REPORT

NOVEMBER 2023 GROUNDWATER MONITORING PASCO BULK FUEL TERMINALS SITE

Submitted to:

Pasco Bulk Fuel Terminals Site Coordinating Group

Submitted by:

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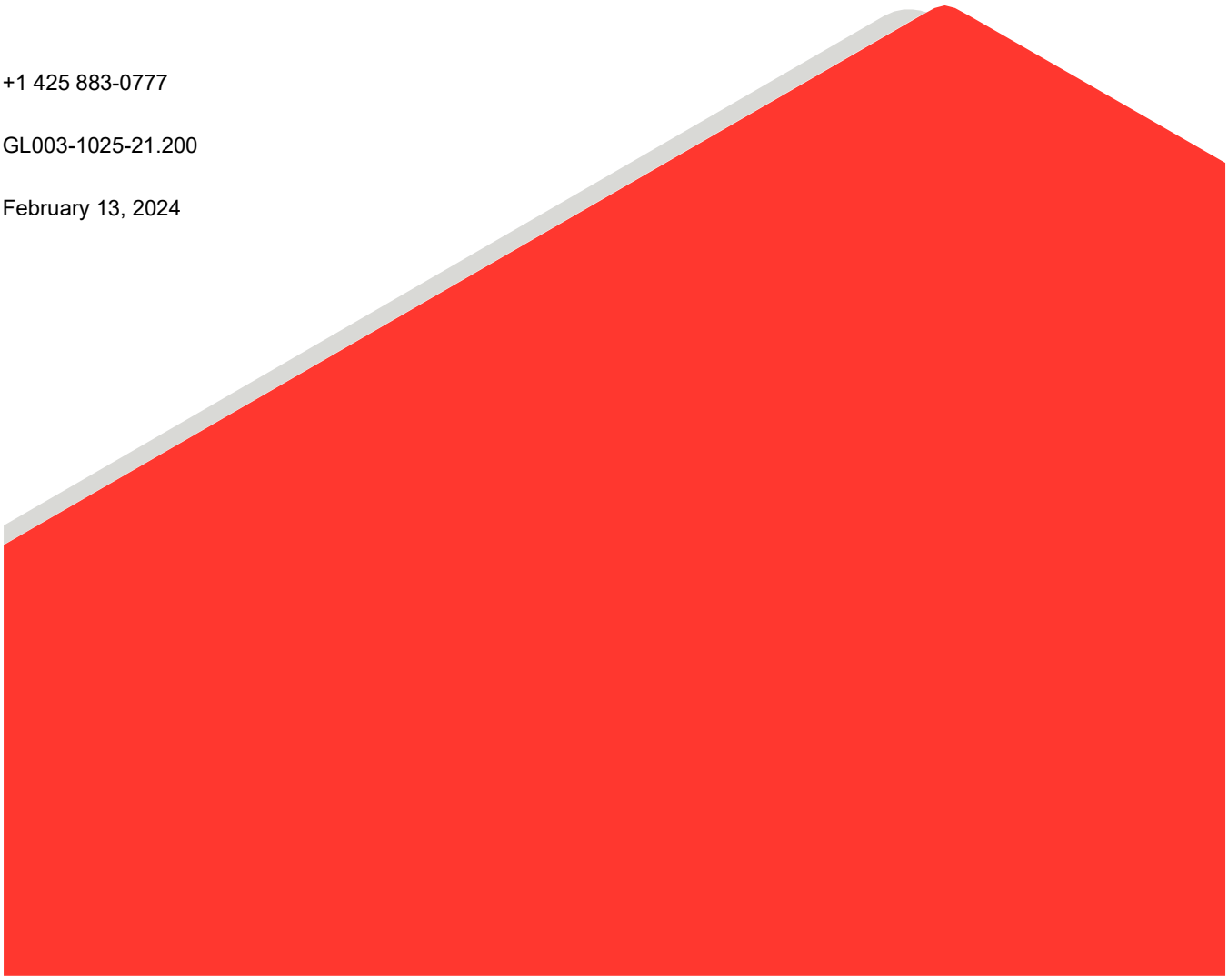

Distribution List

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Pasco Bulk Fuel Terminals Site Coordinating Group

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ACRONYMS AND ABBREVIATIONS

CMP	Compliance Monitoring Plan
COE	United States Army Corps of Engineers
Ecology	Washington State Department of Ecology
Eh	Redox potential
EPA	United States Environmental Protection Agency
Fe	Iron
Golder	Golder Associates USA Inc.
HDPE	High-density polyethylene
IAS	In-situ air sparging
MCL	Maximum Contaminant Limit
ml/min	Milliliters per minute
Mn	Manganese
MNA	Monitored Natural Attenuation
PCE	Perchloroethylene (tetrachloroethene)
SAP	Sampling and Analysis Plan
SEP-OUT	Sample identification for the COE oil-water separator outlet
Site	Pasco Bulk Fuel Terminals Site
SVE	Soil vapor extraction
TCE	Trichloroethene (trichloroethylene)
TPH	Total petroleum hydrocarbons
µg/L	micrograms per liter

1.0 INTRODUCTION

This report presents the results of the November 2023 groundwater monitoring fieldwork conducted by WSP USA Inc. (WSP; formerly Golder Associates USA Inc. [Golder]) at the Pasco Bulk Fuel Terminals Site (the Site) in Pasco, Washington. A Site map is presented in Figure 1. This work was conducted in accordance with the Monitored Natural Attenuation (MNA) Performance Monitoring Plan (Golder 2019) in conjunction with the Sampling and Analysis Plan (SAP) contained within the Compliance Monitoring Plan (CMP) for the Site dated December 20, 2000 (Golder 2000).

Remedial actions conducted at the Site from 1999 through 2014 consisted primarily of in-situ air sparging (IAS) in combination with soil vapor extraction (SVE). Groundwater extraction and treatment ("pump-and-treat") was also used in some areas. During active remediation, major progress was made toward achieving cleanup across the Site. Based on SVE off-gas monitoring data, approximately 58,000 pounds of total petroleum hydrocarbons (TPH) were removed by IAS-SVE. The total TPH removal was greater because this estimate does not account for removal that occurred by pump-and-treat nor for in-situ biodegradation. TPH mass removal rates using IAS-SVE reached asymptotic levels; thus, IAS-SVE was no longer effective.

Under MNA, the group evaluated the Site risk and various alternatives to achieve Site closure (Golder 2013). The results of the evaluation indicated that MNA and institutional controls (institutional controls as described in the Cleanup Action Plan [Ecology 1999]) were protective of human health and the environment and were the preferred alternative for achieving groundwater cleanup levels throughout the Site. Ecology issued a decision letter dated September 19, 2018 (Ecology 2018) that indicated MNA as a remedial action was covered under the existing Consent Decree for the Site, such that MNA can be implemented at the Site without modifying the Consent Decree.

The MNA Performance Monitoring Plan (Golder 2019) was prepared to work in conjunction with the SAP and Quality Assurance Project Plan contained within the CMP (Golder 2000) to provide the scope, methods, and procedures that will occur to ensure natural attenuation is occurring, is effective and protective of human health and the environment and demonstrates compliance with Site cleanup standards. Groundwater monitoring conducted under the MNA Performance Monitoring Plan was started in June 2019.

1.1 Field Work

The November 2023 groundwater monitoring was performed on November 6 and 7, 2023 and included the following activities:

- Groundwater monitoring was conducted on 16 groundwater-monitoring wells (MW-06, MW-08, MW-11A, MW-12, MW-13, MW-17, MW-18, MW-19, MW-20, MW-33, MW-34, MW-48, MW-49, MW-62R, MW-63, and MW-66).
- Water level measurements were made on these wells, except for MW-48 and MW-49. These wells contain roots within them that obstruct a water level tape.
- Surface water sampling of the discharge from the oil-water separator (SEP-OUT) on the United States Army Corps of Engineers' (COE) drain. In accordance with the CMP (Golder 2000), the COE drain is only sampled when there has been no measurable rain during the four days prior to sample collection. This ensures that the sample collected is predominately associated with groundwater from the COE drain.

In accordance with the MNA Performance Monitoring Plan (Golder 2019), each well was analyzed for those indicator substances that remain above cleanup levels in that well. In addition, select monitoring wells were also analyzed for geochemical parameters - dissolved oxygen, nitrate, manganese, iron, sulfate, methane, redox potential (Eh), and alkalinity. Changes in these geochemical parameters can indicate that biodegradation is occurring. These changes can be evaluated over time within a well, or by comparing levels of these parameters in wells that are still impacted with indicator substances to wells that are located upgradient or in clean areas of the Site.

Positive evidence of biodegradation includes:

- Depressed oxygen, nitrate, or sulfate levels in source area wells as compared to background wells
- Low Oxidation-Reduction Potential (i.e., reducing conditions) in source area wells as compared to background wells
- Higher iron (Fe2+), manganese (Mn2+), and methane in source area wells as compared to background wells

During performance monitoring, natural attenuation parameters are measured in two wells (MW-18 and MW-62R) that have been below cleanup levels for more than five years, and in a selection of wells that have relatively higher petroleum hydrocarbon concentrations (MW-08, MW-11A, MW-12, MW-33, MW-34, and MW-63). The testing of these wells allows for comparison of geochemical parameters in areas where contaminants are being biodegraded compared to clean areas of the Site.

1.2 Field Equipment

Wells were sampled using peristaltic pumps with dedicated high-density polyethylene (HDPE) and silicone tubing. During previous sampling events, HDPE tubing was placed in each well at a depth approximately halfway between the bottom of the well screen and the water level in the well. A summary of monitoring well completion data, including tubing depths for each well, is presented in Table 1.

The HDPE tubing was inserted into a short (< 0.5 foot) length of silicone tubing that was inserted into the peristaltic pump. An extra length of HDPE tubing was used to connect the silicon tubing to a flow-through cell. Each length of silicon tubing and HDPE sample tubing was used only once to avoid cross-contamination between wells, except for well-specific dedicated tubing. The flow-through cell consisted of a 2-inch-diameter acrylic cylinder with a capped bottom that was attached to a 5-gallon bucket. The flow-through cell had an inlet port near the bottom and another outlet port near the top. The sample tubing was connected to the bottom port, so the cell filled from the bottom and flowed out the top port into a purge water container. A multimeter (pH, temperature, specific conductance, dissolved oxygen, and Eh) was inserted into the flow cell from the top and was monitored every 3-5 minutes to determine when field parameters had stabilized in the purge water.

Once the well was purged and field parameters had stabilized, the tubing was disconnected from the flow cell and the groundwater samples were collected directly from the sample tubing. The flow cells were rinsed with deionized water between wells. The HDPE tubing dedicated to each well was capped and left hanging in the well by attaching it to the well cap using line. The thermos-type well caps were used to secure the well after sampling. Well monument covers were securely bolted.

1.3 Micropurging

Well purging was conducted following the “micropurging” procedure accepted by EPA and described in Groundwater Sampling Procedure Low Stress Purging and Sampling (EPA 1997). This procedure recommends an initial purging rate of 200 to 500 milliliters per minute (ml/min) and a sampling rate of 100 to 250 ml/min, while ensuring water level drawdown does not exceed 0.3 feet. This low-flow method minimizes well disturbances and therefore reduces turbidity, minimizes aeration of the groundwater during sample collection, and reduces the volume of purge water generated. In some cases, the well yield was insufficient to maintain a drawdown of less than 0.3 feet while continuously pumping at the minimal purge rate. Wells were considered sufficiently purged when field parameters remained stable for three consecutive measurements taken approximately 3 to 5 minutes apart. The field parameters were considered stable based on the following criteria:

- +/- 0.1 for pH
- +/- 3% for specific conductance
- +/- 10% for dissolved oxygen
- +/- 10% mV for Eh
- +/- 0.5 degree C for temperature

The stabilized field measurements for pH, temperature, specific conductance, dissolved oxygen, and Eh for each well at the time sampling was initiated are presented in Table 2.

1.4 Purge Water

Purge water was collected in 5-gallon containers at each sampling location. The purge water was then transferred into the 55-gallon drums for subsequent treatment and disposal.

2.0 DATA SUMMARY

2.1 Water Level Data

Water level data collected during November 2023 are presented in Figure 2 and Table 3.

2.2 Analytical Results

Groundwater samples were stored in coolers with ice until retrieved by Eurofins, an Ecology-certified laboratory located in Tacoma, Washington. Chain-of-custody procedures were followed. A complete tabulation of analytical results is provided in Appendix A.

All analytical data were subject to a data validation review. Data validation was conducted in accordance with the EPA Contract Laboratory Program, National Functional Guidelines for Organic and Inorganic Data Review (EPA 2017a, b). Data reporting qualifiers are included with the analytical results in Appendix A.

2.3 Monitored Natural Attenuation Performance Assessment and Cleanup Determination

2.3.1 MNA Performance Assessment

Table 4 provides a summary of the geochemical analytical results obtained from the two background wells and from the six higher concentration wells or “impacted wells”. Evaluation of the results confirms that biodegradation is occurring in the remaining higher concentration areas. Evidence of biodegradation includes the following:

- Alkalinity is generally higher in the impacted wells, which is caused as carbon dioxide is produced during biodegradation.
- Oxygen, nitrate, and sulfate concentrations are lower in the impacted wells as these electron acceptors are used up in the biodegradation process.
- Reduced forms of iron and manganese concentrations are higher in the impacted wells, due to the reduction of forms Fe3+ and Mn4+.
- Methane concentrations are significantly higher in the impacted wells as methane is produced during biodegradation under anaerobic conditions. Methane was not detected above the reporting limit in the clean wells.

