation of the LTU occurred because the site received adequate precipitation throughout the year. Table 3.1 lists historical LTU water application data pertaining to the 1999 to 2019 period of record.

As part of construction at the site that began in December 2018, the LTU irrigation system was dismantled and removed from the LTU as part of the final offload and decommissioning of the LTU.

3.3 LTU SOIL SAMPLING AND RESULTS

Soil currently in the LTU was sampled annually from 2007 through 2013. Based on historical data, LTU soils were not sampled during 2014 to 2017 as part of site operations. Table 3.2 summarizes historical analytical data from these years.

Average concentration of PCP in all LTU zones sampled in 2012 was 26.7 milligrams per kilogram (mg/kg); in 2013, average concentration of PCP in LTU soils was 26.8 mg/kg. These data indicate that average concentration of PCP in LTU soils was less than the ROD soil cleanup level (34 mg/kg) during two consecutive monitoring events. Average dioxin (TEQ) concentrations during the 2012 and 2013 monitoring events were above the ROD cleanup level of 0.2 micrograms per kilogram (µg/kg), as was the case in previous offloads. Therefore, the cleanup goal for dioxin in soil has not been met. LTU soils were not analyzed for PAH during the October 2013 round of sampling because all sections of the LTU previously had met the cleanup goal for PAH during two successive monitoring events.

Tetra Tech completed a data gaps investigation in mid-2017, and issued a final report presenting results of that investigation in November 2017 (Tetra Tech 2017). Development of the 30 percent design for the final offload has begun. The design will include offload of all the soil in the LTU, removal and disposal of the LTU liner and associated materials and equipment, removal the retention pond and berms, and reclamation of the current LTU and retention pond areas.

3.4 LTU UNDERDRAIN AND POND SAMPLING AND RESULTS

During the August 2019 annual monitoring event, the LTU underdrain discharge (station LTUDIS) and LTU retention pond water (station RETPOND) were sampled for analyses to support ongoing planning for the LTU offload. The LTU discharge sample is representative of leachate associated with the underdrain of the LTU soil treatment area. Leachate from the underdrain flows by gravity to the LTU retention pond, where some degradation of PCP is known to occur, as discussed below.

An unfiltered sample from station LTUDIS was submitted to the laboratory for analysis of PCP. The concentration of PCP in unfiltered LTU discharge (station LTUDIS) was 13.4 µg/L. The concentration of PCP in the unfiltered LTU retention pond water sample (station RETPOND) was substantially lower (3.1 µg/L). These data support a conclusion that physical and biological degradation of PCP occurs in the LTU pond.

Samples from stations LTUDIS and RETPOND were not analyzed for chlorophenols (other than PCP), PAHs, or dioxins in 2019.

4.0 SURFACE WATER AND GROUNDWATER MONITORING

Water quality at the MPTP site was monitored regularly from 2001 until August 2010, as specified in the Site-Wide Operations and Maintenance Manual (Camp Dresser & McKee, Inc. [CDM] 2000). The MPTP monitoring program was revised starting with the November 2010 monitoring event, as specified in the GWMP, Revision 0 (Tetra Tech 2011). Data presented in this 2019 annual sampling and monitoring report were acquired according to the guidelines provided in the GWMP, Revision 2 (Tetra Tech 2013b). GWMP, Revision 2, supersedes previous versions of this document. Future revisions to the GWMP, as needed, will continue to be numbered sequentially.

Semi-annual monitoring occurred during February 2019, and all groundwater and surface water samples were analyzed for PCP. Annual monitoring of surface water and groundwater occurred in August 2019. Table 2.3 summarizes the monitoring program for 2019.

4.1 SURFACE WATER MONITORING

As part of routine monitoring at the MPTP site, three surface water locations (SW-05, SS-06A, and SW-09) were sampled in February 2019 (for PCP analysis only) and again in August 2019 (for analyses for PCP and analytes on the "extended parameter list"), as outlined in Table 2.3. In addition to PCP (analysis via EPA Method 528), analytes on the "extended parameter list" included chlorophenols (analysis via EPA Method SW8270C), PAHs (analysis via EPA Method SW8270C), and dioxins (analysis via EPA Method SW8290). Surface water monitoring locations sampled in 2019 appear on Figure 4.1 and include:

- SW-05: on Silver Bow Creek, due west (downstream) of the MPTP site
- SS-06A: on Silver Bow Creek, on the downstream side of the MPTP site but immediately upstream from the WTP effluent discharge rill
- SW-09: on Silver Bow Creek, due east (upstream) of the MPTP site.

Analytical results for each category of contaminant are discussed below.

PCP

Concentrations of PCP in surface water are conveyed in Appendix A and Appendix B-2, and are summarized in Table 4.1 over the 2001 to 2019 period of record. The only detection of PCP occurred in August 2019 at SW-05 (0.106 µg/L), and was below the ROD surface water cleanup level (1.0 µg/L). Other than this one detection, concentrations of PCP at surface water stations SW-05, SS-06A, and SW-09 in 2019 were below the laboratory detection limit (0.1 µg/L) and below the ROD surface water cleanup level (1.0 µg/L).

Over the last 9-year period (2010 to 2019), concentrations of PCP at stations SW-05, SS-06A, and SW-09 have been below the detection limit, or slightly above the detection limit (0.1 µg/L, [0.2 µg/L before July 31, 2017]), and consistently below the ROD surface water cleanup level for PCP (1 µg/L).

In August 2019, samples from surface water stations SW-05, SS-06A, and SW-09 were also analyzed for the "extended parameter list" of analytes. Results appear in Appendix A (full database), Appendix B-3 (dioxin TEQ), Table 4.2 (dioxins), and Table 4.3 (PAH and chlorophenols). Analytical results are discussed below.

Chlorophenols

Detection of 4-chloro-3-methylophenol in SW-09 occurred during the August 2019 sampling event (Table 4.3). The ROD specified no surface water cleanup level for 4-chloro-3-methylophenol, and sample location SW-09 is the upstream sample point. All other chlorophenols for which the ROD specified surface water cleanup levels in surface water were not detected above MDLs at stations SW-05, SS-06A, and SW-09, and were therefore below those ROD benchmarks.

PAHs

All PAHs for which the ROD specified surface water cleanup levels in surface water were detected below those ROD benchmarks at stations SW-05, SS-06A, and SW-09 (Table 4.3). Calculated values of total D PAH[1] at stations SW-05, SS-06A, and SW-09 were 1.58, 2.24, and 1.93 µg/L, respectively, using method detection limits (MDLs) for non-detections; the ROD total D PAH cleanup level is 360 µg/L.

Dioxins

Applying both the MPTP ROD Methodology (Table 4.2 and Appendix B-3) and the DEQ-7 Methodology (Appendix B-3), dioxin (TEQ) was below the 1.00E-05 µg/L (equivalent to 10 picograms per liter [pg/L]) ROD surface water cleanup level at MPTP surface stations SW-05, SS-06A, and SW-09.

4.2 GROUNDWATER MONITORING

Locations of all MPTP groundwater monitoring wells appear on Figure 4.2. Table 4.4 summarizes concentrations of PCP in groundwater at five representative monitoring wells (BMW-01A, BMW-01B, HCA-21, INF-04, and MW-11-04) over the 2000 to 2019 period of record. Analytical results are conveyed in Appendix A and Appendix B-2. Monitoring results are discussed further in Section 4.3.

[1] D PAH concentration equals the sum of acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene concentrations.

Appendix A, Appendix B-3, and Table 4.5 provide analytical results for dioxins in groundwater from historical sampling and from samples collected at five representative monitoring wells (BMW-01A, BMW-01B, HCA-21, INF-04, and MW-11-04) during the 2019 annual monitoring event, as specified in the GWMP, Revision 2 (Tetra Tech 2013b). Analytical results for PAH and chlorophenols in groundwater at these same five monitoring wells are in Appendix A and Table 4.6. Results are discussed further in Section 4.3 below.

Figure 4.3 is a potentiometric surface map based on static water level data acquired from 59 shallow monitoring wells on August 11, 2019. Figure 4.3 indicates that the hydraulic gradient at the MPTP generally was from the southeast to the northwest. The magnitude of the hydraulic gradient was approximately 0.005 foot/foot. These results are consistent with values obtained during historical monitoring events since 2005.

Since the third quarter of 2010, groundwater hydraulic head contours have been influenced by beaver-related activity (beaver dam construction and resulting ponding of water). On August 11, 2019, beaver activity and damming resulted in localized flooding and groundwater mounding, exemplified on Figure 4.3. Groundwater mounding in this area facilitates flow of groundwater south of Silver Bow Creek back toward the NCRT, thus aiding in recovery of dissolved contaminants. Groundwater mounding is expected to continue when beaver dams are present and beaver activity persists. Beaver activity along Silver Bow Creek near the MPTP site in 2019 is discussed in Section 6.3.

Figure 4.4 provides a more focused analysis of groundwater elevations and interpreted flow directions near the NCRT on August 11, 2019. Figure 4.4 indicates radial flow and hydraulic capture in the shallow aquifer near the NCRT. Also evident on Figure 4.4 is groundwater mounding related to flooding resulting from the beaver dam in the WTP discharge rill.

4.3 ROD COMPLIANCE MONITORING

ROD compliance monitoring has historically incorporated water quality data pertaining to ROD contaminants (PCP and the “extended parameter list” of analytes) acquired from plant discharge (station EFF), surface water (stations SW-05, SS-06A, and SW-09), and groundwater (monitoring wells BMW-01A, BMW-01B, and HCA-21), as specified in the GWMP (Tetra Tech 2013b). As noted in the 2017 Annual report, sampling was discontinued at monitoring wells 10-12 and GW-14R-98; therefore, “extended parameter list” data from these two wells are unavailable.

Concentrations of PCP from the February (semi-annual) and August (annual) groundwater monitoring events were evaluated to assess the distribution of PCP in groundwater during 2019. The following sections present results of groundwater monitoring and assess compliance with ROD requirements and cleanup levels.

4.3.1 2019 Monitoring Events

WTP Effluent

WTP effluent (treated groundwater at WTP station EFF) was monitored for PCP weekly—52 samples were collected (excluding duplicates) and analyzed for PCP in 2019. WTP effluent was also monitored for the “extended parameter list” of analytes during the August 2019 annual sampling event.

One-hundred percent of results from weekly PCP analyses (52 of the 52 samples) were below the PCP 1.0 µg/L ROD discharge to surface water cleanup level (Table 2.4). Dioxins, PAHs, and chlorophenols for which the ROD specified discharge to surface water cleanup levels were detected at concentrations below those ROD benchmarks (Table 2.5 and Table 2.6).

Surface Water

Surface water in Silver Bow Creek (stations SW-09, SS-06A, and SW-05) was monitored for PCP and the “extended parameter list” of analytes during the August 2019 annual sampling event.

PCP concentrations (Table 4.1) were below the PCP 1.0 µg/L ROD discharge to surface water cleanup level. Dioxins (Table 4.2) and PAHs and chlorophenols (Table 4.3) for which the ROD specified discharge to surface water cleanup levels were detected at concentrations below those ROD benchmarks.

Groundwater

Sixty-two shallow monitoring wells, four intermediate monitoring wells, and eight deep monitoring wells were scheduled for sampling during the February 2019 semi-annual monitoring event, and 64 shallow monitoring wells were sampled during the August 2019 annual sampling event, per the GWMP (Tetra Tech 2013b). With few exceptions, samples were collected from all wells listed in the GWMP and were analyzed for PCP via EPA Method 528 (Appendix A and Appendix B). Exceptions included wells that were frozen, blocked, or physically compromised (see Section 4.0 and Appendix A).

Data from shallow wells were plotted and contoured to evaluate trends in concentration and the spatial distribution of PCP contamination. Figure 4.5 and Figure 4.6 show the distribution of PCP in groundwater on the south side of Silver Bow Creek based on data acquired during the February 2019 semi-annual monitoring event and the most current (August 2019) annual monitoring event.

Figures 4.5 and 4.6 indicate presence of a plume of PCP approximately 1,000 feet wide by 1,700 feet long on the south side of Silver Bow Creek oriented along the principal direction of groundwater flow (southeast to northwest). The figures indicate several PCP "hot spots," as summarized in the discussion below of the associated monitoring event.

February 2019 Semi-annual Monitoring Event

As shown on Figure 4.5, the plume core and "hot spots" were noted:

- Plume core under the interstate highway and extending northeast near the WTP and monitoring well MW-11-04
- Hot spot west of the LTU near monitoring wells GW-05, INF-13 and INF-16
- Relic plume core north of the NCRT adjacent to the Burlington Northern railroad tracks near monitoring well MW-I-01 (the remnant of the plume core on the downgradient side of the NCRT, likely sustained by back diffusion and/or desorption of PCP from organic matter)
- Relic plume core north of the NCRT adjacent to the Burlington Northern railroad tracks near monitoring well MW-H-01 (also a remnant of the plume core on the downgradient side of the NCRT, likely sustained by back diffusion and/or desorption of PCP from organic matter).

August 2019 Annual Monitoring Event

As shown on Figure 4.6, "hot spots" were noted:

- Plume core under the interstate highway and extending northeast near the WTP and monitoring well MW-11-04
- Relic plume core north of the NCRT adjacent to the Burlington Northern railroad tracks near monitoring well MW-I-01 (the remnant of the plume core on the downgradient side of the NCRT, likely sustained by back diffusion and/or desorption of PCP from organic matter)
- Relic plume core north of the NCRT adjacent to the Burlington Northern railroad tracks near monitoring well MW-H-01 (also a remnant of the plume core on the downgradient side of the NCRT, likely sustained by back diffusion and/or desorption of PCP from organic matter).

During the August 2019 annual monitoring event, groundwater sampling from three shallow monitoring wells (HCA-21, INF-04, and MW-11-04) and two deep wells (BMW-01A and BMW-01B) was scheduled for analyses for constituents on the "extended parameter list," including PAH, dioxins, and chlorophenols, as per the GWMP, Revision 2 (Tetra Tech 2013b). These five wells were selected to indicate a range of representative groundwater quality conditions across the site relative to (1) the location of the PCP plume (as defined by the 1 µg/L PCP contour interval), and (2) PCP plume core. Rationale for selecting these wells included:

- Monitoring wells BMW-01A (deep) and BMW-01B (deepest) were selected because they can be considered downgradient sentinel monitoring wells (shallow and deep well completions) on the south bank of Silver Bow Creek. Data from these wells can be used to evaluate plume capture and potential for off-site migration of contaminants.

- Monitoring well HCA-21 (shallow) was selected because of location on the south bank of Silver Bow Creek within the footprint of the PCP plume, a long-term period of record, and usefulness to evaluate progress of groundwater remediation over an extended period.
- Monitoring wells INF-04 and MW-11-04 were selected because of locations in or near "the core of the PCP plume."

All available results for dioxin in groundwater (both historical and during 2019) are conveyed in Appendix A, Appendix B-3, and Table 4.5. In 2019, dioxin (TEQ) was below the 3.00E-05 µg/L (equivalent to 30 pg/L) ROD groundwater cleanup level in all monitoring wells (by application of both the MPTP ROD Methodology and the DEQ-7 Methodology) except wells INF-04 (9.218E-05 µg/L [equivalent to 92.1 pg/L]) and MW-11-04 (8.90E-05 µg/L [equivalent to 89.0 pg/L]).

Analytical results for PAH and chlorophenols are in Table 4.6 and Appendix A. At the wells sampled, PAHs and chlorophenols (with exception of pentachlorophenol) were detected at concentrations below ROD established benchmarks.

4.3.2 Data Evaluation and Progress of Remediation

One WTP station (station EFF [treated groundwater]), three surface water stations (stations SW-05, SS-06A, and SW-09), and five groundwater stations (monitoring wells BMW-01A, BMW-01B, 10-12, GW-14R-98, and HCA-21) have historically been sampled to evaluate compliance with ROD requirements related to progress of remediation. As previously noted, sampling from wells 10-12 and GW-14-R-98 was discontinued in 2017, and these wells thus were not part of this evaluation. Figure 4.7 shows locations of the original monitoring wells relative to the location of the recent PCP plume boundary (August 2019), as well as locations of the two potential alternative wells (10-04 and 10-05).

To be consistent with ROD requirements, the following seven criteria have been evaluated in previous annual reports, as well as this 2019 annual report. Data historically used to evaluate satisfaction of each criterion are also provided below (with exceptions for this 2019 annual report noted):

<u>Criterion 1</u>. The WTP effluent (station EFF) must meet the 1 µg/L discharge to surface water cleanup level for PCP, and other contaminants for which the ROD specified cleanup levels must be at concentrations below those ROD benchmarks.

<u>Criterion 2</u>. Surface water in Silver Bow Creek must meet the 1 µg/L surface water cleanup level for PCP, and other contaminants for which the ROD specified cleanup levels must be at concentrations below those ROD benchmarks.

<u>Criterion 3</u>. The PCP plume must remain on site. This criterion is assumed to be met if concentrations of PCP in groundwater in downgradient sentinel monitoring wells continue to meet the groundwater cleanup level for PCP.

Criterion 4. Concentrations of dioxins, PAHs, and chlorophenols for which the ROD specified groundwater cleanup levels must meet those ROD benchmarks in groundwater at representative monitoring wells along the south bank of Silver Bow Creek.

Criterion 5. The long-term trend in concentrations of PCP in groundwater over time should be decreasing, suggesting that groundwater quality will eventually meet the 1 µg/L groundwater cleanup level for PCP.

Criterion 6. The long-term trend around the PCP plume must be stable or shrinking, showing that ongoing remedial action is effectively preventing spread of contamination.

Criterion 7. The short-term trend (previous 5 years) around the PCP plume must be stable or shrinking, showing that ongoing remedial action is effectively preventing spread of contamination.

Water quality data acquired in 2019 were used to evaluate satisfaction of the first four criteria (Criterion 1 through Criterion 4). Available historical data (1993 to 2019) were used evaluate satisfaction of the last three criteria (Criterion 5 through Criterion 7) by analyzing trends through time. Results are listed in Table 4.7 and summarized below.

- **Criterion 1**. Criterion 1 was satisfied. Concentrations of PCP met the 1 µg/L discharge to surface water cleanup level. Concentrations of dioxins, PAHs, and chlorophenols for which the ROD specified surface water cleanup levels met those ROD benchmarks at station EFF.
- **Criterion 2**. Criterion 2 was satisfied. Concentrations of PCP met the 1 µg/L discharge to surface water cleanup level. Concentrations of dioxins, PAHs, and chlorophenols for which the ROD specified surface water cleanup levels met those ROD benchmarks at the three surface water stations on Silver Bow Creek.
- **Criterion 3**. Criterion 3 was satisfied. Concentrations of PCP in downgradient sentinel monitoring wells BMW-01A and BMW-01B continued to meet the 1 µg/L groundwater cleanup level for PCP, indicating that the on-site PCP plume was not migrating off site.
- **Criterion 4**. Criterion 4 was satisfied (for wells BMW-01A, BMW-01B, and HCA-21). Concentrations of dioxins, PAHs, and chlorophenols for which the ROD specified groundwater cleanup levels met those ROD benchmarks at the three wells.
- **Criterion 5**. Criterion 5 was partly satisfied. Mann-Kendall statistical testing of PCP data from monitoring well HCA-21 indicated the long-term (2004 to 2019) trend in concentrations of PCP decreasing at greater than the 99.9 percent confidence level (Appendix F and Table 4.8). Monitoring well GW-14R-98 was not included in the analysis because sampling there had been discontinued. This analysis supports a conclusion that ongoing remediation continues to be effective in the long term.

  Criterion 6. Criterion 6 was satisfied. Digitized PCP plumes and plume area calculations are provided in Appendix G. All available monitoring well data were used to construct the 1 µg/L PCP isocontour for each year when data were accessible. A long-term plume area comparison also appears on Figure 4.8. The long-term trend around the PCP plume indicates ongoing remedial activities have significantly reduced the area of the PCP plume. Specifically, over the past 24 years (since the ROD was signed), total area of the PCP plume on the south side of Silver Bow Creek (based on the 1 µg/L isocontour line) has decreased from 41.7 acres (in August 1993) to 19.1 acres (in August 2019). This 22.6-acre decrease represents an approximate 49 percent reduction around the PCP plume since 1993. Mann-Kendall statistical testing indicates that, over the long term (2004 to 2019), the area of the PCP plume has been probably decreasing at greater than 90 percent confidence level (see Appendix F).

Criterion 7. Criterion 7 was satisfied. Mann-Kendall statistics indicate the shorter-term 5-year trend (2014 to 2019) in plume area is “No Trend” (Appendix F). In 2018, an additional monitoring well was sampled that changed the west side plume area coverage, resulting in an increased plume size compared to the previous 5 years. The same monitoring well was sampled again in 2019. The “No Trend” determination of plume size is believed to be resulting from increased sampling density for better plume definition near the highway, and not necessarily from an increase in lateral extent of the plume.

Conveyance of results of groundwater monitoring and statistical analysis of the area of the PCP plume will continue in future annual reports to further evaluate the short-term trend in plume area and to suggest operational adjustments, if necessary. Compliance with ROD cleanup levels will also be evaluated annually. If wells 10-12 and GW-14R-98 are not replaced, recommendation is to collect groundwater samples from monitoring wells 10-04 and 10-05 and analyze these for PCP and the “extended parameter list” of analytes during future annual monitoring events.

4.3.3 Light Non-Aqueous Phase Liquid

LNAPL (floating product) was not detected in any monitoring well during any sampling in calendar year 2019. As noted in Section 2.2.1, no floating product was measured in the NHRT in 2019; however, a light sheen was observed. The historical volume of LNAPL recovered during the 2000 through 2019 period of record is listed in Table 4.8.

5.0 RESIDENTIAL WELL MONITORING

Historical concentrations of PCP in groundwater collected from residential wells were below the ROD groundwater cleanup level during several years leading up to 2010; therefore, no residential wells were sampled in 2019. Results of residential well sampling during the 2001 to 2019 period of record are listed in Table 5.1.

6.0 ADDITIONAL SITE ACTIVITIES

Additional activities at the site in 2019 included monitoring of beaver activity and construction, discussed in the following sections.

6.1 MONITORING OF BEAVER ACTIVITY IN 2019

Groundwater hydraulic head contours have been influenced by beaver-related activity (beaver dam construction and resulting ponding of water) since the third quarter of 2010. In 2019, only one beaver dam was in the WTP discharge rill, resulting in localized flooding and groundwater mounding, as exemplified on Figure 4.3 and Figure 4.4. Groundwater mounding along Silver Bow Creek north of the WTP facilitates flow of groundwater south of Silver Bow Creek back toward the NCRT, thus aiding in recovery of remaining dissolved contaminants in this area.

In the future, DEQ is expected to exert no effort to remove the existing beaver dam on Silver Bow Creek because beaver dam-induced flooding north of the MPTP site helps maintain a hydraulic gradient toward the NCRT, which enhances capture of PCP-contaminated groundwater in this area.

6.2 MPTP CONSTRUCTION

Construction at the site began in fourth quarter 2018, with completion during first quarter 2019. Work included the following:

- Clearing and grubbing of work areas
- Protection of wells
- Removals of oil tank, structures, and concrete basin
- Removal of interior contents of the WTP addition
- Removal of the blower building interior, dismantlement of the building, and removal of the concrete pad
- Removal of the nutrient feed building interior, dismantlement of the building, and removal of the concrete pad
- Removals of storage building asphalt floors and concrete footers, decontamination pad, and utilities
- Removals of existing water vault and bollards
- Removal of asphalt from former residence
- Removals of retention pond vaults and utilities, central pivot sprinkler system, and abandoned utilities and vaults
- Installations of a new water line, new water vault, and temporary power pedestals and conduits
- Removal of select fencing
- Crushing, screening, and hauling of clean debris for recycling

- Stockpiling of contaminated debris on the LTU.

A construction report (Tetra Tech 2019) details the completion of construction activities at site.

6.3 HAZARDOUS WASTE REMOVAL

Hazardous waste was categorized as Resource Conservation and Recovery Act (RCRA) F032 hazardous waste. RCRA F032 hazardous waste category includes; wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that currently use or have previously used chlorophenolic formulations such as pentachlorophenol. All hazardous waste had accumulated during cleaning and removal of the oil-water separator, cleaning of the sump tank, cleaning and removal of the outdoor oil tank off the west side of the water treatment plant, and removal of foam insulation from under concrete slabs removed during construction on the south side of the site. Waste was removed in three phases—on January 22, February 11, and March 11, 2019. Daily summary reports with associated photographs are in Appendix D.

6.4 ABANDONED DRUM DISPOSAL

A steel 55-gallon drum and a small quantity of solid waste were illegally deposited at the entrance to the site at some time during the weekend of September 22-23, 2019. The abandoned drum was characterized, profiled, and transported to Clean Harbors Facility, where it underwent disposal via incineration. Complete details of the drum characterization and disposal appear in the "Montana Pole and Treating Plant Abandoned Drum Removal Technical Memorandum" (Tetra Tech 2020).

7.0 DATABASE MANAGEMENT

The following database-related activities were completed in 2019:

- Uploaded all electronic data deliverables (EDD) received from the Montana Bureau of Mines and Geology (MBMG) and Pace Analytical Services, Inc. to the MPTP Microsoft Access 2016 database
- Performed QC of all chains of custody (COC), MBMG laboratory EDDs, MBMG sample delivery groups (SDG), and MBMG laboratory Microsoft Excel spreadsheets
- Added 1,400 records to the existing database (at the end of 2019, 22,760 individual data records were in the database for the 2010 to 2019 period of record)
- Corrected selected records in the MPTP database to address any QC issues uncovered during the QC review process
- Maintained an SDG versus COC “lookup table” to easily match SDGs to COCs for future reference (Appendix H).

8.0 CLIMATE AND STREAMFLOW

Climatic conditions such as temperature, precipitation, and stream flow factor into understanding operations and water management on the site. For example, extremes in temperature can affect pipeline integrity, pump operations, or ability to collect samples from shallow monitoring wells. Precipitation affects surface runoff and on-site ponding of water, groundwater recharge, elevation of the water table, and movements of contaminants in the vadose zone and aquifer. Stream flow conditions vary from base flow to flood conditions, and potentially affect sample collection, groundwater flow, and migration of contaminants. Relevant climate statistics for 2019 were obtained from the National Weather Service (NWS) (NWS 2019) (Appendix I). Stream flow statistics were obtained from the U.S. Geological Survey (USGS) National Water Information System Web Interface (USGS 2019) (Appendix J). Climate and streamflow characteristics that affected WTP operations or on-site water management activities in 2019 are summarized below.

2019 – First Quarter

- Overall, mean high temperature during first quarter 2019 (30 degrees Fahrenheit [°F]) was 2°F warmer than average first-quarter temperature (28 °F) based on the 1981 to 2010 period of record.
- Total precipitation in Butte, Montana, during first quarter 2019 was 1.9 inches (0.14 inch in January, 1.05 inches in February, and 0.71 inch in March). Measured precipitation during the first quarter 2019 was 0.24 inch more than historical mean first-quarter precipitation during the 1981 to 2010 period of record (1.66 inches). Other than water captured in the LTU retention pond, no localized ponding of water occurred on site. All surface water was contained, and no surface water runoff was documented.
- A stream flow hydrograph pertaining to USGS station 12323250 (Silver Bow Creek below Blacktail Creek at Butte, Montana) is in Appendix J. The hydrograph depicts peak flow during first quarter 2019 at 62 cubic feet per second (cfs). Base flows during first quarter 2019 ranged from about 15 to 25 cfs—similar to the long-term mean base flow during first quarters.

