

**CSSA B-3 BIOREACTOR OPERATIONS  
ANNUAL PERFORMANCE STATUS REPORT  
(QUARTER 41 – QUARTER 44, MAY 2017 – APRIL 2018)**

**JUNE 29, 2018**

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This status report summarizes the operation of a bioreactor at Solid Waste Management Unit (SWMU) B-3 from May 2017 through April 2018, comprising the eleventh year of bioreactor operations and monitoring since system start-up. This status report includes descriptions of current conditions, field observations, analytical results, and an anticipated schedule of activities for the next reporting period. Analytical results from monthly and quarterly regulatory and performance sampling through April 2018 are attached for reference. Parsons personnel responsible for bioreactor operation during the reporting period include Ken Rice, Bradly Dietert, Samantha Elliott, Adrien Lindley, Elisa Rice, Richard Fincke, Fabian Bocanegra, and Scott Pearson.

***Executive Summary***

For the year (May 2017 through April 2018) a total of 23.81 inches of rain was recorded on site, 12.48 inches below average. Injection of extracted groundwater continued through the year with few interruptions. Minor interruptions include: system maintenance, reaching automatic cut-off levels in the wells and/or storage tank, and B-3 bioreactor system upgrade activities. During the reporting period, pumping at wells CS-MW16-CC, B3-EXW-01, and B3-EXW-03 was suspended temporarily for well maintenance. Well maintenance included pump replacements at each of these wells. Currently, all wells are operational, however, production rates are limited due to reduced water availability as drought conditions worsen.

Through the reporting period, approximately 18,425,000 gallons of groundwater, extracted from wells CS-MW16-LGR, CS-MW16-CC, B3-EXW01, B3-EXW02, B3-EXW03, B3-EXW04, and B3-EXW05, were injected into bioreactor trenches 1-6. In January 2018, injections into bioreactor trenches 2-5 were suspended due to low groundwater availability. Currently, only trenches 1 and 6 are receiving extracted groundwater.

During the reporting period, most of the injected groundwater, ~5,453,000 gallons, was extracted from B3-EXW-05, followed by ~3,219,000 gallons from B3-EXW-04 and 3,062,000 gallons from B3-EXW-03. Wells CS-MW16-CC, B3-EXW-01, B3-EXW-02 and CS-MW16-LGR were less productive with ~2,074,000, ~1,686,000, ~1,517,000 and ~1,414,000 gallons extracted, respectively. The total groundwater production for the year (18,425,000 gallons) is approximately 53% of the previous year's total (34,794,000 gallons). Since the start of normal operations in 2007, approximately 206,902,000 gallons of extracted groundwater have been injected into the bioreactor.

Data from monitoring efforts indicate that the B-3 bioreactor has continued to maintain appropriate geochemical conditions for effective anaerobic dechlorination of chlorinated aliphatic hydrocarbons (CAHs). Geochemical parameters indicating optimal conditions include the following:

- Concentrations of dissolved oxygen (DO) are generally less than 0.5 milligrams per liter (mg/L) and oxidation-reduction potential (ORP) values are less than 100 millivolts (mV), indicating an anaerobic environment conducive to dechlorination of CAHs within the trenches;
- Production of methane indicating that fermentation is occurring; and

- Hydrogen concentrations are greater than 1.0 nanomoles per liter (nmol/L), indicating that there is sufficient electron donor present to stimulate anaerobic dechlorination of CAHs.

Analytical results from trench sumps samples provides evidence that biotic and abiotic dechlorination of tetrachloroethene (PCE) and trichloroethene (TCE) is occurring. The presence of ethene indicates that the biotic reductive dechlorination process appears to be the major degradation pathway for CAHs within the trenches and that complete reductive dechlorination is occurring. Additionally, the presence of reduced iron [Fe(II)] and trans-DCE may indicate the presence of a secondary abiotic process at work within the bioreactor.