The above noted geochemical markers of biodegradation were more pronounced in some of the higher concentration wells, but all the impacted wells tested for geochemical parameters had indications that contaminant biodegradation is occurring in those wells.

Trend graphs of the analytical results since the start of monitored natural attenuation in 2014 are presented in Appendix B. Evaluation of trend graphs indicate the following:

- Area 2 – Arsenic is above cleanup levels in MW-06, MW-12, MW-13, and MW-63, with a long-term stable to slightly decreasing trend. Benzene is above cleanup level in MW-12 and MW-63, with a slight long-term decreasing trend. TPH is above cleanup level in MW-12 with a slight long-term decreasing trend since 2014. TPH has been below the cleanup level in MW-63 in two out of the last four sampling rounds.
- Area 3 – Arsenic is below the cleanup level in MW-17 for the first time since May 2018.
- Area 4 – Arsenic and TPH are above the cleanup level in MW-11A, with no apparent recent trend.
- Area 6 – TPH is above the cleanup level in MW-08. TPH concentrations reported in MW-19 were below the cleanup level this round. Arsenic is above the cleanup level in MW-19. Concentrations of arsenic and TPH are steady to slightly decreasing in MW-19, and TPH concentrations are slightly decreasing in MW-08.
- Area 7 – Tetrachloroethene (PCE) is above the cleanup level in MW-20 and MW-49. Trichloroethene (TCE) is slightly below the cleanup level in MW-49 for the last three sampling rounds. TPH is above the cleanup level in MW-33 and MW-34 and has a slight decreasing trend. Arsenic is above the cleanup level in MW-34 and has a slightly decreasing long-term trend.
- Area 8 – Arsenic concentrations have been decreasing in MW-48 in the long-term and have been fluctuating around the cleanup level since 2018. Arsenic concentrations in MW-48 were below the cleanup level in two of the last four sampling rounds.

- COE Drain Oil-Water Separator - Starting with the October 2019 sampling round, the COE Drain sample is collected from the oil-water separator discharge pipe. During previous rounds, samples were collected from inside the concrete vault of the oil-water separator. Samples collected directly from the end of the discharge pipe of the oil-water separator are safer for sampling personnel and are more representative of the actual concentration contained in the water discharged from the COE Drain oil-water separator. PCE has historically been detected slightly above the 1.75 micrograms per liter (µg/L) cleanup level, however, PCE has been below the drinking water Maximum Contaminant Limit (MCL) of 5 µg/L since October 2008. PCE concentrations have been decreasing since 2015. The concentration of PCE detected during two of the last four sampling rounds was below the cleanup level.

2.3.2 Cleanup Determination

Under the MNA Performance Monitoring Plan, groundwater cleanup for each Remediation Area will be determined as follows:

a) Within a Remediation Area, if any single well has not exceeded cleanup levels for a particular indicator substance for two consecutive annual monitoring events, then the performance monitoring for that contaminant in that well can be suspended.

b) A well that has met Condition "a" can move into confirmational monitoring. Once in confirmational monitoring, if the indicator substance remains below its cleanup level for two consecutive confirmational sampling rounds, then that well will be considered clean for that substance. Monitoring events will not occur more frequently than semi-annually.

When all wells within a Remediation Area have met Condition "b" for all indicator substances, then the Remediation Area will have met groundwater cleanup levels.

To assist in evaluating compliance with the above criteria, Table 5 presents the analytical results for each indicator substance detected during the last four sampling events. Table 5 is sorted by cleanup area, and results presented in the table.

No changes to the Performance Monitoring Plan are indicated. During 2024, annual sampling will continue in accordance with the Performance Monitoring Plan (Golder 2019).

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Tables

Table 1: Monitoring Well Completion Data

Well	Installation Date	Coordinates		Ground Elevation	Top of Casing	Stick-up	Total Boring Depth	Total Well Depth	Tubing Depth	Screened Interval			
		Northing	Easting							(ft-bgs)		(ft elevation)	
		(ft)	(ft)	(ft)	(ft elevation)	(ft-bgs)	(ft-bgs)	(ft-bgs)	(ft-bgs)	from	to	from	to
MW-06	11/22/86	326,727	2,354,911	342.31	342.10	-0.21	14.5	13	10	3.0	13.0	339.3	329.3
MW-08	11/22/86	327,200	2,354,238	339.86	339.67	-0.19	10	10	7	2.0	10.0	337.9	329.9
MW-11A	10/20/87	327,031	2,354,586	342.36	342.04	-0.32	15	14.9	11	5.0	14.9	337.4	327.5
MW-12	03/03/87	327,036	2,354,771	343.07	342.74	-0.33	13	13	10	3.5	13.0	339.6	330.1
MW-13	03/03/87	326,833	2,354,689	342.31	342.15	-0.16	13.6	13.6	10	4.0	13.6	338.3	328.7
MW-17	03/03/87	327,230	2,354,567	343.68	343.32	-0.36	12.9	12.9	10	3.3	12.9	340.4	330.8
MW-18	03/04/87	327,235	2,354,422	340.98	340.68	-0.30	9.3	9.3	7	2.0	9.3	339.0	331.7
MW-19	03/04/87	327,069	2,354,360	340.58	340.17	-0.41	10.3	10.3	8	2.8	10.3	337.8	330.3
MW-20	03/04/87	326,907	2,354,277	340.23	339.93	-0.30	10.4	10.4	7	3.0	10.4	337.2	329.8
MW-33	05/07/93	326,955	2,354,035	340.64	340.12	-0.52	10	9	7	3.5	8.5	337.1	332.1
MW-34	05/07/93	326,815	2,354,243	341.29	340.90	-0.39	9	8.75	8	3.3	8.3	338.0	333.0
MW-48	08/16/94	327,277	2,353,896	342.0	341.79	-0.21	13	11	9	6.0	11.0	336.0	331.0
MW-49	08/16/94	326,998	2,353,747	343.0	343.65	0.65	14	14	12	7.5	14.0	335.5	329.0
MW-62R	02/25/10	--	--	343.24	343.04	-0.2	16	15	10	5.0	15.0	338.2	328.2
MW-63	03/29/01	326,885	2,354,856	343.11	342.81	-0.30	16	15.5	11	5.5	15.5	337.6	327.6
MW-66	06/08/06	326,651	2,354,825	342.87	342.23	-0.64	26.5	24	21	4.0	24.0	338.9	318.9

Notes:
Survey data not obtained for replacement well MW-62R; elevation data relative to MW-63
ft-bgs = feet below ground surface

Table 2: Groundwater Sampling Field Parameters

Well	Date Sampled	Time Sampled	pH	Conductivity (uS/cm)	Temp. (°C)	Dissolved Oxygen (mg/L)	Eh (rel mV)
MW-06	11/6/2023	11:55	7.08	653	17.7	3.52	-89
MW-08	11/6/2023	16:15	6.91	632	18.9	2.99	-106
MW-11A	11/6/2023	13:35	6.89	698	18.8	2.54	-109
MW-12	11/6/2023	8:35	7.07	742	17.9	3.39	-125
MW-13	11/6/2023	12:40	7.01	650	19.0	3.31	-87
MW-17	11/6/2023	10:05	7.12	935	19.1	0.16	-88
MW-18	11/6/2023	11:00	7.23	808	18.7	0.11	8
MW-19	11/6/2023	11:40	7.03	673	19.9	0.13	-122
MW-20	11/6/2023	14:40	7.15	639	18.6	0.15	-28
MW-33	11/6/2023	15:00	6.95	599	16.9	3.02	-109
MW-34	11/6/2023	13:50	7.14	788	19.1	0.15	-97
MW-48	11/7/2023	8:35	6.92	735	17.2	3.75	111
MW-49	11/7/2023	8:24	6.97	595	16.8	4.79	72
MW-62R	11/6/2023	10:00	7.06	712	18.2	4.80	49
MW-63	11/6/2023	10:45	7.18	1,124	18.5	3.51	-134
MW-66	11/6/2023	15:40	7.17	619	16.9	0.12	-133

Notes:
The field parameters on this sheet were recorded after values stabilized, just prior to sample collection
uS/cm = microsiemens per centimeter
mg/L = milligrams per liter
rel mV = relative millivolts

Table 3: Water Levels

Well	Date	Time	Water Level (ft-bgs)	Water Level (ft elevation)	Comments
MW-06	11/6/2023	11:26	5.79	336.52	
MW-08	11/6/2023	15:46	4.88	334.98	
MW-11A	11/6/2023	12:58	6.57	335.79	
MW-12	11/6/2023	7:50	6.96	336.11	
MW-13	11/6/2023	12:17	6.17	336.14	
MW-17	11/6/2023	9:25	8.12	335.56	
MW-18	11/6/2023	10:25	5.74	335.24	
MW-19	11/6/2023	11:20	5.46	335.12	
MW-20	11/6/2023	14:20	5.20	335.03	
MW-33	11/6/2023	14:28	6.16	334.48	
MW-34	11/6/2023	13:35	6.66	334.63	
MW-48	11/7/2023				Roots obstruct well
MW-49	11/7/2023				Roots obstruct well
MW-62R	11/6/2023	9:25	6.61	336.63	
MW-63	11/6/2023	10:21	7.22	335.89	
MW-66	11/6/2023	14:58	6.69	336.18	

Notes:
Survey data is estimated for replacement wells MW-46R and MW-62R
ft-bgs = feet below ground surface

Table 4: Geochemical Evaluation of Natural Attenuation Parameters

Well	Sample Date	Total Organics (µg/L)	Alkalinity, Total as CaCO3 (mg/L)	Sulfate (mg/L)	Nitrogen, Nitrate (mg/L)	Iron (mg/L)	Manganese (mg/L)	Methane (µg/L)	Field DO (mg/L)	Field Redox
Background Wells (1)										
MW-18	11/6/2023	ND	250	62	7.0	0.085 J	0.34	< 5 U	0.11	8
MW-62R	11/6/2023	ND	180	59	3	0.1 J	0.0046 J	< 5 U	4.80	49
Higher Concentration Wells (2)										
MW-08	11/6/2023	3200	290	< 1.5 U	< 0.15 U	2.4	2.4	1100	2.99	-106
MW-11A	11/6/2023	3070	350	1.9	< 0.15 U	5.4	2.4	6300	2.54	-109
MW-12	11/6/2023	2740	290	2.4	< 0.1 UJ	3.3	1.2	1500	3.39	-125
MW-33	11/6/2023	5300	290	17	0.77	3.0	3.0	3900	3.02	-109
MW-34	11/6/2023	1300	320	10.0	< 0.15 U	1.5	1.10	2300	0.15	-97
MW-63	11/6/2023	940	640	5	0.30	1.7	0.21	1500	3.51	-134

Notes: No organic compounds were detected in the "background" wells (ND).
(1) - Background wells are wells that have been clean for at least 10 years
(2) - Higher Concentration Wells are located either within or immediately downgradient of historical source areas.
Indications of biodegradation:

Reduced levels of sulfate and nitrate in the source area wells
Increased iron and manganese in the source area wells
Production of methane in the source area wells
Lower dissolved oxygen (DO) and lower Redox values in source area wells

Table 5: Concentrations of Compounds Detected During the Last Four Sampling Events Monitoring Wells Sorted by Area

AREA 2 WELLS

Parameter	Units	Cleanup Level	MW-06	MW-06	MW-06	MW-06
			Oct-20	Nov-21	Dec-22	Nov-23
Arsenic	µg/L	10	84	81	87	88
Parameter	**Units**	**Cleanup Level**	**MW-12**	**MW-12**	**MW-12**	**MW-12**
			Oct-20	Nov-21	Dec-22	Nov-23
Arsenic	µg/L	10	34	40	43	38
Benzene	µg/L	5	16	12	11	8.1
TPH-Total	µg/L	1000	2020	2660	3320	2740
Parameter	**Units**	**Cleanup Level**	**MW-13**	**MW-13**	**MW-13**	**MW-13**
			Oct-20	Nov-21	Dec-22	Nov-23
Arsenic	µg/L	10	48	44	49	61
Parameter	**Units**	**Cleanup Level**	**MW-63**	**MW-63**	**MW-63**	**MW-63**
			Oct-20	Nov-21	Dec-22	Nov-23
Arsenic	µg/L	10	89	84	59	69
Benzene	µg/L	5	86	99	45	70
TPH-Total	µg/L	1000	770	1030	930	1420

Notes:
"<" - indicates compound was not detected; followed by the reporting limit
µg/L = micrograms per liter
*Highlighted concentration is above the cleanup level. Four rounds below cleanup level

Table 5: Concentrations of Compounds Detected During the Last Four Sampling Events Monitoring Wells Sorted by Area

AREA 3 WELL

Parameter	Units	Cleanup Level	MW-17	MW-17	MW-17	MW-17
			Oct-20	Nov-21	Dec-22	Nov-23
Arsenic	µg/L	10	11	13	11	10

