REPORT

JUNE 2019 GROUNDWATER MONITORING PASCO BULK FUEL TERMINALS SITE

Submitted to:

Pasco Bulk Fuel Terminals Site Coordinating Group

Submitted by:

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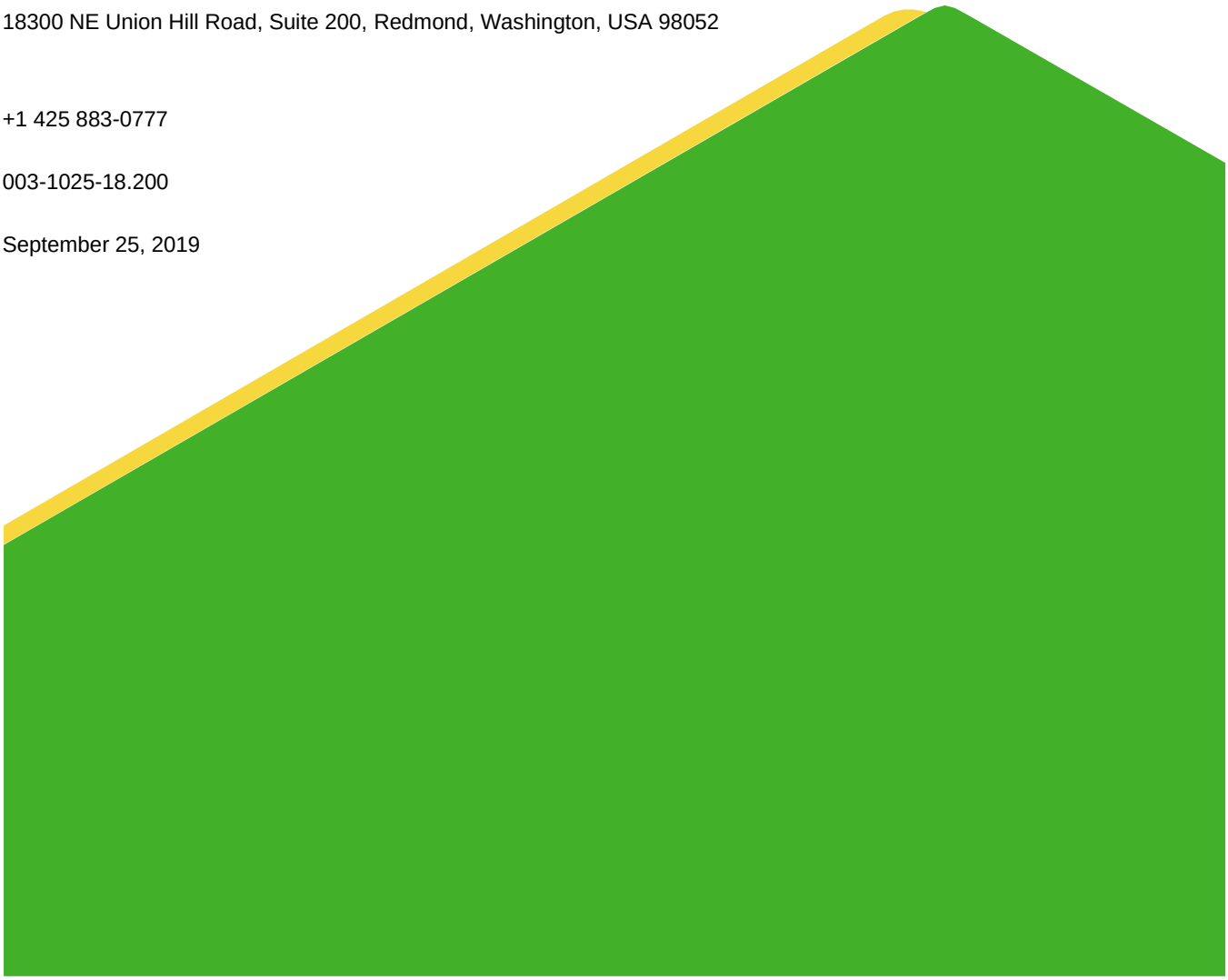

Distribution List

Pasco Bulk Fuel Terminals Site Coordinating Group

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ACRONYMS AND ABBREVIATIONS

As	Arsenic
CMP	Compliance Monitoring Plan
COE	United States Army Corps of Engineers
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
Golder	Golder Associates Inc.
HDPE	High-density polyethylene
IAS	In-situ air sparging
MCL	Maximum Contaminant Limit
MDL	Method detection limit
ml/min	Milliliters per minute
MNA	Monitored Natural Attenuation
PCE	Perchloroethylene (tetrachloroethene)
PQL	Practical quantitation limit
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 June 2019 groundwater monitoring fieldwork conducted by Golder Associates 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 towards achieving cleanup across the Site. Based on SVE offgas 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 or 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 CAP [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 QAPP 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. The June 2019 sampling, described within this report, is the first sampling round conducted under the MNA Performance Monitoring Plan.

1.1 Field Work

The June 2019 groundwater monitoring was performed on June 12 and 13, 2019 and included the following activities:

- Groundwater monitoring was conducted on 19 groundwater-monitoring wells (MW-06, MW-08, MW-10A, MW-11A, MW-12, MW-13, MW-17, MW-18, MW-19, MW-20, MW-31, MW-33, MW-34, MW-47, MW-48, MW-49, MW-60, MW-62R, MW-63, and MW-66).
- Water level measurements were made on these wells.
- 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 Eh (i.e., reducing conditions) in source area wells as compared to background wells
- Higher iron (Fe+2), manganese (Mn+2), 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, and MW-63). The testing of these wells will allow 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 were used only once to avoid cross-contamination between wells. 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. Field probes (pH, temperature, specific conductance, and dissolved oxygen) were inserted into the flow cell from the top and were monitored 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 five 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

The stabilized field measurements for pH, temperature, specific conductance, and dissolved oxygen 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 June 2019 are presented in Figure 2 and Table 3.

2.2 Analytical Results

Groundwater samples were stored in the on-site refrigerator or in coolers with ice until delivered to Test America, an Ecology-certified laboratory 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 (“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.
- Iron and manganese concentrations are higher due to the reduction of Fe^{+3} and Mn^{+4}.
- Methane concentrations are significantly higher in the impacted wells as methane is produced during biodegradation under anaerobic conditions. Methane was not detected 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 slight long-term decreasing trend, except for MW-13 where the arsenic trend is slightly increasing since 2017. Benzene is above cleanup level in MW-12 and MW-63, with slight decreasing trend. TPH is above cleanup level in MW-13 and MW-63, with a slight decreasing trend.
- Area 3 – Arsenic is slightly above the cleanup level in MW-10A and MW-17. Concentrations detected fluctuate around the cleanup level.
- Area 4 – Arsenic and TPH are above the cleanup level in MW-11A, with no apparent recent trend. Trichloroethene (TCE) is above the cleanup level in MW-47 and has a slight downward trend since 2017.
- Area 6 – TPH is above the cleanup level in MW-08 and MW-19. Arsenic is above the cleanup level in MW-19. Concentrations of arsenic and TPH are steady to slightly decreasing.
- Area 7 – Perchloroethylene (PCE) is above the cleanup level in MW-20 and MW-49 and has been above the cleanup level in MW-31 but dropped below the cleanup level during the June 2019 sampling round. TCE is slightly above the cleanup level in MW-49. TPH is above the cleanup level in MW-33 and MW-34 and has a slight decreasing trend. Arsenic is slightly above the cleanup level in MW-34 and has a decreasing trend.
- Area 8 – Arsenic concentrations have been decreasing in MW-48 and were below the cleanup level during the June 2019 sampling round.
- COE Drain Oil-Water Separator - PCE is detected slightly above the 1.75 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.

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 occur not 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 indicate the following criteria have been achieved:

- Area 4 MW-47 – PCE has been below the cleanup level for 3 consecutive rounds, and PCE can move into confirmational monitoring.
- Area 7 MW-31 – TCE has been below cleanup level for 4 consecutive rounds and is now considered clean in MW-31. PCE concentration detected in MW-31 dropped below the cleanup level during the June 2019 round for the first time in the last four rounds; PCE analysis will continue in MW-31.

No other changes to the Performance Monitoring Plan (Golder 2019) are indicated.

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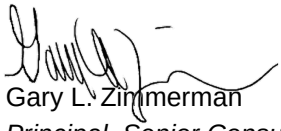

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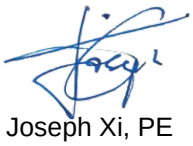

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Tables

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-10A	10/20/87	327,147	2,354,587	342.70	342.35	-0.35	13	12.5	10	2.5	12.5	340.2	330.2
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-21R	02/02/99	327,230	2,354,735	343.42	343.10	-0.32	14.5	14	10	3.4	13.4	340.0	330.0
MW-31	05/09/93	326,849	2,353,859	339.81	339.40	-0.41	9	8.5	7	3.0	8.0	336.8	331.8
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-47	08/16/94	326,943	2,354,388	341.0	340.24	-0.76	9	8.5	6	3.5	8.5	337.5	332.5
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-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 wells MW-46R and MW-62R
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	6/12/2019	14:20	6.49	693	16.2	0.18	8.8
MW-08	6/12/2019	7:40	5.23	706.0	17.2	0.24	36.1
MW-10A	6/12/2019	7:05	6.86	464.4	14.8	0.14	28.3
MW-11A	6/12/2019	8:13	6.88	615.0	15.6	0.14	-37.8
MW-12	6/12/2019	12:50	6.93	990.0	17.3	0.11	-25.2
MW-13	6/12/2019	10:45	7.03	705.0	17.4	0.20	-43.1
MW-17	6/12/2019	7:50	7.04	718.0	16.1	0.11	5.6
MW-18	6/12/2019	6:50	7.17	722.0	18.0	0.36	132.3
MW-19	6/12/2019	8:30	6.94	675.0	17.7	0.25	-71.9
MW-20	6/12/2019	10:10	4.91	564.0	17.1	0.30	25.6
MW-31	6/13/2019	7:40	8.47	860.0	16.8	0.55	3.4
MW-33	6/12/2019	12:50	4.14	704.0	15.9	0.31	81.9
MW-34	6/12/2019	10:50	4.34	734.0	18.9	0.44	80.6
MW-47	6/12/2019	9:55	7.21	503.0	17.7	0.41	36.7
MW-48	6/12/2019	13:30	5.89	662.0	16.4	0.29	-20.2
MW-49	6/13/2019	6:50	8.00	658.0	14.5	0.33	114.0
MW-62R	6/13/2019	6:50	6.65	581.0	15.4	1.16	141.8
MW-63	6/13/2019	7:40	7.09	1,430.0	15.90	0.17	139.5
MW-66	6/13/2019	8:45	7.09	1,062.0	16.20	0.12	113.7

Notes:
NS = not sampled
nm = not measured; meter was not working properly
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	6/12/2019	14:20	5.14	337.17	
MW-08	6/12/2019	7:40	4.21	335.65	
MW-10A	6/12/2019	7:05	6.32	336.38	
MW-11A	6/12/2019	8:13	6.01	336.35	
MW-12	6/12/2019	12:50	6.83	336.24	
MW-13	6/12/2019	15:41	5.73	336.58	
MW-17	6/12/2019	7:50	7.47	336.21	
MW-18	6/12/2019	6:50	4.92	336.06	
MW-19	6/12/2019	8:30	4.76	335.82	
MW-20	6/12/2019	10:10	4.61	335.62	
MW-31	6/13/2019	7:40	6.38	333.43	
MW-33	6/12/2019	12:50	5.71	334.93	
MW-34	6/12/2019	10:50	5.94	335.35	
MW-47	6/12/2019	9:55	5.58	335.42	
MW-48	6/12/2019	13:30			Roots obstruct well
MW-49	6/13/2019	6:50	8.35	334.65	Roots obstruct well
MW-62R	6/13/2019	6:50	5.81	337.43	
MW-63	6/13/2019	7:40	7.10	336.01	
MW-66	6/13/2019	8:45	5.95	336.92	

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 (mg/L)	Alkalinity, Total as CaCO3 (mg/L)	Sulfate (mg/L)	Nitrogen, Nitrate (mg/L)	Iron (mg/L)	Man-ganese (mg/L)	Methane (µg/L)	Field DO (mg/L)	Field Redox
Background Wells (1)										
MW-18	6/12/2019	ND	230	65	10	0.3	0.67	< 5	0.36	132
MW-62R	6/13/2019	ND	180	51	19	< 0.5	0.005	< 5	1.16	142
Higher Concentration Wells (2)										
MW-08	6/12/2019	4.2	340	0.6	< 0.15	3.8	3.40	1800	0.24	36
MW-11A	6/12/2019	2.8	320	5.4	0.1	5.8	2.50	4600	0.14	-38
MW-12	6/12/2019	2.9	400	69	0.2	2.1	1.50	1600	0.11	-25
MW-33	6/12/2019	6.0	300	5.1	< 0.15	4.1	3.10	6400	0.31	82
MW-34	6/12/2019	1.5	330	20	1.6	0.65	0.73	1900	0.44	81
MW-63	6/13/2019	1.3	720	95	7.2	0.47	0.20	640	0.17	140