2019 – Second Quarter

- Overall, the mean temperature during the second quarter of 2019 (47.6 °F) was 0.2 °F warmer than the normal second-quarter temperature (47.4 °F) based on the 1981 to 2010 period of record.
- During the second quarter of 2019, monthly recorded precipitation in Butte, Montana, was 1.81 inches in April, 2.53 inches in May, and 0.81 inch in June (total second-quarter precipitation of 5.15 inches). Measured precipitation during the second quarter of 2019 was 0.36 inch below the average second-quarter precipitation of 5.51 inches based on the 1981 to 2010 period of record (Appendix I).
- A stream flow hydrograph pertaining to USGS station 12323250 (Silver Bow Creek below Blacktail Creek at Butte, Montana) is on Figure 1.2 and in Appendix J. The hydrograph indicates

that peak flow during the second quarter of 2019 was 145 cfs, recorded on April 9, 2019. Average flow during the second quarter was 52 cfs.

2019 – Third Quarter

- Overall, the mean temperature during third quarter 2019 (59.8 °F) was 0.7 °F warmer than the normal third-quarter temperature (59.1 °F) based on the 1981 to 2010 period of record.
- During third quarter 2019, total precipitation recorded in Butte, Montana, was 4.97 inches (1.54 inches in July, 1.48 inches in August, and 1.95 inches in September). Measured precipitation during third quarter 2019 was 1.27 inches above the average third-quarter precipitation of 3.7 inches based on the 1981 to 2010 period of record (Appendix I).
- A stream flow hydrograph pertaining to USGS station 12323250 (Silver Bow Creek below Blacktail Creek at Butte, Montana) is on Figure 1.2 and in Appendix J. The hydrograph indicates peak flow during third quarter 2019 at 47.8 cfs, recorded on September 9, 2019. Average flow during the third quarter was 27.6 cfs.

2019 – Fourth Quarter

- Overall, mean temperature during fourth quarter 2019 (28 degrees °F) was equal to the average fourth-quarter temperature (28 °F) based on the 1981 to 2010 period of record.
- Total precipitation in Butte, Montana, during fourth quarter 2019 was 0.64 inch—1.25 inches less than normal fourth-quarter precipitation during the 1981 to 2010 period of record (1.89 inches). No localized ponding of water occurred on site.
- A stream flow hydrograph pertaining to USGS station 12323250 (Silver Bow Creek below Blacktail Creek at Butte, Montana) appears in Appendix J. This station is about 3,500 feet upstream of MPTP. The hydrograph indicates that peak flow during fourth quarter 2019 was 43.0 cfs, recorded on November 6, 2019. Average flow during fourth quarter 2019 was 38.7 cfs.

9.0 RECOMMENDATIONS

This annual report offers the following recommendations that can be considered as cleanup of the MPTP site progresses:

- Investigate further potentially promising alternatives (Tetra Tech 2013a) to remediate the continuing source of contamination under the interstate highway (see Section 1.4).
- Investigate the decrease in sustainable pumping rate in the NHRT and the increase in iron affecting WTP operations. To support this investigation, analyze trench samples for iron species at greater frequency than annually, and increase monitoring of groundwater pH, dissolved oxygen, and oxidation-reduction potential (see Section 2.6.1).
- Engage a licensed Montana monitoring well contractor to properly abandon monitoring wells MW-11-05, 10-12, and GW-14R-98. Drill replacement wells at these locations to maintain consistency with the existing long-term data sets associated with these wells (see Section 4.0).
- If deficient wells 10-12 and GW-14R-98 are not replaced, recommendation is to include in future annual monitoring events sampling of wells 10-04 and 10-05 for the "extended parameter list" of analytes (Section 4.3).
- Properly abandon Well MW-11-05, where a sampling device is stuck in the borehole (Section 4.0).

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TABLES

TABLE 2.1
2019 WATER TREATMENT PLANT DISCHARGE RATES

Date	Approximate Discharge Rate [a] (gpm)
1/7/2019	270
1/14/2019	270
1/21/2019	270
1/28/2019	270
2/4/2019	270
2/11/2019	270
2/18/2019	270
2/25/2019	270
3/4/2019	270
3/11/2019	270
3/18/2019	270
3/25/2019	270
4/1/2019	270
4/8/2019	270
4/15/2019	270
4/22/2019	270
4/29/2019	270
5/6/2019	270
5/13/2019	270
5/13/2019	270
5/20/2019	270
5/28/2019	270
6/3/2019	270
6/10/2019	270
6/17/2019	270
6/24/2019	270
7/1/2019	270
7/8/2019	270
7/15/2019	270
7/22/2019	270
7/29/2019	270
8/5/2019	270
8/11/2019	270
8/19/2019	270
8/26/2019	270
9/3/2019	270
9/9/2019	270
9/16/2019	270
9/23/2019	270
9/30/2019	270
10/7/2019	270
10/14/2019	270
10/21/2019	270
10/28/2019	270
11/4/2019	270
11/11/2019	270
11/18/2019	270
11/25/2019	270
12/2/2019	270
12/9/2019	270
12/16/2019	270
12/23/2019	270
12/30/2019	270
Annual Average	**270[b]**

Notes:

a The discharge rate is an instantaneous measurement recorded by the plant operator for the date shown.

b The annual average discharge rate is calculated from 365 daily flows and not on the 52 instantaneous measurement provided in this table.

gpm Gallons per minute

TABLE 2.2
APPROXIMATE VOLUME OF WATER TREATED

Dates	Approximate Volume of Water Treated (gallons)
1993 through 1996	231,920,600
1996 through 1997	51,321,600
1998	96,832,800
1999	119,730,200
2000	113,904,000
2001	114,681,600
2002	184,464,000
2003	189,734,400
2004	163,857,600
2005	150,710,400
2006	216,360,000
2007	233,892,000
2008	181,332,000
2009	177,645,600
2010	176,076,000
2011	196,574,400
2012	179,193,600
2013	177,127,200
2014	156,518,200
2015	161,514,000
2016	158,342,400
2017	141,912,000
2018	141,912,000
2019	141,912,000
Total	**3,857,468,600**

TABLE 2.3

SUMMARY OF MONITORING EVENTS - 2019

Monitoring Event[a]	Location	Number of Samples Collected and Analyzed[b]	Analytical Parameters of Interest	Method Number for Analysis
Weekly Sampling Event[a] (3)	Plant Water	Influent Water (1) Effluent Water (1) BABB Water (1)	PCP	EPA Method 528
Monthly Sampling Event[a] (5)	Plant Water	Influent Water (1) Effluent Water (1) BABB Water (1) NCRT/NHRT effluent (2)	PCP	EPA Method 528
Semi-Annual Sampling Event[a] (79)	Plant Water	Influent Water (1) Effluent Water (1) BABB Water (1) NCRT/NHRT effluent (2)	PCP	EPA Method 528
	Groundwater	Shallow Monitoring Wells (59)[c] Intermediate Monitoring Wells (4) Deep Monitoring Wells (8)	PCP	EPA Method 528
	Surface Water	Surface Water Stations (3)	PCP	EPA Method 528
Annual Sampling Event[a]	Plant Water	BABB Water (1)	PCP	EPA Method 528
	Plant Water	Influent Water (1) Effluent Water (1) NCRT/NHRT effluent (2)	PCP Metals (EFF only)[d] PAHs Dioxins and furans Chlorophenols Anions (EFF only)[d]	EPA Method 528 EPA Method 200.8 EPA Method SW8270C EPA Method SW8290 EPA Method SW8270C EPA Method 300.0
	Groundwater	Shallow Monitoring Wells (59)[c] Intermediate Monitoring Wells (4) Deep Monitoring Wells (8)	PCP	EPA Method 528

TABLE 2.3 (Cont.)

SUMMARY OF MONITORING EVENTS - 2018

Monitoring Event[a]	Location	Number of Samples Collected and Analyzed[b]	Analytical Parameters of Interest	Method Number for Analysis
(Continued) **Annual Sampling Event[a] (86)**	Groundwater	Shallow Monitoring Wells (5) Deep Monitoring Wells (2)	PCP PAHs Dioxins and furans Chlorophenols	EPA Method 528 EPA Method SW8270C EPA Method SW8290 EPA Method SW8270C
	Surface Water	Surface Water Stations (3)	PCP PAHs Dioxins and furans Chlorophenols	EPA Method 528 EPA Method SW8270C EPA Method SW8290 EPA Method SW8270C

Notes:

a The number in parenthesis is the total number of samples that are planned to be collected per monitoring event.
b The number in parenthesis is the total number of samples that are planned to be collected per station.
c A pump was lost in monitoring well MW-11-05 in February 2016; thus, the well could not be sampled.
d Analysis for metals includes arsenic, cadmium, chromium, copper, lead, and zinc; analysis for anions includes bromide, chloride, fluoride, nitrate, nitrite, and phosphate.

The depth to water was measured in each well that was sampled.

BABB	BABB station is located between the primary and secondary carbon units in the WTP
EFF	WTP effluent station (EFF)
EPA	U.S. Environmental Protection Agency
MPTP	Montana Pole and Treating Plant
NCRT	Near creek recovery trench
NCRT/NHRT	Refers to the NCRT effluent sample (NCRTEFF) and the NHRT effluent sample (NHRTEFF)
NHRT	Near highway recovery trench
PAH	Polycyclic aromatic hydrocarbon
PCP	Pentachlorophenol
Plant Water	MPTP water treatment plant process water
WTP	MPTP water treatment plant

TABLE 2.4
HISTORICAL CONCENTRATIONS OF PCP FOR WTP SAMPLES

Date	Laboratory	EPA Method	NHRT Effluent (NHRTEFF)	NCRT Effluent (NCRTEFF)	WTP Influent (IN)	WTP Between Tanks (BABB)	WTP Effluent (EFF)	ROD Cleanup Level[a] (µg/L)
2001 Range	MBMG	528	476 - 1185	6.76 - 55.2	130 - 631	--	0.1U - **1.12**	1.0
2002 Range	MBMG	528	272 - 842	11.5 - 24	143 - 463	--	0.1U - **7.08**	1.0
2003 Range	MBMG	528	140 - 304	4.3 - 8.8	47 - 262	17.0	0.04U - **1.7**	1.0
2004 Range	MBMG	528	97 - 192	2.4 - 6.7	33 - 82	0.11 - 4.1	0.056 - 0.39	1.0
2005 Range	MBMG	528	60 - 149	1.10 - 5.8	25.7 - 73.7	0.04 - 1.2	0.1U - 0.4	1.0
2006 Range	MBMG	528	98 - 180	1.56 - 6.06	4.21 - 98.8	0.062 - 9.83	0.1U - **3.35**	1.0
2007 Range	MBMG	528	63.2 - 286	2.69 - 3.92	19.3 - 310	0.126 - 1.05	0.06 - 0.483	1.0
2008 Range	MBMG	528	84.5 - 306	2.98 - 7.81	16.9 - 296	0.11 - 17.2	0.089 - **2.58**	1.0
2009 Range	MBMG	528	36.4 - 306	1.03 - 4.84	17.8 - 153	0.2U - 18.7	0.082 - **7.13**	1.0
2010 Range	MBMG	528	31.1 - 233	1.70 - 7.38	10.8 - 84.6	0.2U - 4.3	0.207 - **1.46**	1.0
2011 Range	MBMG	528	84.2 - 333	3.18 - 11.5	9.14 - 137	0.267 - 39.4	0.208 - **15.7**	1.0
2012 Range	MBMG	528	232 -379	0.79 - 49.4	35.5 - 161	0.456 - 14.6	0.23 - **1.03**	1.0
2013 Range	MBMG	528	126 - 345	2.54 - 8.71	0.852 -176	0.2U - 31.1	0.2U - **11.1**	1.0
2014 Range	MBMG	528	159 - 326	0.2U - 12.2	17.5 - 250	0.2U - 38.9	0.2U - **10.4**	1.0
2015 Range	MBMG	528	100 - 245	4.10 - 9.5	22.7 - 52.3	0.2U - 0.64	0.2U - 0.271	1.0
2016 Range	MBMG	528	97 - 186	3.58 - 6.8	22.3 - 52.5	0.2U - 0.93	0.2U - 0.633	1.0
2017 Range	MBMG	528	121 - 510	4.96 - 8.2	27.4 - 139	0.284- 0.870	0.166 - 0.640	1.0
2018 Range	MBMG	528	174 - 693	6.63 - 21.0	47.9 - 193	0.36 - 3.720	0.242 - **1.810**	1.0
2019 Range	MBMG	528	187 - 402	1.54 - 7.77	34.8 - 114	0.165 - 2.96	0.16 - 0.872	1.0
1/7/2019	MBMG	528	285	7.24	66.5	0.782	0.347	1.0
1/14/2019	MBMG	528	-	-	84.6	0.402	0.317	1.0
1/21/2019	MBMG	528	-	-	59.2	0.714	0.400	1.0
1/28/2019	MBMG	528	-	-	94.3	0.410	0.273	1.0
2/4/2019	MBMG	528	224	7.77	56.3	0.233	0.202	1.0
2/11/2019	MBMG	528	-	-	38.5	0.772	0.547	1.0
2/18/2019	MBMG	528	-	-	54.4	0.549	0.394	1.0
2/25/2019	MBMG	528	-	-	35.0	0.860	0.357	1.0
3/4/2019	MBMG	528	187	5.47	42.9	0.452	0.315	1.0
3/11/2019	MBMG	528	-	-	37.4	0.218	0.187	1.0
3/18/2019	MBMG	528	-	-	48.2	0.241	0.222	1.0
3/25/2019	MBMG	528	-	-	42.8	0.290	0.199	1.0
4/1/2019	MBMG	528	194	6.51	35.9	0.294	0.267	1.0
4/8/2019	MBMG	528	-	-	72.8	0.608	0.424	1.0
4/15/2019	MBMG	528	-	-	84.2	0.583	0.430	1.0
4/22/2019	MBMG	528	-	-	79.7	0.590	0.458	1.0
4/29/2019	MBMG	528	-	-	86.4	0.941	0.396	1.0
5/6/2019	MBMG	528	305	1.54	47.8	0.802	0.447	1.0
5/13/2019	MBMG	528	-	-	87.3	0.540	0.390	1.0
5/20/2019	MBMG	528	-	-	84.4	0.938	0.776	1.0
5/28/2019	MBMG	528	-	-	85.9	0.629	0.513	1.0
6/3/2019	MBMG	528	402	5.94	94.1	1.320	0.674	1.0
6/10/2019	MBMG	528	-	-	101.0	0.990	0.560	1.0
6/17/2019	MBMG	528	-	-	88.6	2.960	0.872	1.0
6/24/2019	MBMG	528	-	-	93.9	0.463	0.436	1.0
7/1/2019	MBMG	528	392	7.3	94.0	1.030	0.628	1.0
7/8/2019	MBMG	528	-	-	114.0	0.785	0.603	1.0
7/15/2019	MBMG	528	-	-	73.8	0.632	0.646	1.0
7/22/2019	MBMG	528	-	-	89.8	0.688	0.513	1.0
7/29/2019	MBMG	528	-	-	75.6	0.871	0.690	1.0
8/5/2019	MBMG	528	-	-	81.3	0.762	0.697	1.0
8/11/2019	MBMG	528	296	4.1	34.8	0.165	0.323	1.0
8/19/2019	MBMG	528	-	-	70.9	0.667	0.394	1.0
8/26/2019	MBMG	528	-	-	66.8	0.521	0.242	1.0
9/3/2019	MBMG	528	226	2.73	53.9	0.287	0.695	1.0
9/9/2019	MBMG	528	-	-	71.3	0.259	0.319	1.0
9/16/2019	MBMG	528	-	-	69.1	0.635	0.372	1.0
9/23/2019	MBMG	528	-	-	74.6	0.447	0.358	1.0
9/30/2019	MBMG	528	-	-	77.6	0.720	0.476	1.0
10/7/2019	MBMG	528	266	7.07	88	0.578	0.503	1.0
10/14/2019	MBMG	528	-	-	73.9	0.979	0.58	1.0
10/21/2019	MBMG	528	-	-	77	0.706	0.589	1.0
10/28/2019	MBMG	528	-	-	60	0.447	0.308	1.0
11/4/2019	MBMG	528	205	6.91	67.4	0.294	0.346	1.0
11/11/2019	MBMG	528	-	-	69.5	0.681	0.392	1.0
11/18/2019	MBMG	528	-	-	56.8	0.402	0.342	1.0
11/25/2019	MBMG	528	-	-	38.4	0.304	0.195	1.0
12/2/2019	MBMG	528	302	7.58	49.5	0.192	0.194	1.0
12/9/2019	MBMG	528	-	-	52.9	0.182	0.16	1.0
12/16/2019	MBMG	528	-	-	67.2	0.304	0.172	1.0
12/23/2019	MBMG	528	-	-	72.9	0.283	0.2	1.0
12/30/2019	MBMG	528	-	-	41	0.228	0.185	1.0
		2019 Average	274	5.8	68.5	0.608	0.414	1.0

Notes:
All units are in µg/L unless otherwise noted.

a	Cleanup level applies to the WTP effluent sample, only.
--	Not sampled
µg/L	Micrograms per liter
Bold	WTP effluent concentration exceeds the ROD discharge to surface water cleanup level.
BABB	WTP sample collected from between primary and secondary carbon vessels
EPA	U.S. Environmental Protection Agency
gpm	Gallons per minute
MBMG	Montana Bureau of Mines and Geology
MPTP	Montana Pole and Treating Plant
NCRT	Near creek recovery trench
NHRT	Near highway recovery trench
PCP	Pentachlorophenol
ROD	Record of Decision
U	Analyzed for but not detected above the method detection limit
WTP	MPTP water treatment plant

TABLE 2.5
HISTORICAL CONCENTRATIONS OF DIOXIN (TEQ) FOR WTP SAMPLES
(µg/L)

Sample Date	NHRT Effluent (NHRTEFF)	NCRT Effluent (NCRTEFF)	WTP Influent (IN)	WTP Effluent (EFF)	ROD Cleanup Level[a]
8/13/2001	4.60E-07	9.20E-07	2.03E-06	2.40E-07	1.00E-05
2/4/2002	4.60E-07	1.60E-07	3.21E-06	1.30E-07	1.00E-05
8/12/2002	5.50E-07	1.19E-06	1.53E-06	2.10E-07	1.00E-05
2/3/2003	2.70E-07	4.17E-06	2.16E-06	6.90E-07	1.00E-05
8/4/2003	2.30E-07	2.16E-06	1.57E-06	3.00E-07	1.00E-05
2/2/2004	1.50E-07	8.30E-07	8.50E-07	1.40E-07	1.00E-05
8/2/2004	2.20E-07	3.09E-06	1.40E-06	5.60E-07	1.00E-05
8/8/2005	7.60E-07	1.29E-06	1.95E-05	1.28E-06	1.00E-05
2/6/2006	2.10E-07	8.50E-07	2.78E-06	1.00E-06	1.00E-05
8/21/2006	2.10E-07	2.70E-07	7.70E-07	2.86E-06	1.00E-05
8/27/2007	8.70E-08	8.10E-07	0.00E+00	3.10E-07	1.00E-05
8/26/2008	1.70E-07	1.58E-06	5.60E-07	1.70E-07	1.00E-05
8/10/2009	6.20E-07	3.92E-06	1.80E-06	1.80E-07	1.00E-05
8/16/2010	1.12E-05	5.84E-06	4.40E-06	5.80E-07	1.00E-05
8/15/2011 [b]	1.91E-07	1.90E-07	3.91E-07	7.60E-08	1.00E-05
8/13/2012	2.27E-05	1.21E-05	7.26E-06	4.40E-07	1.00E-05
8/12/2013	1.27E-04	7.72E-06	3.58E-05	3.69E-07	1.00E-05
8/11/2014	1.06E-05	3.07E-06	6.75E-06	7.99E-07	1.00E-05
8/10/2015	5.68E-06	7.72E-06	4.48E-06	4.00E-07	1.00E-05
8/8/2016	4.95E-06	2.12E-06	2.80E-06	3.08E-07	1.00E-05
8/10/2017	9.20E-06	5.11E-06	3.57E-06	1.87E-06	1.00E-05
8/13/2018	9.87E-06	4.34E-06	7.27E-06	2.05E-06	1.00E-05
8/11/2019	1.59E-06	8.08E-07	9.36E-07	1.35E-06	1.00E-05

HISTORICAL CONCENTRATIONS OF DIOXIN (TEQ) FOR WTP SAMPLES
(pg/L)

Sample Date	NHRT Effluent (NHRTEFF)	NCRT Effluent (NCRTEFF)	WTP Influent (IN)	WTP Effluent (EFF)	ROD Cleanup Level[a]
8/13/2001	0.46	0.92	2.03	0.24	10.00
2/4/2002	0.46	0.16	3.21	0.13	10.00
8/12/2002	0.55	1.19	1.53	0.21	10.00
2/3/2003	0.27	4.17	2.16	0.69	10.00
8/4/2003	0.23	2.16	1.57	0.30	10.00
2/2/2004	0.15	0.83	0.85	0.14	10.00
8/2/2004	0.22	3.09	1.40	0.56	10.00
8/8/2005	0.76	1.29	19.50	1.28	10.00
2/6/2006	0.21	0.85	2.78	1.00	10.00
8/21/2006	0.21	0.27	0.77	2.86	10.00
8/27/2007	0.09	0.81	0.00	0.31	10.00
8/26/2008	0.17	1.58	0.56	0.17	10.00
8/10/2009	0.62	3.92	1.80	0.18	10.00
8/16/2010	11.2	5.84	4.40	0.58	10.00
8/15/2011 [b]	0.19	0.19	0.39	0.08	10.00
8/13/2012	22.7	12.1	7.26	0.44	10.00
8/12/2013	127	7.72	35.80	0.37	10.00
8/11/2014	10.6	3.07	6.75	0.80	10.00
8/10/2015	5.68	7.72	4.48	0.40	10.00
8/8/2016	4.95	2.12	2.80	0.31	10.00
8/10/2017	9.20	5.11	3.57	1.87	10.00
8/13/2018	9.87	4.34	7.27	2.05	10.00
8/11/2019	1.59	0.81	0.94	1.35	10.00

Notes:

For this table, TEQs are calculated using the MPTP ROD Methodology.

See Appendix B-3 for TEQ values calculated using both the MPTP ROD Methodology and the DEQ-7 Methodology.

a	Cleanup level applies to the WTP effluent sample, only.
b	Data for this date appear to be anomalously low.
µg/L	Micrograms per liter
pg/L	Picograms per liter
MPTP	Montana Pole and Treating Plant
NCRT	Near creek recovery trench
NHRT	Near highway recovery trench
ROD	Record of Decision
TEF	Toxicity equivalence factor
TEQ	Toxicity equivalence quotient
WTP	MPTP water treatment plant

TABLE 2.6
CONCENTRATIONS OF PAH, CHLOROPHENOLS, ANIONS, AND METALS FOR WTP SAMPLES

	NHRT Effluent (NHRTEFF)	Q	NCRT Effluent (NCRTEFF)	Q	WTP Influent (IN)	Q	WTP Effluent (EFF)	Q	ROD[b]
ANALYTES									
PAH (EPA Method SW8270C)									
ACENAPHTHENE	0.25	U	0.25	U	0.25	U	0.25	U	-
ACENAPHTHYLENE	0.347		0.25	U	0.323		0.25	U	-
ANTHRACENE	0.25	U	0.25	U	0.25	U	0.25	U	-
BENZO(A)ANTHRACENE	0.1	U	0.25	U	0.1	U	0.1	U	1
BENZO(A)PYRENE	0.1	U	0.1	U	0.1	U	0.1	U	0.2 (0.05/0.038) [c]
BENZO(B)FLUORANTHENE	0.25	U	0.1	U	0.25	U	0.25	U	0.2
BENZO(G,H,I)PERYLENE	0.5	U	0.25	U	0.5	U	0.5	U	1
BENZO(K)FLUORANTHENE	0.1	U	0.5	U	0.1	U	0.1	U	1
CHRYSENE	0.1	U	0.1	U	0.1	U	0.1	U	1
DIBENZO(A,H)ANTHRACENE	0.1	U	0.1	U	0.1	U	0.1	U	0.2
FLUORANTHENE	0.25	U	0.1	U	0.25	U	0.67		-
FLUORENE	0.25	U	0.25	U	0.25	U	0.25	U	-
INDENO(1,2,3-CD)PYRENE	0.1	U	0.25	U	0.1	U	0.1	U	1
NAPHTHALENE	0.705		0.1	U	0.25	U	0.461		-
PHENANTHRENE	0.25	U	0.25	U	0.25	U	0.25	U	-
PYRENE	0.25	U	0.25	U	0.25	U	0.25	U	-
TOTAL D PAHs	2.1		1.2		1.6		2.1		360
CHLOROPHENOLS (EPA Method SW8270C)									
2,3,4,6-TETRACHLOROPHENOL	23	D	0.5	U	5.58		0.5	U	-
2,4,5-TRICHLOROPHENOL	2.77		1	U	1.0	U	1	U	-
2,4,6-TRICHLOROPHENOL	1.29		0.5	U	0.5	U	0.5	U	-
2,4-DICHLOROPHENOL	0.905		0.5	U	0.5	U	0.5	U	45
2-CHLOROPHENOL	0.5	U	0.5	U	0.5	U	0.5	U	27
4-CHLORO-3-METHYLPHENOL	4.2		0.5	U	0.5	U	0.5	U	6.5
PENTACHLOROPHENOL	296	D	0.25	U	34.8	D	0.323	U	1
ANIONS[a] (EPA Method 300)									
BROMIDE	238		226		230		230		-
CHLORIDE (mg/L)	59.25		61.94		60.76		60.81		-
FLUORIDE (mg/L)	0.34		0.49		0.42		0.41		-
NITRATE (mg/L)	0.02	U	0.08	J	0.04	J	0.05	J	-
NITRITE (mg/L)	1.9		8.3		6.76		6.72		-
PHOSPHATE (mg/L)	0.01	U	0.1	U	0.01	U	0.01	U	-
METALS, DISSOLVED[a] (EPA Method 200.8)									
ARSENIC	10.74		2.67		4.74		2.95		48
CADMIUM	0.25	U	0.25	U	0.25	U	0.25	U	1.1
CHROMIUM	0.77	J	0.63	J	0.25	U	0.73	J	11
COPPER	1.25	U	1.4	J	1.5	J	1.25	U	12
IRON (mg/L)	1.354		0.038	U	0.282		0.038	U	-
LEAD	0.15	U	0.15	U	0.15	U	0.15	U	3.2
MANGANESE (mg/L)	0.601		0.103	J	0.211		0.005	U	-
ZINC	8.656		19.36		20.51		6.14		110
METALS, TOTAL RECOVERABLE[a] (EPA Method 200.8)									
ARSENIC	12.49		2.59		5.11		3.37		48
CADMIUM	0.25	U	0.25	U	0.25	U	0.25	U	1.1 (0.8) [c]
CHROMIUM	0.9	J	1.14	J	1.05	J	1.24	J	11
COPPER	1.25	U	1.82	J	1.78	J	1.25	U	12
IRON (mg/L)	1.671		0.038	U	0.387		0.038	U	-
LEAD	0.15	U	0.15	U	0.15	U	0.15	U	3.2
MANGANESE (mg/L)	0.606		0.082	J	0.22		0.005	U	-
ZINC	1.995	J	18.55		14.66		6.73		110

Notes:
All units are in µg/L unless otherwise noted.
All samples were collected on August 7, 2017.

a Concentration units for anion constituents (other than bromide), as well as for the two metals iron and manganese, are mg/L.
b Cleanup level applies to the WTP effluent sample (station EFF), only.
c The water quality standards for cadmium and benzo(a)pyrene outlined in Circular DEQ-7 are lower than the cleanup levels for groundwater and surface water specified in the ROD tables; therefore, the lower DEQ-7 standards (in parentheses) currently take precedence over the ROD cleanup levels for these analytes.
The hardness-adjusted DEQ-7 Aquatic Life Standard for the chronic standard for cadmium is 0.8 µg/L.
The DEQ-7 standard for benzo(a)pyrene for groundwater is 0.05 µg/L; the DEQ-7 standard for benzo(a)pyrene for surface water is 0.038 µg/L

- No cleanup level specified in the ROD.