AREA 4 WELL

Parameter	Units	Cleanup Level	MW-11A	MW-11A	MW-11A	MW-11A
			Oct-20	Nov-21	Dec-22	Nov-23
Arsenic	µg/L	10	110	92	94	94
TPH-Total	µg/L	1000	2630	2670	2360	3070

AREA 6 WELLS

Parameter	Units	Cleanup Level	MW-08	MW-08	MW-08	MW-08
			Oct-20	Nov-21	Dec-22	Nov-23
TPH-Total	µg/L	1000	2430	3600	3300	3200
Parameter	**Units**	**Cleanup Level**	**MW-19**	**MW-19**	**MW-19**	**MW-19**
			Oct-20	**Nov-21**	**Dec-22**	**Nov-23**
Arsenic	µg/L	10	94	78	74	86
TPH-Total	µg/L	1000	1520	1790	1240	750

Notes:
"<" - indicates compound was not detected; followed by the reporting limit
µg/L = micrograms per liter
*Highlighted concentration is above the cleanup level. Four rounds below cleanup level

Table 5: Concentrations of Compounds Detected During the Last Four Sampling Events Monitoring Wells Sorted by Area

AREA 7 WELLS

Parameter	Units	Cleanup Level	MW-20	MW-20	MW-20	MW-20
			Oct-20	Nov-21	Dec-22	Nov-23
Tetrachloroethene (PCE)	µg/L	1.75	2.3	1.1	2.1	5.7
Parameter	**Units**	**Cleanup Level**	**MW-33**	**MW-33**	**MW-33**	**MW-33**
			Oct-20	**Nov-21**	**Dec-22**	**Nov-23**
TPH-Total	µg/L	1000	4700	4200	4500	5300
Parameter	**Units**	**Cleanup Level**	**MW-34**	**MW-34**	**MW-34**	**MW-34**
			Oct-20	**Nov-21**	**Dec-22**	**Nov-23**
Arsenic	µg/L	10	25	20	16	23
TPH-Total	µg/L	1000	1460	1860	1660	2060
Parameter	**Units**	**Cleanup Level**	**MW-49**	**MW-49**	**MW-49**	**MW-49**
			Oct-20	**Nov-21**	**Dec-22**	**Nov-23**
Tetrachloroethene (PCE)	µg/L	1.75	19	18	16	14
Trichloroethene (TCE)	µg/L	2	2.1	1.8	2.0	1.6

Notes:
"<" - indicates compound was not detected; followed by the reporting limit
µg/L = micrograms per liter
*Highlighted concentration is above the cleanup level. Four rounds below cleanup level

Table 5: Concentrations of Compounds Detected During the Last Four Sampling Events Monitoring Wells Sorted by Area

AREA 8 WELL

Parameter	Units	Cleanup Level	MW-48	MW-48	MW-48	MW-48
			Oct-20	Nov-21	Dec-22	Nov-23
Arsenic	µg/L	10	17	6.5	9.5	19

AREA 9 WELL

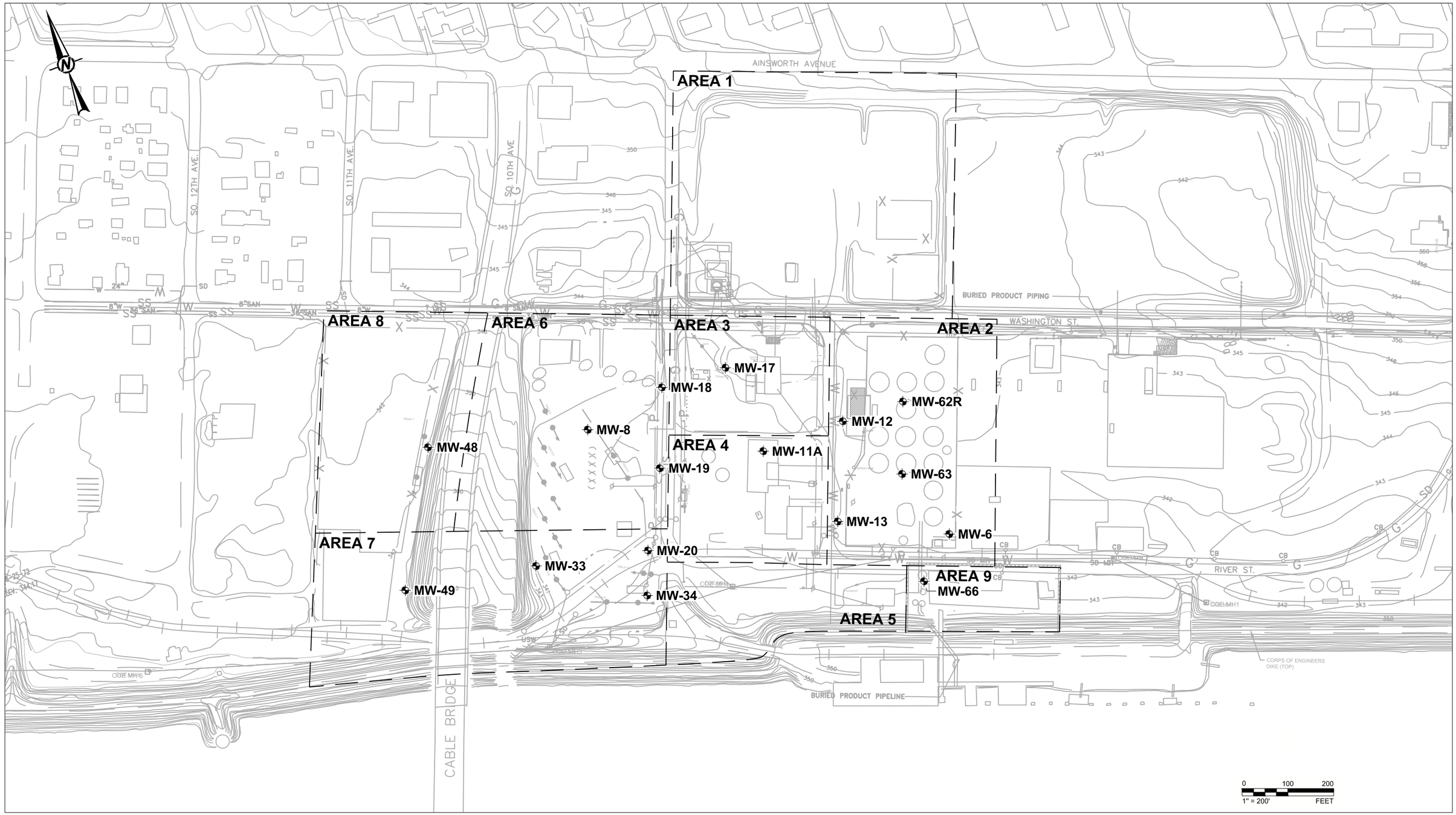
Parameter	Units	Cleanup Level	MW-66	MW-66	MW-66	MW-66
			Oct-20	Nov-21	Dec-22	Nov-23
Arsenic	µg/L	10	17	na	15	<5 U
TPH-Total	µg/L	1000	790	1020	970	1100

COE Drain Oil Water Separator

Parameter	Units	Cleanup Level	SEP-OUT	SEP-OUT	SEP-OUT	SEP-OUT
			Oct-20	Nov-21	Dec-22	Nov-23
Tetrachloroethene (PCE)	µg/L	1.75	0.33	2.2	0.36 J	1.9

Notes:
"<" - indicates compound was not detected; followed by the reporting limit
µg/L = micrograms per liter
*Highlighted concentration is above the cleanup level.
na - 11/21 arsenic analysis in MW-66 was inadvertently omitted from the requested analyses

Figures



LEGEND

- MW-48 MONITORING WELL LOCATION
- REMEDIATION AREA BOUNDARY

NOTE(S)

1. BASE MAP MODIFIED FROM UNDATED USCOE DRAWING FILES TITLED "93-S1.DWG" AND "93-S2.DWG", AND ON DRAWING TITLED "PROPOSED TRENCH RECOVERY SYSTEM", BY ASSOCIATED EARTH SCIENCES, INC., UNDATED, AND ON DRAWING BY HDR ENGINEERS, FILE NAME "WASHST.DWG", DATED 1/22/99.

CLIENT
PASCO BULK FUEL TERMINALS SITE COORDINATING GROUP

CONSULTANT
wsp

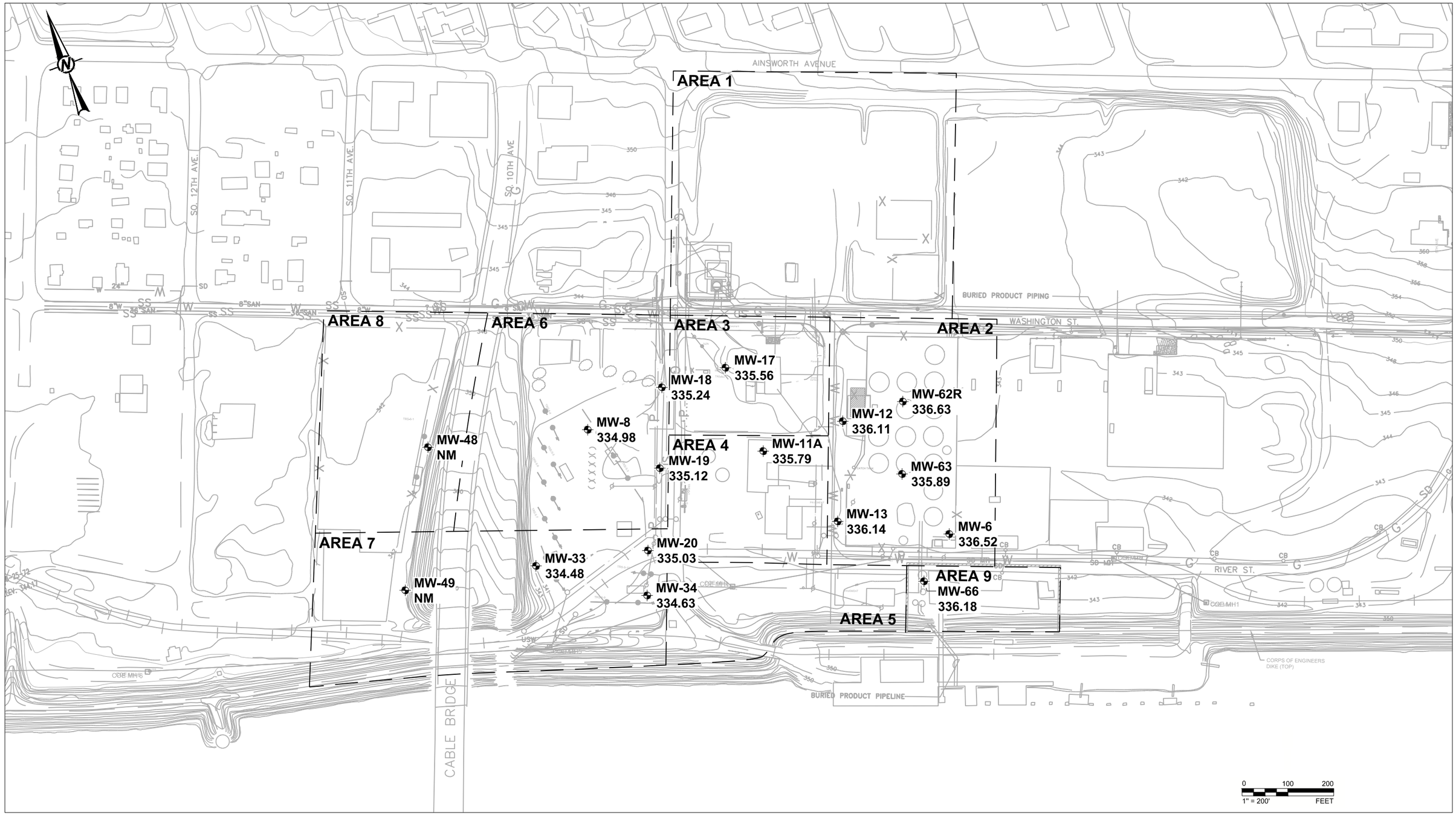
YYYY-MM-DD	2024-01-22
DESIGNED	GZ
PREPARED	REDMOND
REVIEWED	GZ
APPROVED	GZ

PROJECT
SITE CLEANUP
PASCO BULK FUEL TERMINALS SITE

TITLE
SITE MAP

PROJECT NO.	PHASE	REV.	FIGURE
003102521	200	A	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

MW-33 334.78	MONITORING WELL LOCATION AND GROUNDWATER ELEVATION (FEET)
——— ———	REMEDIATION AREA BOUNDARY
NM	NOT MEASURED (SEE TABLE 3)

NOTE(S)

1. BASE MAP MODIFIED FROM UNDATED USCOE DRAWING FILES TITLED "93-S1.DWG" AND "93-S2.DWG", AND ON DRAWING TITLED "PROPOSED TRENCH RECOVERY SYSTEM", BY ASSOCIATED EARTH SCIENCES, INC., UNDATED, AND ON DRAWING BY HDR ENGINEERS, FILE NAME "WASHST.DWG", DATED 1/22/99.