CSSA is participating in a Strategic Environmental Research and Development Program (SERDP) funded program for the “Abiotic Transformation of Chloroethenes in Low Permeability Formations” (ER-2622) investigated by Dr. David Freedman of Clemson University. The overall objective of this project is to develop a protocol that can be used to estimate the contribution and impact of productive abiotic transformation processes on chlorinated ethene contaminant degradation under intrinsic or enhanced conditions. This project will evaluate naturally-occurring abiotic transformation processes and biologically-mediated abiotic degradation in fractured bedrock sites. The specific objectives are to:

1. determine if geochemical modeling can be used for identification of sites that have a high potential for abiotic transformation of chlorinated ethenes;
2. determine if laboratory studies can accurately predict the likelihood of in situ abiotic transformation of chlorinated ethenes using a protocol involving intact rock core microcosms, under conditions that simulate natural attenuation and in response to amendments;
3. determine if geophysical techniques can assess the potential for abiotic degradation based on sensitivity to magnetite and iron sulfide minerals in the rock matrix, using a protocol involving correlation of geophysical measurements and results of microcosm experiments; and
4. determine if using in situ passive vapor diffusion (PVD) samplers can greatly enhance the detection of acetylene in groundwater, the key abiotic chlorinated ethene degradation product.

As a participant, CSSA is expected to have site specific data evaluated with potential geochemical parameters identified for these abiotic processes geochemical modeling and potential new monitoring techniques identified. Field efforts, including the collection of intact cores samples of bedrock near the bioreactor, were completed during the year. Laboratory testing is ongoing, and a report of the investigation is forthcoming.

### ***Summary of Bioreactor Operation***

Analytical results from biannual sampling at the bioreactor sumps indicate that SWMU B-3 trenches contain a range of *cis*-DCE levels (non-detect (ND) to 102 µg/L) as well as concentrations of other dechlorination products (e.g., VC, ethene). A summary of the analytical data collected for the reporting period (year 11) is included in Table 1. A summary of biannual monitoring results from the bioreactor trench sumps are attached, analytical results of the surrounding SWMU B-3 multi-port monitoring wells (MPMW or Westbay<sup>®</sup>) and monitoring wells are also attached.

Results of volatile organic carbon (VOC) analyses indicate that groundwater from the uppermost saturated zone (LGR-03B) of Westbay<sup>®</sup> wells CS-WB05, CS-WB06, and CS-WB07 contain less than 100 micrograms per liter (µg/L) of PCE and TCE while well CS-WB08 contains less than 100 µg/L of PCE and greater than 100 µg/L TCE. Additionally, wells CS-WB05, CS-WB06, and

CS-WB08 contain greater than 100 µg/L of *cis*-DCE, and CS-WB07 contains less than 100 µg/L of *cis*-DCE. Similar analysis of groundwater from extraction wells indicate wells CS-MW16-LGR, CS-MW16-CC, B3-EXW02, B3-EXW03, and B3-EXW05 all contain less than 100 µg/L of PCE, TCE, and *cis*-DCE while wells B3-EXW01 and B3-EXW04 contain greater than 100 µg/L of PCE, TCE, and *cis*-DCE.

VOC analytical results from bioreactor trench sumps samples indicate slight increases in contaminant mass (total molar concentration) in trench sumps T1-1, T1-2, T1-3, T2-1, T3-2, T4-1, and T6-1 and T6-2 and decreases in trench sumps T2-2, T3-1, T5-1, and T5-2 since the last reporting period in April 2017. Over the bioreactor operational period (11 years), contaminant mass appears stable or decreasing. Currently, extracted groundwater is being applied to bioreactor trenches 1 and 6. Applications in trench 1 began in 2006 as the bioreactor became operable and has been ongoing for 11 years. Applications in trench 2 began in 2009 (eight years of application), followed by applications in trench 6 in 2010 (seven years), and trenches 3, 4, and 5 in 2016 (two years of application).

Water quality field measurements from bioreactor trench 1 sumps indicate average annual values for DO, pH, ORP, and specific conductivity were 0.36 mg/L, 6.73, -79.68 mV, and 0.888 mS/cm, respectively, and temperatures ranged from ~19 °C to ~28 °C.

Field measurements from trench 2 during the year include average DO, pH, ORP, and specific conductivity of 0.39 mg/L, 6.73, -63.03 mV, and 0.820 mS/cm respectively; and temperatures ranged between ~18 °C to ~26 °C.

Field measurements from trench 3 during the year indicated average DO, pH, ORP, and specific conductivity of 1.07 mg/L, 6.87, 54.08 mV, and 0.663 mS/cm respectively; and temperatures ranged between 20 °C to 24 °C.

Field measurements from trench 4 indicated average DO, pH, ORP, and specific conductivity of 0.12 mg/L, 6.77, -91.66 mV, and 0.777 mS/cm respectively; and temperatures ranged between 21 °C to 25 °C.

Field measurements from trench 5 during the year include average DO, pH, ORP, and specific conductivity of 0.77 mg/L, 6.53, -7.72 mV, and 0.812 mS/cm respectively; and temperatures ranged between 21 °C to 31 °C.