D PAH	Sum of the acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene concentrations
DEQ	Montana Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
J	Detected above the MDL but less than the MRL
mg/L	Milligrams per liter
MPTP	Montana Pole and Treating Plant
NCRT	Near creek recovery trench
NHRT	Near highway recovery trench
PAH	Polycyclic aromatic hydrocarbon
Q	Data qualifier
ROD	Record of Decision
µg/L	Micrograms per liter
U	Analyzed for but not detected above the method detection limit
WTP	MPTP water treatment plant

TABLE 2.7
QUALITY CONTROL - SOURCE WATER BLANKS

Date Sampled	Sample ID	Analyte	EPA Method	Concentration	Q	Units
PENTACHLOROPHENOL (EPA Method 528)						
1/14/2019	WTPVS011419	PENTACHLOROPHENOL	528	0.1	U	µg/L
1/21/2019	OPOQVS012119	PENTACHLOROPHENOL	528	0.1	U	µg/L
2/2/2019	SW-07020219	PENTACHLOROPHENOL	528	0.1	U	µg/L
2/2/2019	MW-18020219	PENTACHLOROPHENOL	528	0.1	U	µg/L
2/3/2019	MW-21020319	PENTACHLOROPHENOL	528	0.1	U	µg/L
2/11/2019	OPOQVS021119	PENTACHLOROPHENOL	528	0.1	U	µg/L
2/25/2019	OPOQVS022519	PENTACHLOROPHENOL	528	0.1	U	µg/L
3/18/2019	WTPVS031819	PENTACHLOROPHENOL	528	0.1	U	µg/L
3/25/2019	OPOQVS032519	PENTACHLOROPHENOL	528	0.1	U	µg/L
4/22/2019	OPOQVS042219	PENTACHLOROPHENOL	528	0.1	U	µg/L
5/6/2019	OPOQVS050619	PENTACHLOROPHENOL	528	0.1	U	µg/L
5/20/2019	OPOQVS052019	PENTACHLOROPHENOL	528	0.1	U	µg/L
6/10/2019	WTPVS061019	PENTACHLOROPHENOL	528	0.1	U	µg/L
6/24/2019	WTPVS062419	PENTACHLOROPHENOL	528	0.1	U	µg/L
7/8/2019	WTPVS070819	PENTACHLOROPHENOL	528	0.1	U	µg/L
7/15/2019	OPOQVS071519	PENTACHLOROPHENOL	528	0.1	U	µg/L
8/5/2019	OPOQVS080519	PENTACHLOROPHENOL	528	0.1	U	µg/L
8/6/2019	MW-E-98080619	PENTACHLOROPHENOL	528	0.1	U	µg/L
8/11/2019	SW-07081119	PENTACHLOROPHENOL	528	0.1	U	µg/L
8/19/2019	OPOQVS081919	PENTACHLOROPHENOL	528	0.1	U	µg/L
9/3/2019	OPOQVS090319	PENTACHLOROPHENOL	528	0.1	U	µg/L
9/23/2019	WTPVS092319	PENTACHLOROPHENOL	528	0.1	U	µg/L
8/6/2019	MW-C-99080619	PENTACHLOROPHENOL	528	0.1	U	µg/L
8/7/2019	MW-G-98080719	PENTACHLOROPHENOL	528	0.1	U	µg/L
9/30/2019	OPOQVS093019	PENTACHLOROPHENOL	528	0.1	U	µg/L
10/21/2019	WTPVS102119	PENTACHLOROPHENOL	528	0.1	U	µg/L
10/28/2019	OPOQVS102819	PENTACHLOROPHENOL	528	0.1	U	µg/L
11/18/2019	WTPVS111819	PENTACHLOROPHENOL	528	0.1	U	µg/L
11/25/2019	OPOQVS112519	PENTACHLOROPHENOL	528	0.1	U	µg/L
12/23/2019	OPOQVS122319	PENTACHLOROPHENOL	528	0.1	U	µg/L
PAH (EPA Method 8270)						
8/11/2019	SW-07081119	ACENAPHTHENE	8270	0.25	U	µg/L
8/11/2019	SW-07081119	ACENAPHTHYLENE	8270	0.25	U	µg/L
8/11/2019	SW-07081119	ANTHRACENE	8270	0.25	U	µg/L
8/11/2019	SW-07081119	BENZO(A)ANTHRACENE	8270	0.1	U	µg/L
8/11/2019	SW-07081119	BENZO(A)PYRENE	8270	0.1	U	µg/L
8/11/2019	SW-07081119	BENZO(B)FLUORANTHENE	8270	0.25	U	µg/L
8/11/2019	SW-07081119	BENZO(G,H,I)PERYLENE	8270	0.5	U	µg/L
8/11/2019	SW-07081119	BENZO(K)FLUORANTHENE	8270	0.1	U	µg/L
8/11/2019	SW-07081119	CHRYSENE	8270	0.1	U	µg/L
8/11/2019	SW-07081119	DIBENZO(A,H)ANTHRACENE	8270	0.1	U	µg/L
8/11/2019	SW-07081119	FLUORANTHENE	8270	0.25	U	µg/L
8/11/2019	SW-07081119	FLUORENE	8270	0.25	U	µg/L
8/11/2019	SW-07081119	INDENO(1,2,3-CD)PYRENE	8270	0.1	U	µg/L
8/11/2019	SW-07081119	NAPHTHALENE	8270	0.25	U	µg/L
8/11/2019	SW-07081119	PHENANTHRENE	8270	0.25	U	µg/L
8/11/2019	SW-07081119	PYRENE	8270	0.25	U	µg/L

TABLE 2.7
QUALITY CONTROL - SOURCE WATER BLANKS

Date Sampled	Sample ID	Analyte	EPA Method	Concentration	Q	Units
SVOC (EPA Method 8270)						
8/11/2019	SW-07081119	2,3,4,6-TETRACHLOROPHENOL	8270	0.5	U	µg/L
8/11/2019	SW-07081119	2,4,5-TRICHLOROPHENOL	8270	1	U	µg/L
8/11/2019	SW-07081119	2,4,6-TRICHLOROPHENOL	8270	0.5	U	µg/L
8/11/2019	SW-07081119	2,4-DICHLOROPHENOL	8270	0.5	U	µg/L
8/11/2019	SW-07081119	2-CHLOROPHENOL	8270	0.5	U	µg/L
8/11/2019	SW-07081119	4-CHLORO-3-METHYLPHENOL	8270	0.5	U	µg/L
DIOXIN (TEQ) (EPA Method 8290)						
8/11/2019	DFBLKAM	DIOXIN (TEQ)	8290	**1.4**		pg/L
ANIONS (EPA Method 300.1)						
8/11/2019	SW-07081119	BROMIDE	300.1	10	U	µg/L
8/11/2019	SW-07081119	CHLORIDE	300.1	0.1	U	mg/L
8/11/2019	SW-07081119	FLUORIDE	300.1	0.01	U	mg/L
8/11/2019	SW-07081119	NITRATE	300.1	0.01	U	mg/L
8/11/2019	SW-07081119	NITRITE	300.1	0.01	U	mg/L
8/11/2019	SW-07081119	PHOSPHATE	300.1	0.02	U	mg/L
METALS - TOTAL RECOVERABLE (EPA Method 200.8)						
8/11/2019	SW-07081119	ARSENIC	200.8	0.25	U	µg/L
8/11/2019	SW-07081119	CADMIUM	200.8	0.25	U	µg/L
8/11/2019	SW-07081119	CHROMIUM	200.8	**1.29**		µg/L
8/11/2019	SW-07081119	COPPER	200.8	1.25	U	µg/L
8/11/2019	SW-07081119	IRON	200.8	0.038	U	mg/L
8/11/2019	SW-07081119	LEAD	200.8	0.15	U	µg/L
8/11/2019	SW-07081119	MANGANESE	200.8	0.005	U	mg/L
8/11/2019	SW-07081119	ZINC	200.8	**2.52**	J	µg/L
METALS - DISSOLVED (EPA Method 200.8)						
8/11/2019	SW-07081119	ARSENIC	200.8	0.1	U	µg/L
8/11/2019	SW-07081119	CADMIUM	200.8	0.1	U	µg/L
8/11/2019	SW-07081119	CHROMIUM	200.8	0.1	U	µg/L
8/11/2019	SW-07081119	COPPER	200.8	0.5	U	µg/L
8/11/2019	SW-07081119	IRON	200.8	0.015	U	mg/L
8/11/2019	SW-07081119	LEAD	200.8	0.06	U	µg/L
8/11/2019	SW-07081119	MANGANESE	200.8	0.002	U	mg/L
8/11/2019	SW-07081119	ZINC	200.8	**2.53**		µg/L

Notes
Dioxin (TEQ) calculated using 0 for values qualified as "U" and ROD TEFs (MPTP ROD methodology).

µg/L	Micrograms per liter	MPTP	Montana Pole and Treating Plant
pg/L	Picograms per liter	PAH	Polycyclic aromatic hydrocarbon
Bold	Analyte detected in source water blank	Q	Laboratory data qualifier
Dioxin	Polychlorinated dibenzo-p-dioxins	ROD	Record of Decision
EPA	U.S. Environmental Protection Agency	SVOC	Semivolatile organic compound
ID	Identification	TEF	Toxicity equivalence factor
J	Estimated	TEQ	Toxicity equivalence quotient
mg/L	Milligrams per liter	U	Analyzed for but not detected above the method detection limit

TABLE 2.8
QUALITY CONTROL - FIELD DUPLICATES

Sample Date	Original Sample ID	Analyte	Original Concentration	Q	Original Sample RL	Duplicate Sample ID	Duplicate Concentration	Q	Duplicate Sample RL	Units	RPD[a]
PENTACHLOROPHENOL (EPA Method 528)											
1/7/2019	NCRTEFF010719	PENTACHLOROPHENOL	7.24		0.1	OPOQVS010719	6.92		0.1	µg/L	4.5
1/28/2019	EFF012819	PENTACHLOROPHENOL	0.273		0.1	WTPVS012819	0.364		0.1	µg/L	**28.6**
2/2/2019	SS-06A020219	PENTACHLOROPHENOL	0.1	U	0.1	MW-20020219	0.1	U	0.1	µg/L	0.0
2/2/2019	10-09020219	PENTACHLOROPHENOL	25		0.1	MW-E-9802020219	24.2		0.1	µg/L	3.3
2/3/2019	MW-G-01020319	PENTACHLOROPHENOL	0.657		0.1	MW-C-99020319	0.308		0.1	µg/L	**72.3**
2/18/2019	IN021819	PENTACHLOROPHENOL	54.4	D	0.1	WTPVS021819	55.39	D	0.1	µg/L	1.8
3/4/2019	NHRTEFF030419	PENTACHLOROPHENOL	187	D	0.1	WTPVS030419	193	D	0.1	µg/L	3.2
3/11/2019	BABB031119	PENTACHLOROPHENOL	0.218		0.1	OPOQVS031119	0.286		0.1	µg/L	**27.0**
4/1/2019	NCRTEFF040119	PENTACHLOROPHENOL	6.51		0.1	WTPVS040119	5.79		0.1	µg/L	11.7
4/29/2019	IN042919	PENTACHLOROPHENOL	86.4	D	0.1	WTPVS042919	75.6	D	0.1	µg/L	13.3
5/13/2019	BABB051319	PENTACHLOROPHENOL	0.54		0.1	WTPVS051319	0.524		0.1	µg/L	3.0
5/28/2019	EFF052819	PENTACHLOROPHENOL	0.513		0.1	WTPVS052819	0.565		0.1	µg/L	9.6
6/3/2019	NHRTEFF060319	PENTACHLOROPHENOL	402	D	0.1	OPOQVS060319	399	D	0.1	µg/L	0.7
6/17/2019	IN061719	PENTACHLOROPHENOL	88.6	D	0.1	OPOQVS061719	82.3	D	0.1	µg/L	7.4
7/1/2019	NCRTEFF070119	PENTACHLOROPHENOL	7.32		0.1	OPOQVS070119	6.54		0.1	µg/L	11.3
7/22/2019	EFF072219	PENTACHLOROPHENOL	0.513		0.1	WTPVS072219	0.49		0.1	µg/L	4.6
8/5/2019	MW-I-96080519	PENTACHLOROPHENOL	1.59		0.1	WTPVS080519	1.59		0.1	µg/L	0.0
8/6/2019	10-02080619	PENTACHLOROPHENOL	16.7		0.1	MW-18080619	14.5		0.1	µg/L	14.1
8/11/2019	HCA-21081119	PENTACHLOROPHENOL	0.444		0.1	MW-20081119	0.802		0.1	µg/L	**57.5**
8/26/2019	BABB082619	PENTACHLOROPHENOL	0.521		0.1	WTPVS082619	0.368		0.1	µg/L	**34.4**
9/9/2019	IN090919	PENTACHLOROPHENOL	71.3	D	0.1	WTPVS090919	62.6	D	0.1	µg/L	13.0
9/16/2019	BABB091619	PENTACHLOROPHENOL	0.635		0.1	OPOQVS091619	0.518		0.1	µg/L	**20.3**

TABLE 2.8
QUALITY CONTROL - FIELD DUPLICATES

Sample Date	Original Sample ID	Analyte	Original Concentration	Q	Original Sample RL	Duplicate Sample ID	Duplicate Concentration	Q	Duplicate Sample RL	Units	RPD[a]
8/6/2019	GW-05080619	PENTACHLOROPHENOL	0.951		0.1	MW-21080619	1.78		0.1	µg/L	**60.7**
8/7/2019	NCRT-2010080719	PENTACHLOROPHENOL	5.26		0.1	MW-19080719	5.18		0.1	µg/L	1.5
10/7/2019	NHRTEFF100719	PENTACHLOROPHENOL	266		0.1	WTPVS100719	259	D	0.1	µg/L	2.7
10/14/2019	EFF101419	PENTACHLOROPHENOL	0.58		0.1	OPOQVS101419	0.813		0.1	µg/L	**33.5**
11/4/2019	NCRTEFF110419	PENTACHLOROPHENOL	6.91		0.1	WTPVS110419	6.77		0.1	µg/L	2.0
11/11/2019	IN111119	PENTACHLOROPHENOL	69.5	D	0.1	OPOQVS111119	69.5	D	0.1	µg/L	0.0
12/2/2019	NHRTEFF120219	PENTACHLOROPHENOL	302	D	0.1	WTPVS120219	301	D	0.1	µg/L	0.3
12/16/2019	BABB121619	PENTACHLOROPHENOL	0.304		0.1	WTPVS121619	0.189		0.1	µg/L	**46.7**
SVOC (EPA Method 8270)											
8/11/2019	HCA-21081119	2,3,4,6-TETRACHLOROPHENOL	0.5	U	0.5	MW-20081119	0.5	U	0.5	µg/L	0.0
8/11/2019	HCA-21081119	2,4,5-TRICHLOROPHENOL	1	U	1	MW-20081119	1	U	1	µg/L	0.0
8/11/2019	HCA-21081119	2,4,6-TRICHLOROPHENOL	0.5	U	0.5	MW-20081119	0.5	U	0.5	µg/L	0.0
8/11/2019	HCA-21081119	2,4-DICHLOROPHENOL	0.5	U	0.5	MW-20081119	0.5	U	0.5	µg/L	0.0
8/11/2019	HCA-21081119	2-CHLOROPHENOL	0.5	U	0.5	MW-20081119	0.5	U	0.5	µg/L	0.0
8/11/2019	HCA-21081119	4-CHLORO-3-METHYLPHENOL	0.5	U	0.5	MW-20081119	0.5	U	0.5	µg/L	0.0
PAH (EPA Method 8270)											
8/11/2019	HCA-21081119	ACENAPHTHENE	0.25	U	0.25	MW-20081119	0.25	U	0.25	µg/L	0.0
8/11/2019	HCA-21081119	ACENAPHTHYLENE	0.328		0.25	MW-20081119	0.25	U	0.25	µg/L	**27.0**
8/11/2019	HCA-21081119	ANTHRACENE	0.25	U	0.25	MW-20081119	0.25	U	0.25	µg/L	0.0
8/11/2019	HCA-21081119	BENZO(A)ANTHRACENE	0.1	U	0.1	MW-20081119	0.1	U	0.1	µg/L	0.0
8/11/2019	HCA-21081119	BENZO(A)PYRENE	0.1	U	0.1	MW-20081119	0.1	U	0.1	µg/L	0.0
8/11/2019	HCA-21081119	BENZO(B)FLUORANTHENE	0.25	U	0.25	MW-20081119	0.25	U	0.25	µg/L	0.0
8/11/2019	HCA-21081119	BENZO(G,H,I)PERYLENE	0.5	U	0.5	MW-20081119	0.5	U	0.5	µg/L	0.0

TABLE 2.8
QUALITY CONTROL - FIELD DUPLICATES

Sample Date	Original Sample ID	Analyte	Original Concentration	Q	Original Sample RL	Duplicate Sample ID	Duplicate Concentration	Q	Duplicate Sample RL	Units	RPD[a]
8/11/2019	HCA-21081119	BENZO(K)FLUORANTHENE	0.1	U	0.1	MW-20081119	0.1	U	0.1	µg/L	0.0
8/11/2019	HCA-21081119	CHRYSENE	0.1	U	0.1	MW-20081119	0.1	U	0.1	µg/L	0.0
8/11/2019	HCA-21081119	DIBENZO(A,H)ANTHRACENE	0.1	U	0.1	MW-20081119	0.1	U	0.1	µg/L	0.0
8/11/2019	HCA-21081119	FLUORANTHENE	0.25	U	0.25	MW-20081119	0.677		0.25	µg/L	**92.1**
8/11/2019	HCA-21081119	FLUORENE	0.25	U	0.25	MW-20081119	0.25	U	0.25	µg/L	0.0
8/11/2019	HCA-21081119	INDENO(1,2,3-CD)PYRENE	0.1	U	0.1	MW-20081119	0.1	U	0.1	µg/L	0.0
8/11/2019	HCA-21081119	NAPHTHALENE	0.25	U	0.25	MW-20081119	0.25	U	0.25	µg/L	0.0
8/11/2019	HCA-21081119	PHENANTHRENE	0.25	U	0.25	MW-20081119	0.25	U	0.25	µg/L	0.0
8/11/2019	HCA-21081119	PYRENE	0.25	U	0.25	MW-20081119	0.25	U	0.25	µg/L	0.0

TABLE 2.8
QUALITY CONTROL - FIELD DUPLICATES

Sample Date	Original Sample ID	Analyte	Original Concentration	Q	Original Sample RL	Duplicate Sample ID	Duplicate Concentration	Q	Duplicate Sample RL	Units	RPD[a]
DIOXINS AND FURANS (TEQ) (EPA Method SW8290)											
8/11/2019	HCA-21081119	Dioxin TEQ	8.41			MW-20081119	1.69			pg/L	**133.1**
ANIONS (EPA Method 300.1)											
8/11/2019	EFF081119	BROMIDE	230		10	MW-F-99081119	182		10	UG/L	**23.3**
8/11/2019	EFF081119	CHLORIDE	60.81		0.1	MW-F-99081119	45.9		0.1	MG/L	**27.9**
8/11/2019	EFF081119	FLUORIDE	0.41		0.01	MW-F-99081119	0.31		0.01	MG/L	**27.8**
8/11/2019	EFF081119	NITRATE	6.72		0.01	MW-F-99081119	5.12		0.01	MG/L	**27.0**
8/11/2019	EFF081119	NITRITE	0.01	U	0.01	MW-F-99081119	0.01	U	0.01	MG/L	0.0
8/11/2019	EFF081119	PHOSPHATE	0.05	J	0.02	MW-F-99081119	0.04	J	0.02	MG/L	**22.2**
METALS - TOTAL RECOVERABLE (EPA Method 200.8)											
8/11/2019	EFF081119	ARSENIC	3.37		0.1	MW-F-99081119	3.09		0.1	µg/L	8.7
8/11/2019	EFF081119	CADMIUM	0.25	U	0.25	MW-F-99081119	0.25	U	0.25	µg/L	0.0
8/11/2019	EFF081119	CHROMIUM	1.24	J	0.25	MW-F-99081119	0.08	J	0.25	µg/L	**175.8**
8/11/2019	EFF081119	COPPER	1.25	U	1.25	MW-F-99081119	1.25	U	1.25	µg/L	0.0
8/11/2019	EFF081119	IRON	0.038	U	1.25	MW-F-99081119	0.038	U	1.25	mg/L	0.0
8/11/2019	EFF081119	LEAD	0.15	U	0.02	MW-F-99081119	0.15	U	0.02	µg/L	0.0
8/11/2019	EFF081119	MANGANESE	0.005	U	0.06	MW-F-99081119	0.005	U	0.06	mg/L	0.0
8/11/2019	EFF081119	ZINC	6.73		0.015	MW-F-99081119	6.87		0.015	µg/L	2.1
METALS - DISSOLVED (EPA Method 200.8)											
8/11/2019	EFF081119	ARSENIC	2.95		0.1	MW-F-99081119	3.03		0.1	µg/L	2.7
8/11/2019	EFF081119	CADMIUM	0.25	U	0.015	MW-F-99081119	0.25	U	0.015	µg/L	0.0
8/11/2019	EFF081119	CHROMIUM	0.73	J	0.1	MW-F-99081119	0.63	J	0.1	µg/L	14.7
8/11/2019	EFF081119	COPPER	1.25	U	0.5	MW-F-99081119	1.25	U	0.5	µg/L	0.0

TABLE 2.8
QUALITY CONTROL - FIELD DUPLICATES

Sample Date	Original Sample ID	Analyte	Original Concentration	Q	Original Sample RL	Duplicate Sample ID	Duplicate Concentration	Q	Duplicate Sample RL	Units	RPD[a]
8/11/2019	EFF081119	IRON	0.038	U	0.015	MW-F-99081119	0.038	U	0.015	mg/L	0.0
8/11/2019	EFF081119	LEAD	0.15	U	0.1	MW-F-99081119	0.15	U	0.1	μg/L	0.0
8/11/2019	EFF081119	MANGANESE	0.005	U	0.02	MW-F-99081119	0.005	U	0.02	mg/L	0.0
8/11/2019	EFF081119	ZINC	6.14		0.5	MW-F-99081119	5.99		0.5	μg/L	2.5
										Average RPD:	14.3

Notes:

a If one concentration is "U" and the other is detected, the RL is used as the value for the "U" result

μg/L Micrograms per liter

pg/L Picograms per liter

Bold RPD exceeds the 35 percent project goal for precision

D Dilution
EPA U.S. Environmental Protection Agency
ID Identification
J Estimated
mg/L Milligrams per liter
PAH Polycyclic aromatic hydrocarbon
Q Laboratory data qualifier
RL Laboratory reporting limit
RPD Relative percent difference
SVOC Semivolatile organic compound
TEQ Toxicity equivalence quotient
U Analyzed for but not detected above the method detection limit

TABLE 3.1
HISTORICAL LTU WATER APPLICATION

Year	LTU Water Application (gallons)
1999	710,700
2000	425,250
2001	3,188,700
2002	2,321,700
2003	7,395,500
2004	5,034,300
2005	1,921,600
2006	7,007,600
2007	3,042,800
2008	5,784,800
2009	3,758,000
2010	3,169,400
2011	2,141,200
2012	1,171,900
2013	884,700
2014	0
2015	0
2016	0
2017	0
2018*	0
2019	0
Total Volume Applied:	**47,958,150**

Notes:
LTU Land treatment unit

TABLE 3.2
LTU SOIL SAMPLING RESULTS (2007 - 2013)

	2-Oct-07		2-Jul-08	2-Oct-08	8-Jul-09	14-Oct-10	19-Sep-11	26-Sep-12		1-Oct-13	
Sample	PCP	Dioxin TEQ	PCP	PCP	PCP	PCP	PCP	PCP	Dioxin TEQ	PCP	Dioxin TEQ
Cleanup levels	34 mg/kg	0.2 µg/kg	34 mg/kg	34 mg/kg	34 mg/kg	34 mg/kg	34 mg/kg	34 mg/kg	0.2 µg/kg	34 mg/kg	0.2 µg/kg
Units	mg/kg	µg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/kg	mg/kg	µg/kg
Laboratory	MBMG	TAL	MBMG	MBMG	MBMG	MBMG	MBMG	MBMG	Pace	MBMG	Pace
Method	8270	8290	8270	8270	8270	8270	8270	8270	8290	8270	8290
LTUZ01 0-24"	20.7	--	**82.10**	**61.9**	**42**	22.2	18.6	13.9	--	--	--
LTUZ01 24-36"	17.5	--	**69.10**	**52.2**	**41.2**	20.8	10.3	1.3	--	--	--
LTUZ01 Comp	--	**1.9**		--	--	--	--	--	**3.6**	--	**2.5**
LTUZ02 0-24"	28.4	--	**109**	**75.7**	**81.1**	**67.3**	**34.9**	32.6	--	20.3	--
LTUZ02 24-36"	**87.6**	--	**124**	**160**	**162**	**64.4**	**47.6**	**36.2**	--	18.6	--
LTUZ02 Comp	--	**9.1**		--	--		--	--	**2.8**	--	**4.2**
LTUZ03 0-24"	**55.9**	--	**187**	**79.5**	21.5	14.5	**97.9**	**91.7**	--	**39.1**	--
LTUZ03 24-36"	**153**	--	**343**	--	**149**	16.6	**96.1**	**77.7**	--	**39.3**	--
LTUZ03 Comp	--	**2.6**		--	--	--	--	--	**1.8**	--	**2.3**
LTUZ04 0-24"	15.9	--	**156**	**36.2**	**46.9**	14.6	**49.9**	12.2	--	**45.7**	--
LTUZ04 24-36"	13.4	--	**246**	**256**	**37.2**	14.5	**50.9**	13.1	--	**40.9**	--
LTUZ04 Comp	--	**1.6**		--	--	--	--	--	**2.8**	--	**1.9**
LTUZ05 0-24"	18.3	--	**49.1**	**63.3**	**42.6**	**34.0**	**51.8**	**37.2**	--	13.9	--
LTUZ05 24-36"	15.5	--	**64.2**	**147**	**50.1**	**50.7**	**41.9**	**34.2**	--	12.2	--
LTUZ05 Comp	--	**1.2**		--	--	--	--	--	**3.7**	--	**1.0**
LTUZ06 0-24"	21.8	--	**40.6**	**50.5**	**63.9**	28.5	33.4	**41.3**	--	19.3	--
LTUZ06 24-36"	16.7	--	32.1	**93.3**	**79**	31.6	32.8	**46.2**	--	19.1	--
LTUZ06 Comp	--	**1.9**		--	--	--	--	--	**2.5**	--	**2.7**
LTUZ07 0-24"	18.9	--	3.6	--	--	--	20.2	20.1	--	--	--
LTUZ07 24-36"	13.0	--	32.6	--	--	--	20.3	22.4	--	--	--
LTUZ07 Comp	--	**1.1**	--	--	--	--	--	--	**6.0**	--	**3.7**
LTUZ08 0-24"	13.1	--	1.9	--	--	--	27.6	18.6	--	--	--
LTUZ08 24-36"	33.7	--	4.7	--	--	--	28.2	15.7	--	--	--
LTUZ08 Comp	--	**1.3**	--	--	--	--	--	--	**1.9**	--	**3.2**
LTUZ09 0-24"	9.26	--	2.74	--	--	--	16.3	6.2	--	--	--
LTUZ09 24-36"	32.0	--	2.3	--	--	--	22.8	5.8	--	--	--
LTUZ09 Comp	--	**1.1**	--	--	--	--	--	--	**1.0**	--	**2.0**
LTUZ10 0-24"	15.4	--	4.1	--	--	--	32.0	1.4	--	--	--
LTUZ10 24-36"	15.0	--	4.1	--	--	--	**35.8**	6.5	--	--	--
LTUZ10 Comp	--	**0.9**	--	--	--	--	--	--	**1.6**	--	**2.2**
Average	30.7	**2.3**	77.9	97.8	68.0	31.6	38.5	26.7	**2.8**	26.8	**2.6**

Notes:

October 2007 sampling was conducted after the 2007 LTU offload, and after addition of SSP soils for final treatment.