CLIENT
PASCO BULK FUEL TERMINALS SITE COORDINATING GROUP

CONSULTANT
wsp

YYYY-MM-DD	2024-01-22
DESIGNED	GZ
PREPARED	REDMOND
REVIEWED	GZ
APPROVED	GZ

PROJECT
SITE CLEANUP
PASCO BULK FUEL TERMINALS SITE

TITLE
MNA PERFORMANCE MONITORING WELL GROUNDWATER ELEVATIONS - NOVEMBER 2023

PROJECT NO.	PHASE	REV.	FIGURE
003102521	200	A	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in
0

APPENDIX A

Complete Tabulated Results for Groundwater Samples – November 2023

Appendix A: Complete Tabulated Results for Groundwater Samples - November 2023

Sample Location	Date Sampled	Parameter	Result	Qualifier	PQL	MDL	Units
FBMW-12	06-Nov-23	Arsenic	0.005	U	0.005	0.001	mg/L
FBMW-12	06-Nov-23	Benzene	0.2	U	0.2	0.03	ug/L
FBMW-12	06-Nov-23	TPH-Diesel	0.12	U	0.12	0.07	mg/L
FBMW-12	06-Nov-23	TPH-Gas	0.1	U	0.1	0.014	mg/L
FBMW-12	06-Nov-23	TPH-Oil	0.38	U	0.38	0.1	mg/L
FBMW-20	06-Nov-23	Tetrachloroethene (PCE)	0.5	U	0.5	0.084	ug/L
MW-06	06-Nov-23	Arsenic	0.088		0.005	0.001	mg/L
MW-08	06-Nov-23	Alkalinity	290		7	7	mg/L
MW-08	06-Nov-23	Iron	2.4		0.5	0.067	mg/L
MW-08	06-Nov-23	Manganese	2.4		0.01	0.0023	mg/L
MW-08	06-Nov-23	Methane	1100		5	0.63	ug/L
MW-08	06-Nov-23	Nitrate + Nitrite (as N)	0.15	U	0.15	0.06	mg/L
MW-08	06-Nov-23	Sulfate	1.5	U	1.5	0.8	mg/L
MW-08	06-Nov-23	TPH-Diesel	1.1		0.12	0.072	mg/L
MW-08	06-Nov-23	TPH-Gas	2.1		0.1	0.014	mg/L
MW-08	06-Nov-23	TPH-Oil	0.39	U	0.39	0.11	mg/L
MW-11A	06-Nov-23	Alkalinity	350		7	7	mg/L
MW-11A	06-Nov-23	Arsenic	0.094		0.005	0.001	mg/L
MW-11A	06-Nov-23	Iron	5.4		0.5	0.067	mg/L
MW-11A	06-Nov-23	Manganese	2.4		0.01	0.0023	mg/L
MW-11A	06-Nov-23	Methane	6300		5	0.63	ug/L
MW-11A	06-Nov-23	Nitrate + Nitrite (as N)	0.15	U	0.15	0.06	mg/L
MW-11A	06-Nov-23	Sulfate	1.9		1.5	0.8	mg/L
MW-11A	06-Nov-23	TPH-Diesel	0.87		0.12	0.069	mg/L
MW-11A	06-Nov-23	TPH-Gas	2.2		0.1	0.014	mg/L
MW-11A	06-Nov-23	TPH-Oil	0.37	U	0.37	0.1	mg/L
MW-11A dup-75A	06-Nov-23	Alkalinity	350		7	7	mg/L
MW-11A dup-75A	06-Nov-23	Arsenic	0.093		0.005	0.001	mg/L
MW-11A dup-75A	06-Nov-23	Iron	5.4		0.5	0.067	mg/L
MW-11A dup-75A	06-Nov-23	Manganese	2.4		0.01	0.0023	mg/L
MW-11A dup-75A	06-Nov-23	Methane	5900		5	0.63	ug/L
MW-11A dup-75A	06-Nov-23	Nitrate + Nitrite (as N)	0.15	U	0.15	0.06	mg/L
MW-11A dup-75A	06-Nov-23	Sulfate	2		1.5	0.8	mg/L
MW-11A dup-75A	06-Nov-23	TPH-Diesel	0.74		0.11	0.065	mg/L
MW-11A dup-75A	06-Nov-23	TPH-Gas	2.3		0.1	0.014	mg/L
MW-11A dup-75A	06-Nov-23	TPH-Oil	0.35	U	0.35	0.096	mg/L
MW-12	06-Nov-23	Alkalinity	290		7	7	mg/L
MW-12	06-Nov-23	Arsenic	0.038		0.005	0.001	mg/L
MW-12	06-Nov-23	Benzene	8.1		0.2	0.03	ug/L
MW-12	06-Nov-23	Iron	3.3		0.5	0.067	mg/L
MW-12	06-Nov-23	Manganese	1.2		0.01	0.0023	mg/L
MW-12	06-Nov-23	Methane	1500		5	0.63	ug/L
MW-12	06-Nov-23	Nitrate + Nitrite (as N)	0.1	UJ	0.15	0.06	mg/L
MW-12	06-Nov-23	Sulfate	2.4		1.5	0.8	mg/L
MW-12	06-Nov-23	TPH-Diesel	0.84		0.11	0.067	mg/L
MW-12	06-Nov-23	TPH-Gas	1.9		0.1	0.014	mg/L
MW-12	06-Nov-23	TPH-Oil	0.36	U	0.36	0.099	mg/L
MW-13	06-Nov-23	Arsenic	0.061		0.005	0.001	mg/L
MW-17	06-Nov-23	Arsenic	0.01		0.005	0.001	mg/L
MW-18	06-Nov-23	Alkalinity	250		7	7	mg/L
MW-18	06-Nov-23	Iron	0.085	J	0.5	0.067	mg/L
MW-18	06-Nov-23	Manganese	0.34		0.01	0.0023	mg/L
MW-18	06-Nov-23	Methane	5	U	5	0.63	ug/L
MW-18	06-Nov-23	Nitrate + Nitrite (as N)	7		0.15	0.06	mg/L
MW-18	06-Nov-23	Sulfate	62		1.5	0.8	mg/L

Appendix A: Complete Tabulated Results for Groundwater Samples - November 2023

Sample Location	Date Sampled	Parameter	Result	Qualifier	PQL	MDL	Units
MW-19	06-Nov-23	Arsenic	0.086		0.005	0.001	mg/L
MW-19	06-Nov-23	TPH-Diesel	0.31		0.11	0.067	mg/L
MW-19	06-Nov-23	TPH-Gas	0.44		0.1	0.014	mg/L
MW-19	06-Nov-23	TPH-Oil	0.36	U	0.36	0.099	mg/L
MW-20	06-Nov-23	Tetrachloroethene (PCE)	5.7		0.5	0.084	ug/L
MW-33	06-Nov-23	Alkalinity	290		7	7	mg/L
MW-33	06-Nov-23	Iron	3		0.5	0.067	mg/L
MW-33	06-Nov-23	Manganese	3		0.01	0.0023	mg/L
MW-33	06-Nov-23	Methane	3900		5	0.63	ug/L
MW-33	06-Nov-23	Nitrate + Nitrite (as N)	0.77		0.15	0.06	mg/L
MW-33	06-Nov-23	Sulfate	17		1.5	0.8	mg/L
MW-33	06-Nov-23	TPH-Diesel	1.6		0.12	0.073	mg/L
MW-33	06-Nov-23	TPH-Gas	3.7		0.1	0.014	mg/L
MW-33	06-Nov-23	TPH-Oil	0.39	U	0.39	0.11	mg/L
MW-34	06-Nov-23	Alkalinity	320		7	7	mg/L
MW-34	06-Nov-23	Arsenic	0.023		0.005	0.001	mg/L
MW-34	06-Nov-23	Iron	1.5		0.5	0.067	mg/L
MW-34	06-Nov-23	Manganese	1.1		0.01	0.0023	mg/L
MW-34	06-Nov-23	Methane	2300		5	0.63	ug/L
MW-34	06-Nov-23	Nitrate + Nitrite (as N)	0.15	U	0.15	0.06	mg/L
MW-34	06-Nov-23	Sulfate	10		1.5	0.8	mg/L
MW-34	06-Nov-23	TPH-Diesel	0.76		0.11	0.067	mg/L
MW-34	06-Nov-23	TPH-Gas	1.3		0.1	0.014	mg/L
MW-34	06-Nov-23	TPH-Oil	0.36	U	0.36	0.098	mg/L
MW-48	07-Nov-23	Arsenic	0.019		0.005	0.001	mg/L
MW-49	07-Nov-23	Tetrachloroethene (PCE)	14		0.5	0.084	ug/L
MW-49	07-Nov-23	Trichloroethene (TCE)	1.6		0.2	0.066	ug/L
MW-49 dup-79	07-Nov-23	Tetrachloroethene (PCE)	14		0.5	0.084	ug/L
MW-49 dup-79	07-Nov-23	Trichloroethene (TCE)	1.6		0.2	0.066	ug/L
MW-62R	06-Nov-23	Alkalinity	180		7	7	mg/L
MW-62R	06-Nov-23	Iron	0.1	J	0.5	0.067	mg/L
MW-62R	06-Nov-23	Manganese	0.0046	J	0.01	0.0023	mg/L
MW-62R	06-Nov-23	Methane	5	U	5	0.63	ug/L
MW-62R	06-Nov-23	Nitrate + Nitrite (as N)	3.1		0.15	0.06	mg/L
MW-62R	06-Nov-23	Sulfate	59		1.5	0.8	mg/L

Appendix A: Complete Tabulated Results for Groundwater Samples - November 2023

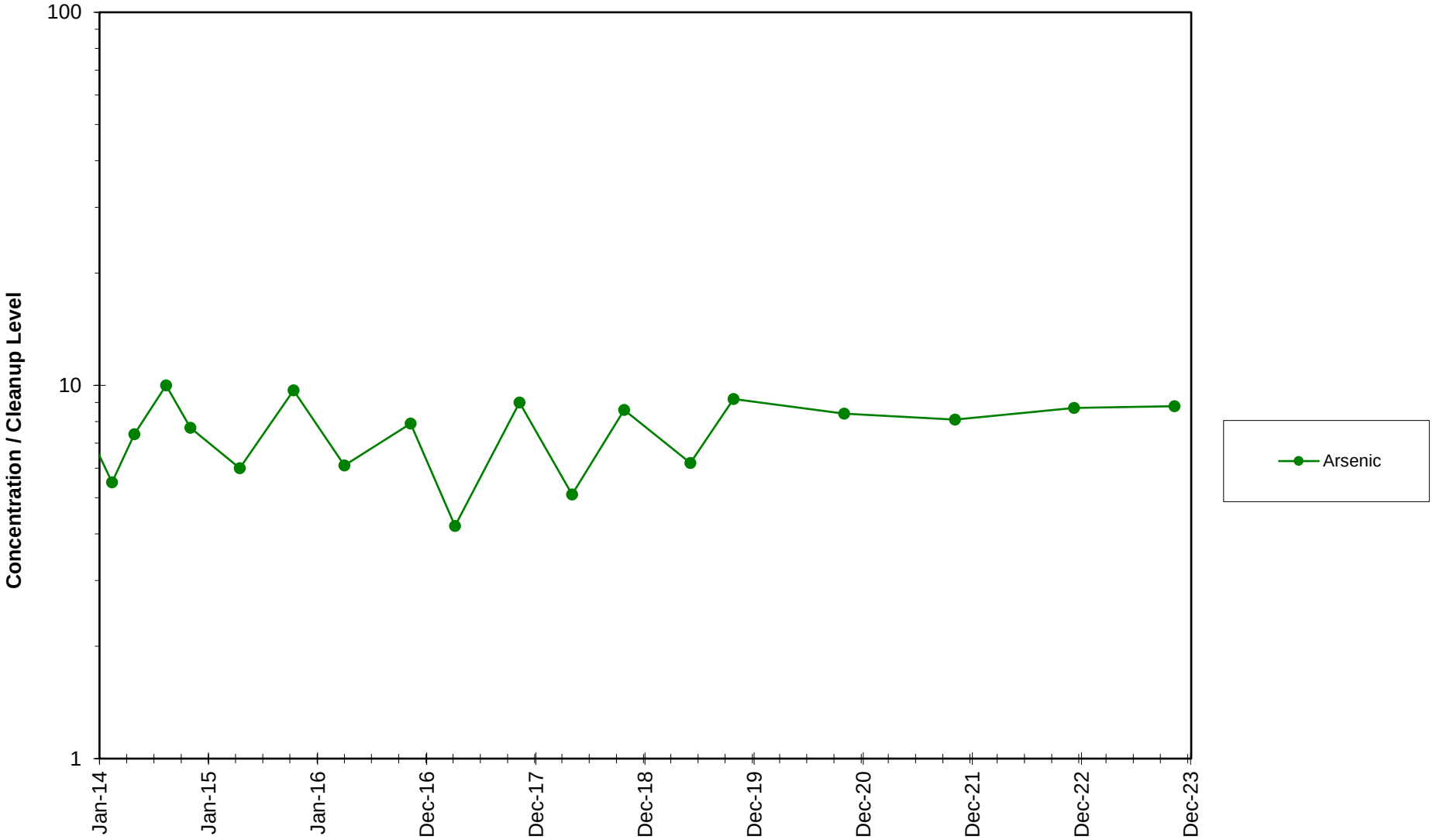
Sample Location	Date Sampled	Parameter	Result	Qualifier	PQL	MDL	Units
MW-63	06-Nov-23	Alkalinity	640		7	7	mg/L
MW-63	06-Nov-23	Arsenic	0.069		0.005	0.001	mg/L
MW-63	06-Nov-23	Benzene	70		2	0.3	ug/L
MW-63	06-Nov-23	Iron	1.7		0.5	0.067	mg/L
MW-63	06-Nov-23	Manganese	0.21		0.01	0.0023	mg/L
MW-63	06-Nov-23	Methane	1500		5	0.63	ug/L
MW-63	06-Nov-23	Nitrate + Nitrite (as N)	0.3		0.15	0.06	mg/L
MW-63	06-Nov-23	Sulfate	5.1		1.5	0.8	mg/L
MW-63	06-Nov-23	TPH-Diesel	0.48		0.11	0.065	mg/L
MW-63	06-Nov-23	TPH-Gas	0.94		0.1	0.014	mg/L
MW-63	06-Nov-23	TPH-Oil	0.35	U	0.35	0.097	mg/L
MW-66	06-Nov-23	Arsenic	0.005	U	0.005	0.001	mg/L
MW-66	06-Nov-23	TPH-Diesel	0.3		0.11	0.066	mg/L
MW-66	06-Nov-23	TPH-Gas	0.8		0.1	0.014	mg/L
MW-66	06-Nov-23	TPH-Oil	0.36	U	0.36	0.098	mg/L
SEP-OUT	07-Nov-23	Tetrachloroethene (PCE)	1.9		0.5	0.084	ug/L