Notes: Non-detects (ND) were changed to 1/2 the detection limit on this table. No organic compounds were detected in the "background" wells.
(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 biodegredation:

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 Event Monitoring Wells Sorted by Area

AREA 2 WELLS

Parameter	Units	Cleanup Level	MW-06	MW-06	MW-06	MW-06
			Nov-17	May-18	Oct-18	Jun-19
Arsenic	µg/L	10	90	51	86	62
Parameter	**Units**	**Cleanup Level**	**MW-12**	**MW-12**	**MW-12**	**MW-12**
			Nov-17	May-18	Oct-18	Jun-19
Arsenic	µg/L	10	51	26	68	23
Benzene	µg/L	5	30	30	37	24
TPH-Total	µg/L	1000	2700	1690	3200	2850
Parameter	**Units**	**Cleanup Level**	**MW-13**	**MW-13**	**MW-13**	**MW-13**
			Nov-17	May-18	Oct-18	Jun-19
Arsenic	µg/L	10	43	45	51	86
TPH-Total	µg/L	1000	900	1080	1060	1469
Parameter	**Units**	**Cleanup Level**	**MW-63**	**MW-63**	**MW-63**	**MW-63**
			Nov-17	May-18	Oct-18	Jun-19
Arsenic	µg/L	10	80	26	83	41
Benzene	µg/L	5	110	28	80	70
TPH-Total	µg/L	1000	1430	580	1410	1240

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

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

AREA 3 WELLS

Parameter	Units	Cleanup Level	MW-10A	MW-10A	MW-10A	MW-10A
			Nov-17	May-18	Oct-18	Jun-19
Arsenic	µg/L	10	14	7.2	9.6	12
Parameter	**Units**	**Cleanup Level**	**MW-17**	**MW-17**	**MW-17**	**MW-17**
			Nov-17	May-18	Oct-18	Jun-19
Arsenic	µg/L	10	9.4	7	11	16

AREA 4 WELLS

Parameter	Units	Cleanup Level	MW-11A	MW-11A	MW-11A	MW-11A
			Nov-17	May-18	Oct-18	Jun-19
Arsenic	µg/L	10	90	87	97	100
TPH-Total	µg/L	1000	2040	2590	2600	2649
Parameter	**Units**	**Cleanup Level**	**MW-47**	**MW-47**	**MW-47**	**MW-47**
			Nov-17	May-18	Oct-18	Jun-19
Tetrachloroethene (PCE)	µg/L	1.75	1.8	1.6	1.3	1.1
Trichloroethene (TCE)	µg/L	2	2.8	2.6	2.6	2.4

AREA 6 WELLS

Parameter	Units	Cleanup Level	MW-08	MW-08	MW-08	MW-08
			Nov-17	May-18	Oct-18	Jun-19
TPH-Total	µg/L	1000	2290	3560	3510	4149
Parameter	**Units**	**Cleanup Level**	**MW-19**	**MW-19**	**MW-19**	**MW-19**
			Nov-17	May-18	Oct-18	Jun-19
Arsenic	µg/L	10	84	74	85	66
TPH-Total	µg/L	1000	1320	1280	2070	1899

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

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

AREA 7 WELLS

Parameter	Units	Cleanup Level	MW-20	MW-20	MW-20	MW-20
			Nov-17	May-18	Oct-18	Jun-19
Tetrachloroethene (PCE)	µg/L	1.75	4.7	3.2	1.9	4.3
Trichloroethene (TCE)	µg/L	2	2.3	2.0	1.3	3.1
Parameter	**Units**	**Cleanup Level**	**MW-31**	**MW-31**	**MW-31**	**MW-31**
			Nov-17	**May-18**	**Oct-18**	**Jun-19**
Tetrachloroethene (PCE)	µg/L	1.75	3.3	2.7	2.7	0.68
Trichloroethene (TCE)	µg/L	2	1.4	1.7	1.3	0.67
Parameter	**Units**	**Cleanup Level**	**MW-33**	**MW-33**	**MW-33**	**MW-33**
			Nov-17	**May-18**	**Oct-18**	**Jun-19**
TPH-Total	µg/L	1000	5900	5140	6100	5850
Parameter	**Units**	**Cleanup Level**	**MW-34**	**MW-34**	**MW-34**	**MW-34**
			Nov-17	**May-18**	**Oct-18**	**Jun-19**
Arsenic	µg/L	10	21	15	25	12
TPH-Total	µg/L	1000	1370	1550	1900	1470
Parameter	**Units**	**Cleanup Level**	**MW-49**	**MW-49**	**MW-49**	**MW-49**
			Nov-17	**May-18**	**Oct-18**	**Jun-19**
Tetrachloroethene (PCE)	µg/L	1.75	18	17	19	14
Trichloroethene (TCE)	µg/L	2	2.5	2.4	2.7	2.4

Notes:

"<" - indicates compound was not detected; followed by the reporting limit

µg/L = micrograms per liter

*Highlighted concentration is above the cleanup level.

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

AREA 8 WELL

Parameter	Units	Cleanup Level	MW-48	MW-48	MW-48	MW-48
			Nov-17	May-18	Oct-18	Jun-19
Arsenic	µg/L	10	17	12	13	8.8

AREA 9 WELL

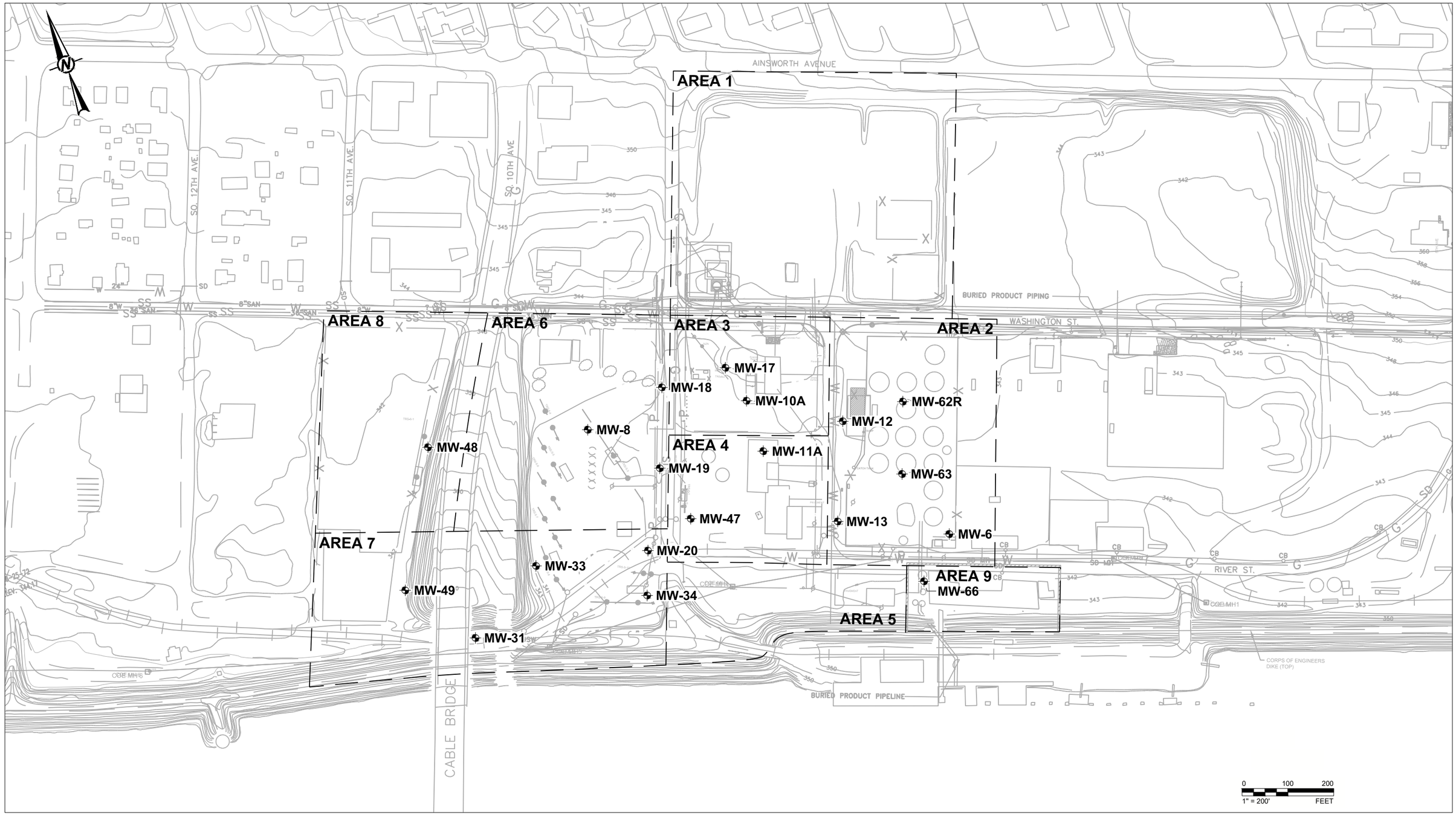
Parameter	Units	Cleanup Level	MW-66	MW-66	MW-66	MW-66
			Nov-17	May-18	Oct-18	Jun-19
Arsenic	µg/L	10	26	17	13	7.5
TPH-Total	µg/L	1000	800	880	1140	335

COE Drain Oil Water Separator

Parameter	Units	Cleanup Level	SEP-OUT	SEP-OUT	SEP-OUT	SEP-OUT
			Nov-17	May-18	Oct-18	Jun-19
Tetrachloroethene (PCE)	µg/L	1.75	3.0	2.8	2.5	2.7

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

Figures



LEGEND

- 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
GOLDER

YYYY-MM-DD	2019-08-13
DESIGNED	GZ
PREPARED	REDMOND
REVIEWED	GZ
APPROVED	GZ

PROJECT
SITE CLEANUP
PASCO BULK FUEL TERMINALS SITE

TITLE
MNA PERFORMANCE MONITORING WELLS

PROJECT NO.	PHASE	REV.	FIGURE
003102518	200	A	1

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

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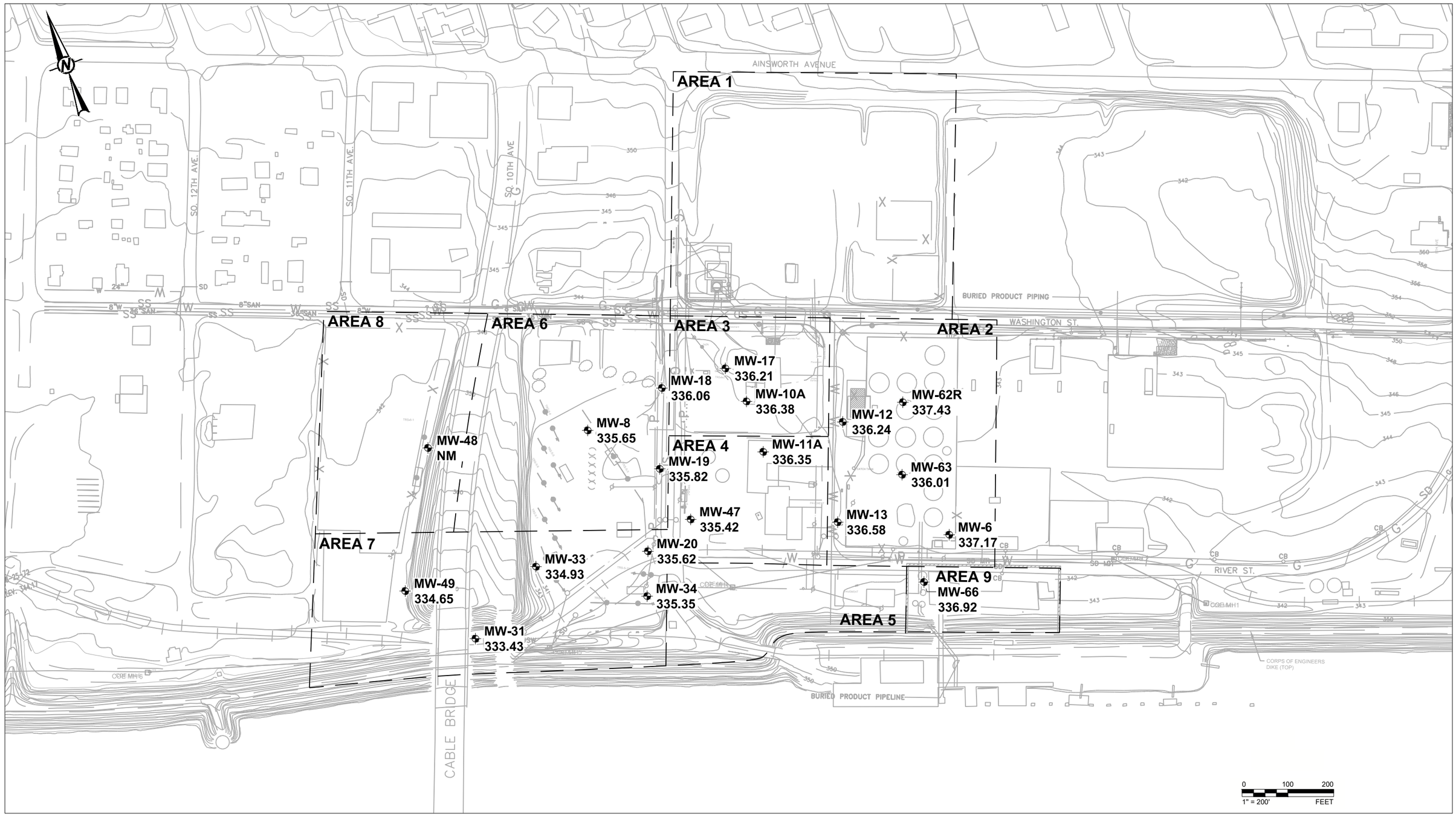