For this table, dioxin (TEQ) was calculated using the MPTP ROD Methodology. Also see Appendix B for TEQs calculated using the DEQ-7 Methodology, where available.

Soil samples were not collected from the LTU in 2014, 2015, or in 2016 as part of site operations.

Soil samples were collected from the LTU in 2017. Refer to the Final Soil and Surface Water Data Gap Investigation for details (Tetra Tech 2017).

--	Not analyzed	Pace	Pace Analytical
µg/kg	Micrograms per kilogram	PCP	Pentachlorophenol
Bold	Concentration greater than cleanup level	ROD	Record of Decision
Comp	Composite	SSP	Soil salvage piles
LTU	Land treatment unit	TAL	Test America Laboratories / Severn Trent Laboratories, Inc.
MBMG	Montana Bureau of Mines and Geology Laboratory	TEF	Toxicity equivalency factor
mg/kg	Milligrams per kilogram	TEQ	Toxicity equivalence quotient
MPTP	Montana Pole and Treating Plant		

TABLE 4.1
HISTORICAL CONCENTRATIONS OF PCP FOR SURFACE WATER SAMPLES

Surface Water Station:	**SW-05**	**SS-06A**	**SW-09**	
Analyte:	PCP	PCP	PCP	
Units:	(µg/L)	(µg/L)	(µg/L)	
Laboratory:	MBMG	MBMG	MBMG	ROD
EPA Method:	8270/528[a]	8270/528[a]	8270/528[a]	Cleanup Level (µg/L)
2001 Range	0.071 - **1.8**	--	--	1.0
2002 Range	0.423 - **2.36**	--	--	1.0
2003 Range	0.058 - 0.15	--	--	1.0
2004 Range	--	--	--	1.0
2005 Range	0.45 - 0.071	--	--	1.0
2006 Range	0.038 - **1.03**	--	0.6	1.0
2007 Range	0.1U - 0.349	--	0.1U - 0.246	1.0
2008 Range	0.1U - 0.349	--	0.1U - 0.246	1.0
2009 Range	0.061 - 0.188	--	0.064 - 0.454	1.0
2010 Range	0.2U - 0.186	0.2U	0.2U	1.0
2011 Range	0.2U - 0.281	0.2U	0.2U	1.0
2012 Range	0.2U - 0.670	0.2U	0.2U	1.0
2013 Range	0.2U	0.2U - 0.214	0.2U	1.0
2014 Range	0.2U	0.2U	0.2U	1.0
2015 Range	0.2U	0.2U	0.2U	1.0
2016 Range	0.1U - 0.2U	0.1U - 0.2U	0.1U - 0.2U	1.0
2017 Range	0.195 - 0.1U	0.1U	0.1U	1.0
2018 Range	0.1U	0.1U - 0.241	0.1U	1.0
2019 Range	0.1U - 0.106	0.1U	0.1U	1.0
February 2, 2019 (semi-annual sampling event)	0.1U	0.1U	0.1U	1.0
August 11, 2019 (annual sampling event)	0.106	0.1U	0.1U	1.0

Notes:

a	U.S. EPA Method 8270 was used prior to 2011; U.S. EPA Method 528 was used beginning in 2011.
--	Not sampled
µg/L	Micrograms per liter
Bold	Concentration exceeds ROD surface water cleanup level (1.0 µg/L)
EPA	U.S. Environmental Protection Agency
MBMG	Montana Bureau of Mines and Geology laboratory
PCP	Pentachlorophenol
ROD	Record of Decision
U	Analyzed for but not detected above the method detection limit

Data prior to October 2010 have not been back-checked against original laboratory data sheets.

TABLE 4.2

HISTORICAL CONCENTRATIONS OF DIOXIN (TEQ) FOR SURFACE WATER SAMPLES
(µg/L)

Sample Date	SS-06A	SW-05	SW-09	ROD Cleanup Level
8/21/2006	--	0	0	1.00E-05
8/26/2007	--	7.70E-07	--	1.00E-05
8/25/2008	--	0	5.10E-08	1.00E-05
8/10/2009	--	0	0	1.00E-05
8/16/2010	--	0	0	1.00E-05
8/15/2011	1.09E-07	8.10E-08	1.70E-08	1.00E-05
8/13/2012	4.10E-08	3.47E-07	3.40E-08	1.00E-05
8/13/2013[a]	1.90E-07	4.56E-07	1.86E-06	1.00E-05
8/11/2014	4.13E-08	5.84E-08	1.90E-08	1.00E-05
8/10/2015	3.94E-08	2.30E-08	5.14E-08	1.00E-05
8/8/2016	2.17E-07	2.15E-07	7.88E-08	1.00E-05
8/7/2017	1.90E-08	1.40E-07	1.20E-08	1.00E-05
8/12/2018	1.70E-08	5.90E-08	4.53E-08	1.00E-05
8/11/2019	1.73E-07	4.20E-07	3.84E-08	1.00E-05

HISTORICAL CONCENTRATIONS OF DIOXIN (TEQ) FOR SURFACE WATER SAMPLES
(pg/L)

Sample Date	SS-06A	SW-05	SW-09	ROD Cleanup Level
8/21/2006	--	0	0	10.00
8/26/2007	--	0.77	--	10.00
8/25/2008	--	0	0.05	10.00
8/10/2009	--	0	0	10.00
8/16/2010	--	0	0	10.00
8/15/2011	0.11	0.08	0.02	10.00
8/13/2012	0.04	0.35	0.03	10.00
8/12/2013[a]	0.19	0.46	1.86	10.00
8/11/2014	0.04	0.06	0.02	10.00
8/10/2015	0.04	0.02	0.05	10.00
8/8/2016	0.22	0.22	0.08	10.00
8/7/2017	0.02	0.14	0.01	10.00
8/12/2018	0.02	0.06	0.05	10.00
8/11/2019	0.17	0.42	0.04	10.00

Notes:
For this table, TEQs are calculated using the MPTP ROD Methodology.
See Appendix B-3 for dioxin (TEQ) values calculated using both the MPTP ROD Methodology and the DEQ-7 Methodology.

[a]	Significant rain event on August 1, 2013 (0.6 inch)
0	All dioxin congeners were below the reporting limit and set to 0 for the calculation of TEQ, resulting in a TEQ value equal to 0.
--	Not sampled
µg/L	Micrograms per liter
pg/L	Picograms per liter
MPTP	Montana Pole and Treating Plant
ROD	Record of Decision
TEQ	Toxicity equivalence quotient

TABLE 4.3
CONCENTRATIONS OF PAH AND CHLOROPHENOLS FOR SURFACE WATER SAMPLES

Surface Water Station:	SS-06A		SW-05		SW-09		ROD
Sample Date:	8/11/2019		8/11/2019		8/11/2019		Cleanup Level
Laboratory:	MBMG		MBMG		MBMG		
Units:	(µg/L)	Q	(µg/L)	Q	(µg/L)	Q	(µg/L)
ANALYTES							
PAH (EPA Method 8270)							
ACENAPHTHENE	0.25	U	0.25	U	0.25	U	-
ACENAPHTHYLENE	0.332		0.33		0.25	U	-
ANTHRACENE	0.25	U	0.25	U	0.25	U	-
BENZO(A)ANTHRACENE	0.1	U	0.1	U	0.1	U	1
BENZO(A)PYRENE	0.1	U	0.1	U	0.1	U	0.2/0.038[a]
BENZO(B)FLUORANTHENE	0.25	U	0.25	U	0.25	U	0.2
BENZO(G,H,I)PERYLENE	0.5	U	0.5	U	0.5	U	1
BENZO(K)FLUORANTHENE	0.1	U	0.1	U	0.1	U	1
CHRYSENE	0.1	U	0.1	U	0.1	U	1
DIBENZO(A,H)ANTHRACENE	0.1	U	0.1	U	0.1	U	0.2
FLUORANTHENE	0.684		0.25	U	0.681		-
FLUORENE	0.25	U	0.25	U	0.25	U	-
INDENO(1,2,3-CD)PYRENE	0.1	U	0.1	U	0.1	U	1
NAPHTHALENE	0.471		0.25	U	0.25	U	-
PHENANTHRENE	0.25	U	0.25	U	0.25	U	-
PYRENE	0.25	U	0.25	U	0.25	U	-
Total D PAH	2.237		1.58		1.931		360
CHLOROPHENOLS (EPA Method 8270)							
2,3,4,6-TETRACHLOROPHENOL	0.5	U	0.5	U	0.5	U	-
2,4,5-TRICHLOROPHENOL	1	U	1	U	1	U	-
2,4,6-TRICHLOROPHENOL	0.5	U	0.5	U	0.5	U	6.5
2,4-DICHLOROPHENOL	0.5	U	0.5	U	0.5	U	27
2-CHLOROPHENOL	0.5	U	0.5	U	0.5	U	45
4-CHLORO-3-METHYLPHENOL	0.5	U	0.5	U	0.777		-
PENTACHLOROPHENOL	0.1	U	0.1	U	0.1	U	1.0

Notes:

[a] The water quality standard for benzo(a)pyrene outlined in Circular DEQ-7 is lower than the cleanup levels specified in the ROD tables; therefore, the lower DEQ-7 standard (in parentheses) currently takes precedence over the ROD cleanup level for this analyte. The DEQ-7 standard for benzo(a)pyrene for surface water is 0.038 µg/L.

- \- No cleanup level specified in ROD
- µg/L Micrograms per liter
- D PAH Sum of the acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene concentrations
- DEQ Montana Department of Environmental Quality
- EPA U.S. Environmental Protection Agency
- MBMG Montana Bureau of Mines and Geology
- PAH Polycyclic aromatic hydrocarbons
- Q Data qualifier
- ROD Record of Decision
- U Analyzed for but not detected above the method detection limit

TABLE 4.4
HISTORICAL CONCENTRATIONS OF PCP FOR SELECTED GROUNDWATER SAMPLES

Monitoring Well:	10-12	BMW-01A	BMW-01B	GW-14R-98	HCA-21	INF-04	MW-11-04	ROD Cleanup Level (µg/L)
Units:	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	
Laboratory:	MBMG	MBMG	MBMG	MBMG	MBMG	MBMG	MBMG	
EPA Method:	8270/528[a]	8270/528[a]	8270/528[a]	8270/528[a]	8270/528[a]	8270/528[a]	8270/528[a]	
2000 Range	NI	--	--	**9.02 - 34.5**	**265**	**787 - 1,500**	NI	1.0
2001 Range	NI	--	--	**2.1 - 38.9**	**253**	**14 - 663**	NI	1.0
2002 Range	NI	--	--	**1.6 - 37.5**	**165 - 201**	**5.4 - 72.3**	NI	1.0
2003 Range	NI	--	--	**1.8 - 28**	**171**	**12 - 151**	NI	1.0
2004 Range	NI	--	--	**1.3 - 4.6**	**84**	**13 - 17**	NI	1.0
2005 Range	NI	--	--	**1.1 - 37.5**	**57**	**28 - 35**	NI	1.0
2006 Range	NI	--	--	**17.5 - 72.7**	**1.11 - 39.2**	**18 - 205**	NI	1.0
2007 Range	NI	--	--	**2.25 - 15.2**	**20.2 - 20.6**	**119 - 199**	NI	1.0
2008 Range	NI	--	--	**1.1 - 4.41**	**13.7 - 26.3**	**102 - 124**	NI	1.0
2009 Range	NI	0.2U	0.2U	0.2U - **2.6**	**3.69 - 28.9**	**44.2 - 79.3**	NI	1.0
2010 Range	0.605 - **1.03**	0.186	0.164	0.806 - **3.45**	0.873 - **7.67**	**80.0 - 81.3**	NI	1.0
2011 Range	0.618 - **1.51**	NS	NS	0.60 - **1.45**	**6.18 - 16.9**	**31.7 - 56.3**	**3,490**	1.0
2012 Range	0.2U - 0.351	0.2U	0.2U	**1.05**	**1.16 - 9.35**	**1.61 - 67.7**	**1,440 - 1,450**	1.0
2013 Range	0.213 - 0.305	0.2U - 0.251	0.2U	0.297	0.49	**21.5 - 43.2**	**1,536 - 7,400**[b]	1.0
2014 Range	0.2U - 0.626	0.2U	0.2U	0.2U	0.34	**10.3 - 105**	**668 - 1197**	1.0
2015 Range	0.2U	0.2U	0.2U	0.2U - 1.32	0.2U - 0.37	**47.7 - 53.4**	**340 - 1,022**	1.0
2016 Range	0.1U - 0.2U	0.1U - 0.2U	0.1U - 0.2U	0.903 - 1.28	0.212 - 0.646	**83 - 109**	**1,220 - 1,606**	1.0
2017 Range	0.158	0.1U - 0.103	0.109 - 0.422	0.576	0.544 - 0.699	**62.8 - 149**	**1,560 - 3,305**	1.0
2018 Range	--	0.1U	0.1U - 0.207	--	0.867 - 1.680	**72 - 159**	**2,680 - 24,700**	1.0
2019 Range	--	0.1U	0.1U	--	0.444 - 0.589	**107 - 164**	**722 - 967**	1.0
February 2, 2019 (semi-annual monitoring event)	--	0.1U	0.1U	--	0.589	**107.0**	**722**	1.0
August 11, 2019 (annual monitoring event)	--	0.1U	0.1U	--	0.444	**164**	**967**	1.0

Notes:

[a] EPA Method 8270 was used prior to 2011; EPA Method 528 was used in 2011 and thereafter
[b] Insufficient water to fully bail well before sample was collected; concentration biased high

--	Not sampled
µg/L	Micrograms per liter
Bold	Concentration exceeds ROD groundwater cleanup level
EPA	U.S. Environmental Protection Agency
MBMG	Montana Bureau of Mines and Geology
NI	Monitoring well was not yet installed
NS	Not sampled
PCP	Pentachlorophenol
ROD	Record of Decision
U	Analyzed for but not detected above the method detection limit

TABLE 4.5
HISTORICAL CONCENTRATIONS OF DIOXIN (TEQ) FOR GROUNDWATER SAMPLES
(µg/L)

Sample Date	12-Oct	BMW-01A	BMW-01B	GW-12	GW-14R-98	HCA-21	INF-04	INF-05	INF-06	MW-11-04	MW-B-98	MW-D-96	MW-E-01	MW-L-96	MW-U-01	MW-V-01	NWW	ROD Cleanup Level
8/13/2001	--	--	--	--	--	--	--	--	3.83E-06	--	--	--	7.70E-08	2.10E-08	--	--	--	3.00E-05
8/12/2002	--	--	--	--	--	--	--	--	2.00E-07	--	--	--	2.10E-07	1.70E-07	--	--	--	3.00E-05
8/4/2003	--	--	--	--	--	--	--	--	4.90E-08	--	--	--	1.10E-07	0	--	--	--	3.00E-05
8/2/2004	--	--	--	--	--	--	--	--	7.00E-07	--	--	--	**4.35E-05**	0	--	--	--	3.00E-05
8/1/2005	--	--	--	--	--	--	--	--	9.20E-08	--	--	--	2.70E-06	5.30E-07	--	--	--	3.00E-05
8/21/2006	--	--	--	7.90E-08	--	--	1.29E-05	0	7.20E-08	--	7.80E-08	9.20E-08	**5.96E-05**	0	--	--	--	3.00E-05
8/27/2007	--	--	--	2.80E-07	--	--	6.90E-07	7.00E-08	0.00E+00	--	0	0	1.00E-07	0	--	--	--	3.00E-05
8/25/2008	--	--	--	0	--	--	1.26E-05	8.00E-08	0.00E+00	--	0	6.50E-07	1.30E-07	0	--	--	--	3.00E-05
8/10/2009	--	--	--	--	0	--	1.40E-07	--	--	--	0	--	--	--	0	--	--	3.00E-05
8/16/2010	--	--	--	--	0	--	**4.50E-05**	--	--	--	0	--	--	--	0	--	--	3.00E-05
8/15/2011	--	--	--	--	1.05E-06	--	4.09E-06	--	--	--	9.30E-09	--	--	--	--	2.82E-08	1.70E-08	3.00E-05
8/13/2012	--	--	--	--	1.18E-07	--	2.75E-05	--	--	--	1.04E-07	--	--	--	--	3.30E-08	7.40E-08	3.00E-05
8/13/2013	4.50E-08	8.81E-08	1.12E-07	--	6.70E-07	8.04E-08	5.59E-06	--	--	9.91E-06	--	--	--	--	--	--	--	3.00E-05
8/11/2014	2.70E-08	2.08E-08	1.83E-08	--	1.42E-07	7.77E-07	**1.38E-04**	--	--	7.15E-06	--	--	--	--	--	--	--	3.00E-05
8/10/2015	1.04E-07	7.50E-09	2.70E-08	--	9.03E-06	4.23E-07	6.31E-07	--	--	6.46E-06	--	--	--	--	--	--	--	3.00E-05
8/8/2016	2.30E-08	4.40E-08	1.94E-08	--	4.13E-07	2.02E-07	7.76E-07	--	--	1.56E-05	--	--	--	--	--	--	--	3.00E-05
8/10/2017	--	1.44E-08	8.50E-08	--	--	3.60E-08	8.41E-05	--	--	3.72E-04	--	--	--	--	--	--	--	3.00E-05
8/13/2018	--	2.20E-08	2.81E-08	--	--	2.10E-09	**5.10E-04**	--	--	**5.62E-05**	--	--	--	--	--	--	--	3.00E-05
8/11/2019	--	3.64E-08	1.27E-07	--	--	1.27E-06	**9.21E-05**	--	--	**8.90E-05**	--	--	--	--	--	--	--	3.00E-05

HISTORICAL CONCENTRATIONS OF DIOXIN (TEQ) FOR GROUNDWATER SAMPLES
(pg/L)

Sample Date	12-Oct	BMW-01A	BMW-01B	GW-12	GW-14R-98	HCA-21	INF-04	INF-05	INF-06	MW-11-04	MW-B-98	MW-D-96	MW-E-01	MW-L-96	MW-U-01	MW-V-01	NWW	ROD Cleanup Level
8/13/2001	--	--	--	--	--	--	--	--	3.83	--	--	--	0.077	0.021	--	--	--	30.0
8/12/2002	--	--	--	--	--	--	--	--	0.20	--	--	--	0.21	0.17	--	--	--	30.0
8/4/2003	--	--	--	--	--	--	--	--	0.049	--	--	--	0.11	0.00	--	--	--	30.0
8/2/2004	--	--	--	--	--	--	--	--	0.70	--	--	--	**43.45**	0.00	--	--	--	30.0
8/1/2005	--	--	--	--	--	--	--	--	0.092	--	--	--	2.695	0.53	--	--	--	30.0
8/21/2006	--	--	--	0.079	--	--	12.92	0	0.072	--	0.078	0.092	**59.63**	0.00	--	--	--	30.0
8/26/2007	--	--	--	0.28	--	--	0.69	0.07	0	--	0	0	0.10	0	--	--	--	30.0
8/25/2008	--	--	--	0	--	--	12.64	0.08	0	--	0	0.650	0.13	0	--	--	--	30.0
8/10/2009	--	--	--	--	0	--	0.14	--	--	--	0	--	--	--	0	--	--	30.0
8/16/2010	--	--	--	--	0	--	**45.0**	--	--	--	0	--	--	--	0	--	--	30.0
8/15/2011	--	--	--	--	1.05	--	4.09	--	--	--	0.009	--	--	--	--	0.028	0.017	30.0
8/13/2012	--	--	--	--	0.12	--	27.50	--	--	--	0.104	--	--	--	--	0.033	0.074	30.0
8/12/2013	0.05	0.09	0.11	--	0.67	0.08	5.59	--	--	9.91	--	--	--	--	--	--	--	30.0
8/11/2014	0.03	0.02	0.02	--	0.14	0.78	**138**	--	--	7.15	--	--	--	--	--	--	--	30.0
8/10/2015	0.10	0.01	0.03	--	9.03	0.42	0.63	--	--	6.46	--	--	--	--	--	--	--	30.0
8/8/2016	0.02	0.04	0.02	--	0.41	0.20	0.78	--	--	15.60	--	--	--	--	--	--	--	30.0
8/10/2017	--	0.01	0.09	--	--	0.04	**84.05**	--	--	**372.40**	--	--	--	--	--	--	--	30.0
8/13/2018	--	0.02	0.03	--	--	0.00	**509.81**	--	--	**56.23**	--	--	--	--	--	--	--	30.0
8/11/2019	--	0.04	0.13	--	--	1.27	**92.10**	--	--	**89.00**	--	--	--	--	--	--	--	30.0

Notes:
For this table, TEQs are calculated using the MPTP ROD Methodology.
See Appendix B-3 for dioxin (TEQ) values calculated using both the MPTP ROD Methodology and the DEQ-7 Methodology.

0	Dioxin congeners were below the reporting limit and set to 0 for the calculation of TEQ, resulting in a TEQ equal to 0.
--	Monitoring well did not exist or was not sampled on this date
µg/L	Micrograms per liter
Bold	Concentration exceeds the ROD groundwater cleanup level
pg/L	Picograms per liter
MPTP	Montana Pole and Treating Plant
ND	Not detected
NS	Not sampled
ROD	Record of Decision
TEQ	Toxicity equivalence quotient

TABLE 4.6
CONCENTRATIONS OF PAH AND CHLOROPHENOLS FOR GROUNDWATER SAMPLES

Monitoring Well:	10-12		BMW-01A		BMW-01B		GW-14R-98		HCA-21		INF-04		MW-11-04		
Sample Date:	**NS**		**8/11/2019**		**8/11/2019**		**NS**		**8/11/2019**		**8/11/2019**		**8/11/2019**		**ROD**
Laboratory:	**MBMG**		**MBMG**		**MBMG**		**MBMG**		**MBMG**		**MBMG**		**MBMG**		**Cleanup Level**
Units:	**(µg/L)**	**Q**	**(µg/L)**	**Q**	**(µg/L)**	**Q**	**(µg/L)**	**Q**	**(µg/L)**	**Q**	**(µg/L)**	**Q**	**(µg/L)**	**Q**	**(µg/L)**
ANALYTE															
PAH (EPA Method 8270)															
ACENAPHTHENE	NS		0.25	U	0.25	U	NS		0.25	U	0.872		0.25	U	-
ACENAPHTHYLENE	NS		0.32		0.25	U	NS		0.328		0.34		0.634		-
ANTHRACENE	NS		0.25	U	0.25	U	NS		0.25	U	0.25	U	0.25	U	-
BENZO(A)ANTHRACENE	NS		0.1	U	0.1	U	NS		0.1	U	0.25	U	0.1	U	1
BENZO(A)PYRENE	NS		0.1	U	0.1	U	NS		0.1	U	0.25	U	0.1	U	0.2/0.05[a]
BENZO(B)FLUORANTHENE	NS		0.25	U	0.25	U	NS		0.25	U	0.25	U	0.25	U	0.2
BENZO(G,H,I)PERYLENE	NS		0.5	U	0.5	U	NS		0.5	U	0.25	U	0.5	U	1
BENZO(K)FLUORANTHENE	NS		0.1	U	0.1	U	NS		0.1	U	0.25	U	0.1	U	1
CHRYSENE	NS		0.1	U	0.1	U	NS		0.1	U	0.1	U	0.1	U	1
DIBENZO(A,H)ANTHRACENE	NS		0.1	U	0.1	U	NS		0.1	U	0.1	U	0.1	U	0.2
FLUORANTHENE	NS		0.66		0.656		NS		0.25	U	0.25	U	0.25	U	-
FLUORENE	NS		0.25	U	0.25	U	NS		0.25	U	0.1	U	0.25	U	-
INDENO(1,2,3-CD)PYRENE	NS		0.1	U	0.1	U	NS		0.1	U	0.1	U	0.1	U	1
NAPHTHALENE	NS		0.25	U	0.451		NS		0.25	U	0.1	U	0.892		-
PHENANTHRENE	NS		0.25	U	0.25	U	NS		0.25	U	0.1	U	0.25	U	-
PYRENE	NS		0.25	U	0.25	U	NS		0.25	U	0.5	U	0.25	U	-
Total D PAH	NS		1.98		2.11		NS		1.58		1.91		2.53		360
CHLOROPHENOLS (EPA Method 8270)															
2,3,4,6-TETRACHLOROPHENOL	NS		0.5	U	0.5	U	NS		0.5	U	18.2	U	70.1	D	-
2,4,5-TRICHLOROPHENOL	NS		1	U	1	U	NS		1	U	3.73		4.12		-
2,4,6-TRICHLOROPHENOL	NS		0.5	U	0.5	U	NS		0.5	U	2.12		3.95		6.5
2,4-DICHLOROPHENOL	NS		0.5	U	0.5	U	NS		0.5	U	0.5	U	0.5	U	27
2-CHLOROPHENOL	NS		0.5	U	0.5	U	NS		0.5	U	0.5	U	0.5	U	45
4-CHLORO-3-METHYLPHENOL	NS		0.5	U	0.5	U	NS		0.5	U	0.5	U	4.7		-
PENTACHLOROPHENOL	NS		0.1	U	0.207		NS		0.444		**164**	D	**967**	D	1.0

Notes:

[a] The water quality standard for benzo(a)pyrene outlined in Circular DEQ-7 is lower than the cleanup levels specified in the ROD tables; therefore, the lower DEQ-7 standard (in parentheses) currently takes precedence over the ROD cleanup level for this COC. The DEQ-7 standard for benzo(a)pyrene is 0.05 µg/L.