Notes:
dupl = duplicate, PQL = practical quantitation limit, MDL = method detection limit, TPH = total petroleum hydrocarbons
FB = Field Blank, mg/L = milligrams per liter, ug/L = micrograms per liter TB = Trip Blanks
SEP-OUT is the outlet of the COE drain oil-water separator
U qualifier: Compound was not detected
UJ qualifier: Compound was not detected, the reporting limit is approximate due to minor data validation issue
J+ qualifier: The result is an estimated quantity; the result may be biased high
J qualifier: The result is an estimated quantity
J- qualifier: The result is an estimated quantity; the result may be biased low

APPENDIX B

Trend Graphs

Area 2 MW-06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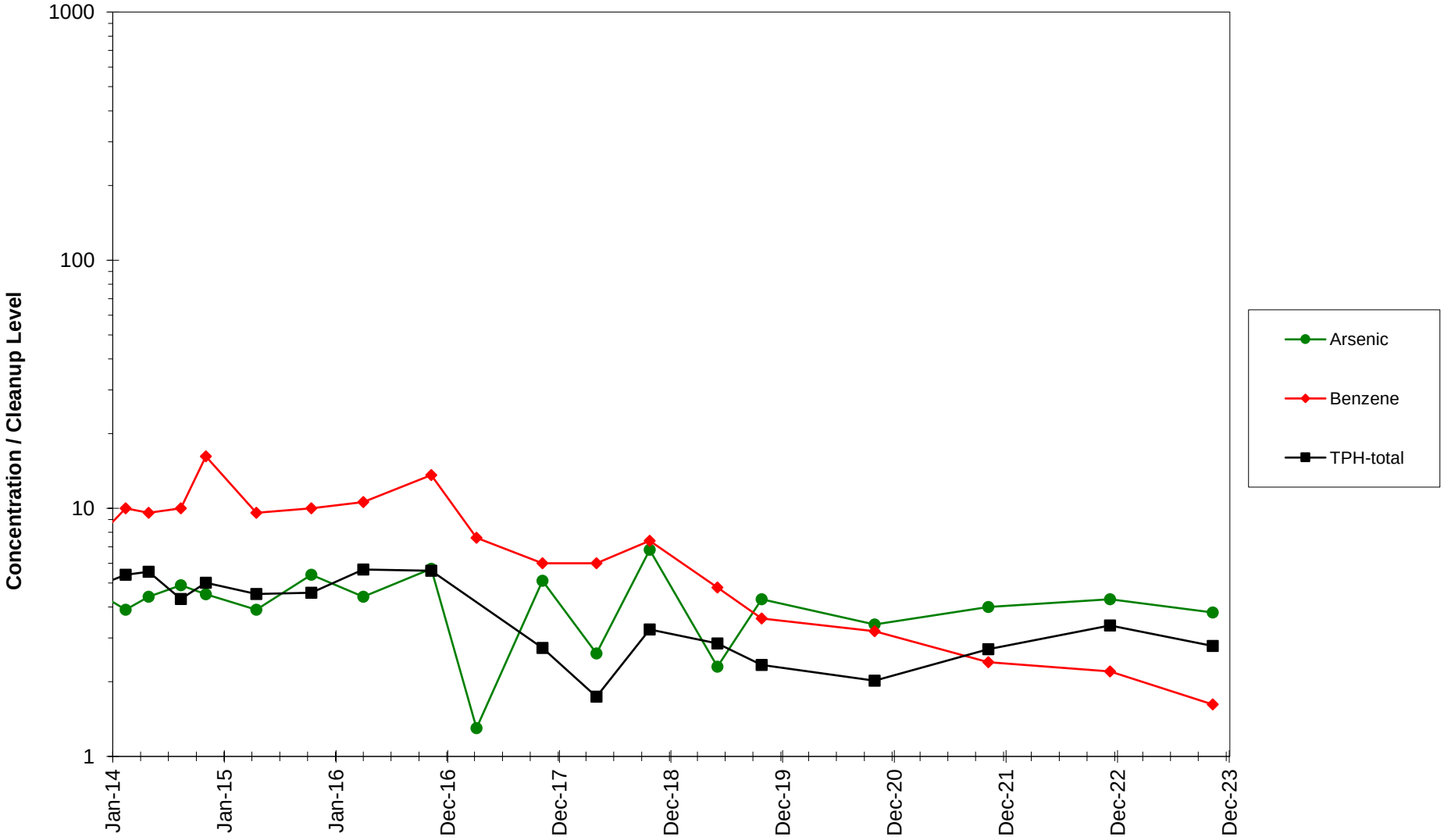
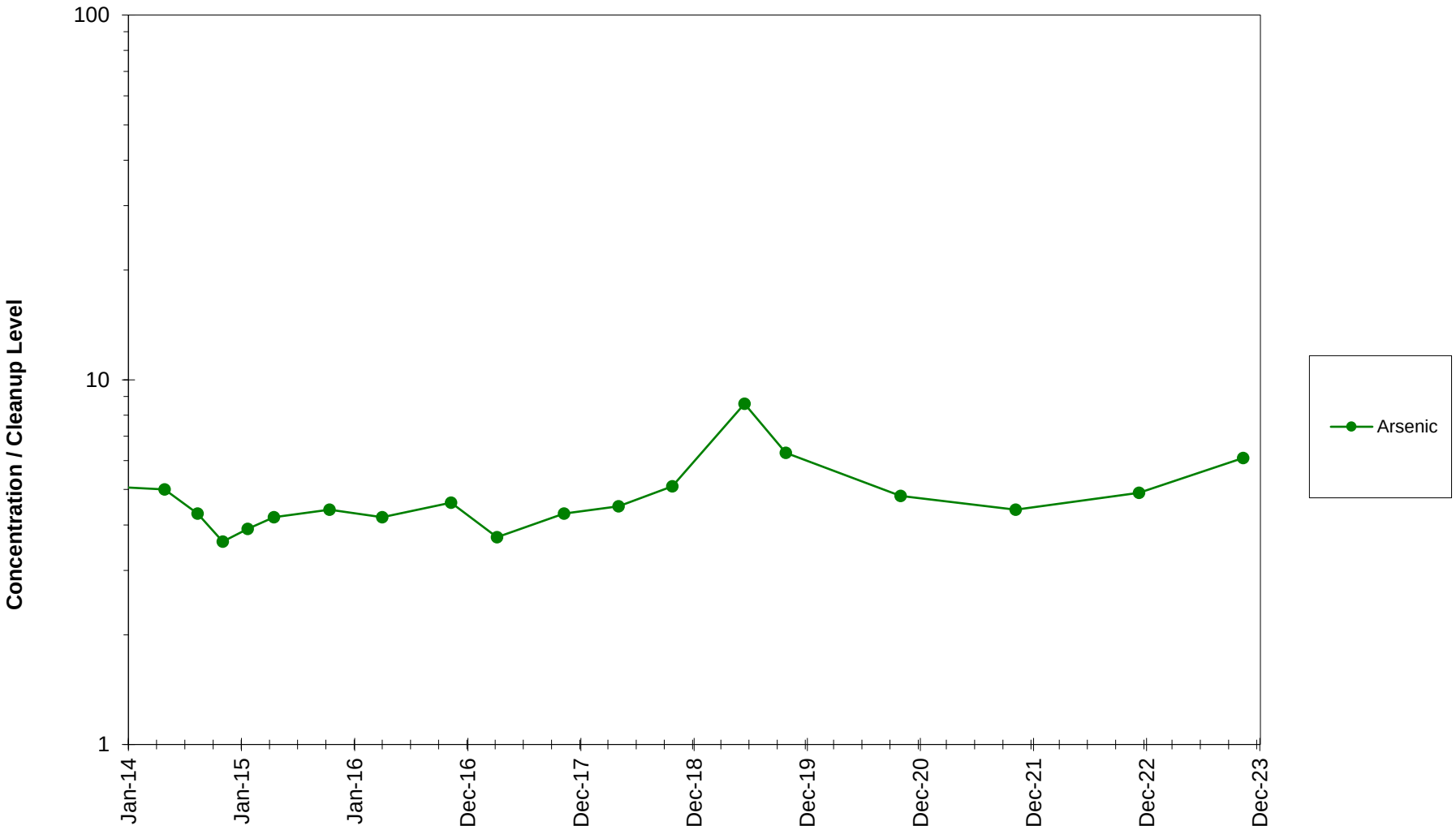
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
Dec-23
Arsenic

Area 2 MW-12


1000
100
10
1
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
Dec-23
Arsenic
Benzene
TPH-total