LEGEND

MW-63 336.01 — MONITORING WELL LOCATION AND GROUNDWATER ELEVATION (FEET)

——— ——— 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
GOLDER

YYYY-MM-DD	2019-08-13
DESIGNED	GZ
PREPARED	REDMOND
REVIEWED	GZ
APPROVED	GZ

PROJECT
SITE CLEANUP
PASCO BULK FUEL TERMINALS SITE

TITLE
MNA PERFORMANCE MONITORING WELL GROUNDWATER ELEVATIONS - JUNE 2019

PROJECT NO.	PHASE	REV.	FIGURE
003102518	200	A	2

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

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APPENDIX A

Complete Tabulated Results for Groundwater Samples – June 2019

Appendix A: Complete Tabulated Results for Groundwater Samples - June 2019

Sample Location	Date Sampled	Parameter	Result	Qualifier	PQL	MDL	Units
FBMW-12	12-Jun-19	Arsenic	0.005	U	0.005	0.001	mg/L
FBMW-12	12-Jun-19	Benzene	3	U	3	0.53	ug/L
FBMW-12	12-Jun-19	TPH-Diesel	0.11	U	0.11	0.066	mg/L
FBMW-12	12-Jun-19	TPH-Gas	0.25	U	0.25	0.1	mg/L
FBMW-12	12-Jun-19	TPH-Oil	0.35	U	0.35	0.097	mg/L
FBMW-20	12-Jun-19	Tetrachloroethene (PCE)	0.5	U	0.5	0.017	ug/L
FBMW-20	12-Jun-19	Trichloroethene (TCE)	0.5	U	0.5	0.009	ug/L
MW-06	12-Jun-19	Arsenic	0.062		0.005	0.001	mg/L
MW-08	12-Jun-19	Alkalinity	340		5	5	mg/L
MW-08	12-Jun-19	Iron	3.8		0.5	0.14	mg/L
MW-08	12-Jun-19	Manganese	3.4		0.02	0.0017	mg/L
MW-08	12-Jun-19	Methane	1800		5	0.63	ug/L
MW-08	12-Jun-19	Nitrate + Nitrite (as N)	0.15	UJ	0.15	0.06	mg/L
MW-08	12-Jun-19	Sulfate	0.6	J	1.2	0.26	mg/L
MW-08	12-Jun-19	TPH-Diesel	1.3	J+	0.11	0.066	mg/L
MW-08	12-Jun-19	TPH-Gas	2.8		0.25	0.1	mg/L
MW-08	12-Jun-19	TPH-Oil	0.36	U	0.36	0.098	mg/L
MW-10A	12-Jun-19	Arsenic	0.012		0.005	0.001	mg/L
MW-11A	12-Jun-19	Alkalinity	320		5	5	mg/L
MW-11A	12-Jun-19	Arsenic	0.1		0.005	0.001	mg/L
MW-11A	12-Jun-19	Iron	5.8		0.5	0.14	mg/L
MW-11A	12-Jun-19	Manganese	2.5		0.02	0.0017	mg/L
MW-11A	12-Jun-19	Methane	4600		5	0.63	ug/L
MW-11A	12-Jun-19	Nitrate + Nitrite (as N)	0.075	J	0.15	0.06	mg/L
MW-11A	12-Jun-19	Sulfate	5.4		1.2	0.26	mg/L
MW-11A	12-Jun-19	TPH-Diesel	1	J+	0.11	0.066	mg/L
MW-11A	12-Jun-19	TPH-Gas	1.6		0.25	0.1	mg/L
MW-11A	12-Jun-19	TPH-Oil	0.36	U	0.36	0.097	mg/L
MW-11A dupl-75A	12-Jun-19	Alkalinity	320		5	5	mg/L
MW-11A dupl-75A	12-Jun-19	Arsenic	0.098		0.005	0.001	mg/L
MW-11A dupl-75A	12-Jun-19	Iron	5.6		0.5	0.14	mg/L
MW-11A dupl-75A	12-Jun-19	Manganese	2.4		0.02	0.0017	mg/L
MW-11A dupl-75A	12-Jun-19	Methane	4800		5	0.63	ug/L
MW-11A dupl-75A	12-Jun-19	Nitrate + Nitrite (as N)	0.074	J	0.15	0.06	mg/L
MW-11A dupl-75A	12-Jun-19	Sulfate	5.3		1.2	0.26	mg/L
MW-11A dupl-75A	12-Jun-19	TPH-Diesel	0.96	J+	0.11	0.066	mg/L
MW-11A dupl-75A	12-Jun-19	TPH-Gas	1.6		0.25	0.1	mg/L
MW-11A dupl-75A	12-Jun-19	TPH-Oil	0.36	U	0.36	0.098	mg/L
MW-12	12-Jun-19	Alkalinity	400		5	5	mg/L
MW-12	12-Jun-19	Arsenic	0.023		0.005	0.001	mg/L
MW-12	12-Jun-19	Benzene	24		3	0.53	ug/L
MW-12	12-Jun-19	Iron	2.1		0.5	0.14	mg/L
MW-12	12-Jun-19	Manganese	1.5		0.02	0.0017	mg/L
MW-12	12-Jun-19	Methane	1600		5	0.63	ug/L
MW-12	12-Jun-19	Nitrate + Nitrite (as N)	0.19		0.15	0.06	mg/L
MW-12	12-Jun-19	Sulfate	69		1.2	0.26	mg/L
MW-12	12-Jun-19	TPH-Diesel	1.5		0.11	0.067	mg/L
MW-12	12-Jun-19	TPH-Gas	1.2		0.25	0.1	mg/L
MW-12	12-Jun-19	TPH-Oil	0.15	J	0.36	0.099	mg/L
MW-13	12-Jun-19	Arsenic	0.086		0.005	0.001	mg/L
MW-13	12-Jun-19	TPH-Diesel	0.94		0.11	0.066	mg/L
MW-13	12-Jun-19	TPH-Gas	0.48		0.25	0.1	mg/L
MW-13	12-Jun-19	TPH-Oil	0.35	U	0.35	0.097	mg/L
MW-17	12-Jun-19	Arsenic	0.016		0.005	0.001	mg/L
MW-18	12-Jun-19	Alkalinity	230		5	5	mg/L
MW-18	12-Jun-19	Iron	0.25	J	0.5	0.14	mg/L
MW-18	12-Jun-19	Manganese	0.67		0.02	0.0017	mg/L
MW-18	12-Jun-19	Methane	5	U	5	0.63	ug/L
MW-18	12-Jun-19	Nitrate + Nitrite (as N)	10		1.5	0.6	mg/L
MW-18	12-Jun-19	Sulfate	65		1.2	0.26	mg/L
MW-19	12-Jun-19	Arsenic	0.066		0.005	0.001	mg/L
MW-19	12-Jun-19	TPH-Diesel	0.65		0.11	0.066	mg/L
MW-19	12-Jun-19	TPH-Gas	1.2		0.25	0.1	mg/L
MW-19	12-Jun-19	TPH-Oil	0.36	U	0.36	0.098	mg/L
MW-20	12-Jun-19	Tetrachloroethene (PCE)	4.3		0.5	0.017	ug/L
MW-20	12-Jun-19	Trichloroethene (TCE)	3.1		0.5	0.009	ug/L

Appendix A: Complete Tabulated Results for Groundwater Samples - June 2019

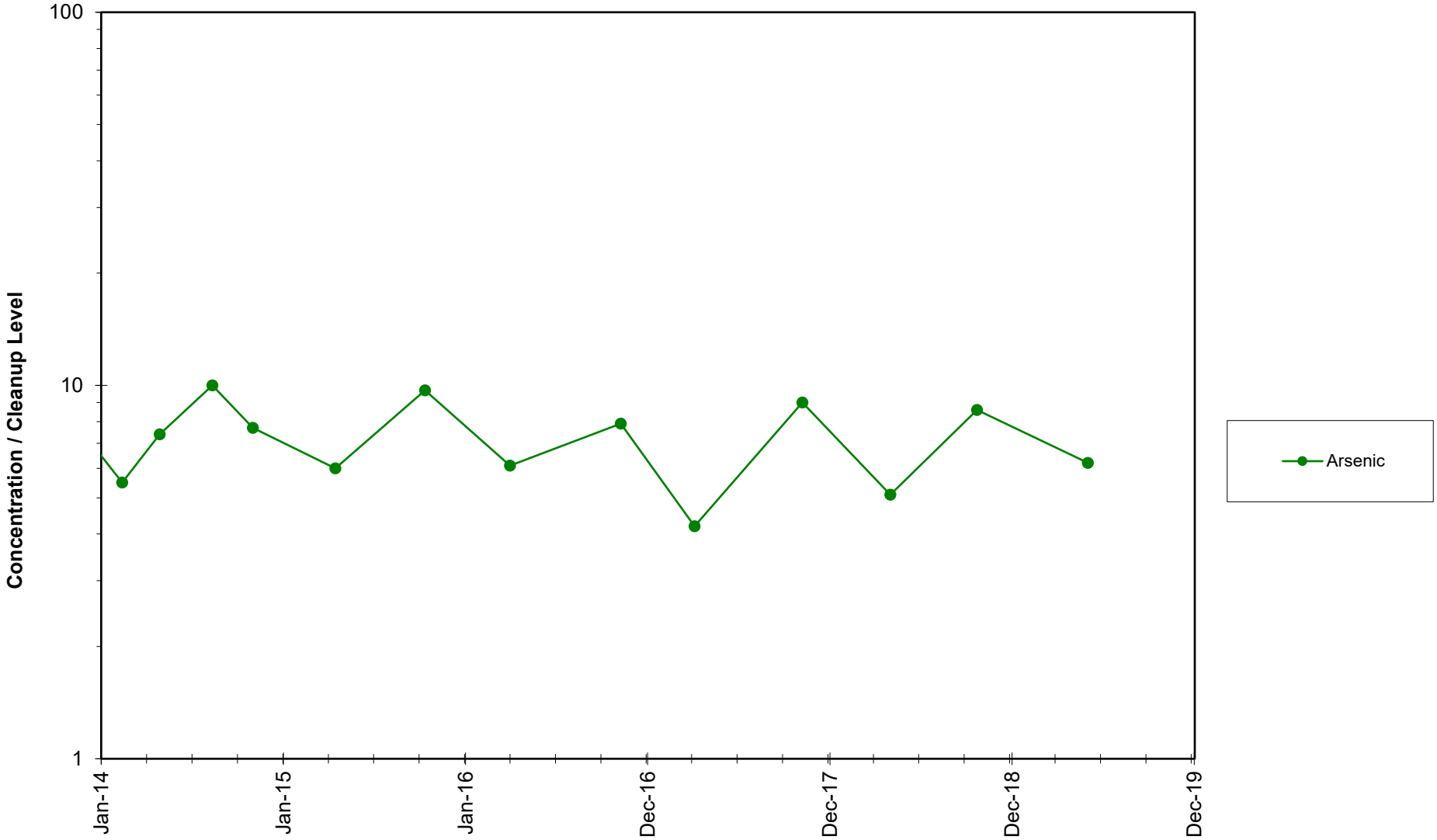
Sample Location	Date Sampled	Parameter	Result	Qualifier	PQL	MDL	Units
MW-31	13-Jun-19	Tetrachloroethene (PCE)	0.68		0.5	0.017	ug/L
MW-31	13-Jun-19	Trichloroethene (TCE)	0.67		0.5	0.009	ug/L
MW-33	12-Jun-19	Alkalinity	300		5	5	mg/L
MW-33	12-Jun-19	Iron	4.1		0.5	0.14	mg/L
MW-33	12-Jun-19	Manganese	3.1		0.02	0.0017	mg/L
MW-33	12-Jun-19	Methane	6400		5	0.63	ug/L
MW-33	12-Jun-19	Nitrate + Nitrite (as N)	0.15	U	0.15	0.06	mg/L
MW-33	12-Jun-19	Sulfate	5.1		1.2	0.26	mg/L
MW-33	12-Jun-19	TPH-Diesel	1.9	J+	0.11	0.067	mg/L
MW-33	12-Jun-19	TPH-Gas	3.9		0.25	0.1	mg/L
MW-33	12-Jun-19	TPH-Oil	0.36	U	0.36	0.099	mg/L
MW-34	12-Jun-19	Alkalinity	330		5	5	mg/L
MW-34	12-Jun-19	Arsenic	0.012		0.005	0.001	mg/L
MW-34	12-Jun-19	Iron	0.65		0.5	0.14	mg/L
MW-34	12-Jun-19	Manganese	0.73		0.02	0.0017	mg/L
MW-34	12-Jun-19	Methane	1900		5	0.63	ug/L
MW-34	12-Jun-19	Nitrate + Nitrite (as N)	1.6		0.15	0.06	mg/L
MW-34	12-Jun-19	Sulfate	20		1.2	0.26	mg/L
MW-34	12-Jun-19	TPH-Diesel	0.47		0.11	0.066	mg/L
MW-34	12-Jun-19	TPH-Gas	0.89		0.25	0.1	mg/L
MW-34	12-Jun-19	TPH-Oil	0.11	J	0.36	0.098	mg/L
MW-47	12-Jun-19	Tetrachloroethene (PCE)	1.1		0.5	0.017	ug/L
MW-47	12-Jun-19	Trichloroethene (TCE)	2.4		0.5	0.009	ug/L
MW-48	12-Jun-19	Arsenic	0.0088		0.005	0.001	mg/L
MW-49	13-Jun-19	Tetrachloroethene (PCE)	14		0.5	0.017	ug/L
MW-49	13-Jun-19	Trichloroethene (TCE)	2.4		0.5	0.009	ug/L
MW-49 dupl-79	13-Jun-19	Tetrachloroethene (PCE)	15		0.5	0.017	ug/L
MW-49 dupl-79	13-Jun-19	Trichloroethene (TCE)	2.6		0.5	0.009	ug/L
MW-62R	13-Jun-19	Alkalinity	180		5	5	mg/L
MW-62R	13-Jun-19	Iron	0.5	U	0.5	0.14	mg/L
MW-62R	13-Jun-19	Manganese	0.0046	J	0.02	0.0017	mg/L
MW-62R	13-Jun-19	Methane	5	U	5	0.63	ug/L
MW-62R	13-Jun-19	Nitrate + Nitrite (as N)	19		1.5	0.6	mg/L
MW-62R	13-Jun-19	Sulfate	51		1.2	0.26	mg/L
MW-63	13-Jun-19	Alkalinity	720		5	5	mg/L
MW-63	13-Jun-19	Arsenic	0.041		0.005	0.001	mg/L
MW-63	13-Jun-19	Benzene	70		3	0.53	ug/L
MW-63	13-Jun-19	Iron	0.47	J	0.5	0.14	mg/L
MW-63	13-Jun-19	Manganese	0.2		0.02	0.0017	mg/L
MW-63	13-Jun-19	Methane	640		5	0.63	ug/L
MW-63	13-Jun-19	Nitrate + Nitrite (as N)	7.2		1.5	0.6	mg/L
MW-63	13-Jun-19	Sulfate	95		1.2	0.26	mg/L
MW-63	13-Jun-19	TPH-Diesel	0.95		0.11	0.067	mg/L
MW-63	13-Jun-19	TPH-Gas	0.18	J	0.25	0.1	mg/L
MW-63	13-Jun-19	TPH-Oil	0.11	J	0.36	0.098	mg/L
MW-66	13-Jun-19	Arsenic	0.0075		0.005	0.001	mg/L
MW-66	13-Jun-19	TPH-Diesel	0.17		0.11	0.065	mg/L
MW-66	13-Jun-19	TPH-Gas	0.25	U	0.25	0.1	mg/L
MW-66	13-Jun-19	TPH-Oil	0.35	U	0.35	0.097	mg/L
SEP-OUT	13-Jun-19	Tetrachloroethene (PCE)	2.7		0.5	0.017	ug/L
SEP-OUT	13-Jun-19	Trichloroethene (TCE)	0.52		0.5	0.009	ug/L
TRIP BLANK -1	13-Jun-19	Benzene	3	U	3	0.53	ug/L
TRIP BLANK -1	13-Jun-19	TPH-Gas	0.25	U	0.25	0.1	mg/L
TRIP BLANK 2	13-Jun-19	Methane	5	U	5	0.63	ug/L
TRIP BLANK 2	13-Jun-19	Tetrachloroethene (PCE)	0.5	U	0.5	0.017	ug/L
TRIP BLANK 2	13-Jun-19	Trichloroethene (TCE)	0.5	U	0.5	0.009	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
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