- No cleanup level specified in ROD
µg/L Micrograms per liter
Bold Concentration exceeds ROD groundwater cleanup level
COC Contaminant of concern
D PAH Sum of the acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene concentrations
DEQ Montana Department of Environmental Quality
EPA U.S. Environmental Protection Agency
MBMG Montana Bureau of Mines and Geology
NS Not sampled
PAH Polycyclic aromatic hydrocarbons
Q Laboratory data qualifier
ROD Record of Decision
U Analyzed for but not detected above the method detection limit

TABLE 4.7
DATA EVALUATION AND PROGRESS OF REMEDIATION

Criterion Number	Criterion	Data Used	Type of Analysis	Results from Analysis	Documentation of Results (refer to)	Comments	Compliance with ROD?
1	The WTP effluent (station EFF) must meet the 1 µg/L discharge to surface water cleanup level for PCP (and specified cleanup levels for other contaminants listed in the ROD, where established).	Data from WTP station EFF (treated groundwater) were evaluated to determine if this criterion was met.	Comparisons of the concentrations of contaminants at WTP station EFF to the ROD discharge to surface water cleanup levels.	92 percent of results from weekly PCP analyses (49 of 53 samples) were below the PCP 1.0 µg/L ROD discharge to surface water cleanup level. The concentrations of dioxins, PAH, and chlorophenols were below the ROD discharge to surface water cleanup levels, where established.	Table 2.4 (PCP) Table 2.5 (dioxins) Table 2.6 (PAH and chlorophenols) Appendix A	-	Criterion 1 was mostly satisfied. Four samples (collected on July 2, 16, and 23, and December 3, 2018) exceeded the ROD surface water screening level for PCP.
2	Surface water in Silver Bow Creek must meet the 1 µg/L surface water cleanup level for PCP (and specified cleanup levels for other contaminants listed in the ROD).	Data from surface water stations SW-05 (downstream from the site), SS-06A (adjacent to the site), and SW-09 (upstream of the site) located on Silver Bow Creek were evaluated.	Comparisons of the concentrations of contaminants at surface water stations SW-05, SS-06A, and SW-09 to the ROD surface water cleanup levels, where established.	The concentrations of PCP, dioxins, PAH, and chlorophenols were below the respective ROD surface water cleanup levels (where established).	Table 4.1 (PCP) Table 4.2 (dioxins) Table 4.3 (PAH and chlorophenols) Appendix A	-	Yes
3	The PCP plume must remain on site. This criterion is assumed to be met if the concentration of PCP in groundwater in downgradient sentinel monitoring wells continue to meet the groundwater cleanup level for PCP.	Data from downgradient sentinel monitoring wells (stations BMW 01A and BMW-01B) were evaluated to determine if the ROD groundwater cleanup level for PCP (1 µg/L) continued to be met at these locations.	Comparison of the concentrations of PCP in downgradient sentinel monitoring wells (BMW-01A and BMW-01B) to the 1 µg/L ROD groundwater cleanup level.	The concentrations of PCP were below the 1 µg/L ROD groundwater cleanup level at downgradient sentinel monitoring wells BMW-01A, and BMW-01B.	Table 4.4 (PCP) Appendix A	-	Yes
4	The concentrations of dioxins, PAH, and chlorophenols in groundwater at representative monitoring wells along the south bank of Silver Bow Creek must meet the specified ROD groundwater cleanup levels, where established.	Data from monitoring ell BMW-01A, BMW-01B, and HCA-21 are evaluated to determine if this criterion was met.	Comparisons of the concentrations of dioxins, PAH, and chlorophenols at groundwater monitoring wells s BMW-01A, BMW-01B, and HCA-21 to the ROD groundwater cleanup levels.	The concentrations of dioxins, PAH, and chlorophenols were below the respective cleanup levels in the wells that were sampled.	Table 4.5 (dioxins) Table 4.6 (PAH and chlorophenols) Appendix A	-	Yes
5	The long-term trend in the concentrations of PCP in groundwater over time should be decreasing, suggesting that groundwater quality will eventually meet the 1 µg/L groundwater cleanup level for PCP.	Data from groundwater monitoring wells with a long-term period of record (2004 to 2018) located along the south bank of Silver Bow Creek, and within the PCP plume footprint were evaluated to determine if this criterion was met.	Mann-Kendall statistical test for trends (90 percent confidence interval)	The trend in the concentration of PCP over time in monitoring well HCA-21 is decreasing at greater than the 90 percent confidence level. The concentrations of PCP in monitoring wells HCA-21 (0.699 µg/L)) during the August 2017 sampling event suggests that groundwater quality will eventually meet the ROD 1 µg/L groundwater cleanup level for PCP.	Appendix A Appendix F	-	Yes
6	The long-term trend in the area of the PCP plume must be stable or shrinking, showing that ongoing remedial action is effectively preventing the spread of contamination.	The long-term trend (since 1993) in the digitized area of the PCP plume was evaluated using all available monitoring well data to construct the 1 µg/L PCP isocontour for each year that data were available.	Direct comparison of PCP plume area after the ROD was signed (1993) to the current area of the PCP plume (August 1, 2017).	Over the past 24 years, the total area of the PCP plume on the south side of Silver Bow Creek (based on the 1 µg/L isocontour line) has decreased from 41.7 acres in 1993 to 16.7 acres on August 1, 2017. This decrease represents a 60 percent reduction in the area of the PCP plume.	Figure 4.8 Appendix F Appendix G	-	Yes
7	The short-term trend (previous 5 years) in the area of the PCP plume must be stable or shrinking, showing that ongoing remedial action is effectively preventing the spread of contamination.	The short-term trend (previous 5 years) in the digitized area of the PCP plume using the 1 µg/L isocontour was evaluated to determine if this criterion was met.	Mann-Kendall statistical test for trends (90 percent confidence interval)	Over the past 5 years, no particular trend is exhibited. However, the vast majority (64 percent) of detections of PCP have been below the 1.0 µg/L groundwater cleanup level; the highest recorded concentration being 1.32 µg/L in monitoring well GW-14R-98 on August 10, 2015. This analysis supports a conclusion that the downgradient edge of the plume may be stable.	Appendix F Appendix G	-	Yes

Notes:

- \- No comment
- µg/L Micrograms per liter
- BSB Butte-Silver Bow
- Dioxins Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans
- EFF WTP effluent station EFF
- GAC Granulated activated carbon
- MK Tests Mann-Kendall statistical tests for trends
- MPTP Montana Pole and Treating Plant
- PAH Polycyclic aromatic hydrocarbons
- PCP Pentachlorophenol
- ROD Record of Decision
- U Analyzed for but not detected above the method detection limit
- WTP MPTP water treatment plant
- WWTP Wastewater treatment plant

TABLE 4.8
HISTORICAL VOLUME OF LNAPL RECOVERED

Year	LNAPL Recovered (gallons)
2000	967
2001	1,367
2002	2,104
2003	570
2004	523
2005	511
2006	461
2007	3
2008	46
2009	6
2010	0
2011	0
2012	0
2013	0
2014	0[a,e]
2015	0[b,e]
2016	0[c,e]
2017	0[d,e]
2018	0[e]
2019	0[e]
Total	6,558

Notes:

[a] An oil sheen was noted in the NHRT from October 20, 2014, to October 23, 2014; adsorbent pads were emplaced.

[b] An oil sheen was noted in the NHRT on May 22, 2015, November 24, 2015, and December 22, 2015; adsorbent pads were emplaced.

[c] An oil sheen was noted in the NHRT July through December; adsorbent pads were emplaced.

[d] Less than 0.02 feet of product was detected in the NHRT during January and February, 2017. A sheen was noted in March, 2017. No product was detected the remainder of the year.

[e] Some residual oils are still present near the NHRT, primarily below the interstate highway and WTP

BSB Butte-Silver Bow
LNAPL Light non-aqueous phase liquid
MPTP Montana Pole and Treating Plant
NHRT Near-highway recovery trench
WTP MPTP water treatment plant

TABLE 5.1

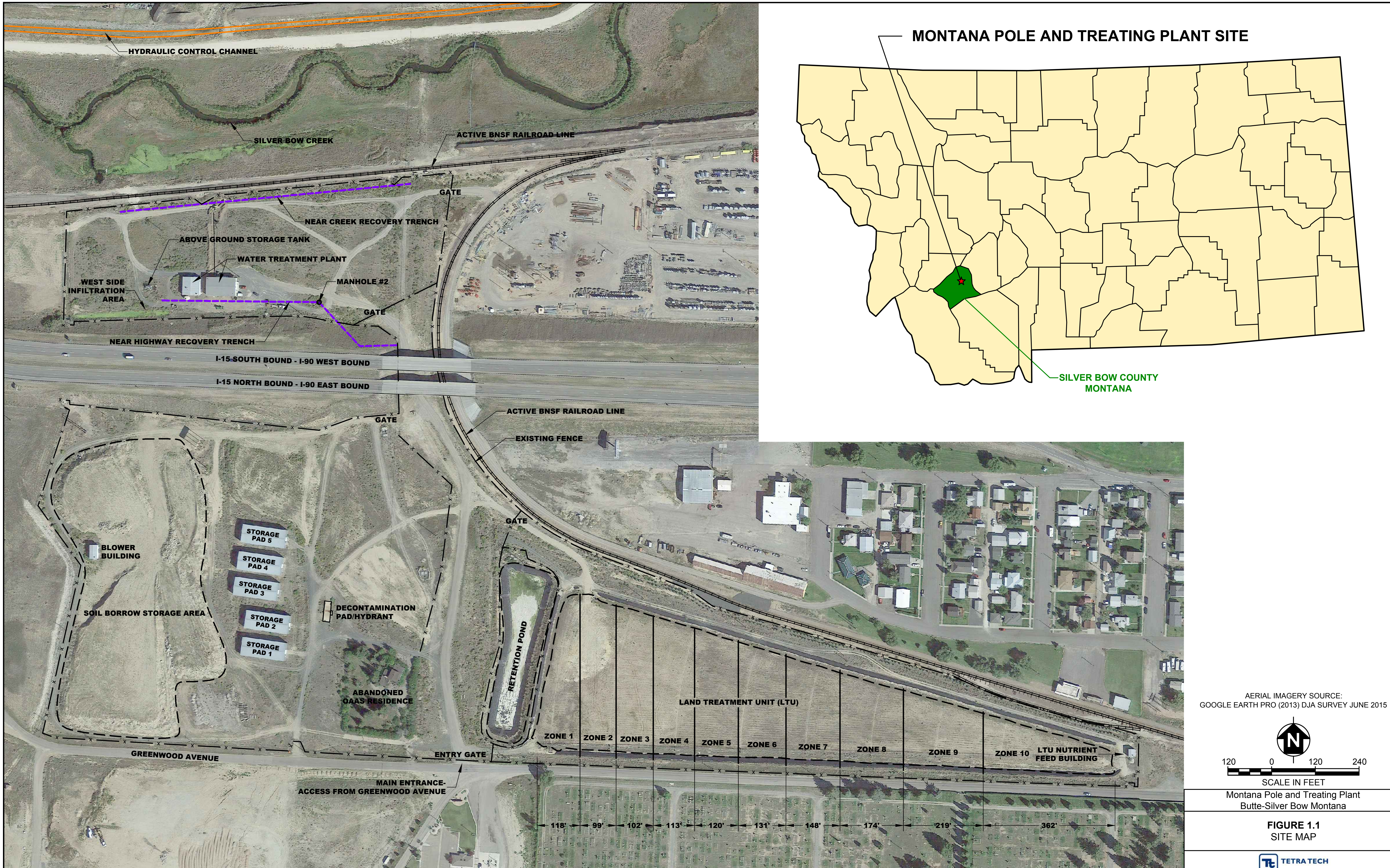
HISTORICAL CONCENTRATIONS OF PCP FOR RESIDENTIAL WELL SAMPLES

		Domestic Well Name:	Wayrynen	Town Pump #1	Bowler	Hendrickson	Dixon (Rongstad)	ROD Cleanup Level
		Location:	Upgradient Business Well - South of Contaminant Plume	Upgradient Business Well - East of Land Treatment Unit	Domestic Irrigation Well - North of Contaminant Plume	Domestic Potable Water well -South East of Contaminant Plume	Domestic Irrigation Well - North of Land Treatment Unit	
		Analyte:	PCP	PCP	PCP	PCP	PCP	
		Units:	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
Year	**Laboratory**	**EPA Method**						
2001	Energy	8151A	0.13	0.14	0.12	0.11	0.1	1.0
2002	Energy	E515.1	0.2U	0.2U	0.2U	0.2U	0.2U	1.0
2002	Energy	E515.1	0.1U	0.1U	0.1U	0.1U	0.1U	1.0
2003	Energy	E515.1	0.040U	0.040U	0.040U	0.040U	0.071	1.0
2004	Energy	E515.1	0.040U	0.040U	0.040U	0.040U	0.040U	1.0
2005	Energy	E515.1	0.040U	0.040U	0.040U	0.040U	0.040U	1.0
2006	MBMG	8041A	0.1U	0.1U	0.1U	0.1U	0.1U	1.0
2007	MBMG	8041A	0.101	0.057	0.467	0.056	0.096	1.0
2008	MBMG	8041A	0.131	0.073	0.083	0.102	0.115	1.0
2009	--	--	--	--	0.2	--	--	1.0
2010	--	--	--	--	--	--	--	1.0
2011	--	--	--	--	--	--	--	1.0
2012	--	--	--	--	--	--	--	1.0
2013	--	--	--	--	--	--	--	1.0
2014	--	--	--	--	--	--	--	1.0
2015	--	--	--	--	--	--	--	1.0
2016	--	--	--	--	--	--	--	1.0
2017	--	--	--	--	--	--	--	1.0
2018	--	--	--	--	--	--	--	1.0
2019	--	--	--	--	--	--	--	1.0

Notes:

--	Not sampled
µg/L	Micrograms per liter
Energy	Energy Laboratories Inc.
EPA	U.S. Environmental Protection Agency
MBMG	Montana Bureau of Mines and Geology
PCP	Pentachlorophenol
ROD	Record of Decision
U	Analyzed for but not detected above the method detection limit

FIGURES

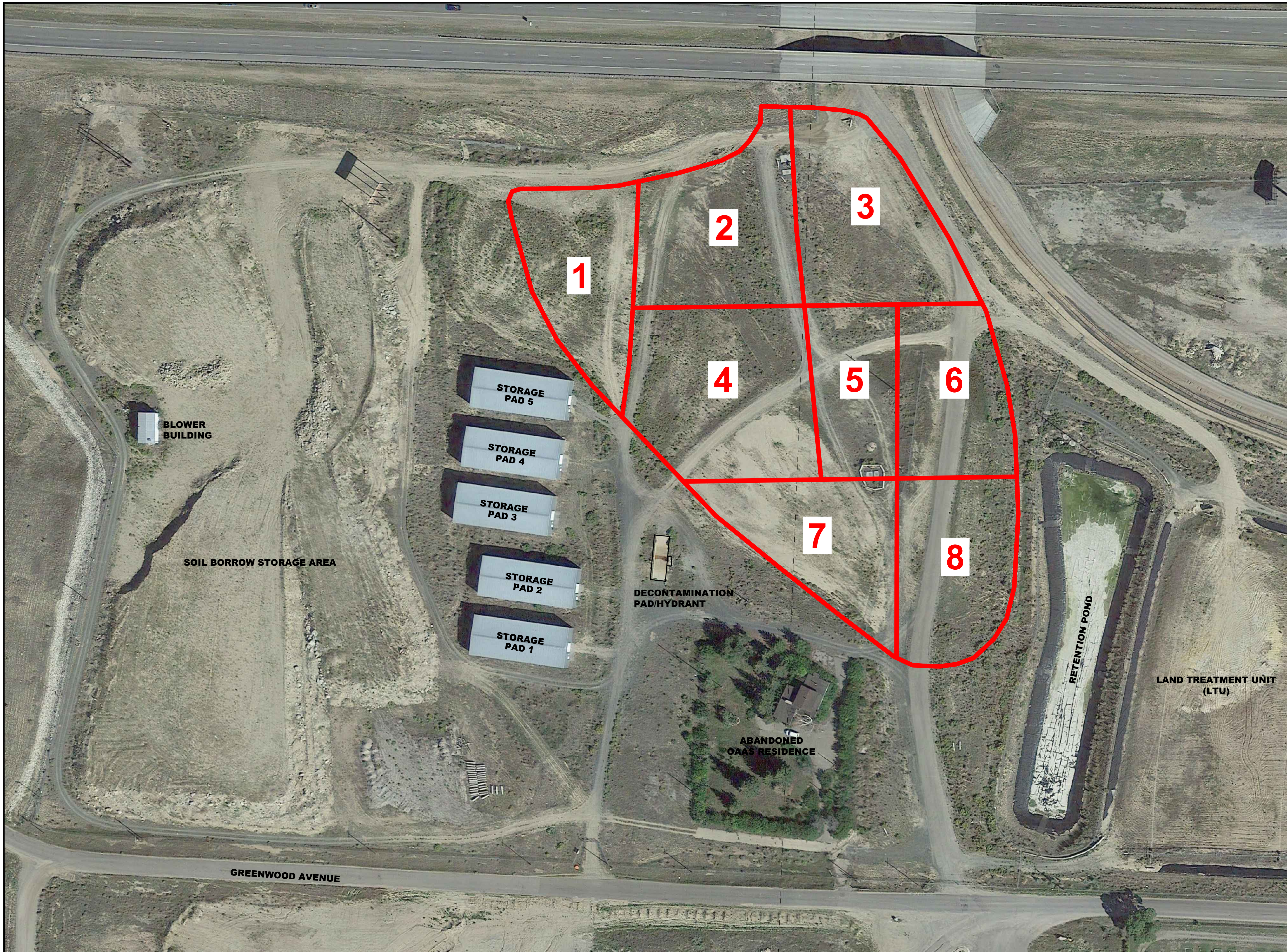


Montana Pole and Treating Plant
Butte-Silver Bow Montana

FIGURE 1.1
SITE MAP

TETRA TECH

Figure 1.1_Site Map.dwg - DWH - 08/27/2018



LEGEND

APPROXIMATE LOCATION OF INFILTRATION CELLS

AERIAL IMAGERY SOURCE:
GOOGLE EARTH PRO (2013) DJA SURVEY JUNE 2015

N

120 0 60 120

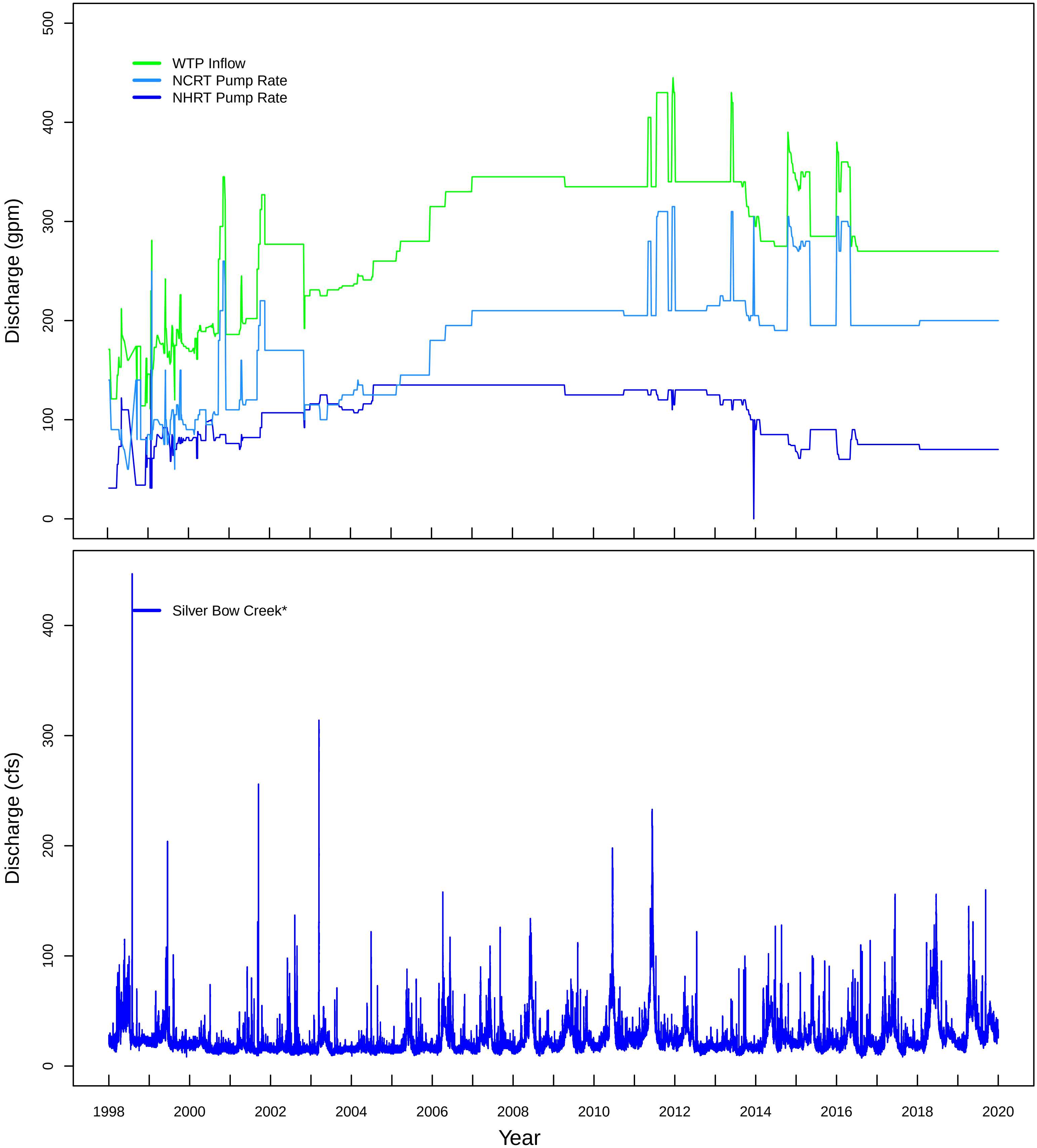
SCALE IN FEET

Montana Pole and Treating Plant
Butte-Silver Bow Montana

FIGURE 2.1
SOUTH INFILTRATION CELLS

TETRA TECH

Figure 2.1_South Infiltration Cells.dwg - DWH - 08/27/2018



cfs cubic feet per second
gpm gallons per minute
NCRT Near Creek Recovery Trench
NHRT Near Highway Recovery Trench
USGS United States Geological Survey
WTP Water Treatment Plant

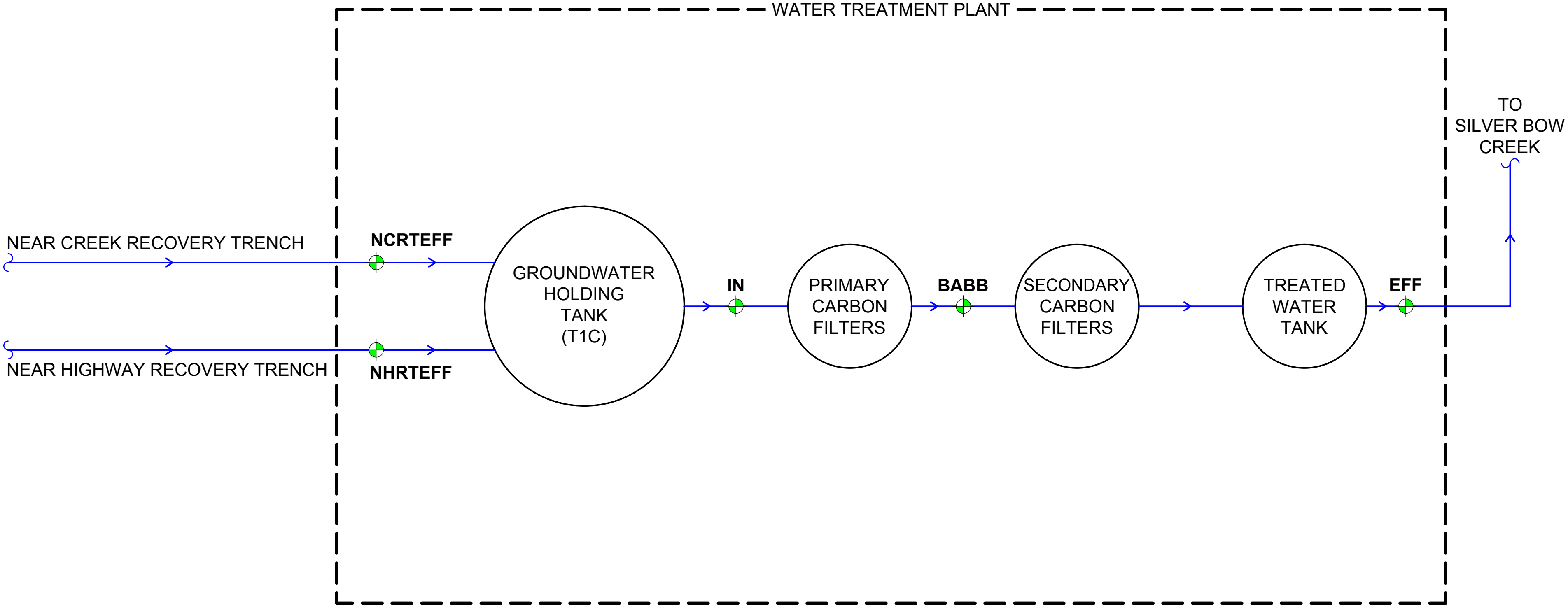
*Silver Bow Creek Discharge measured at
USGS Gage 12323250 Silver Bow Cr bl Blacktail Cr at Butte MT