Area 2 MW-13



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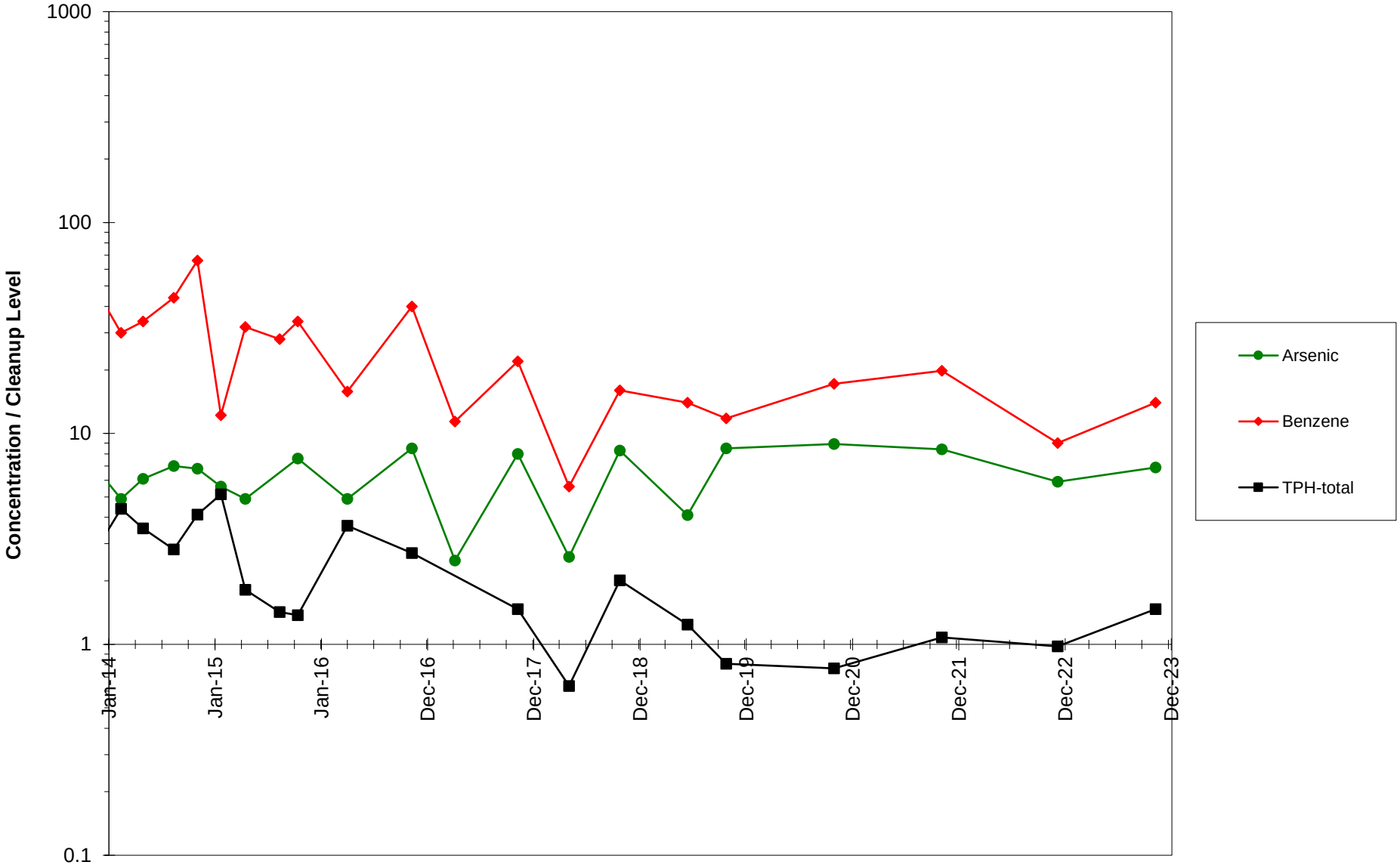
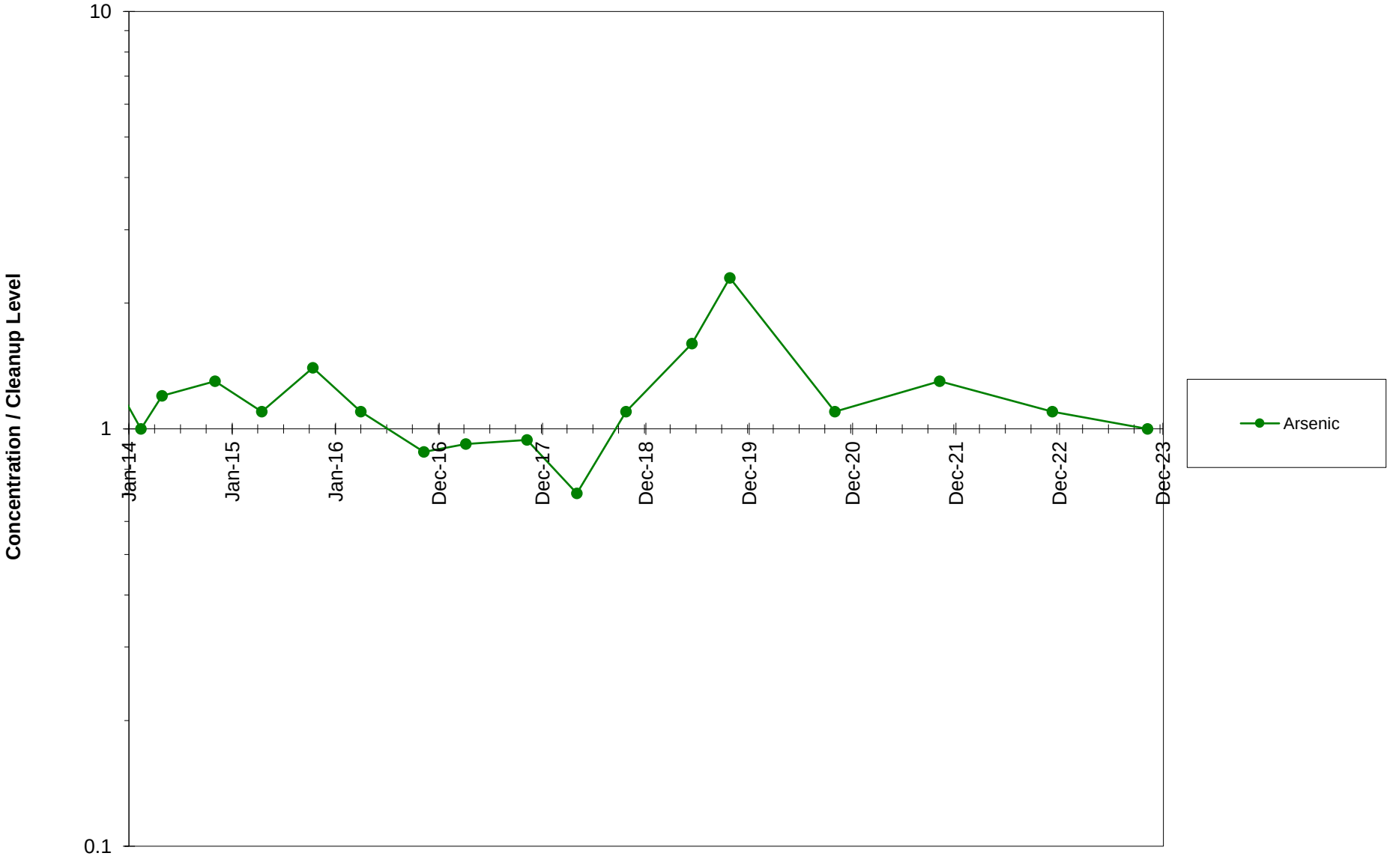
Area 2 MW-63


1000
100
10
1
0.1
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
Dec-23
Arsenic
Benzene
TPH-total

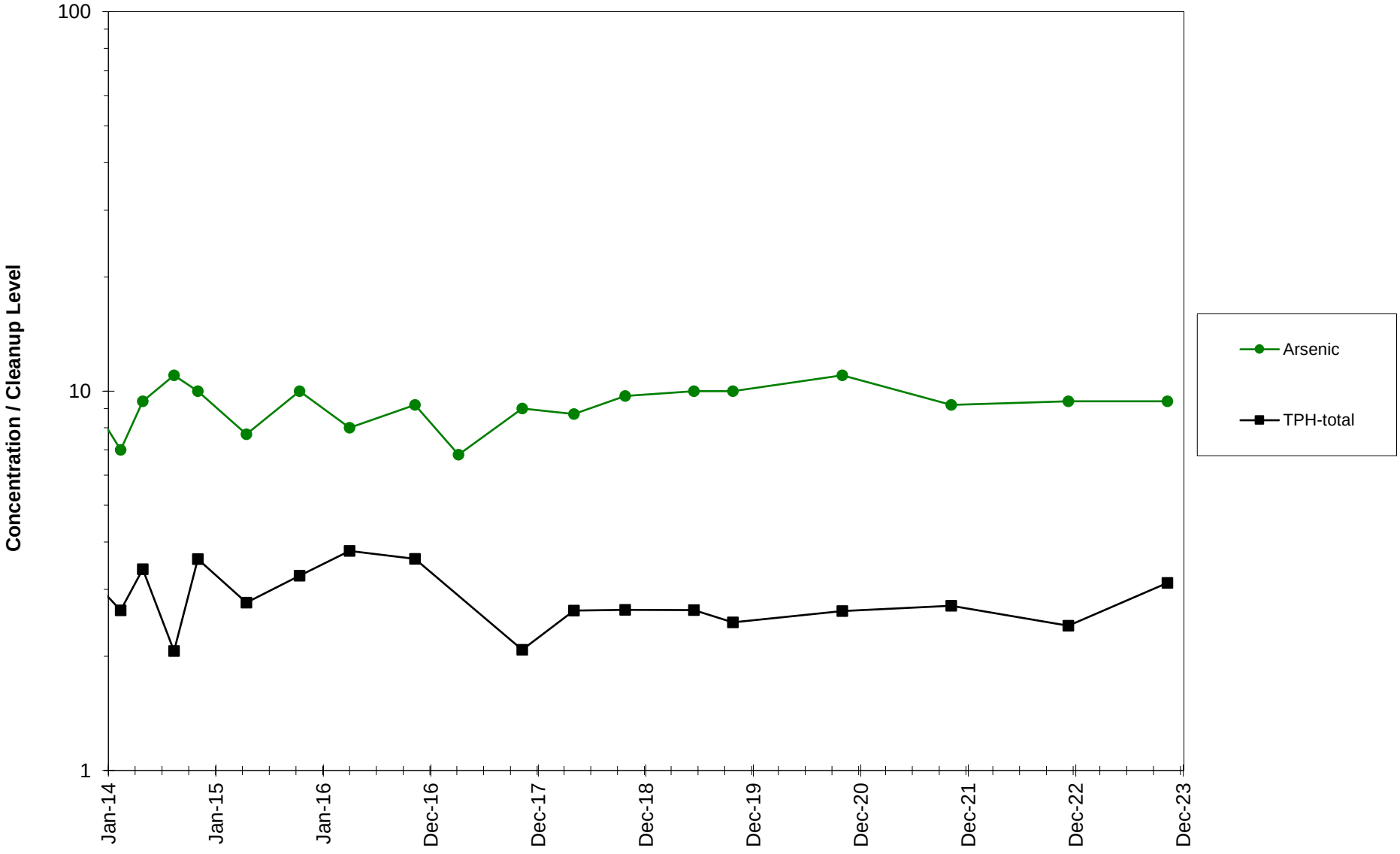
Area 3 MW-17



WSP USA Inc.

Area3.xlsx, Area 3 MW-17

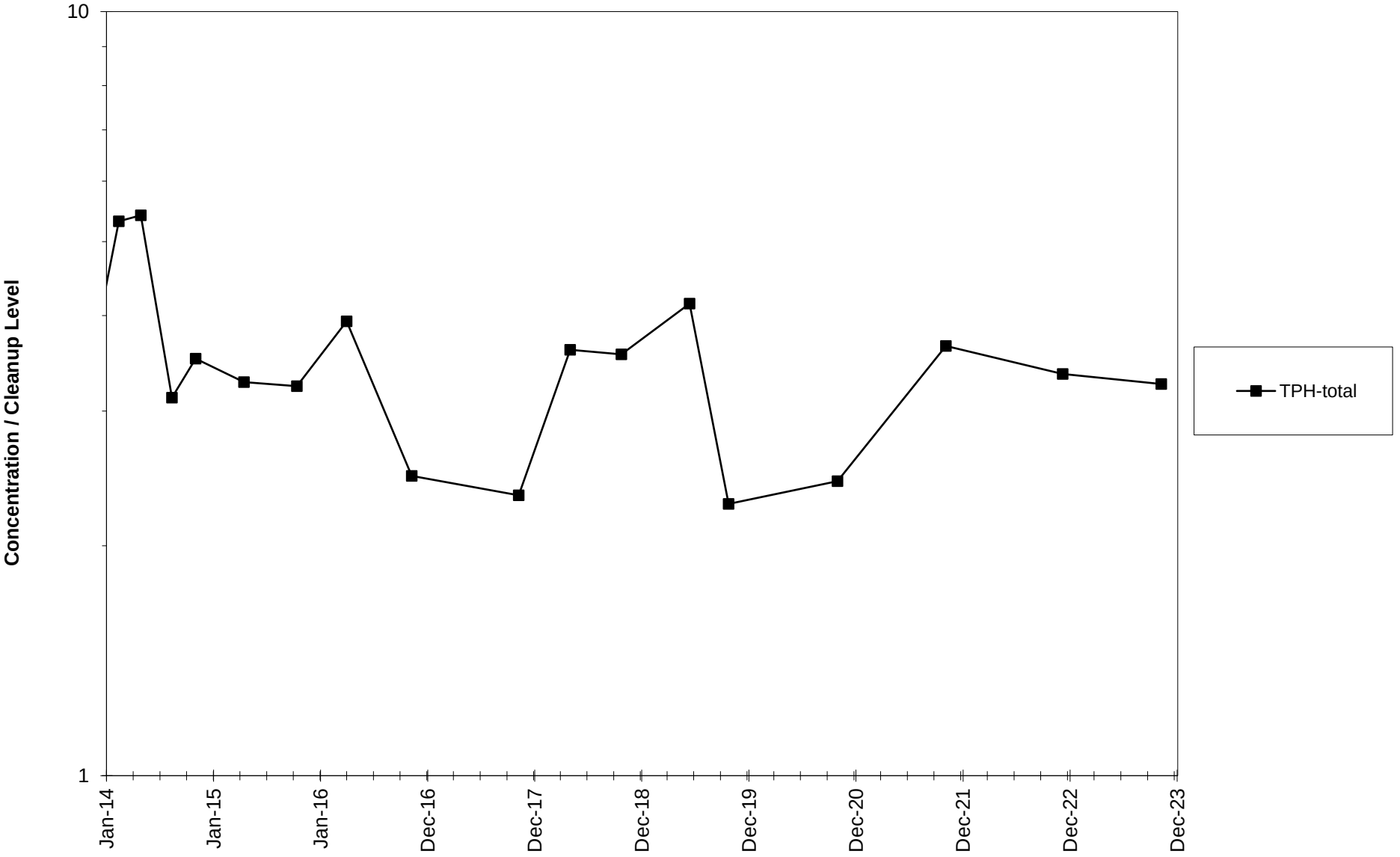
Area 4 MW-11A



WSP USA Inc.