APPENDIX B

Trend Graphs

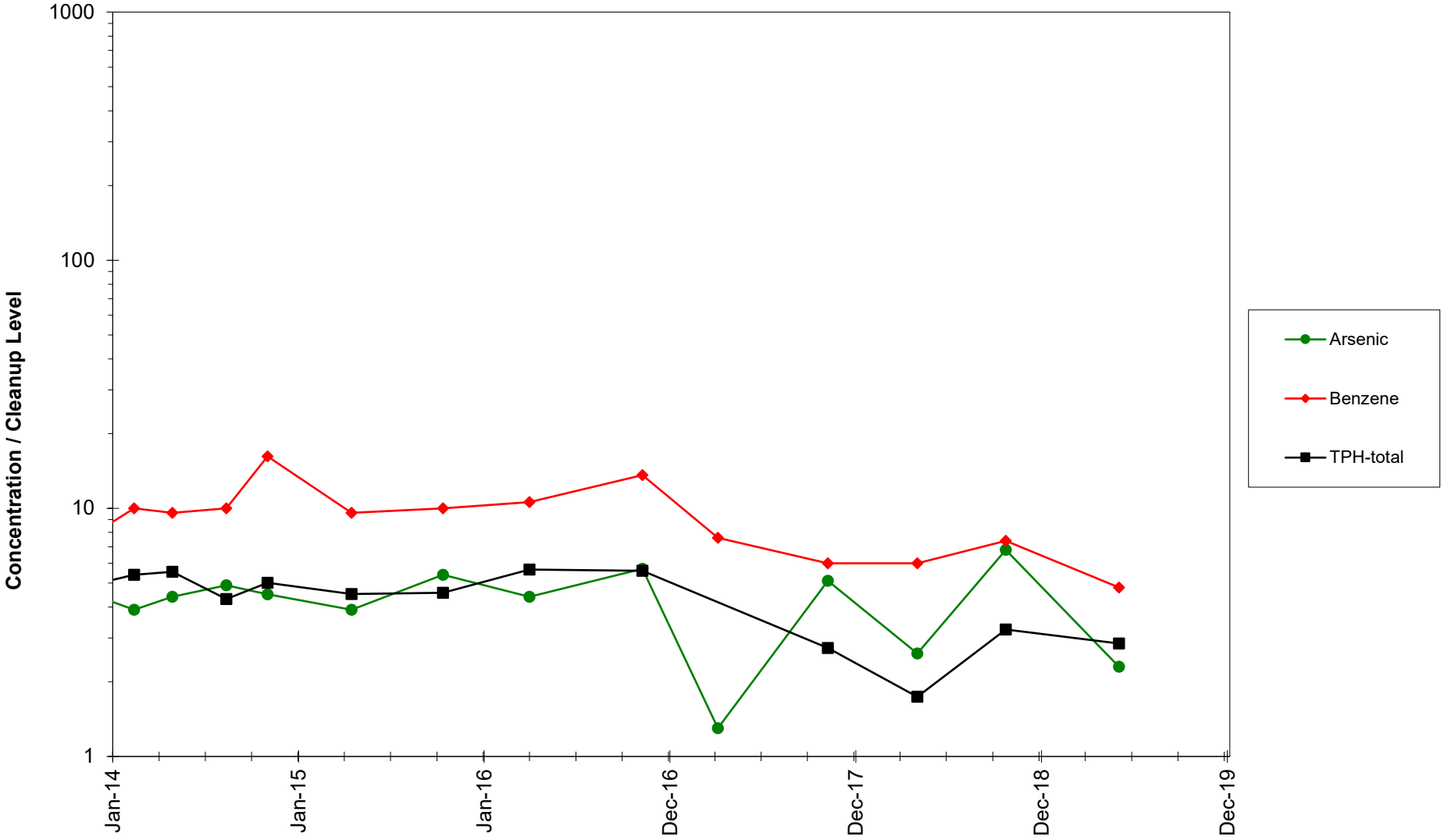
Area 2 MW-06



Golder Associates

Area2.xlsx, Area 2 MW-06

Area 2 MW-12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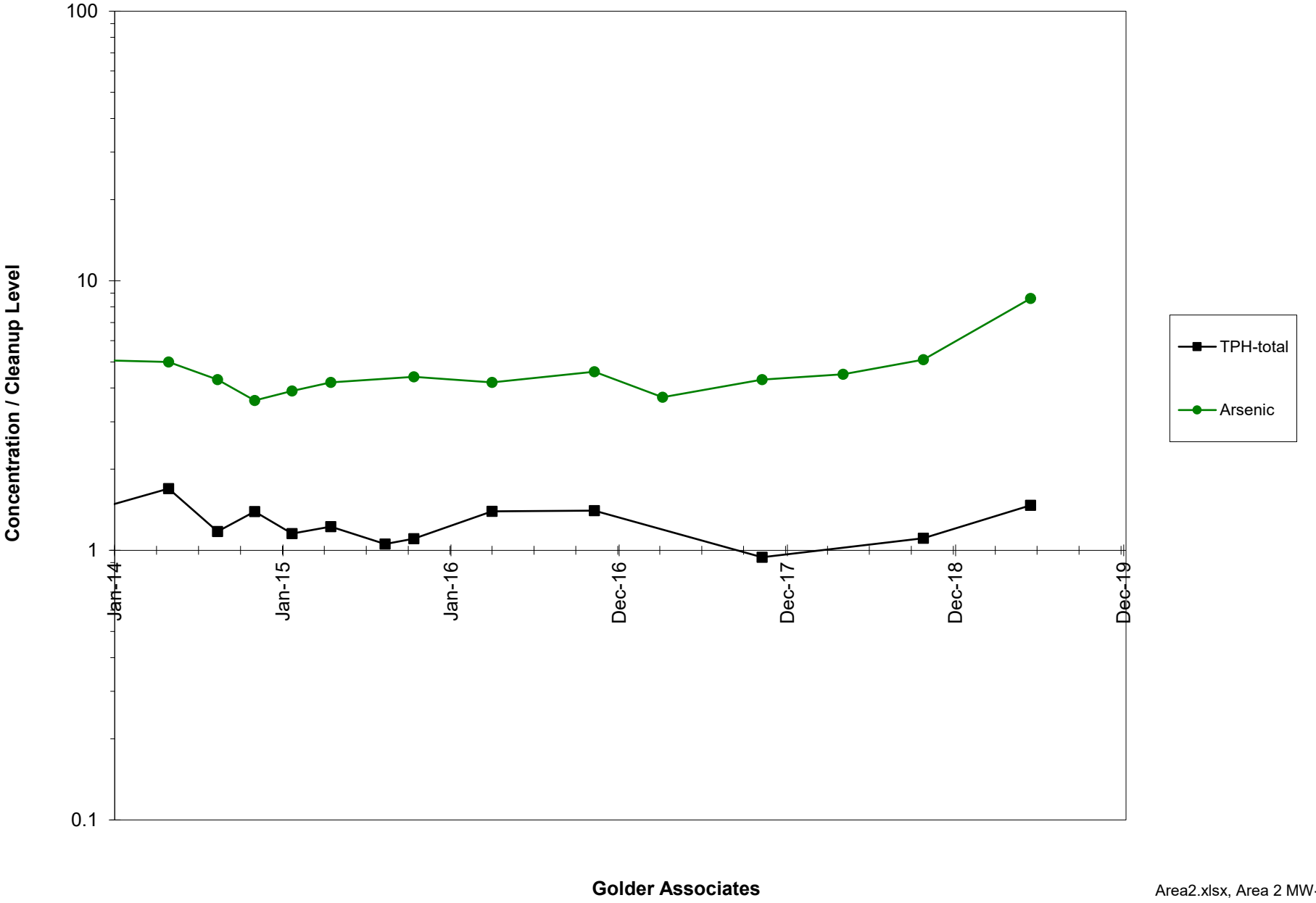
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
Arsenic
Benzene
TPH-total