Montana Pole and Treating Plant
Butte−Silver Bow Montana

FIGURE 1.2
SILVER BOW CREEK AND
WATER TREATMENT PLANT DISCHARGE

TETRA TECH

CJK 20190301



LEGEND

(symbol)	MPTP WATER TREATMENT PLANT SAMPLE STATION
(line)	PIPING
MPTP	MONTANA POLE AND TREATING PLANT

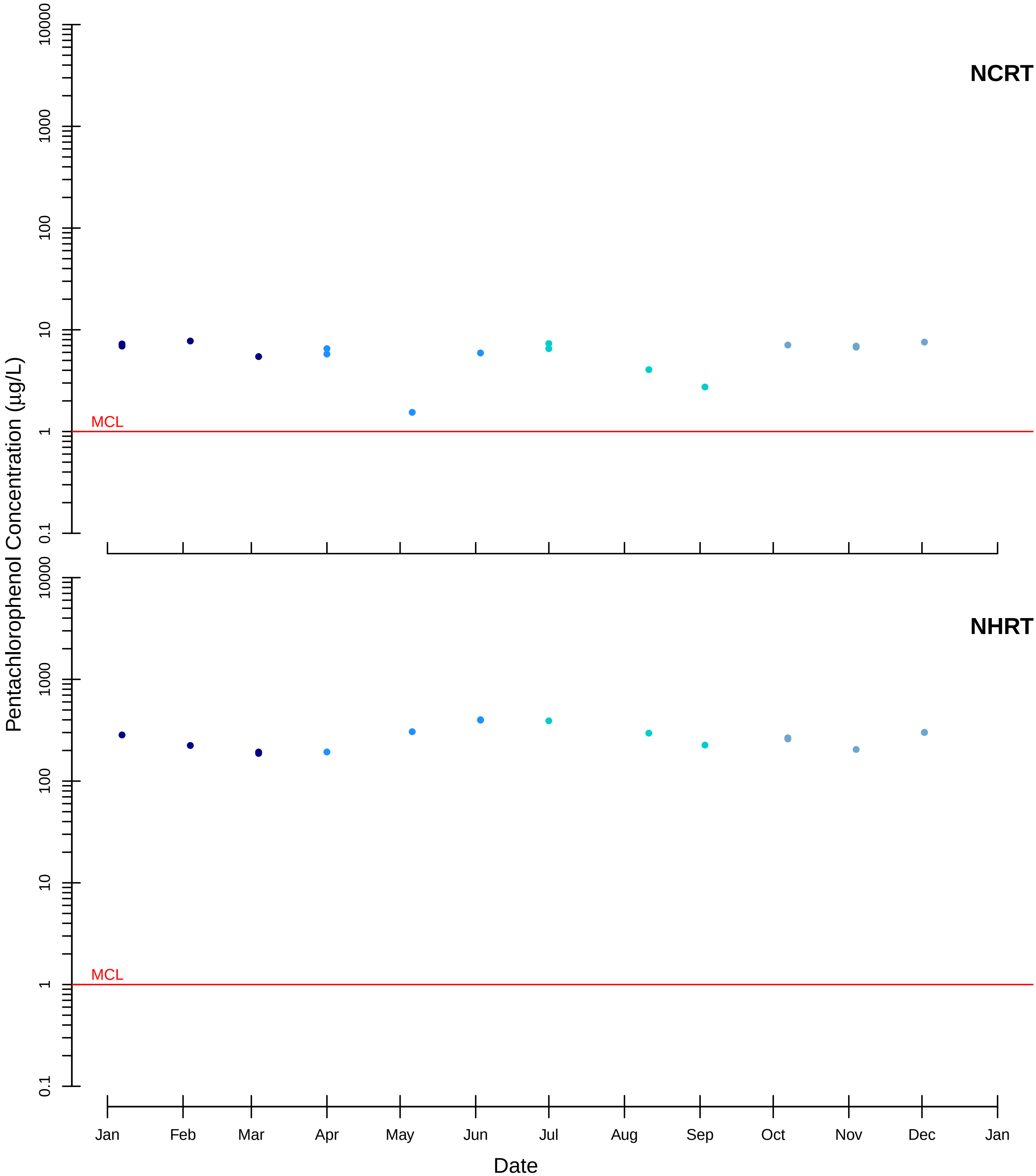
NO SCALE

Montana Pole and Treating Plant
Butte-Silver Bow Montana

FIGURE 2.3
LOCATION OF
MPTP WATER TREATMENT PLANT
SAMPLE STATIONS

TETRA TECH

Figure 2.3_Plant Sample Stations.dwg - DWH - 02/07/2020



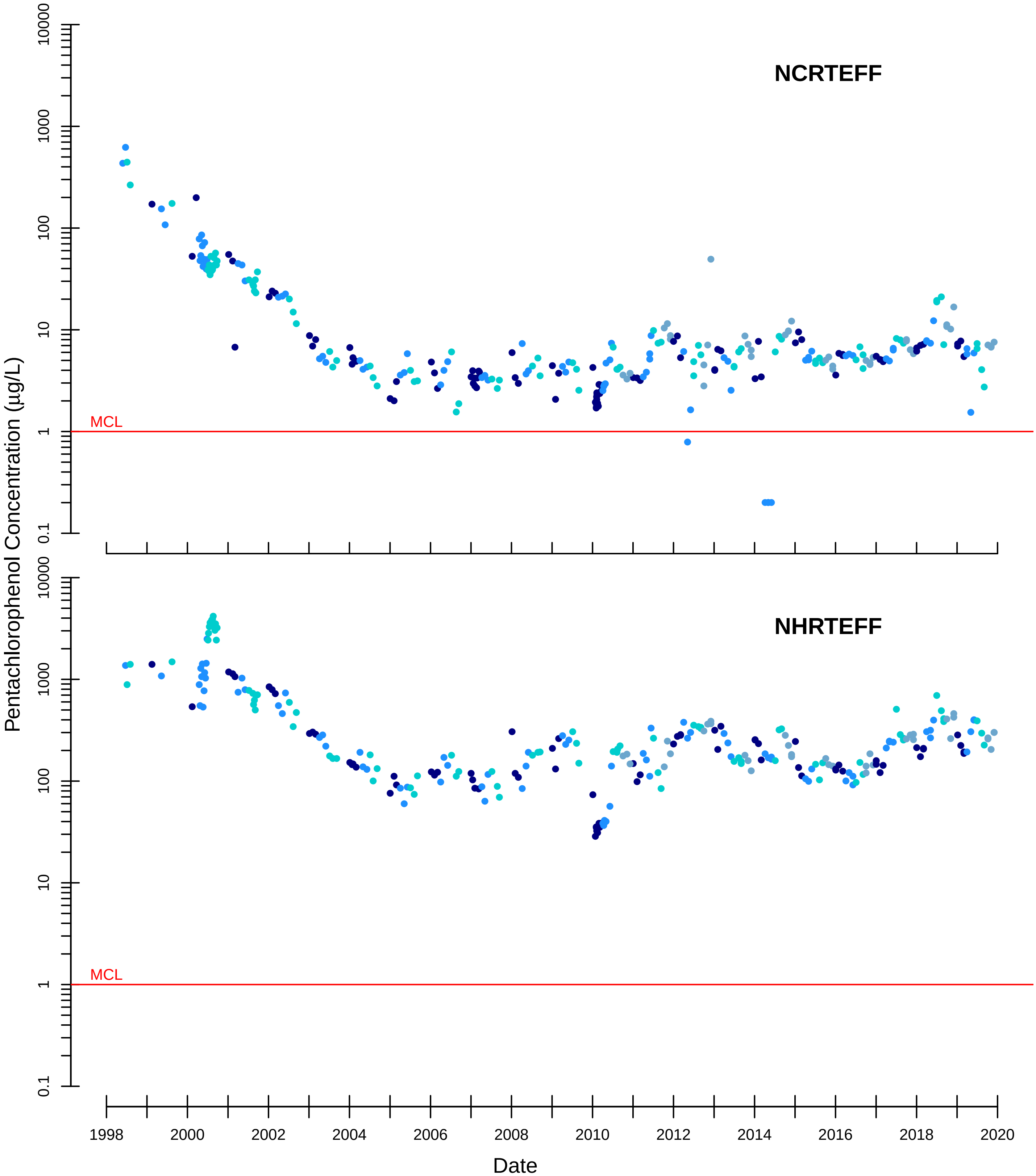
µg/L	Micrograms per liter
MPTP	Montana Pole and Treating Plant
MCL	ROD Maximum Contaminant Level for Groundwater
NCRTEFF	Near Creek Recovery Trench Effluent
NHRTEFF	Near Highway Recovery Trench Effluent
ROD	Montana Pole and Treating Plant Record of Decision

- 1st Quarter
- 2nd Quarter
- 3rd Quarter
- 4th Quarter

Montana Pole and Treating Plant
Butte−Silver Bow Montana

FIGURE 2.4a
NCRT AND NHRT EFFLUENT
2019

TETRA TECH



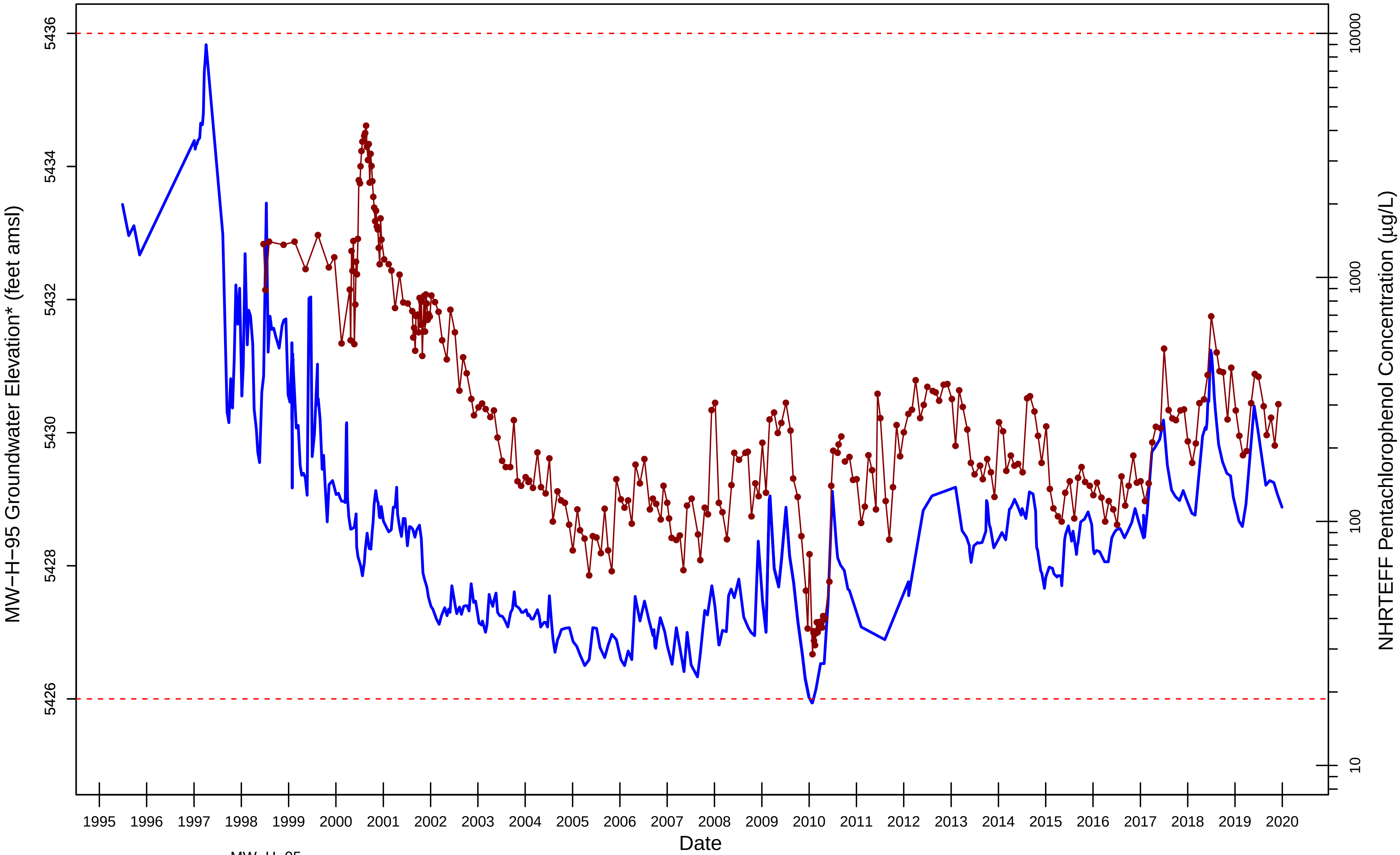
µg/L	Micrograms per liter
MPTP	Montana Pole and Treating Plant
MCL	ROD Maximum Contaminant Level for Groundwater
NCRTEFF	Near Creek Recovery Trench Effluent
NHRTEFF	Near Highway Recovery Trench Effluent
ROD	Montana Pole and Treating Plant Record of Decision

- 1st Quarter
- 2nd Quarter
- 3rd Quarter
- 4th Quarter

Montana Pole and Treating Plant
Butte−Silver Bow Montana

FIGURE 2.4b
NCRT AND NHRT EFFLUENT
SAMPLE RESULTS 1998 − CURRENT

TETRA TECH

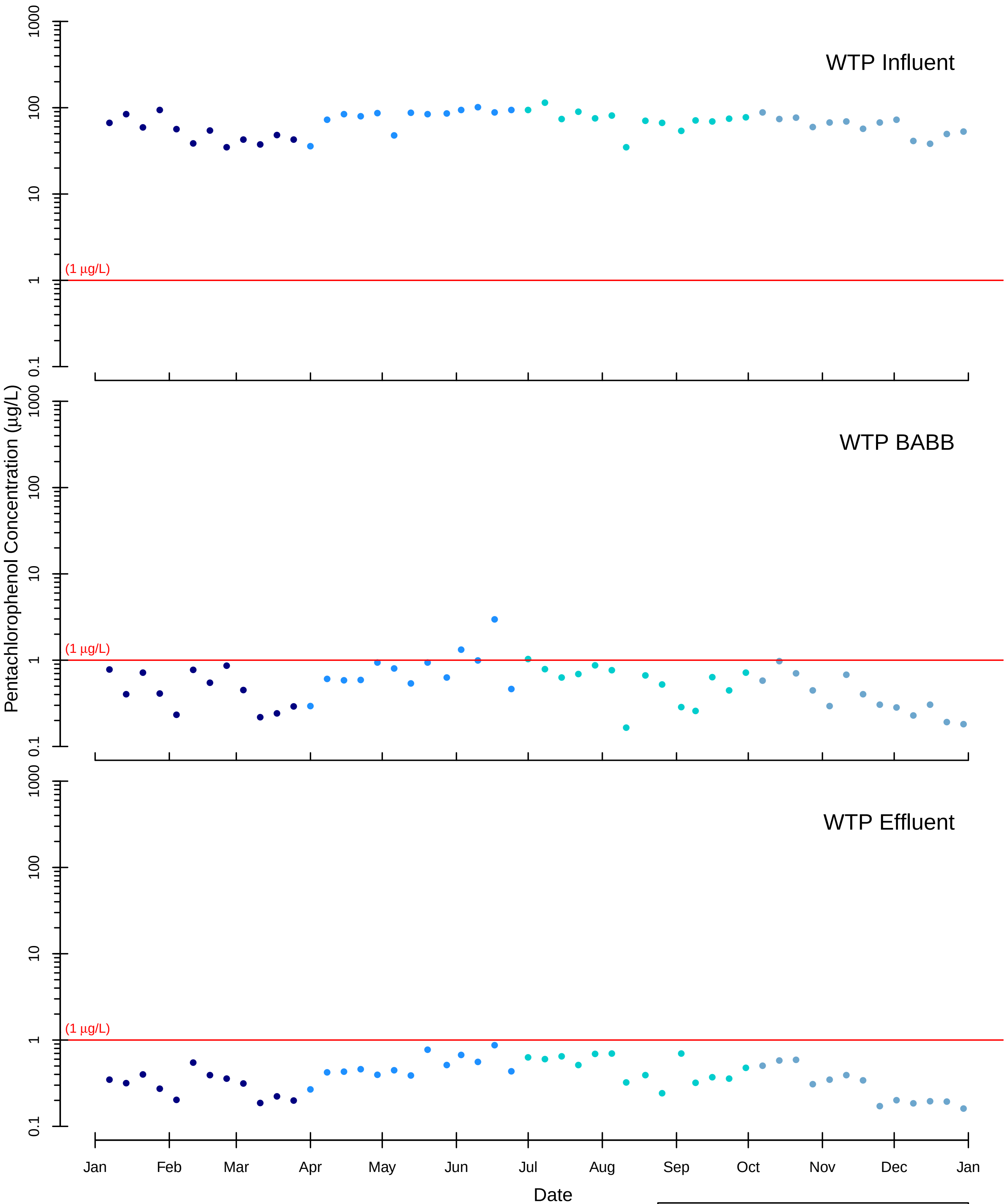


MW−H−95
NHRTEFF
Estimated extent of Smear Zone (5426 to 5436 feet amsl)

µg/L micrograms per liter
amsl above mean sea level
NHRTEFF Near Highway Recovery Trench Effluent
PCP Pentachlorophenol

*Groundwater Elevations prior to 2009 from Montana Bureau Mine and Geology

Montana Pole and Treating Plant Butte−Silver Bow Montana
FIGURE 4.7 GROUNDWATER ELEVATION VS PCP CONCENTRATION 1995−CURRENT
TETRA TECH

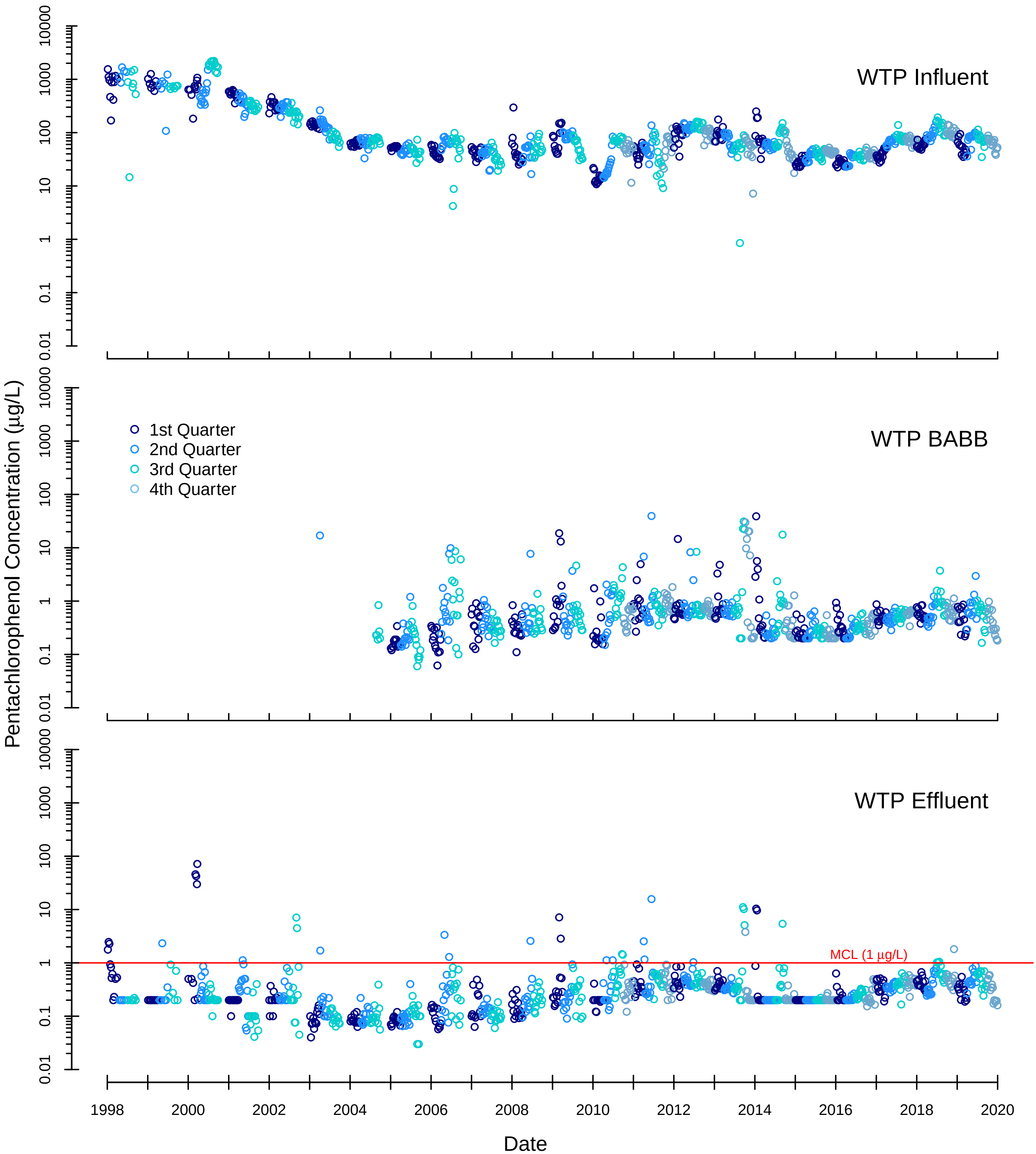


µg/L	Micrograms per liter
MCL	Maximum Contaminant Level for Discharge to Surface Water (1 µg/L)
PCP	Pentachlorophenol
WTP	Water Treatment Plant

Montana Pole and Treating Plant
Butte−Silver Bow Montana

FIGURE 2.6a
WTP EFFLUENT PCP SAMPLE RESULTS
2019

TETRA TECH



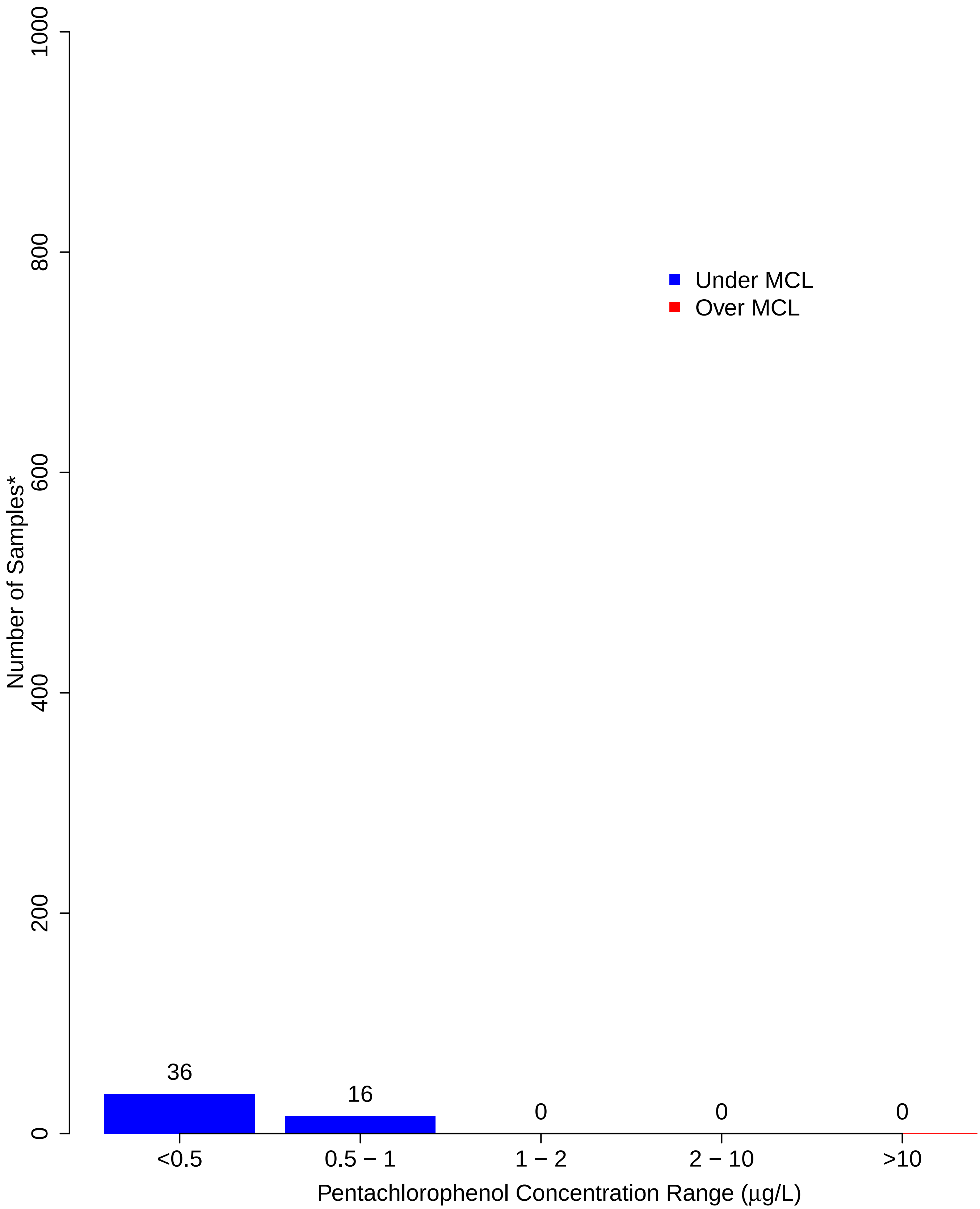
µg/L Micrograms per liter
MCL Maximum Contaminant Level for Discharge to Surface Water
PCP Pentachlorophenol
WTP Water Treatment Plant

*Analytical results from samples collected before 2010 are not in the current database, and may not have undergone the same Quality Controls as samples collected post−2010.