Area4.xlsx, Area 4 MW-11A

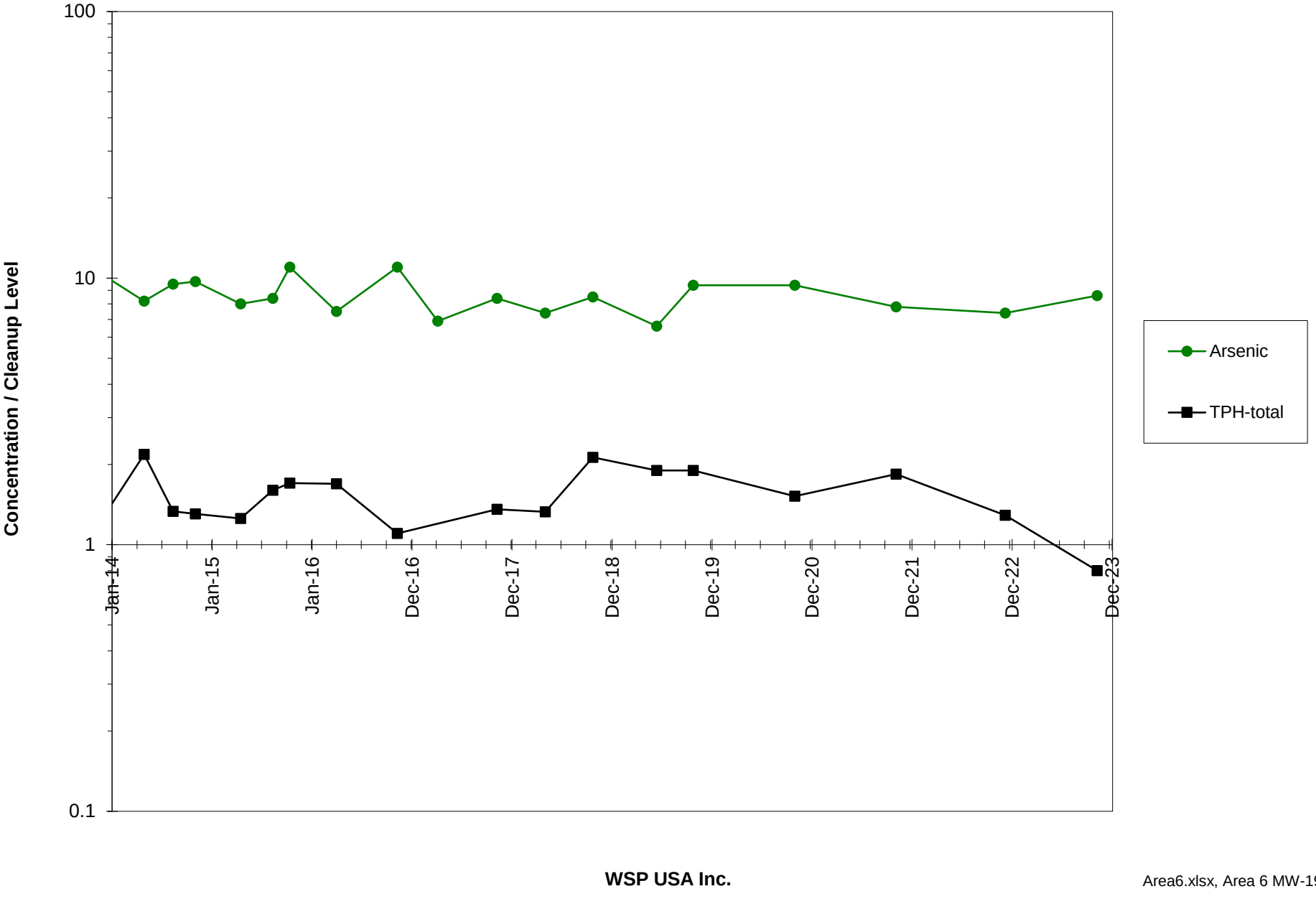
Area 6 MW-08



WSP USA Inc.

Area6.xlsx, Area 6 MW-08

Area 6 MW-19


100
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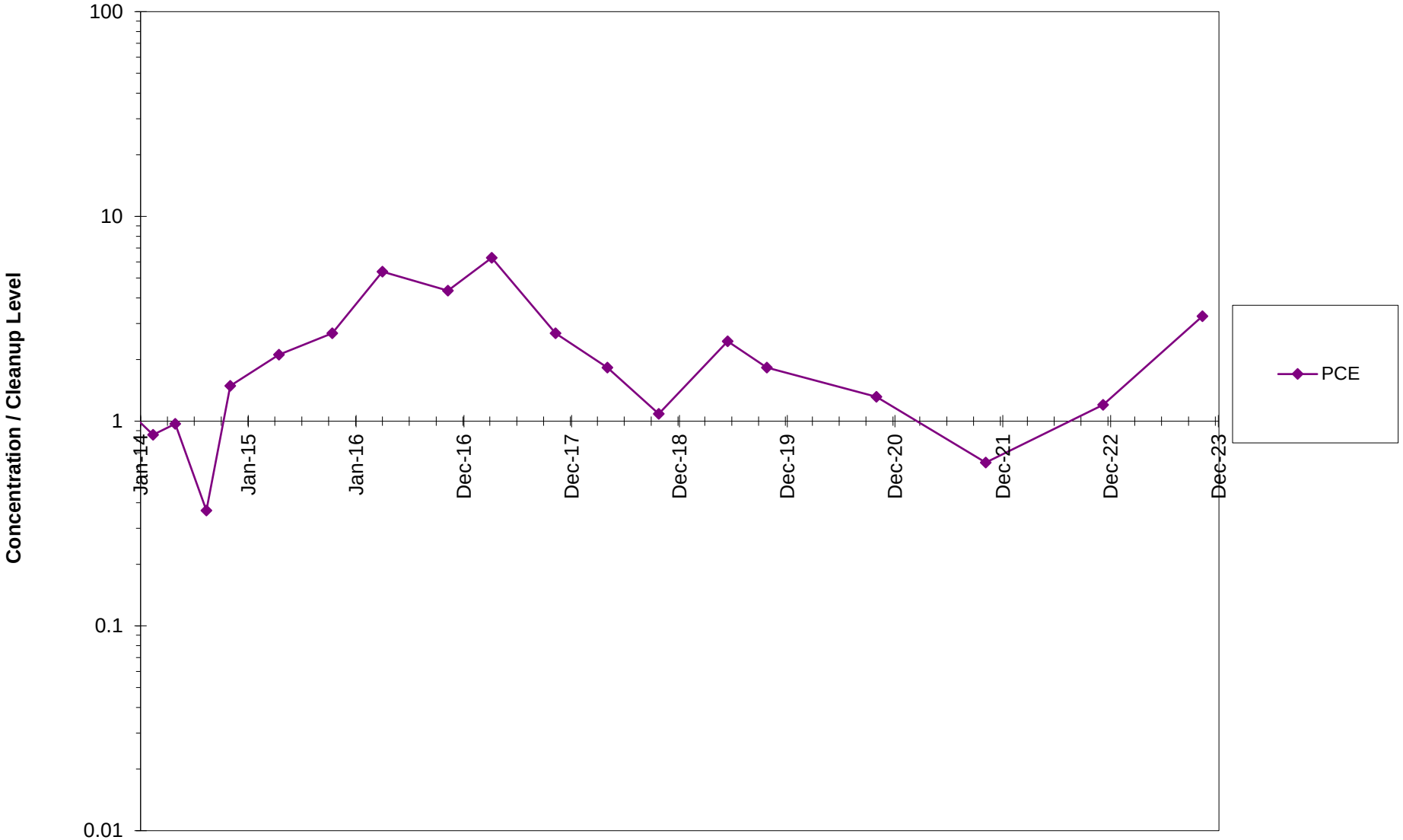
1
0.1
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
Dec-23
Arsenic
TPH-total

Area 7 MW-20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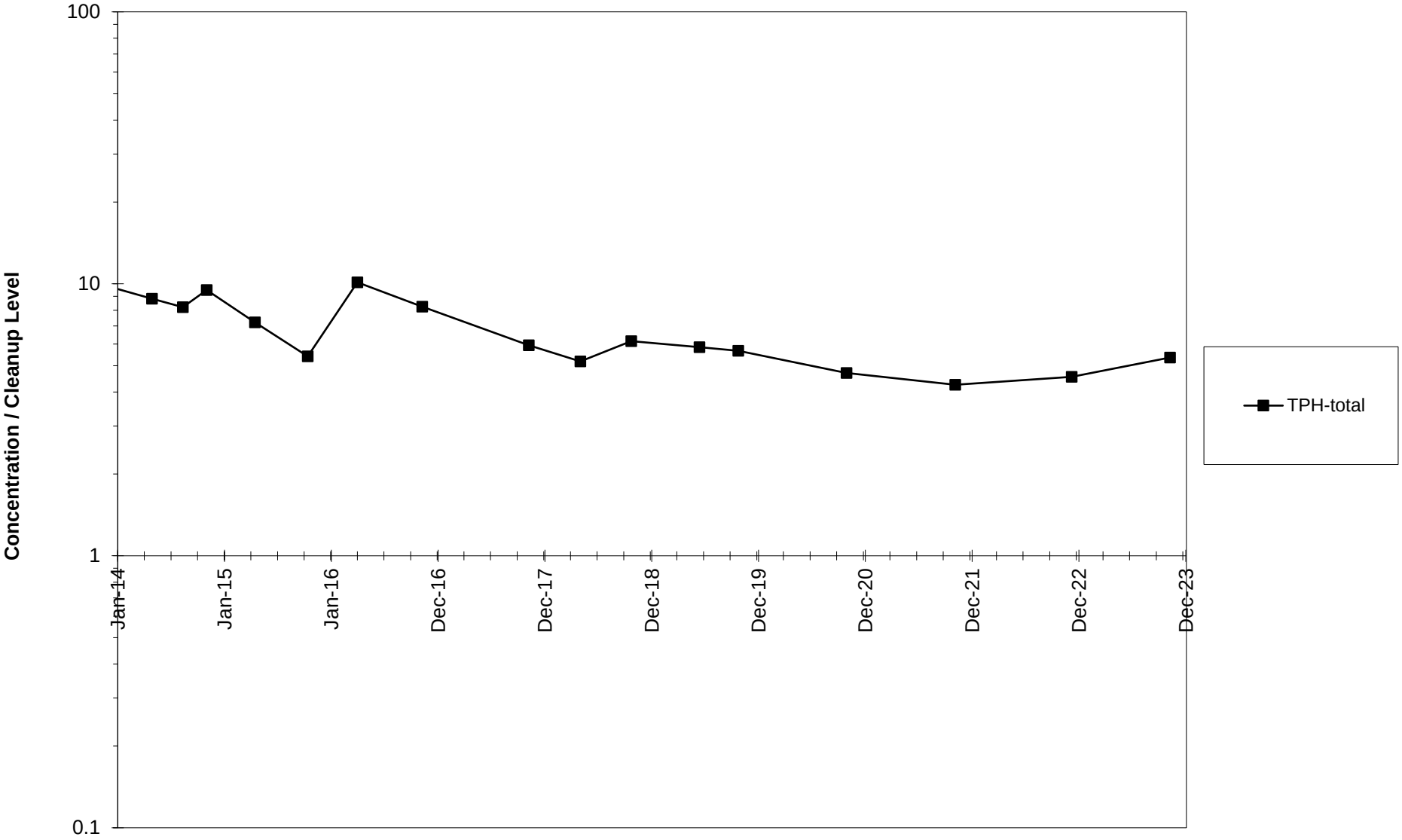
1
0.1
0.01
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
Dec-23
PCE

Area 7 MW-33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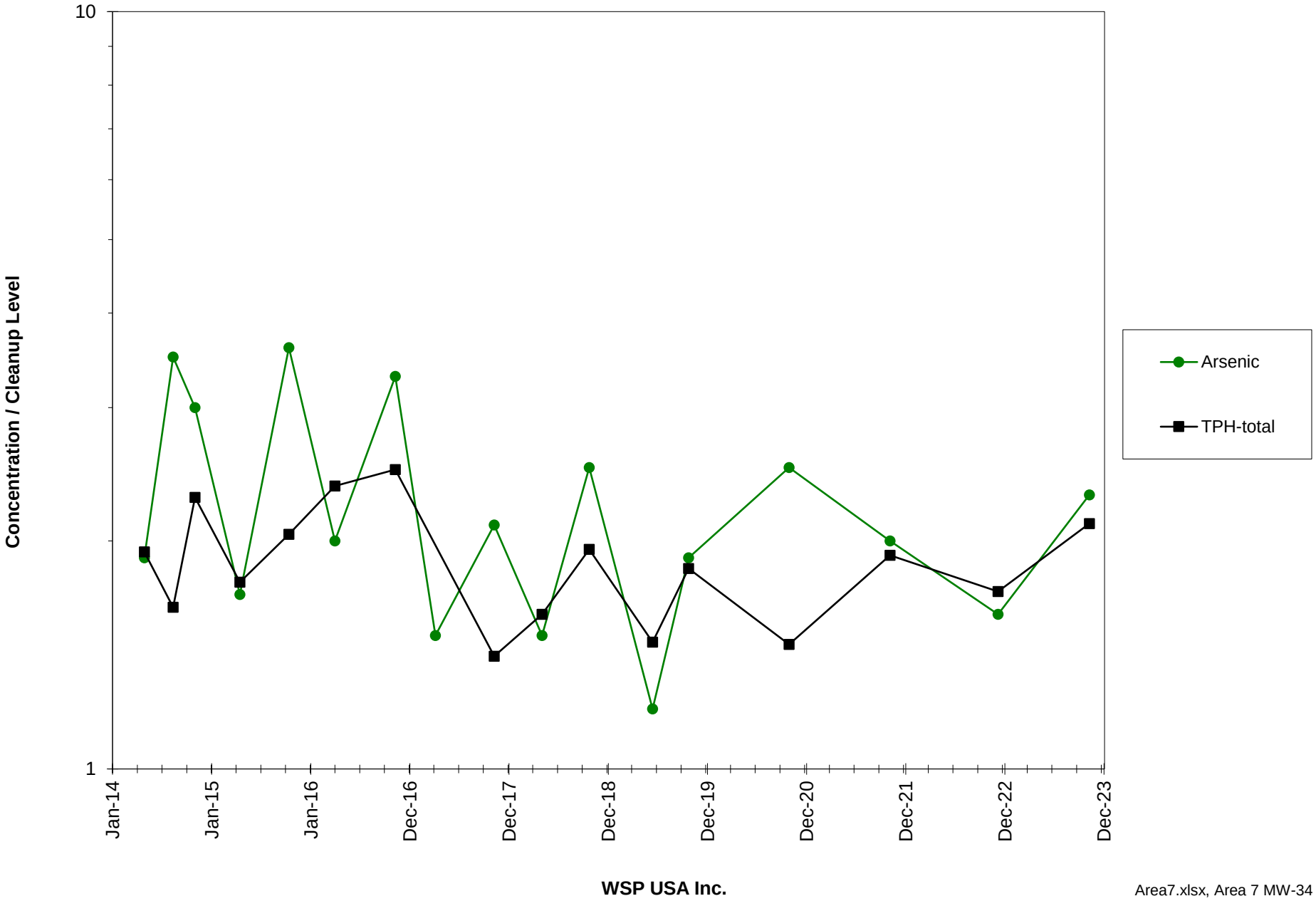
10
1
0.1
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
Dec-23
TPH-total