Area 2 MW-13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Concentration / Cleanup Level
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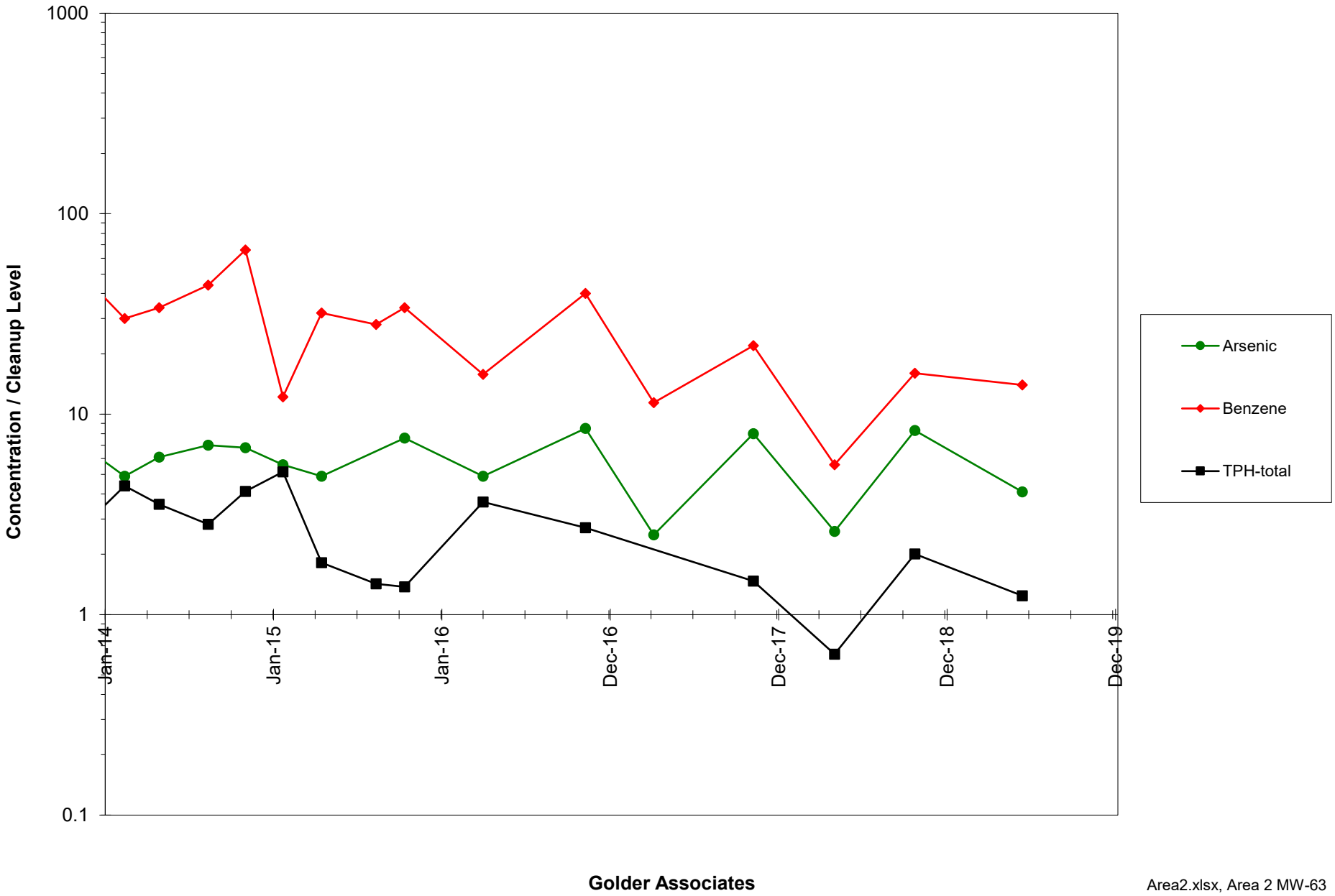
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
TPH-total
Arsenic

Area 2 MW-63



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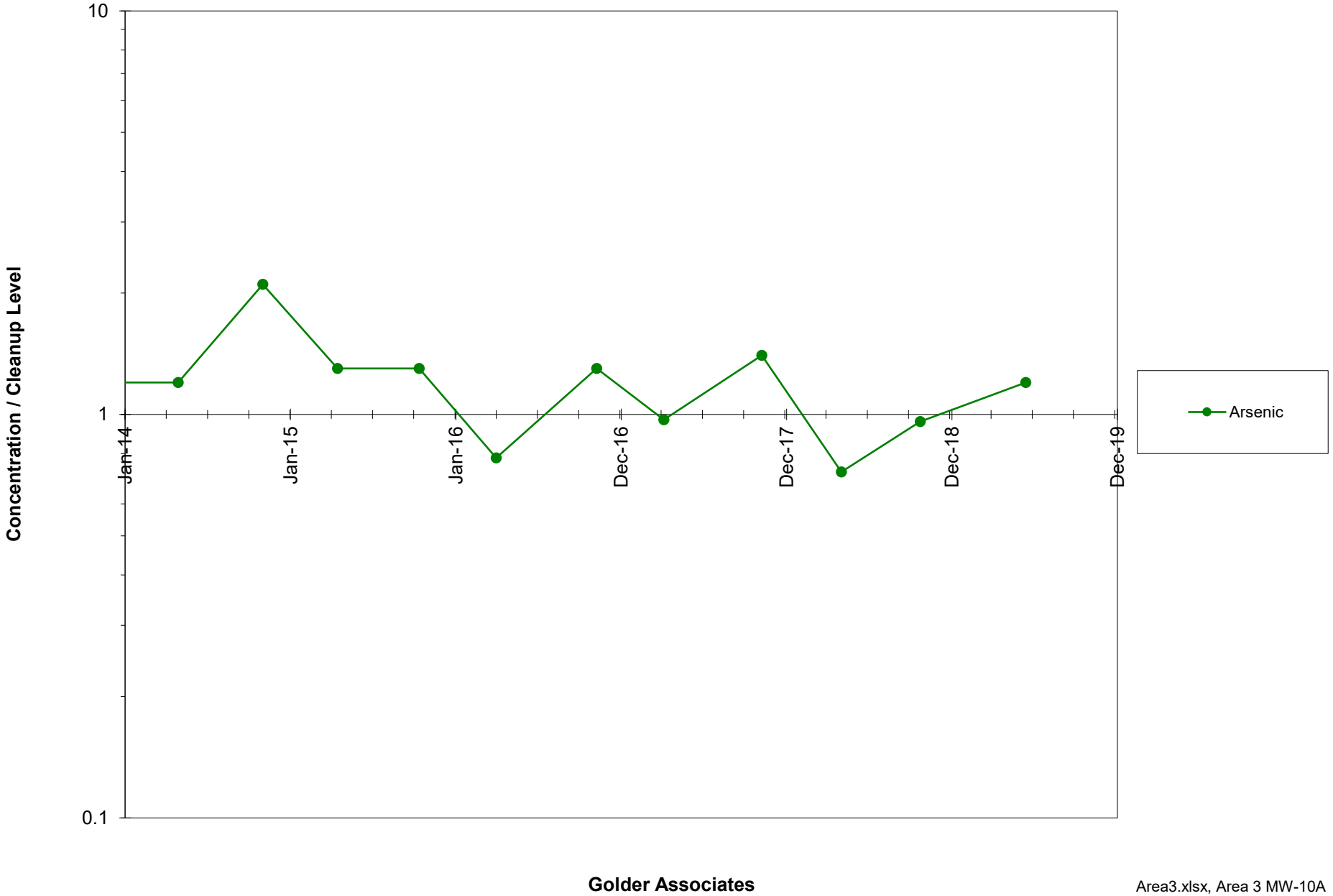
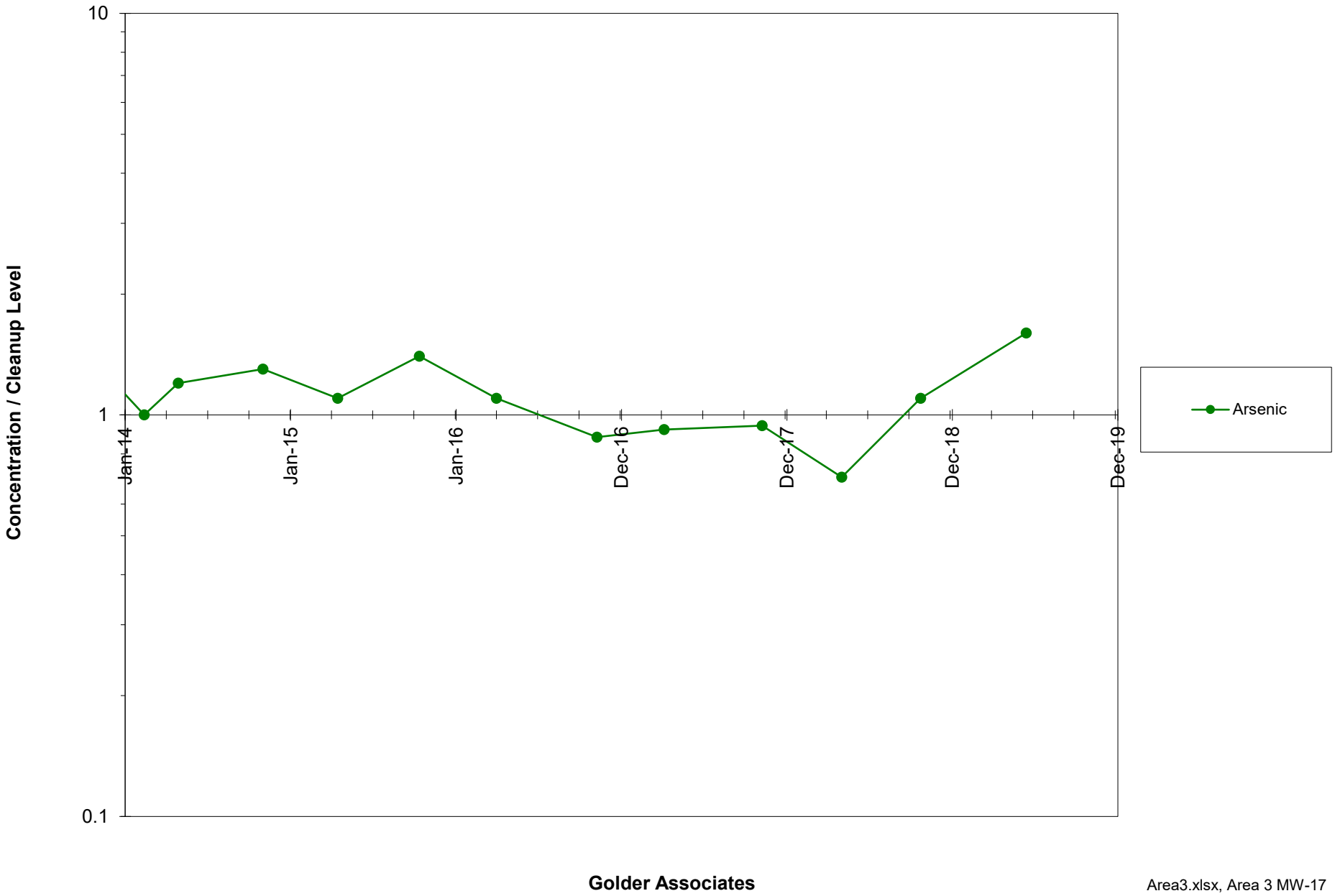
Area 3 MW-10A



Golder Associates

Area3.xlsx, Area 3 MW-10A

Area 3 MW-17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Concentration / Cleanup Level
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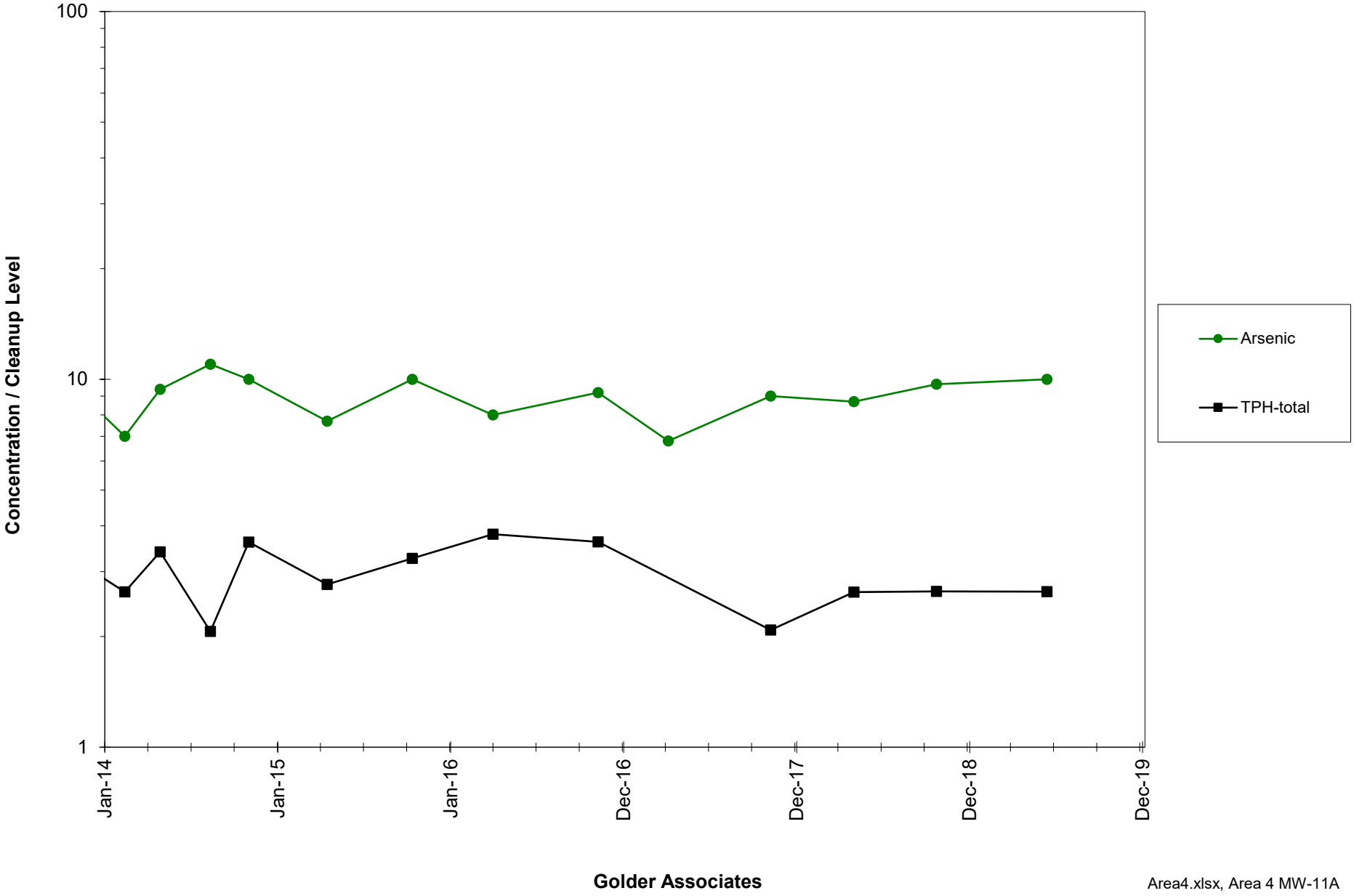
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
Arsenic