Montana Pole and Treating Plant
Butte−Silver Bow Montana

FIGURE 2.6b
WTP PCP SAMPLE RESULTS
1998 − CURRENT

TETRA TECH



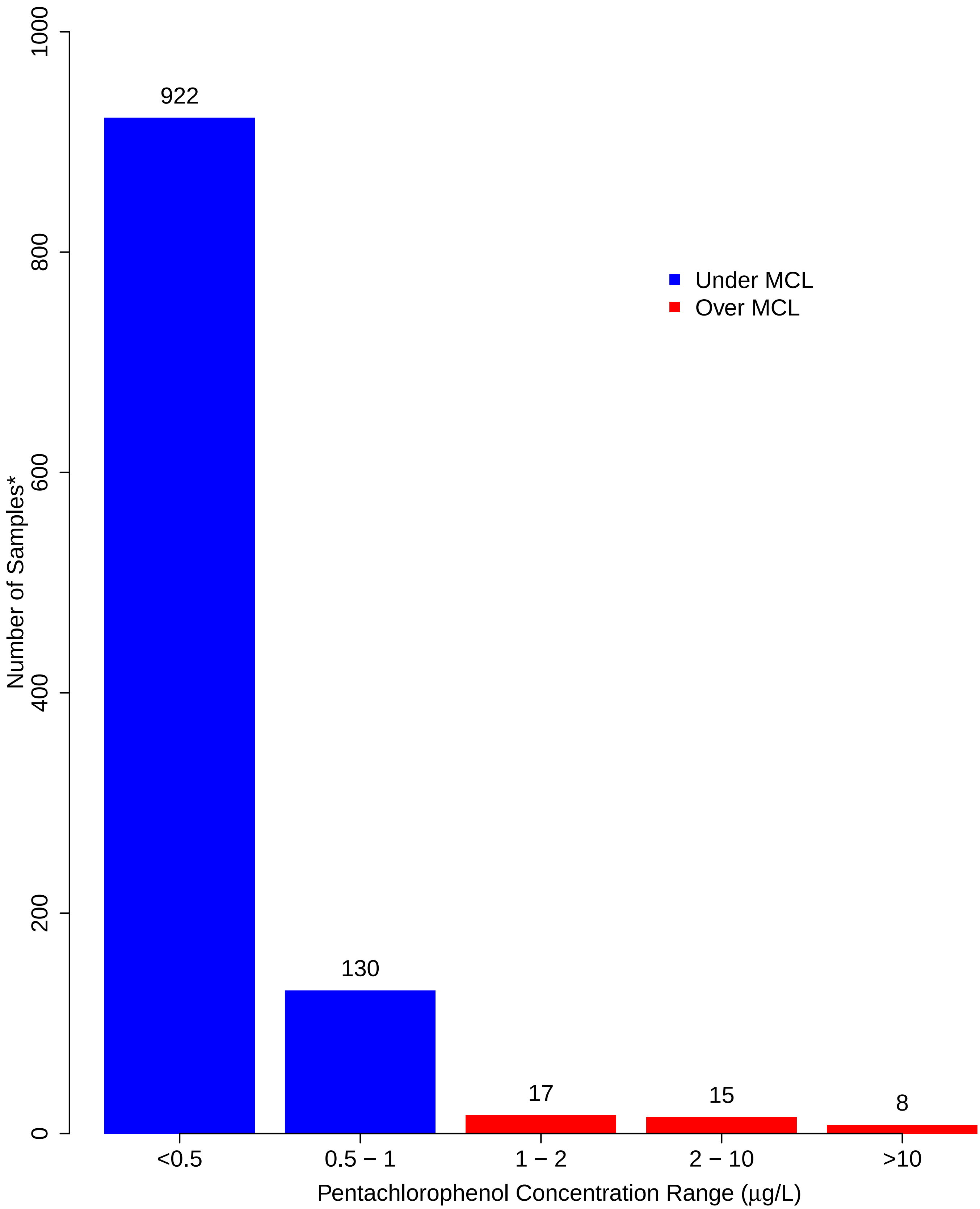
µg/L	Micrograms per liter
PCP	Pentachlorophenol
MCL	Maximum Contaminant Level for Discharge to Surface Water (1 µg/L)
WTP	Water Treatment Plant

*Duplicate Samples Omitted From Analysis

Montana Pole and Treating Plant
Butte−Silver Bow Montana

FIGURE 2.7a
WTP EFFLUENT PCP HISTOGRAM
2019

TETRA TECH



µg/L Micrograms per liter

PCP Pentachlorophenol

MCL Maximum Contaminant Level for Discharge to Surface Water (1 µg/L)

WTP Water Treatment Plant

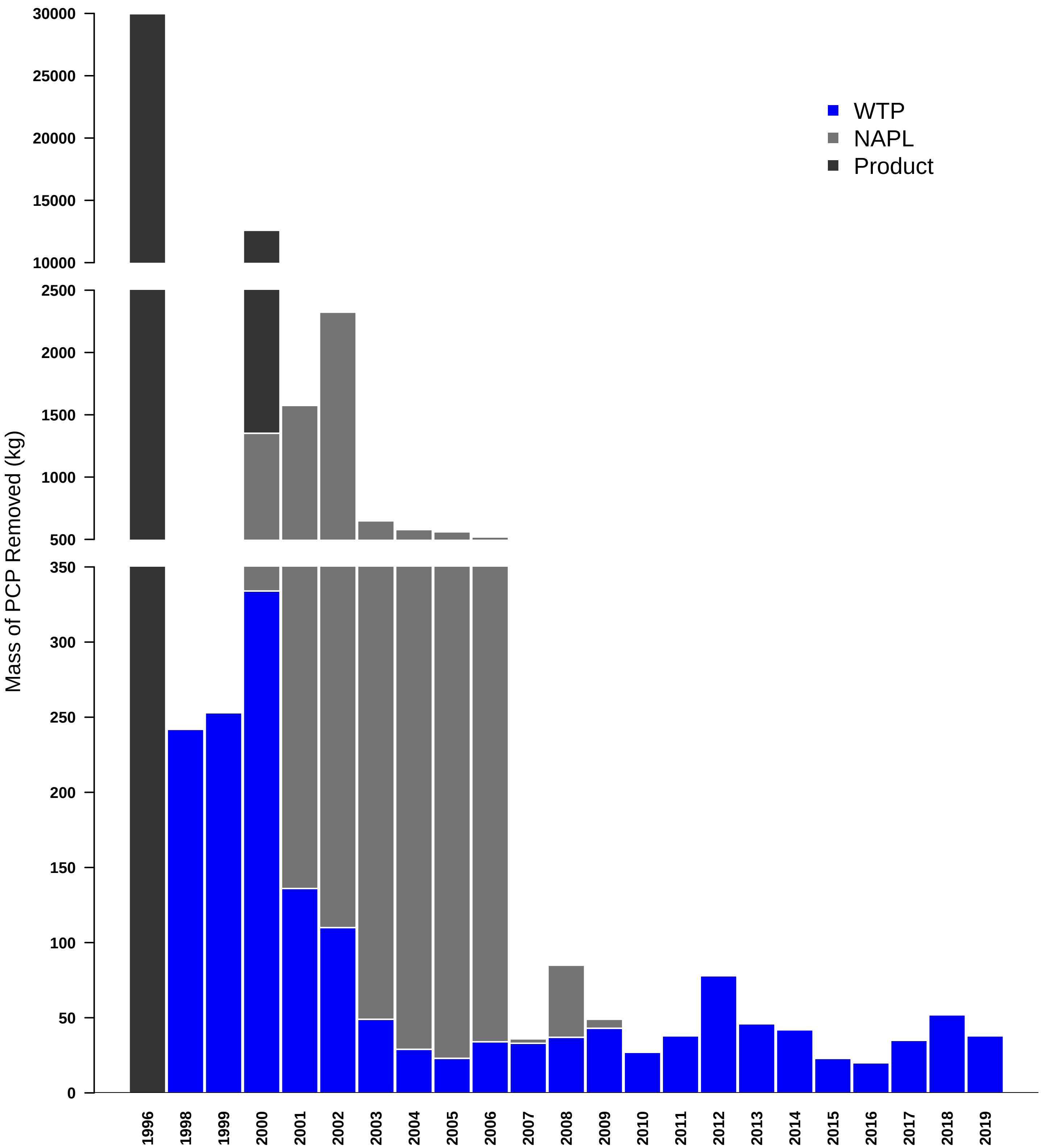
*Duplicate Samples Omitted From Analysis

Montana Pole and Treating Plant
Butte−Silver Bow Montana

FIGURE 2.7b

WTP EFFLUENT PCP HISTOGRAM
1998 − Current

TETRA TECH

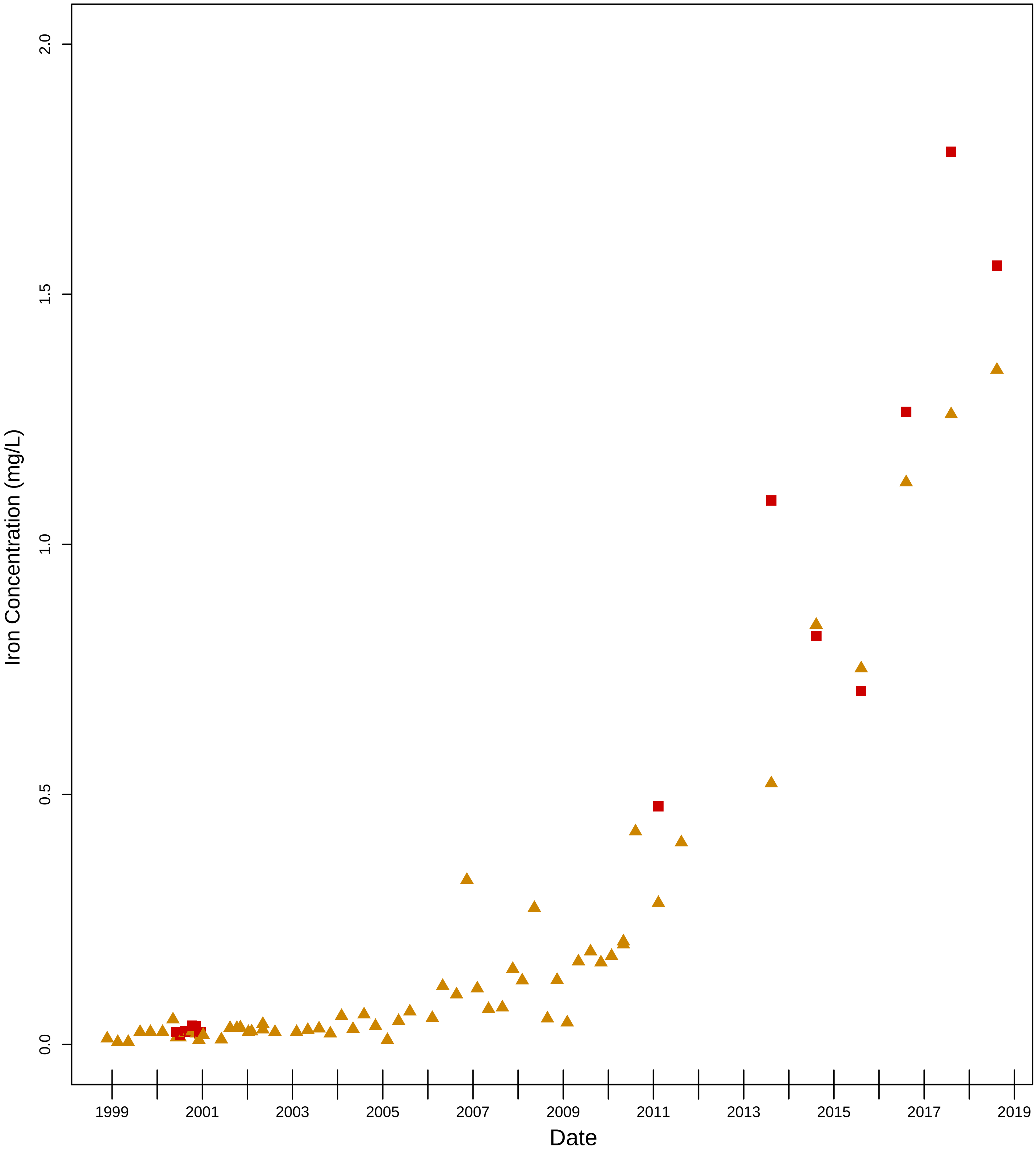


kg kilograms
NAPL non−aqueous phase liquid
PCP Pentachlorophenol
WTP Water Treatment Plant

Montana Pole and Treating Plant
Butte−Silver Bow Montana

FIGURE 2.8
MASS OF PENTACHLOROPHENOL
REMOVED FROM SITE

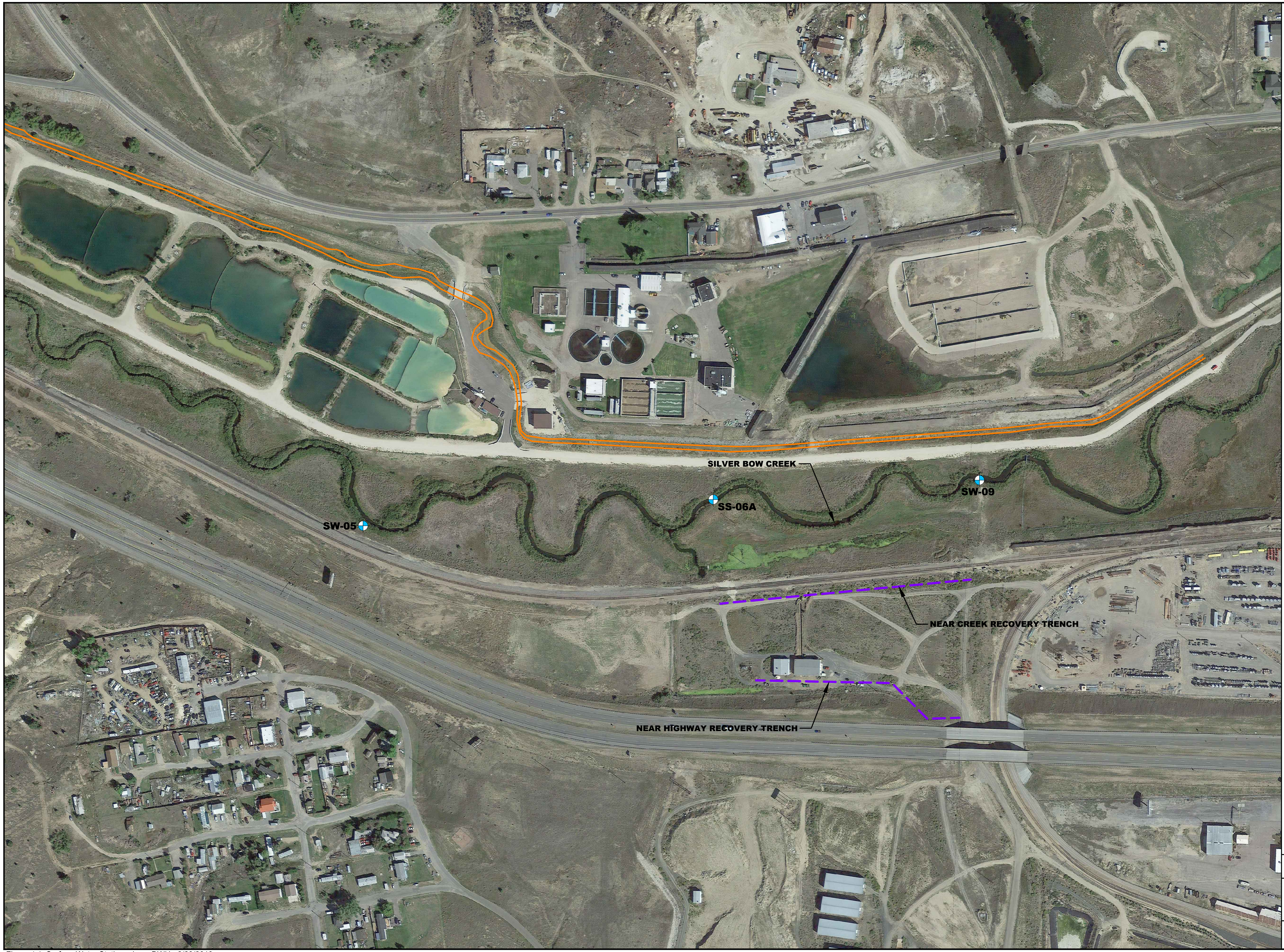
TETRA TECH



DISSOLVED
TOTAL RECOVERABLE

mg/L milligrams per liter

Montana Pole and Treating Plant Butte−Silver Bow Montana
FIGURE 2.9 NEAR HIGHWAY RECOVERY TRENCH IRON CONCENTRATION 1998−CURRENT
TETRA TECH CJK 20190301



LEGEND

SURFACE WATER STATION

HYDRAULIC CONTROL CHANNEL

AERIAL IMAGERY SOURCE:
GOOGLE EARTH PRO (2013) DJA SURVEY JUNE 2015

N

150 0 150 300

SCALE IN FEET

Montana Pole and Treating Plant
Butte-Silver Bow Montana

FIGURE 4.1
LOCATION OF SURFACE WATER STATIONS

TETRA TECH

Figure 4.1_Surface Water Stations.dwg - DWH - 2/28/2019

MONITORING WELL	APPROXIMATE SCREENED INTERVAL	CURRENT STATUS	MAP GRID
10-01	Deep	Existing	5G
10-02	Shallow	Existing	5G
10-03	Deep	Existing	5F
10-04	Shallow	Existing	5F
10-05	Shallow	Existing	5E
10-06	Deep	Existing	5E
10-07	Shallow	Existing	5E
10-08	Deep	Existing	4F
10-09	Shallow	Existing	4F
10-10	Deep	Existing	5J
10-11	Shallow	Existing	5J
10-12	Shallow	Existing	5D
10-13	Deep	Existing	4H
10-14	Shallow	Existing	4H
10-15	Intermediate	Existing	5G
10-16	Deep	Existing	2H
10-17	Intermediate	Existing	2H
10-18	Shallow	Existing	2H
10-19	Deep	Existing	4F
10-20	Intermediate	Existing	4F
10-21	Shallow	Existing	4F
AW-02	Shallow	Abandoned	8J
BMW-01A	Deep	Existing (ARCO)	6D
BMW-01B	Deep	Existing (ARCO)	6D
BMW-13B	Deep	Existing (ARCO)	3E
BMW-9A	Shallow	Existing (ARCO)	5H
BMW-9B	Deep	Existing (ARCO)	5H
CT-84-04	Shallow	Existing (ARCO)	1D
GS-18-R	Deep	Existing (ARCO)	5H
GS-22	Shallow	Existing (ARCO)	6E
GS-25	Shallow	Existing (ARCO)	2D
GS-25-C	Deep	Existing (ARCO)	2D
GS-25-D	Deep	Existing (ARCO)	2D
GS-34-D	Deep	Existing (ARCO)	4G
GS-34-S	Shallow	Existing (ARCO)	4G
GW-05	Shallow	Existing	11J
GW-08	Deep	Existing	13K
GW-09	Shallow	Existing	9G
GW-10	Shallow	Destroyed	9K
GW-12	Deep	Existing	7F
GW-13	Deep	Existing	6K
GW-14R-98	Shallow	Existing	5F
GW-17	Shallow	Existing	5L
GW-21	Shallow	Existing	11L
GW-22R-98	Shallow	Existing	13L
HCA-21	Shallow	Existing (ARCO)	5G
INF-01	Intermediate	Existing	7J
INF-02	Shallow	Existing	7J
INF-03	Deep	Existing	7J
INF-04	Shallow	Existing	6I
INF-05	Intermediate	Existing	6I
INF-06	Deep	Existing	6I
INF-07	Deep	Existing	6H
INF-08	Intermediate	Existing	6H
INF-09	Shallow	Existing	6H
INF-10	Shallow	Existing	9J
INF-11	Intermediate	Existing	9J
INF-12	Deep	Existing	9J
INF-13	Shallow	Existing	10K
INF-14	Intermediate	Existing	10K
INF-15	Deep	Existing	10K
INF-16	Shallow	Existing	10K
INF-17	Intermediate	Existing	11K
INF-18	Deep	Existing	11K
M-01	Shallow	Existing (ARCO)	1D
MP-04 (MF-14)	Deep	Existing	6G
MW-01	Shallow	Existing	6G
MW-03	Shallow	Existing	6K
MW-09	Shallow	Existing	9H
MW-11-01	Shallow	Existing	8H
MW-11-02	Shallow	Existing	8I
MW-11-03	Shallow	Existing	8I
MW-11-04	Shallow	Existing	7I
MW-11-05	Shallow	Existing	7H
MW-14	Shallow	Existing	10I
MW-87-03	Shallow	Existing (ARCO)	6G
MW-A-01	Shallow	Existing	7G
MW-A-04	Shallow	Abandoned	8H
MW-A-95	Shallow	Existing	9I
MW-A-96	Shallow	Existing	13T
MW-A-98	Shallow	Existing	6F
MW-A-99	Shallow	Existing	7H
MW-B-01	Shallow	Existing	7G
MW-B-04	Shallow	Abandoned	8I
MW-B-95	Shallow	Abandoned	8J
MW-B-96	Shallow	Existing	13O
MW-B-98	Shallow	Existing	6K
MW-B-99	Shallow	Existing	7G
MW-C-01	Shallow	Existing	7G
MW-C-04	Shallow	Abandoned	9J
MW-C-96	Shallow	Existing	12P
MW-D-01	Shallow	Existing	6G
MW-D-95	Shallow	Abandoned	8I
MW-D-96	Shallow	Existing	13L
MW-E-01	Shallow	Existing	6G
MW-E-96	Shallow	Existing	10M
MW-F-01	Shallow	Existing	6G
MW-F-95	Shallow	Abandoned	8J
MW-F-96	Shallow	Existing	13H
MW-G-01	Shallow	Existing	6H
MW-G-96	Shallow	Existing (ARCO)	11F
MW-H-01	Shallow	Existing	6G
MW-H-95	Shallow	Existing	7H
MW-H-96	Shallow	Existing (ARCO)	10F
MW-I-01	Shallow	Existing	6H
MW-I-96	Shallow/Intermediate	Existing	6K
MW-J-01	Shallow	Existing	6I
MW-J-96	Intermediate/Deep	Existing	7G
MW-K-01	Shallow	Existing	6J
MW-K-96	Deep	Existing	6F
MW-L-01	Shallow	Existing	6K
MW-L-96	Deep	Existing	6I
MW-M-01	Shallow	Existing	6K
MW-M-96	Deep	Existing	6J
MW-N-01	Shallow	Existing	7J
MW-O-01	Shallow	Existing	7J
MW-P-01	Shallow	Existing	7K
MW-Q-01	Shallow	Abandoned	8K
MW-R-01	Shallow	Abandoned	8K
MW-S-01	Shallow	Existing	9K
MW-T-01	Shallow	Existing	9K
MW-U-01	Shallow	Existing	11L
MW-V-01	Shallow	Existing	11J
MW-W-01	Shallow	Existing	10I
MW-X-01	Shallow	Existing	9J
MW-Y-01	Shallow	Existing	9J
NC-06-S	Shallow	Existing	6G
NCRT PZ-01	In Trench	Existing	6K
NCRT PZ-02	In Trench	Existing	6I
NCRT PZ-03	Shallow	Existing	6H
NCRT PZ-04	In Trench	Existing	6G
NCRT-2010	Shallow	Existing	6H
NHRT MH1	In Trench	Abandoned	8J
NHRT MH2	In Trench	Existing	7J
NHRT PZ-01	Shallow	Abandoned	8J
NHRT PZ-04	In Trench	Existing	7H
NWW	Deep	Existing	13S
Pump-1	Manhole	Existing (BSB)	2E
Pump-2	Manhole	Existing (BSB)	3F
Pump-3	West Sump	Existing (BSB)	2E
PZ-N5-03	Shallow	Existing	7J
PZ-N5-2	Shallow	Existing	7I
PZ-N9-03	Shallow	Existing	7J
PZ-S1-01	Shallow	Existing	9I
PZ-S1-02	Shallow	Existing	9I
PZ-S1-04	Shallow	Existing	9I
PZ-S2-01	Shallow	Existing	9J
PZ-S2-02	Shallow	Existing	9J
PZ-S3-01	Shallow	Abandoned	9J
PZ-S3-02	Shallow	Existing	9J
PZ-S3-04	Shallow	Abandoned	9K
PZ-S3-05	Shallow	Abandoned	9J
PZ-S4-01	Shallow	Existing	10J
PZ-S4-02	Shallow	Existing	10J
PZ-S5-01	Shallow	Existing	10K
PZ-S6-01	Shallow	Existing	10K
PZ-S7-01	Shallow	Existing	11J
PZ-S8-02	Shallow	Existing	11K

AERIAL IMAGERY SOURCE: GOOGLE EARTH PRO (2013) DJA SURVEY JUNE 2015

LEGEND

- GROUNDWATER MONITORING WELL (TO BE RETAINED FOR SAMPLING)
- GROUNDWATER MONITORING WELL (NOT TO BE SAMPLED)
- GROUNDWATER MONITORING WELL (ABANDONED OR DESTROYED)
- UTILITY POLE

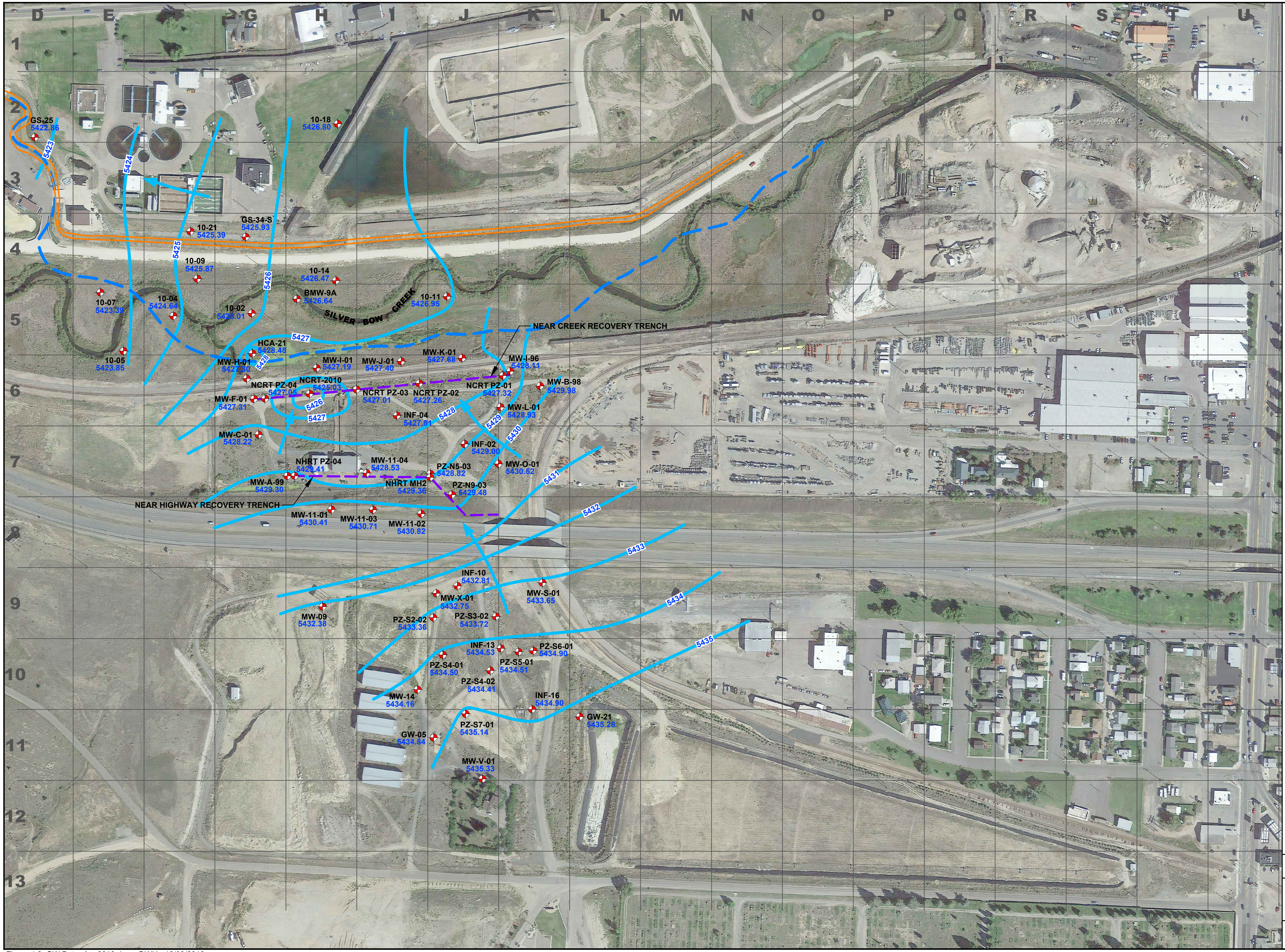
70 0 70 140
SCALE IN FEET

Montana Pole and Treating Plant
Butte-Silver Bow Montana

FIGURE 4.2
LOCATION OF ALL
MONTANA POLE AND TREATING PLANT
MONITORING WELLS

TETRA TECH

Figure 4.2_Location of All MPTP Monitoring Wells.dwg - DWH - 02/28/2019



LEGEND

- MONITORING WELL
- HISTORICAL SILVER BOW CREEK CHANNEL
- HYDRAULIC CONTROL CHANNEL
- GROUNDWATER CONTOUR - 1' INTERVAL
- INTERPRETED DIRECTION OF GROUNDWATER FLOW

NOTES:

1) THIS FIGURE PROVIDES ONE INTERPRETATION OF GROUNDWATER FLOW; OTHER INTERPRETATIONS ARE POSSIBLE.
2) ALL ELEVATIONS PRESENTED IN THIS REPORT ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29) VERTICAL CONTROL DATUM.