Water quality field measurements during the year of injection operations within trench 6 include average DO, pH, ORP, and specific conductivity of 0.67 mg/L, 6.69, -65.84 mV, and 0.819 mS/cm respectively; and temperatures ranged between 20 °C to 27 °C.

The geochemical parameters measured within each of the six trenches indicate adequate conditions exist for reductive anaerobic bioremediation of CAHs.

Ground water elevation data from the shallow UGR monitoring wells (B3-MW26-UGR – MW34) combined with similar data from the Westbay UGR zones (CS-WB06-UGR-01, CS-WB08-UGR-01) and the bioreactor sumps helped confirm the presence of a groundwater “mound” around the bioreactor trenches. Analyses of samples from these wells indicates the presence of vinyl chloride with concentrations ranging from ND to 23 ppb (WB08-UGR-01) with the highest levels typically found north and east of the bioreactor. B3-MW28, located southwest of the bioreactor, has been consistently dry and therefore was not sampled. Water quality parameters in the UGR wells fluctuated during the reporting period. In general, good reducing conditions (low DO, ORP, and pH) were reported in B3-MW27-UGR, B3-MW31-UGR, B3-MW33-UGR, and B3-MW34 while moderate reducing conditions were observed in B3-MW26, B3-MW29, and B3-MW32. Poor reducing conditions were observed in B3-MW30.

During the reporting period, 23.81 inches of precipitation were measured on-post. Over the year, average water thicknesses within active trenches ranged from 6.75 feet in trench 1 to 1.10 feet in trench 4. Average water thickness results indicate saturated conditions within the bioreactor is being maintained.

Attached are graphs including: B-3 trench 1 average water thickness with rainfall data, VOC concentration summaries for extraction wells, storage tanks (UIC), trench 1 and 6 sumps, and in the defined uppermost saturated zones (zone LGR-03B) in the surrounding multi-port monitoring wells, cumulative precipitation, as well as water level elevations in the defined uppermost saturated zone (zone LGR-03B) of the B-3 multi-port monitoring wells with rainfall data.

#### ***Quarter 44 - Analytical Data Observations***

1. Arsenic (As) was detected in concentrations exceeding the MCL (10 µg/L) in six Westbay well zones, CS-WB05-LGR-04B, CS-WB06-UGR-01, CS-WB06-LGR-01, CS-WB06-LGR-04, CS-WB06-LGR-03B, and CS-WB07-LGR-01 (11, 12, 11, 14, 13, and 11 µg/L) during the year. Elevated levels of As were also reported in CS-B3-MW02 (13 µg/L), CS-B3-MW04 (28 µg/L), CS-B3-MW26-UGR (14 µg/L), CS-B3-MW27-UGR (24 µg/L), CS-B3-MW29-UGR (11 µg/L), CS-B3-MW31-UGR (11 µg/L), CS-B3-MW32-UGR (17 µg/L), CS-B3-MW33-UGR (13 µg/L), and CS-B3-MW34-UGR (22 µg/L). Additionally, As was reported in three bioreactor trench water samples, T1-1, T4-1, and T5-2 at concentrations of 16 µg/L, 20 µg/L, and 16 µg/L, respectively. All other multi-port monitoring well (MPMW) zones reported Arsenic levels below the MCL. The elevated levels are likely due to changing pH conditions of the groundwater and the reduction of naturally occurring arsenic within the limestone media to a more soluble form.
2. DO and ORP values were favorable for the reduction of CAHs, and it is likely that geochemical conditions will remain favorable for continued enhanced anaerobic continue to improve as normal bioreactor operations continue.
3. The volatile organic compound summary for the trenches indicates an end-product (DCE isomer, VC, and ethene) dominated chemical composition in water. Total molar concentrations within trenches 1 and 6 have fluctuated through the year and indicate a slight increase in total contaminant mass since last year.
4. *Dehalococcoides* (DHC) bacteria have been identified within the trench sumps, indicating the reductive dechlorination of CAHs by microbial activity is occurring. Over the last two reporting periods (Quarters 37 through 44), DHC cell counts have declined in all trenches. Comparison of CAH mole fractions of extracted groundwater (prior to injection) and trench sump water (after injection) confirms reductive dechlorination of VOCs is occurring within the bioreactor, with VOC parents (PCE, TCE) representing a higher portion of the total molar concentration pre-injection, and daughter products (DCE, VC, and ethene) representing the higher portion of the total molar concentration after injection.
5. Saturated conditions within the bioreactor were maintained through the year with an average water thicknesses ranging from 1.10 feet to 6.03 feet in trenches 1 - 6.