Area 4 MW-11A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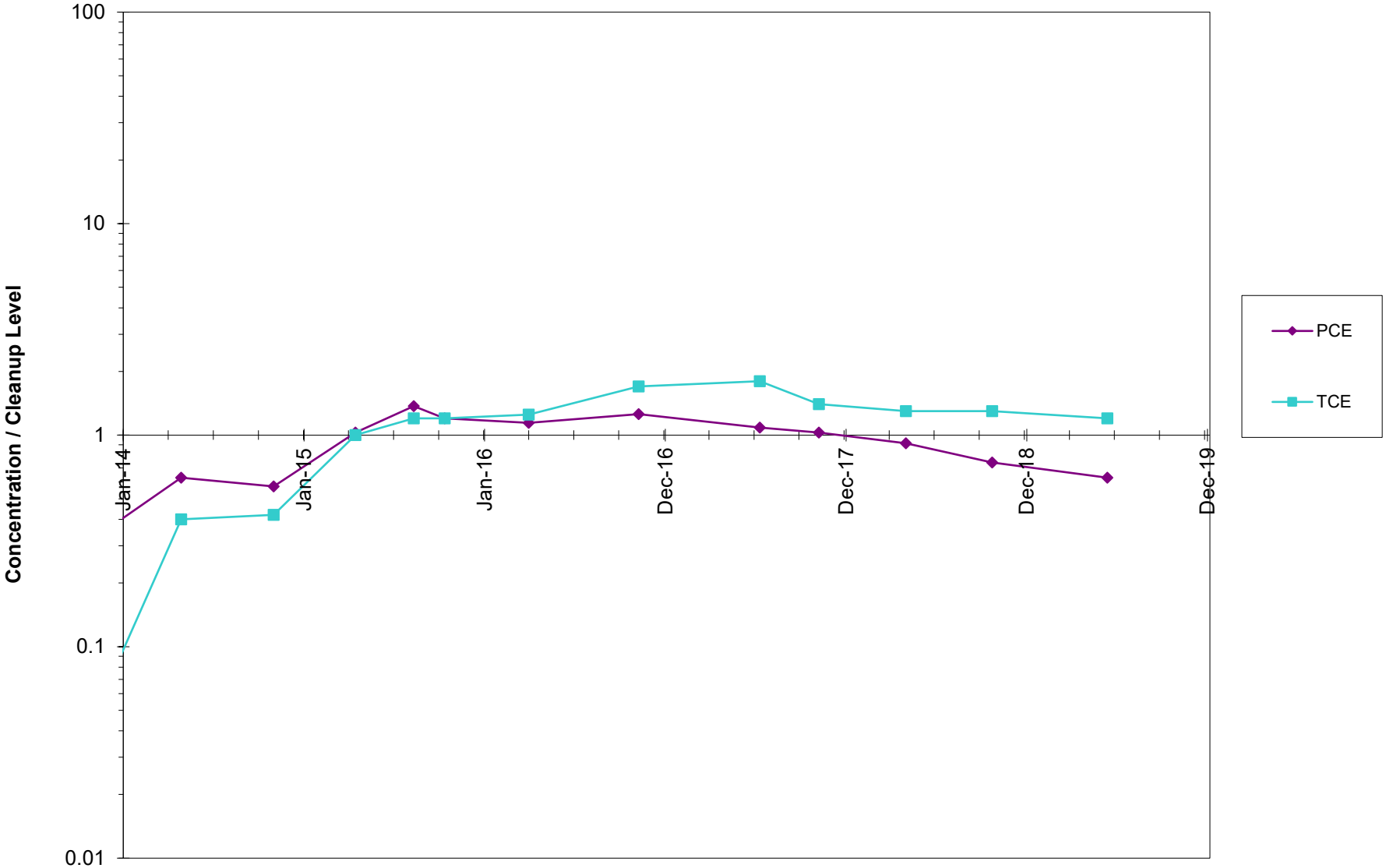
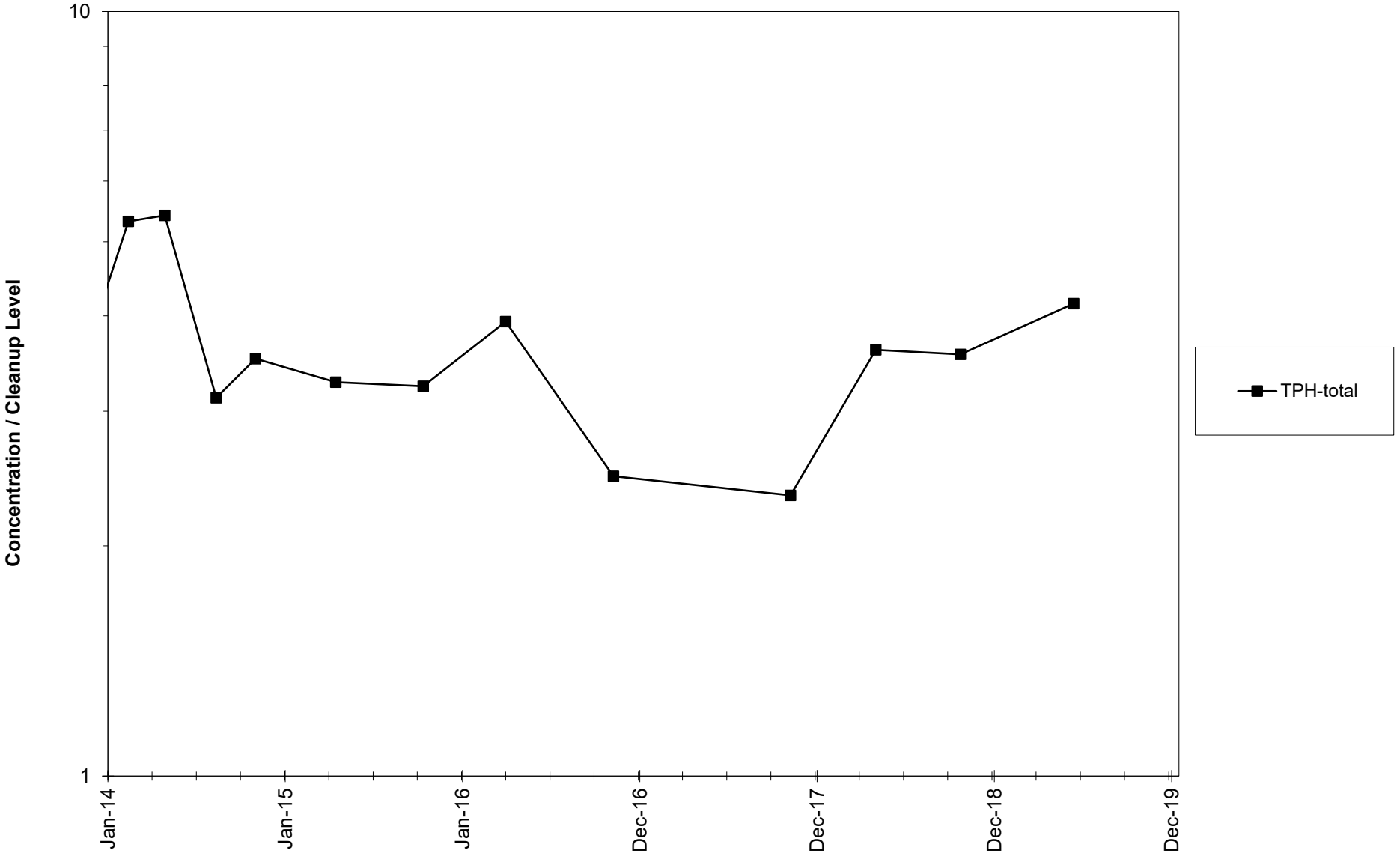
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
Arsenic
TPH-total