AERIAL IMAGERY SOURCE:
GOOGLE EARTH PRO (2013) DJA SURVEY JUNE 2015

N

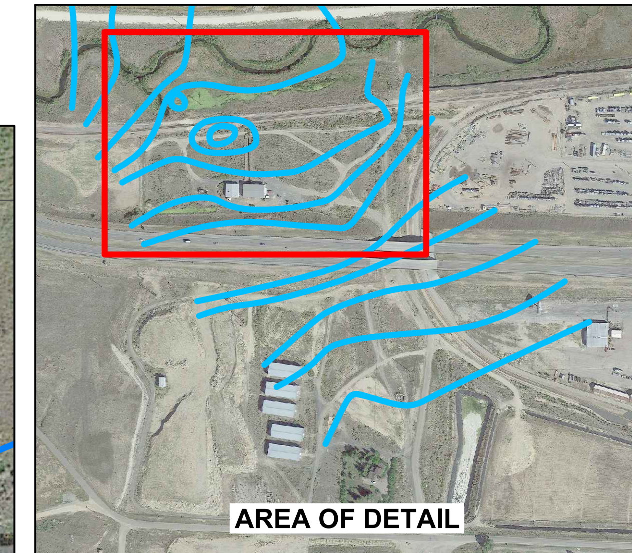
150 0 150 300
SCALE IN FEET

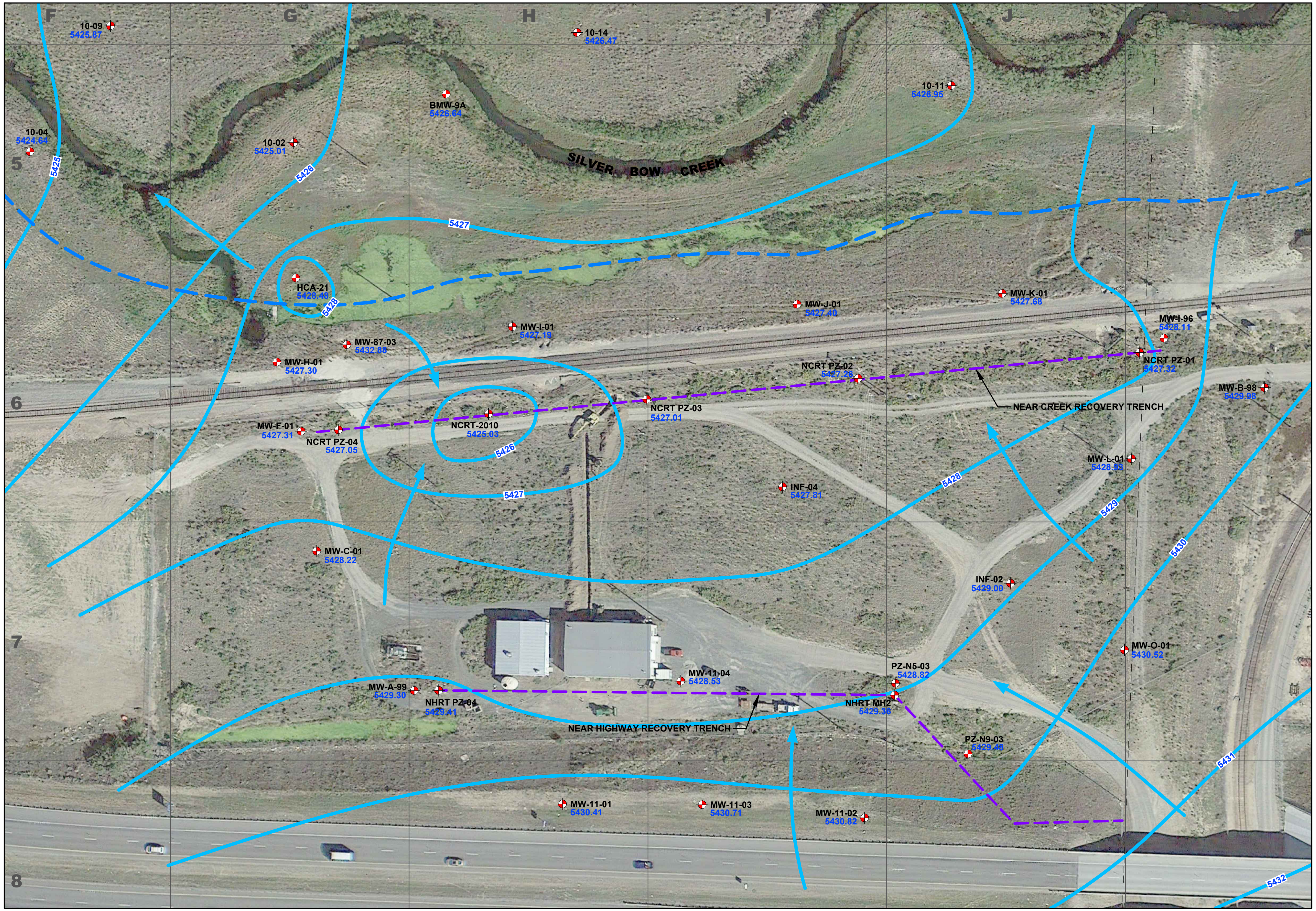
Montana Pole and Treating Plant
Butte-Silver Bow Montana

FIGURE 4.3
GROUNDWATER LEVEL DATA - AUGUST 2019

TETRA TECH

Figure 4.2_GW Data_Aug2019.dwg - DWH - 12/09/2019





LEGEND

MONITORING WELL

HISTORICAL SILVER BOW CREEK CHANNEL

GROUNDWATER CONTOUR - 1' INTERVAL

INTERPRETED DIRECTION OF GROUNDWATER FLOW

NOTES:

1) THIS FIGURE PROVIDES ONE INTERPRETATION OF GROUNDWATER FLOW; OTHER INTERPRETATIONS ARE POSSIBLE.
2) ALL ELEVATIONS PRESENTED IN THIS REPORT ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29) VERTICAL CONTROL DATUM.

AERIAL IMAGERY SOURCE:
GOOGLE EARTH PRO (2013) DJA SURVEY JUNE 2015

N

50 0 50 100

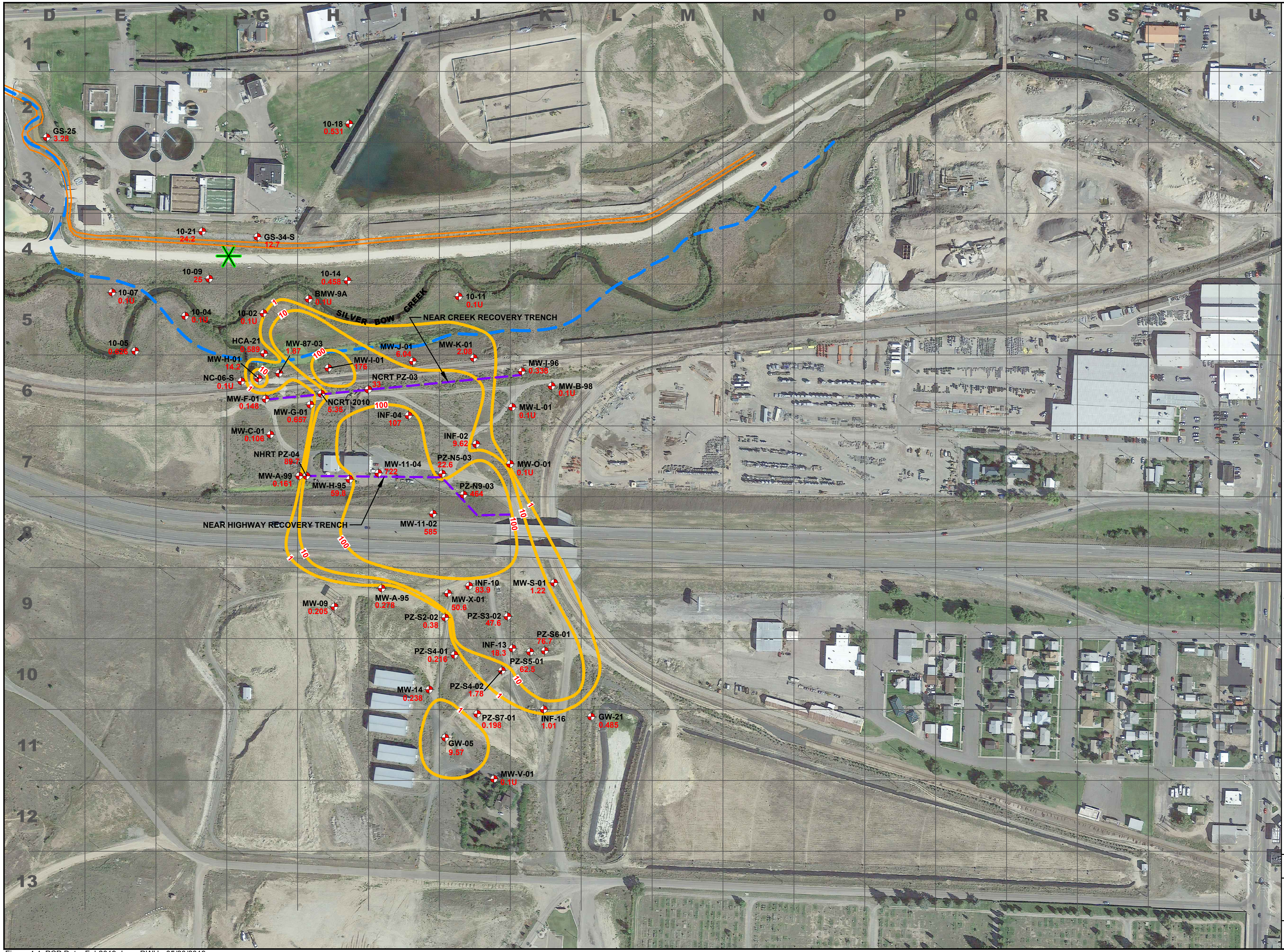
SCALE IN FEET

Montana Pole and Treating Plant
Butte-Silver Bow Montana

FIGURE 4.4
ON-SITE GROUNDWATER LEVEL DATA - AUGUST 2019

TETRA TECH

Figure 4.3_On-Site GW Data_Aug2019.dwg - DWH - 12/09/2019



LEGEND

- MONITORING WELL
- HISTORICAL SILVER BOW CREEK CHANNEL
- HYDRAULIC CONTROL CHANNEL
- OFF-SITE SOURCE OF PCP INTERPRETED TO EXIST APRROXIMATELY IN THIS AREA
- PCP ISOCONTOUR - (µg/L) FEBRUARY 2, 2019
- U — ANALYZED FOR BUT NOT DETECTED ABOVE THE METHOD DETECTION LIMIT
- µg/L — MICROGRAMS PER LITER

NOTES:

1) PENTACHLOROPHENOL (PCP) ISOCONTOURS ARE INTERPRETED; OTHER INTERPRETATIONS ARE POSSIBLE.
2) THE PCP PLUME IS NOT INTERPRETED TO FLOW THROUGH THE NCRT. RATHER, CONTAMINATED GROUNDWATER SOUTH OF THE SILVER BOW CREEK CHANNEL IS INTERPRETED TO BE MIGRATING TOWARD THE NCRT.
3) PLUME AREA SOUTH OF SILVER BOW CREEK BASED ON 1 µg/L CONTOUR INTERVAL: 18.45 ACRES

AERIAL IMAGERY SOURCE:
GOOGLE EARTH PRO (2013) DJA SURVEY JUNE 2015

N

150 0 150 300
SCALE IN FEET

Montana Pole and Treating Plant
Butte-Silver Bow Montana

FIGURE 4.5
PCP DATA - FEBRUARY 2, 2019

TETRA TECH

Figure 4.4_PCP Data_Feb2019.dwg - DWH - 05/20/2019

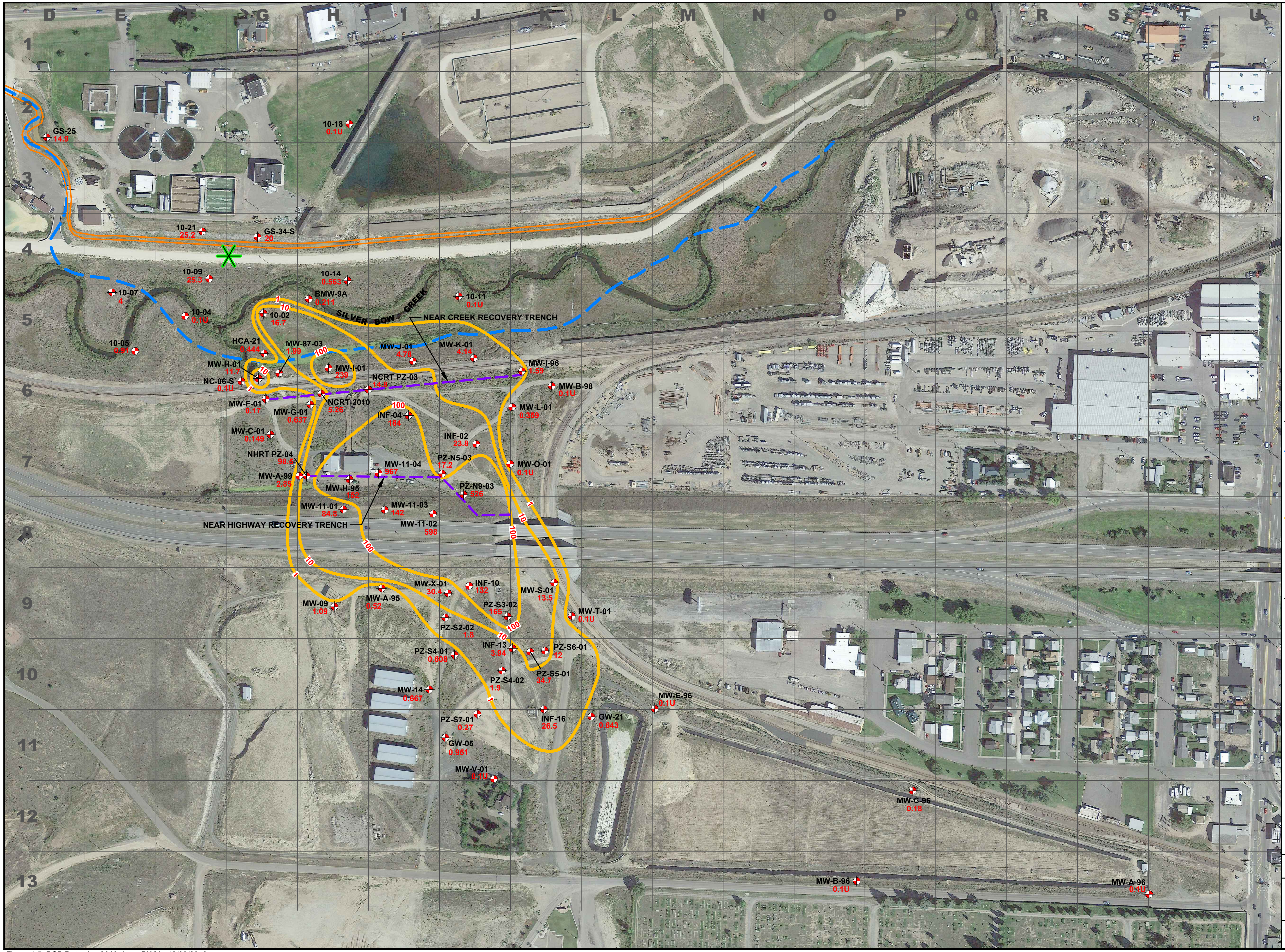


Figure 4.5_PCP Data_Aug2019.dwg - DWH - 12/09/2019

LEGEND

- MONITORING WELL
- HISTORICAL SILVER BOW CREEK CHANNEL
- HYDRAULIC CONTROL CHANNEL
- OFF-SITE SOURCE OF PCP INTERPRETED TO EXIST APPROXIMATELY IN THIS AREA
- PCP ISOCONTOUR - (µg/L) AUGUST 2019
- U — ANALYZED FOR BUT NOT DETECTED ABOVE THE METHOD DETECTION LIMIT
- µg/L — MICROGRAMS PER LITER

NOTES:

1) PENTACHLOROPHENOL (PCP) ISOCONTOURS ARE INTERPRETED; OTHER INTERPRETATIONS ARE POSSIBLE.

2) THE PCP PLUME IS NOT INTERPRETED TO FLOW THROUGH THE NCRT. RATHER, CONTAMINATED GROUNDWATER SOUTH OF THE SILVER BOW CREEK CHANNEL IS INTERPRETED TO BE MIGRATING TOWARD THE NCRT.

3) PLUME AREA SOUTH OF SILVER BOW CREEK BASED ON 1 µg/L CONTOUR INTERVAL: 19.11 ACRES

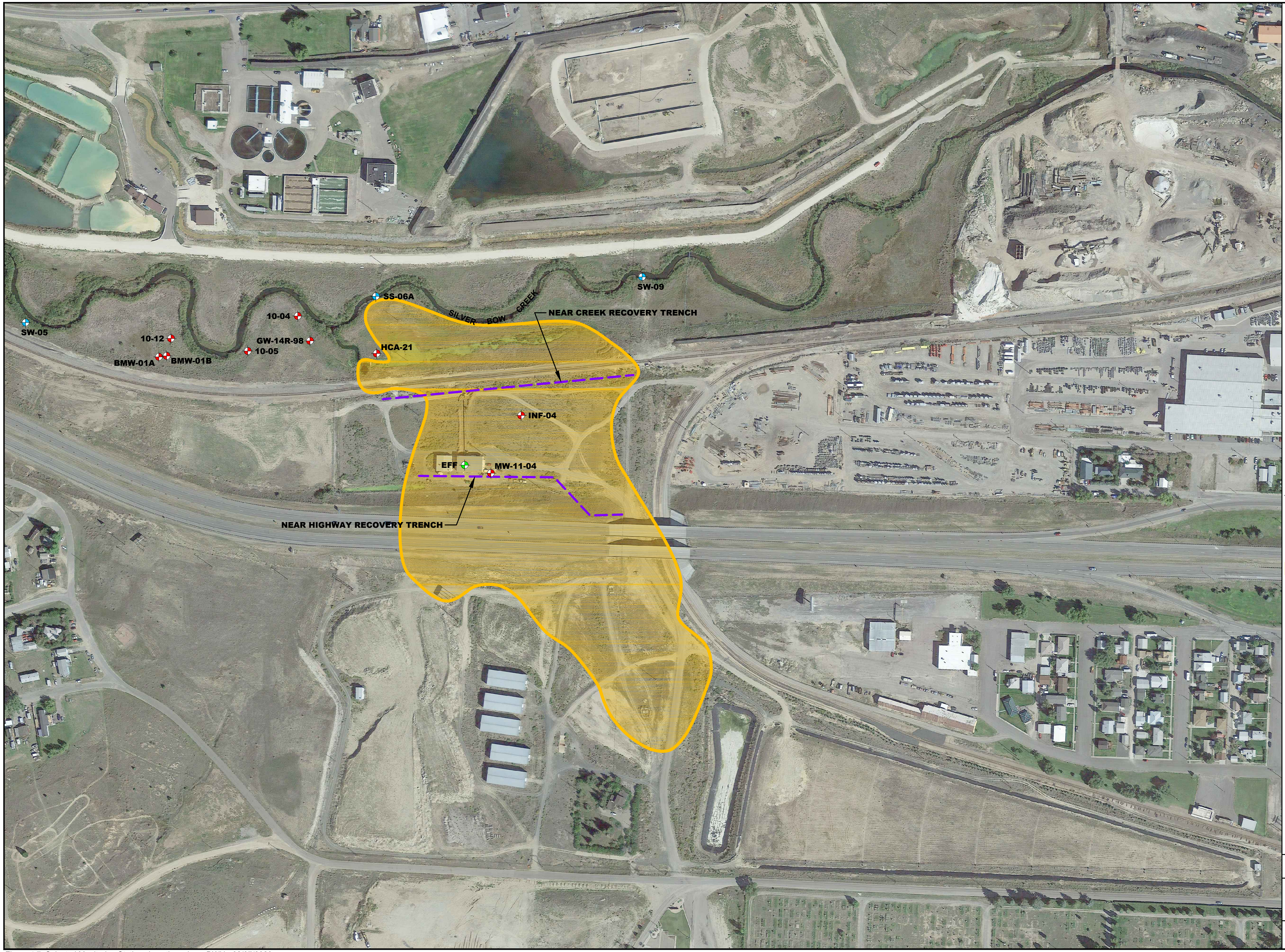
AERIAL IMAGERY SOURCE:
GOOGLE EARTH PRO (2013) DJA SURVEY JUNE 2015

150 0 150 300
SCALE IN FEET

Montana Pole and Treating Plant
Butte-Silver Bow Montana

FIGURE 4.6
PCP DATA - AUGUST 2019

TETRA TECH



LEGEND

- GROUNDWATER MONITORING WELL
- SURFACE WATER STATION
- WATER TREATMENT PLANT SAMPLE STATION
- APPROXIMATE AREA OF PLUME DEFINED BY 1 μg/L PCP ISOCONTOUR
- μg/L MICROGRAMS PER LITER
- PCP PENTACHLOROPHENOL

NOTES:
1) PCP PLUME BOUNDARY IS INTERPRETED; OTHER INTERPRETATIONS ARE POSSIBLE.
2) PLUME OUTLINE INTERPRETED BASED ON AUGUST 2019 CONDITIONS.

AERIAL IMAGERY SOURCE:
GOOGLE EARTH PRO (2013) DJA SURVEY JUNE 2015

N

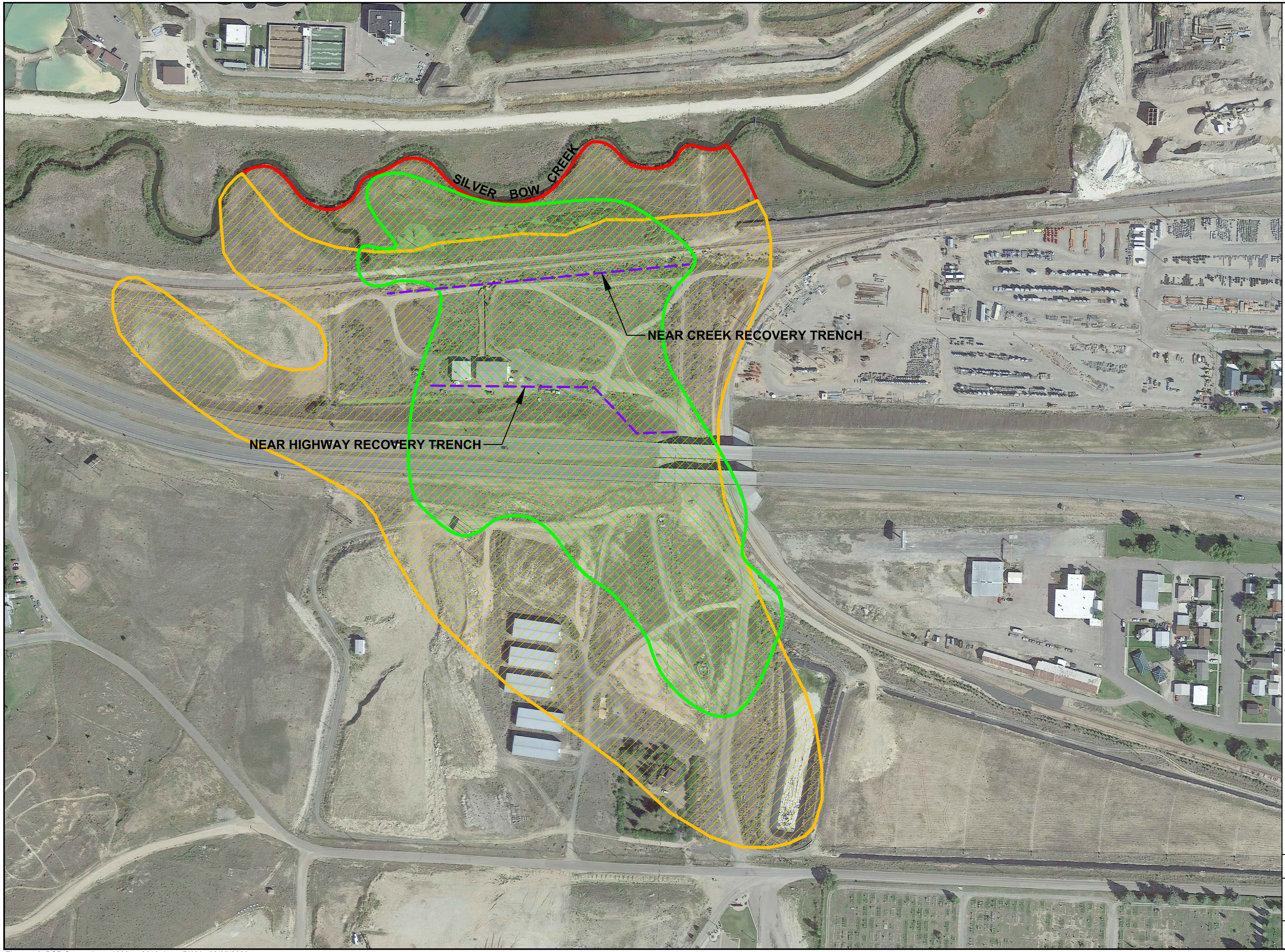
150 0 150 300
SCALE IN FEET

Montana Pole and Treating Plant
Butte-Silver Bow Montana

FIGURE 4.7
LOCATIONS OF
SELECTED MONITORING STATIONS

TETRA TECH

Figure 4.7_Selected Monitoring Stations Locations.dwg - DWH - 02/07/2020



LEGEND

- AUGUST 2019 PCP PLUME CONTOUR (1 µg/L)
- 1993 PCP PLUME CONTOUR (1 µg/L) FROM ROD
- EXTENSION OF 1993 PLUME CONTOUR (1 µg/L) TO CURRENT LOCATION OF SILVER BOW CREEK
- APPROXIMATE AUGUST 2019 PCP PLUME AREA (19.11 acres)
- 1993 PCP PLUME AREA (41.70 acres) (INCLUDES AREA BETWEEN HISTORIC SILVER BOW CREEK (1993) AND CURRENT LOCATION OF SILVER BOW CREEK (2017))

PCP PENTACHLOROPHENOL

ROD RECORD OF DECISION

µg/L MICROGRAMS PER LITER

NOTES:

1) PCP ISOCONTOURS ARE INTERPRETED; OTHER INTERPRETATIONS ARE POSSIBLE.

2) THE PCP PLUME IS NOT INTERPRETED TO FLOW THROUGH THE NEAR CREEK RECOVERY TRENCH (NCRT). RATHER, CONTAMINATED GROUNDWATER SOUTH OF THE SILVER BOW CREEK CHANNEL IS INTERPRETED TO BE MIGRATING TOWARD THE NCRT.

AERIAL IMAGERY SOURCE:
GOOGLE EARTH PRO (2013) DJA SURVEY JUNE 2015

N

125 0 125 250

SCALE IN FEET

Montana Pole and Treating Plant
Butte-Silver Bow Montana

FIGURE 4.8
COMPARISON OF PLUME AREAS
1993 VERSUS AUGUST 2019

TETRA TECH

Figure 4.8_PCP Comparison_1993 vs 2019.dwg - DWH - 02/07/2020

APPENDIX A

Microsoft Access 2010 Database

(Separate CD)

APPENDIX B

2019 Sampling Results and Data

APPENDIX B-1

Water Treatment Plant – PCP

APPENDIX B-2

Groundwater and Surface Water – PCP

APPENDIX B-3

DIOXIN (TEQ) – 2011 TO 2019

MPTP ROD METHODOLOGY VS. DEQ-7 METHODOLOGY

APPENDIX C

2019 Operational Flow Summary

APPENDIX D

Daily Summary Reports

APPENDIX E

R-Studio Water Treatment Plant Field Data Visualizations

APPENDIX F

Mann-Kendall Tests

APPENDIX G

Plume Area Maps

APPENDIX H

Quality Control for Electronic Data Deliverables

APPENDIX I

Climate Statistics

APPENDIX J

Streamflow Statistics