The reductive dechlorination end products VC, ethene, and ethane are present in samples collected from shallow UGR zone wells around the periphery of SWMU B-3 indicating the lateral influence of the bioreactor in the shallow subsurface. VC is present in samples from shallow UGR wells MW26 and MW34, (4.4 and 7.3 µg/L), and in samples from the WB08-UGR-01 (23 µg/L) zone. Ethene and ethane are present in shallow UGR wells MW26, -27, -33, -34, and in samples

from the WB08-UGR-01 zone (ethene: 2.3, 4.2, 1.4, 2.4, and 26 µg/L, respectively; ethane: 6.4, 9.3, 3.7, 1.2, and 8.4 µg/L, respectively).

In addition to reductive dechlorination end products within the UGR, these products are also observed at depth. VC is observed in the LGR-03B, -04A, -04B, and BS-01 zones within WB05 (18, 59, 80, and 2.9 µg/L); and in the LGR-01, -02, -03B, and -04 zones within WB07 (12, 3.5, 0.35, and 1.9 µg/L). Ethene is observed within WB05-LGR-04B, WB07-LGR-01, B3-MW01, and MW27-UGR (6.6, 2.8, 8.2, and 2.1 µg/L). Ethane was observed within wells B3-MW04 and WB07-LGR-01 (0.9 and 3.3 µg/L, respectively) during this reporting period.

### ***Recommendations***

Recommendation for further remedial action include:

- Continue monitoring bioreactor and surrounding wells for UIC Permit and Performance parameters.

### ***Anticipated Schedule for Next Period (May, 2018 – April, 2019):***

- Continue monitoring and maintenance activities for delivery of groundwater to the bioreactor trenches.
- Conduct semi-annual monitoring events for the bioreactor system.
- Continue UIC monitoring with annual reporting due July 2019.
- Continue SCADA control and automation integration.

## **Specific Data Observation Notes for Attachments**

- Table 44.1.1 presents field collected data from bioreactor trench sumps, and indicates saturated conditions were maintained during the year.
- Analytical results from the B-3 trench sump (trenches 1, 2, and 6) samples, shown in Table 44.1.2, present data from the eleventh year of bioreactor operations.
- Table 44.1.2 presents the VOC concentrations from biannual samples collected in bioreactor trench sumps. These data indicate that dechlorination products are being generated within the bioreactor. VC was present at variable concentrations in trench sumps, ranging from, ND to 16 µg/L during the year. Ethene was observed in concentrations ranging from ND to 4.3 µg/L.
- Table 44.1.3 indicates the presence of Fe(II) at concentrations consistent with alternative degradation pathways.
- Table 44.2.3a indicates VC concentrations of 59 µg/L in WB05-LGR04A and 80 µg/L in WB05-LGR04B, suggesting a connection between this zone and CS-B3-MW01. Additionally, ethene was observed in WB05 zone LGR04B during the year at a concentration of 3.6 µg/L.
- Table 44.3.3 indicates that VC was present (4.5 µg/L) in the samples collected from monitoring well CS-B3-MW04, thus reductive dechlorination is occurring at depth, within the LGR.
- Table 44.4.4 indicates moderate to low populations of *Dehalococcoides* (DHC) bacteria exist in trenches 1 - 6 and smaller populations exist at greater depths in B3-EXW-01.

- Figure 44.1.2 presents the changes in molar fraction and total molar concentrations at sumps in trenches 1, 2, and 6 and indicate slight increases in contaminant mass.
- Table 44.6.2 indicates contaminant mass, provided by seven extraction wells, is being available for injection into the bioreactor. Parent products (PCE and TCE) make up the majority of the contaminant mass, though *cis*-DCE is also present.
- Figure 44.2.5 shows that the water levels in Westbay wells are significantly influenced by drought conditions and precipitation, while pumping at CS-MW16-LGR and CS-B3-EXW01 shows strong influence in the deeper LGR zones. Pumping at CS-MW16-CC appears to have no influence on UGR or upper LGR zones.
- Table 44.7.3 indicates the presence of VC in two of the shallow UGR wells with concentrations ranging from ND to 7.3 µg/L. Additionally, Table 40.7.3 provides evidence of the biotic anaerobic degradation pathway as indicated by elevated concentrations of Mn and CO<sub>2</sub>.