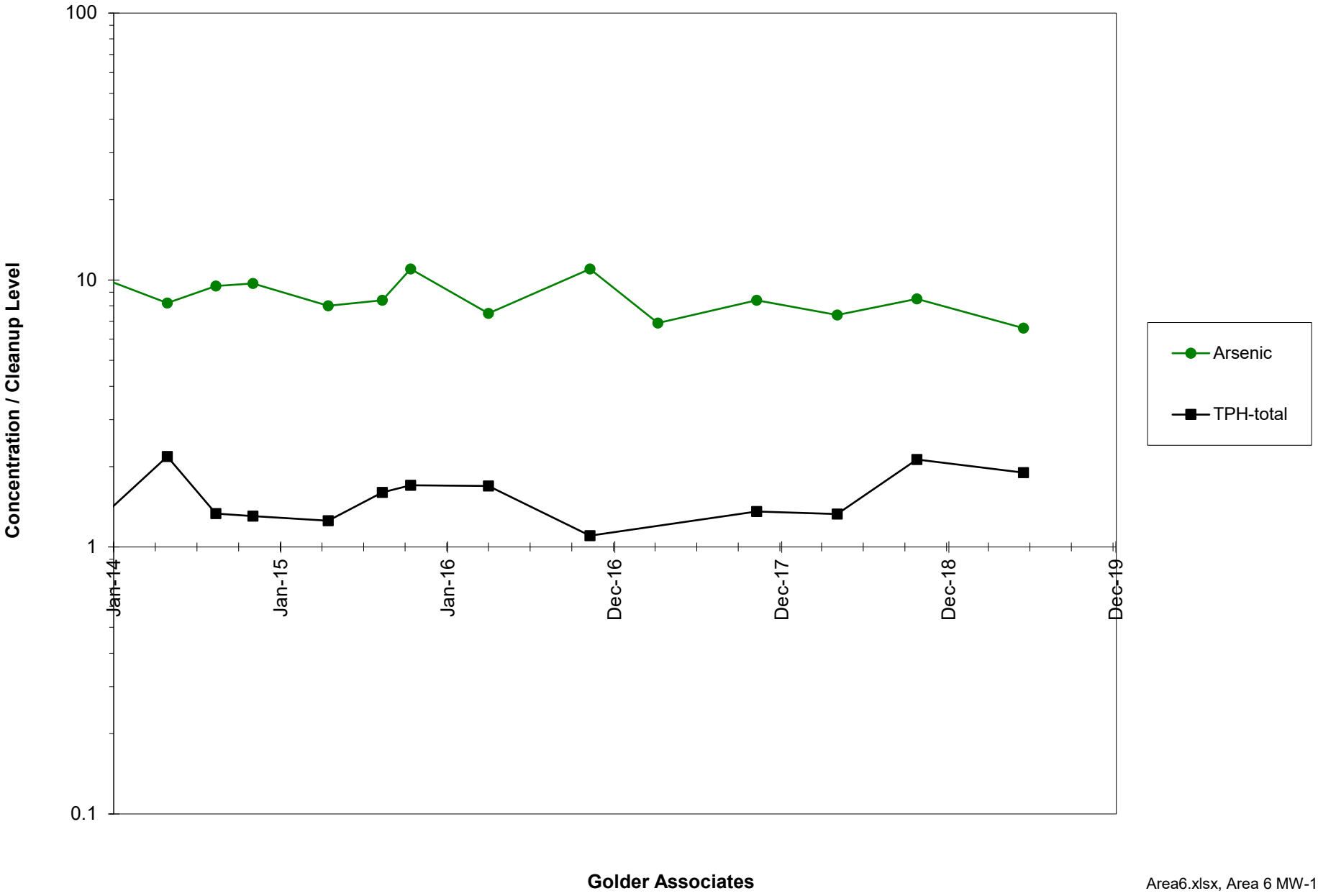
Area 4 MW-47


100
10
1
0.1
0.01
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
PCE
TCE

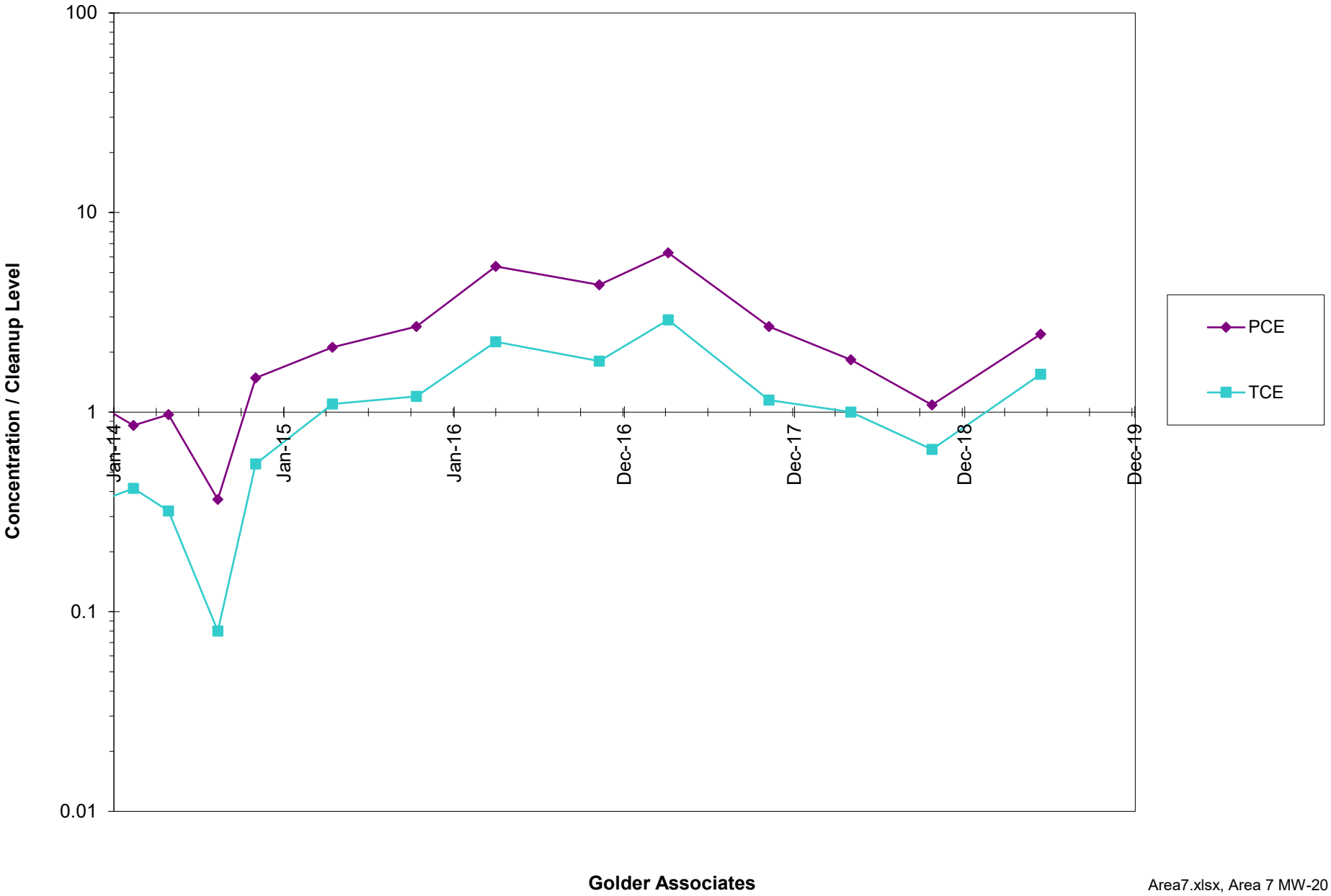
Area 6 MW-08


10
1
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
TPH-total

Area 6 MW-19


100
10
1
0.1
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
Arsenic
TPH-total

Area 7 MW-20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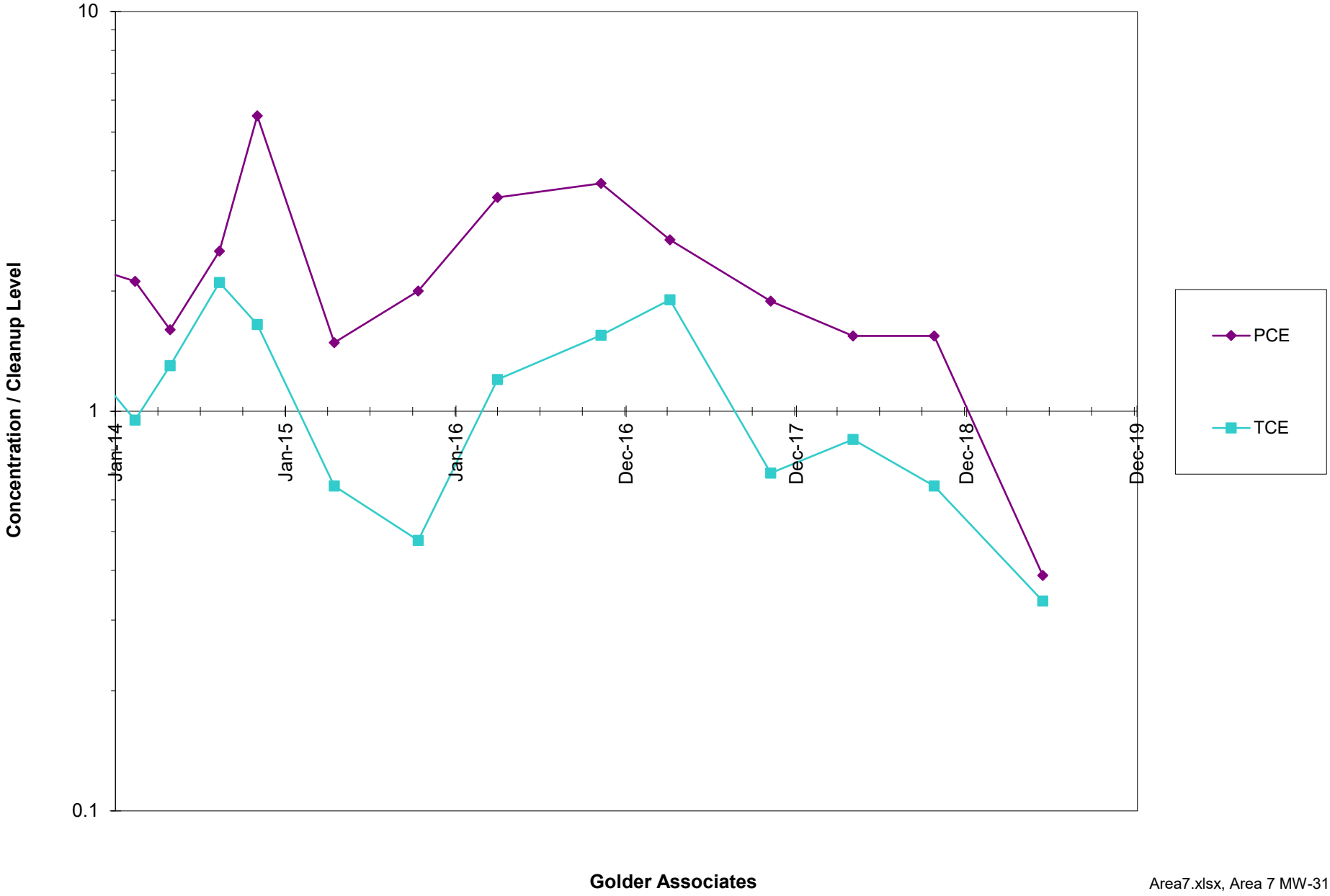
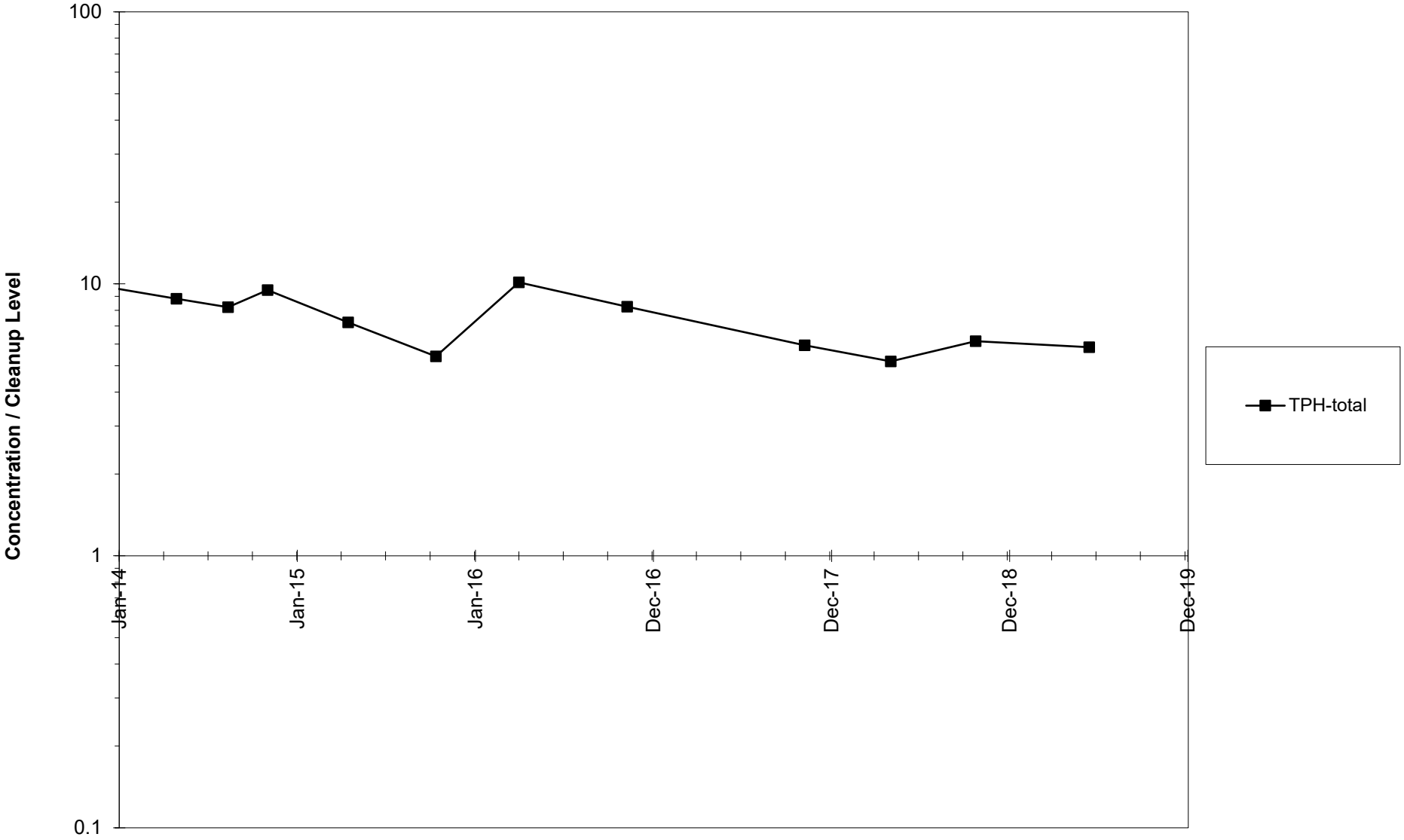
10
1
0.1
0.01
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
PCE
TCE