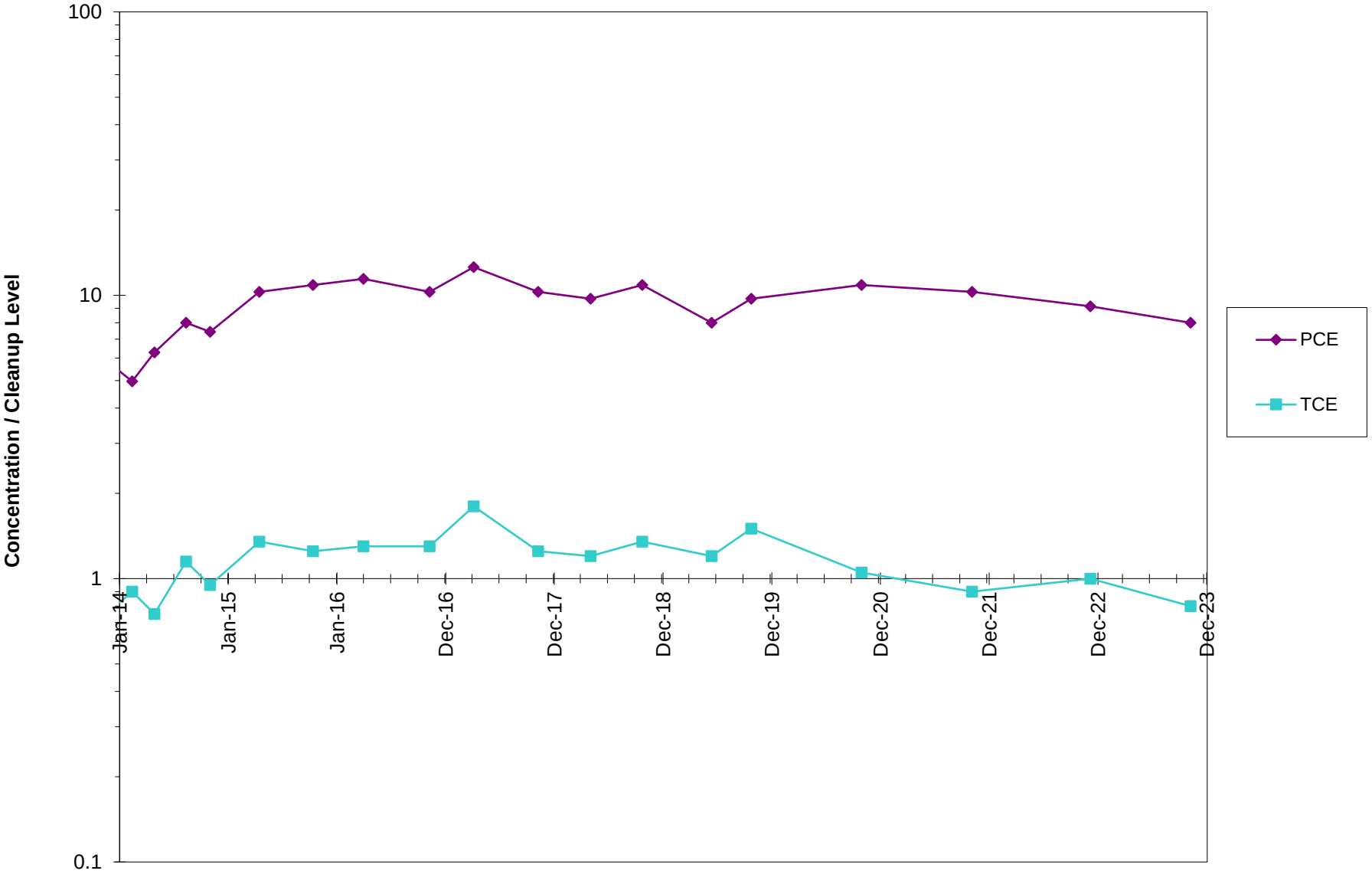
Area 7 MW-34



WSP USA Inc.

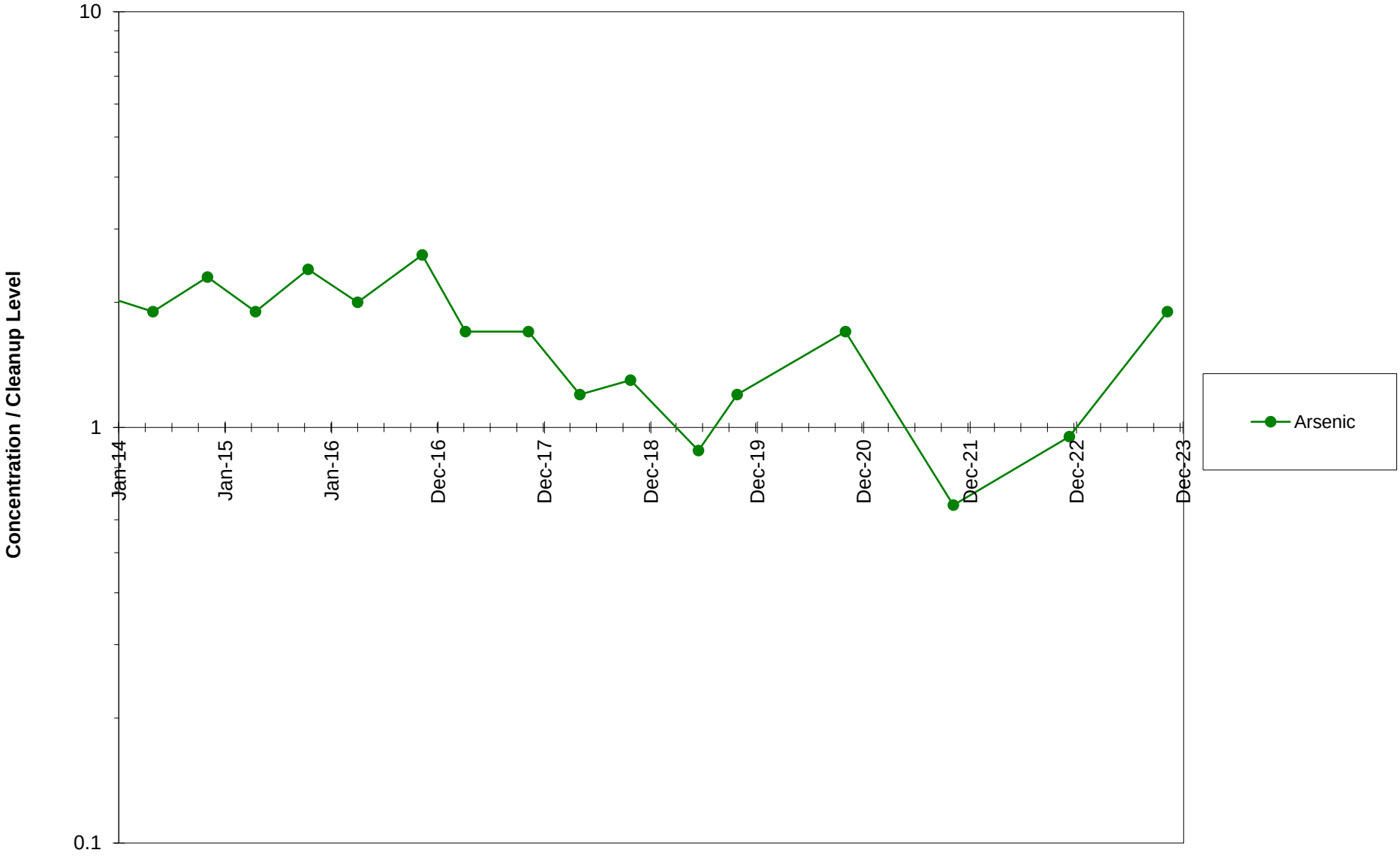
Area7.xlsx, Area 7 MW-34

Area 7 MW-49



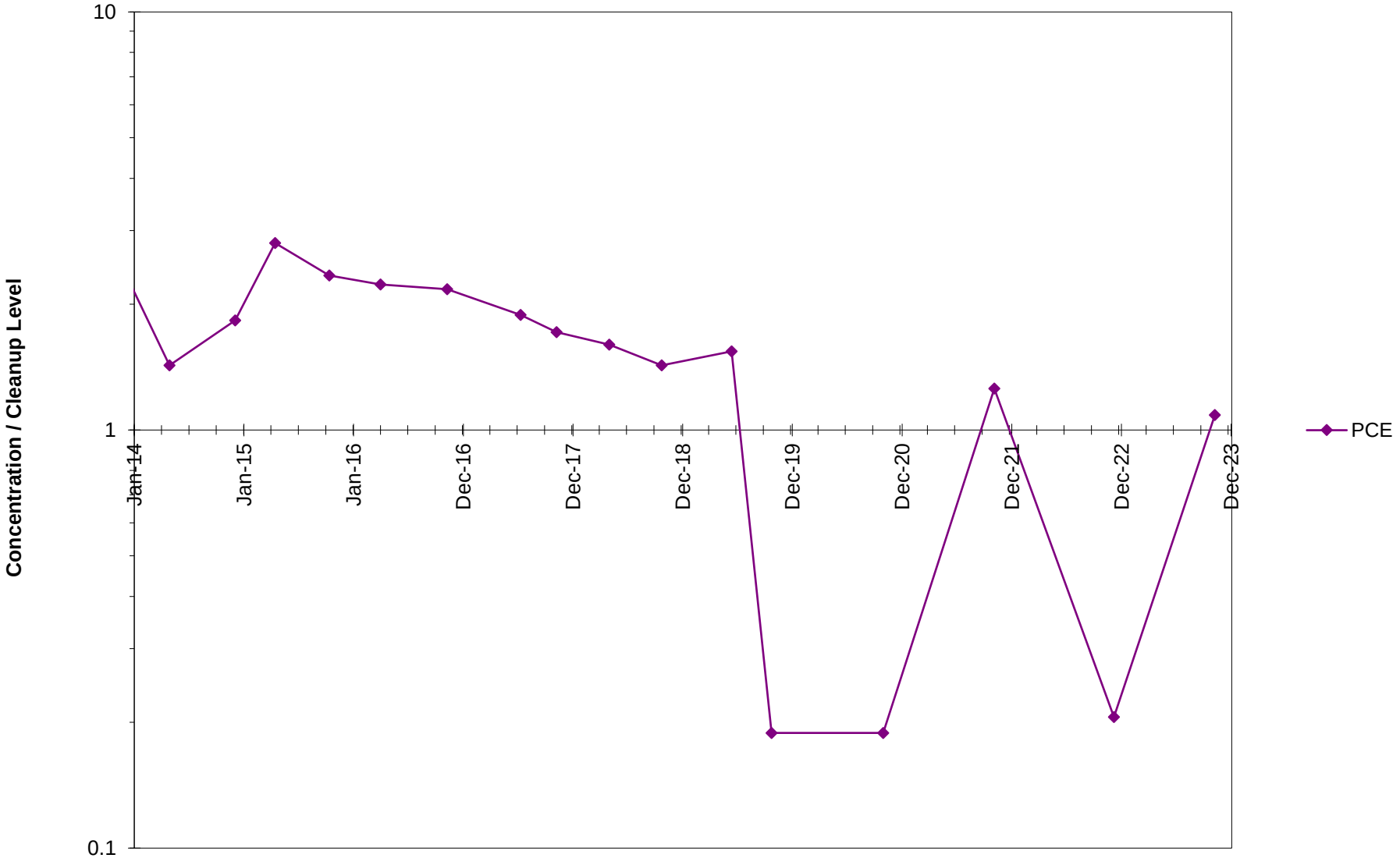
WSP USA Inc.

Area 8 MW-48


10
1
0.1
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
Dec-20
Dec-21
Dec-22
Dec-23
Arsenic

COE Separator Out (1)

OWS — Separator Out



wsp.com