Area 7 MW-31


10
1
0.1
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
PCE
TCE

Area 7 MW-33



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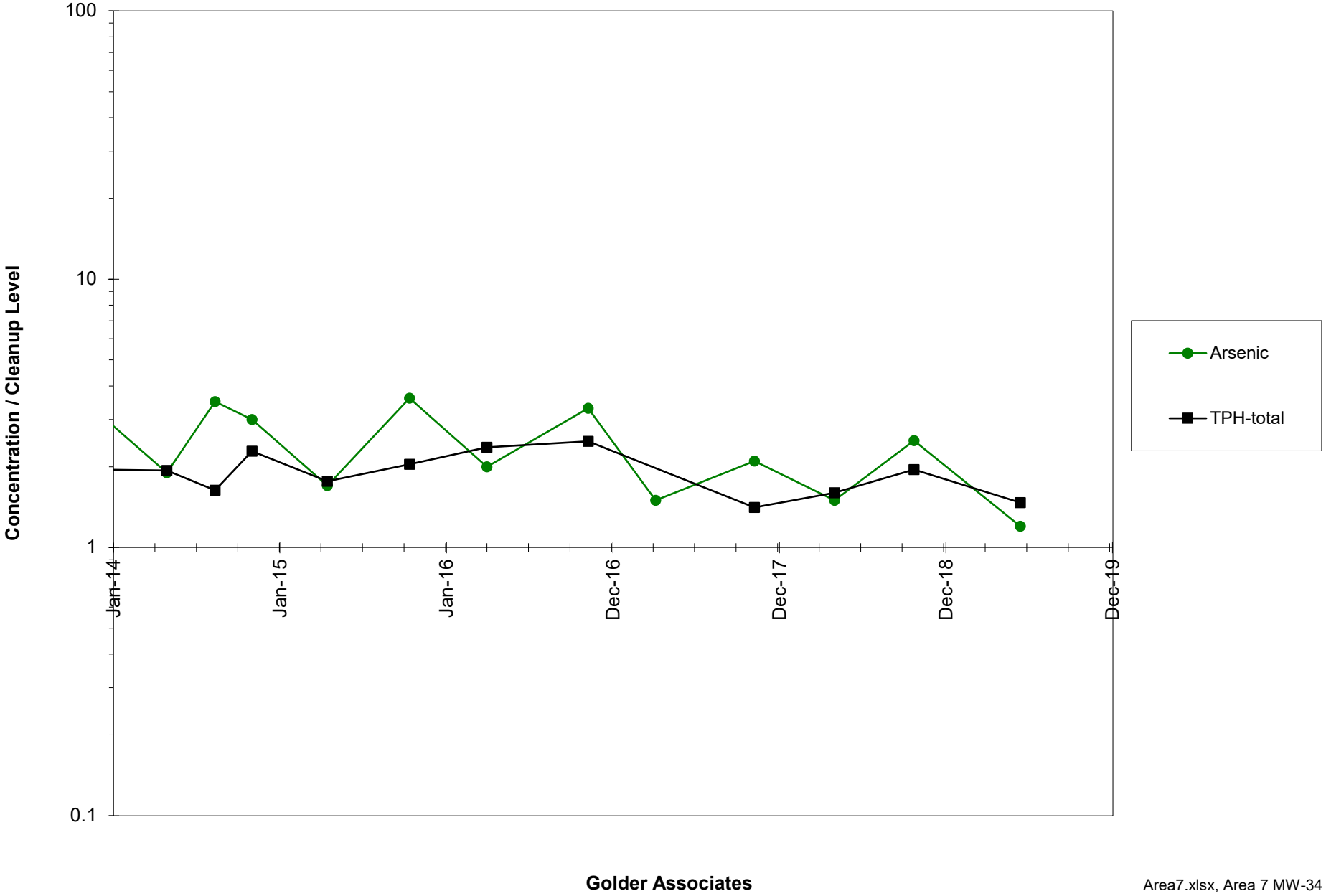
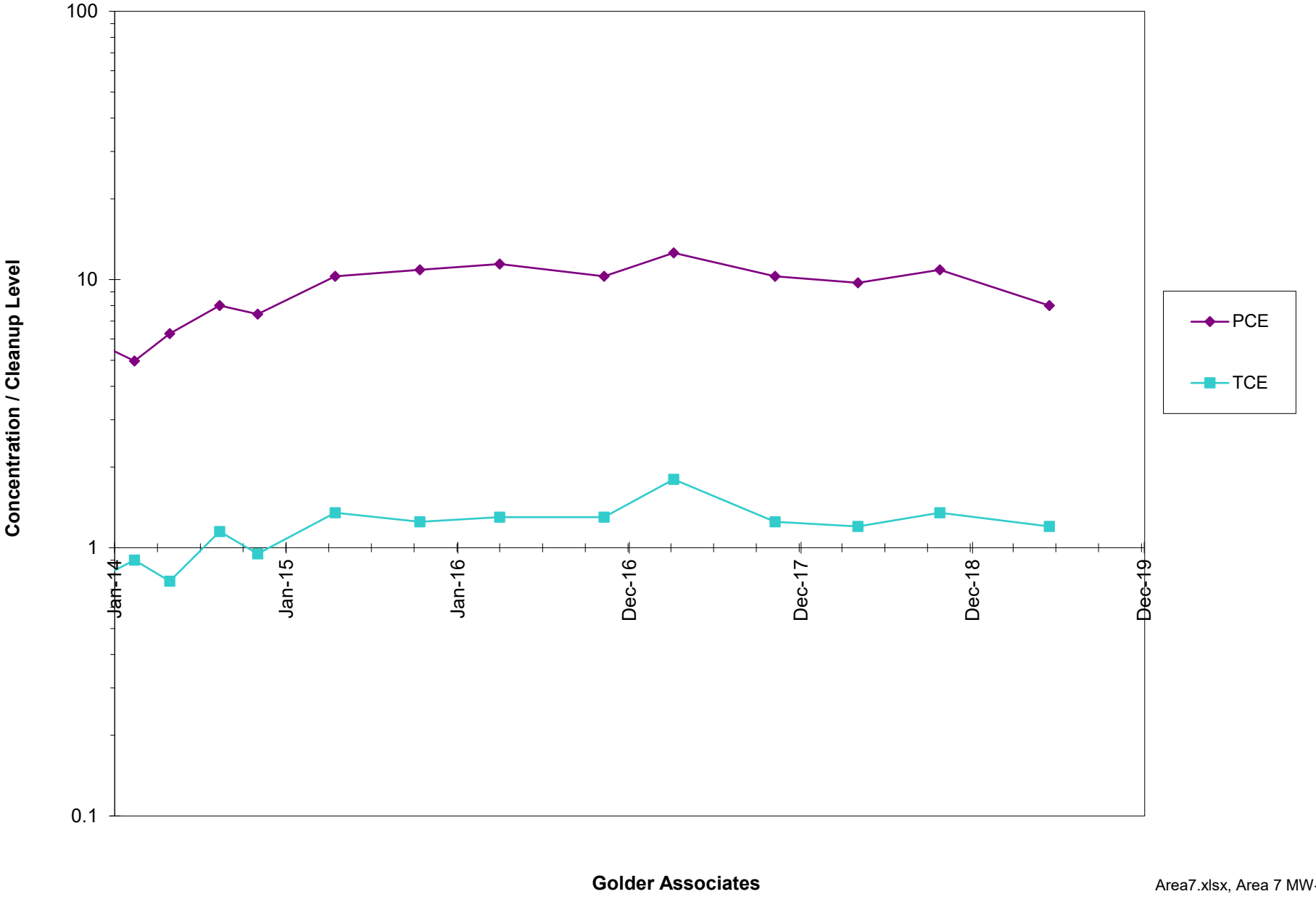
Area7.xlsx, Area 7 MW-33

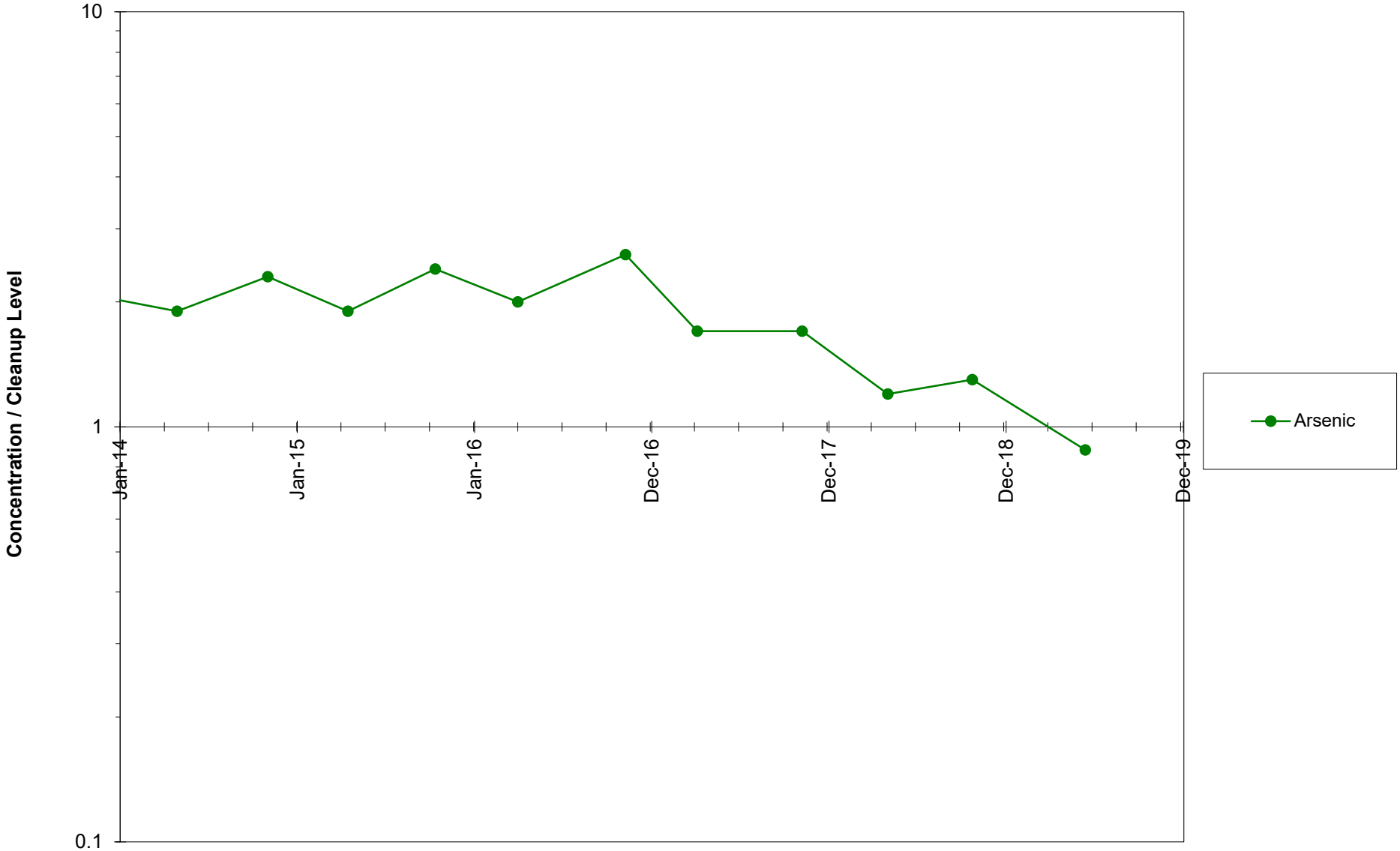
Area 7 MW-34


100
10
1
0.1
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
Arsenic
TPH-total

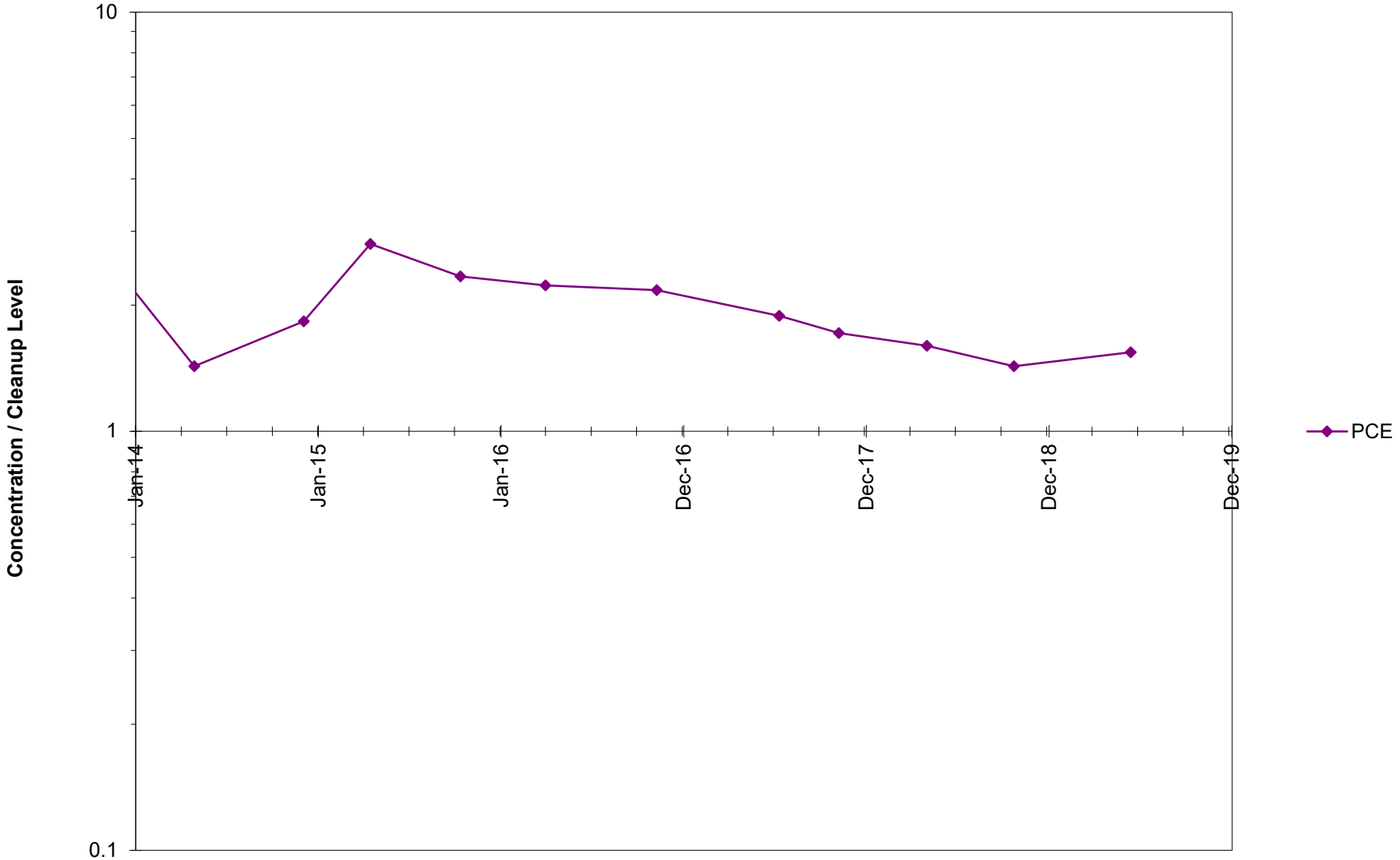
Area 7 MW-49


100
10
1
0.1
Concentration / Cleanup Level
Jan-14
Jan-15
Jan-16
Dec-16
Dec-17
Dec-18
Dec-19
PCE
TCE

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
Arsenic

COE Separator Out (1)



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