## Analytical Summary Data

**Table 1 Summary of Analysis Presented for Reporting Period**

<b>Event</b>	<b>VOCs</b>	<b>TDS</b>	<b>TOC</b>	<b>MEE &amp; CO<sub>2</sub></b>	<b>SO<sub>3</sub><sup>2-</sup></b>	<b>Chloride, Sulfate</b>	<b>Fe<sup>2+</sup></b>	<b>Mn</b>	<b>Metals*</b>	<b>H<sup>+</sup></b>	<b>DHC</b>
Semi-Annual Sampling <sup>a</sup> (Quarter 42)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Semi-Annual Sampling <sup>a</sup> (Quarter 44)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

<sup>a</sup> - Semi-annual sampling includes samples from B3-trench sumps, Monitoring Wells, Extraction Wells, and Multi-port (Westbay) wells.

\* - Metals analyses was reduced to include only arsenic results beginning with the Month 44 sampling event.

## Figures



### Average Water Thickness

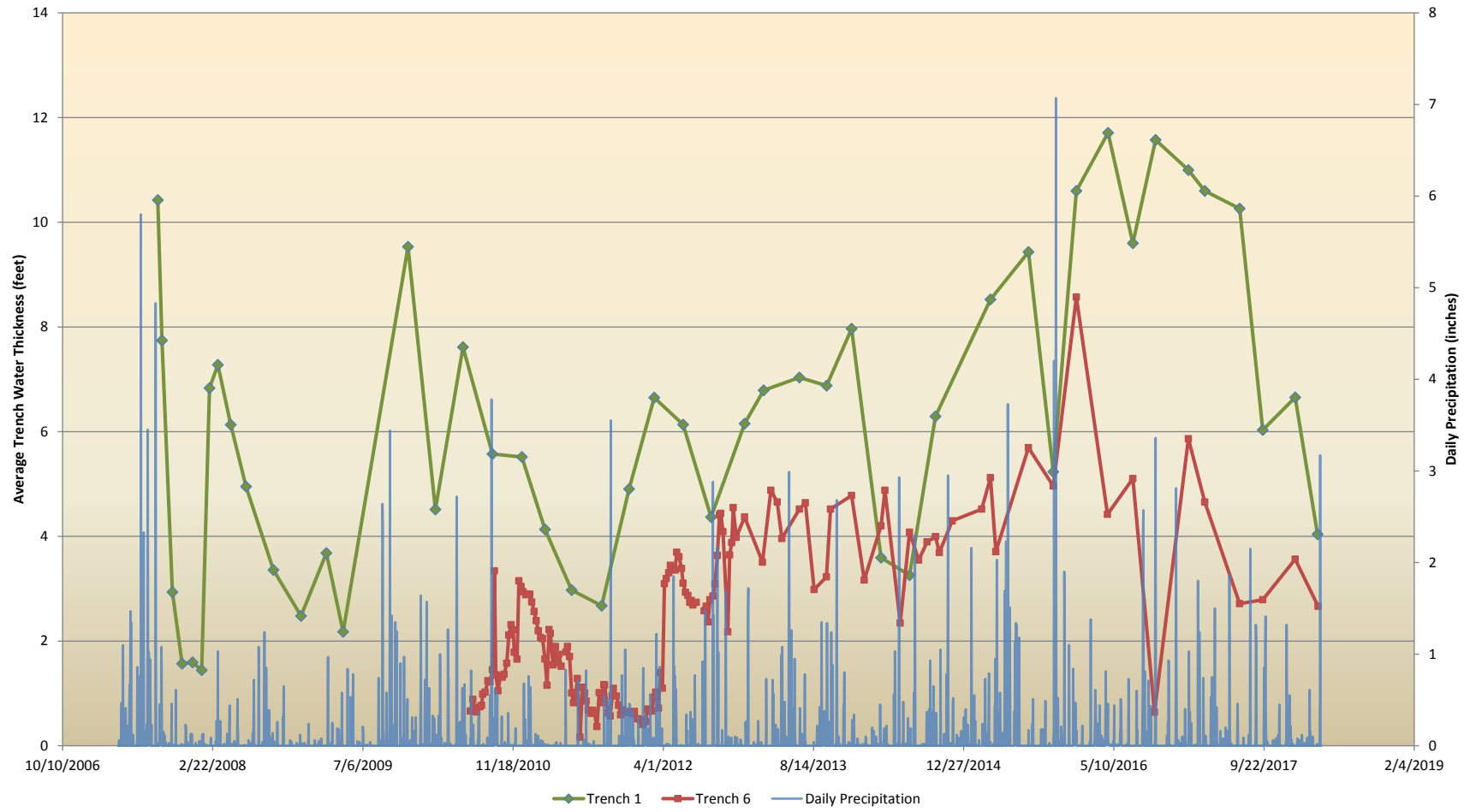


Figure 44.1.2 T1-1

**B-3 Bioreactor Trench 1 Sump 1 VOC Summary  
Mar 2017 - Mar 2018**

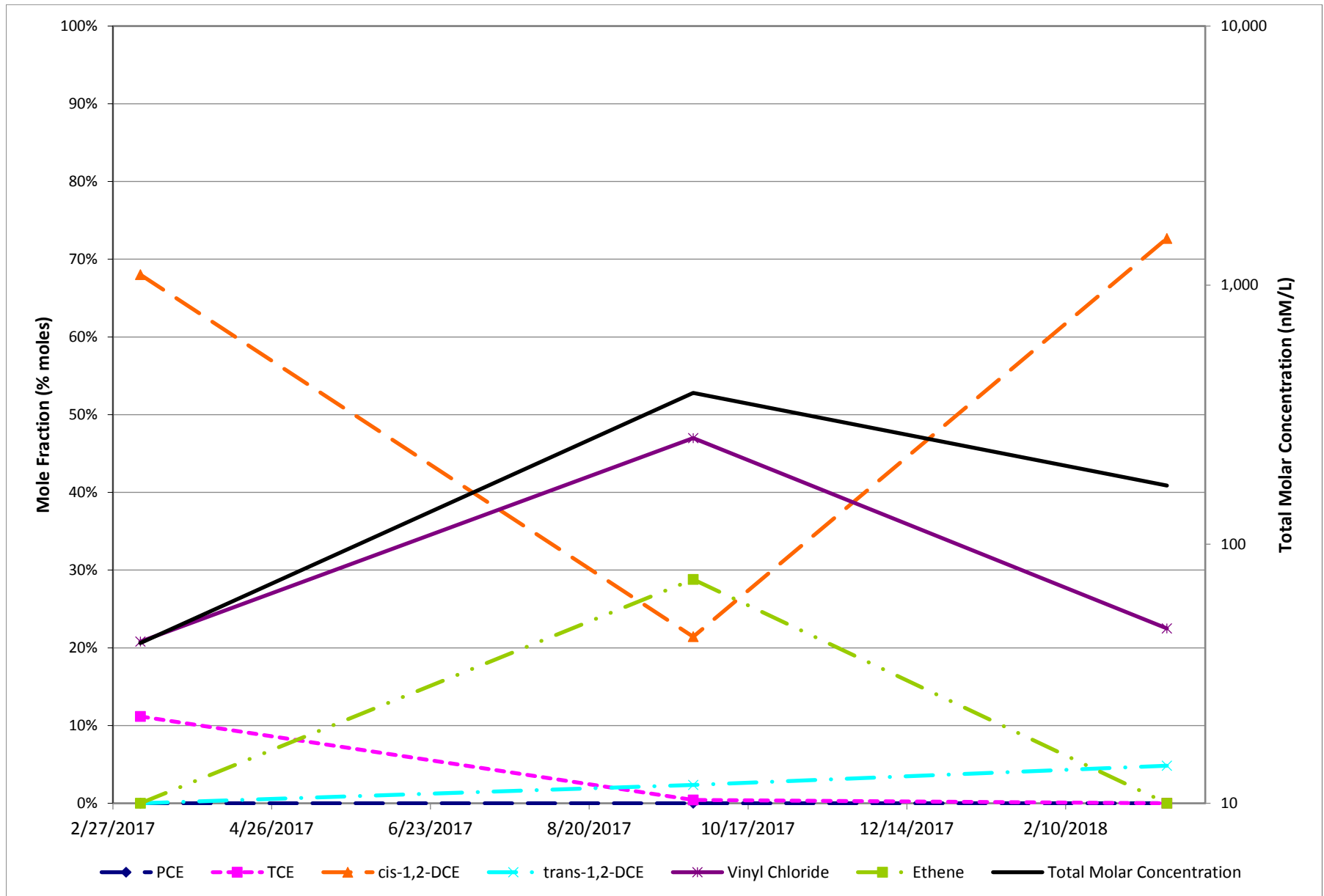


Figure 44.1.2 T1-2

**B-3 Bioreactor Trench 1 Sump 2 VOC Summary  
Mar 2017 - Mar 2018**

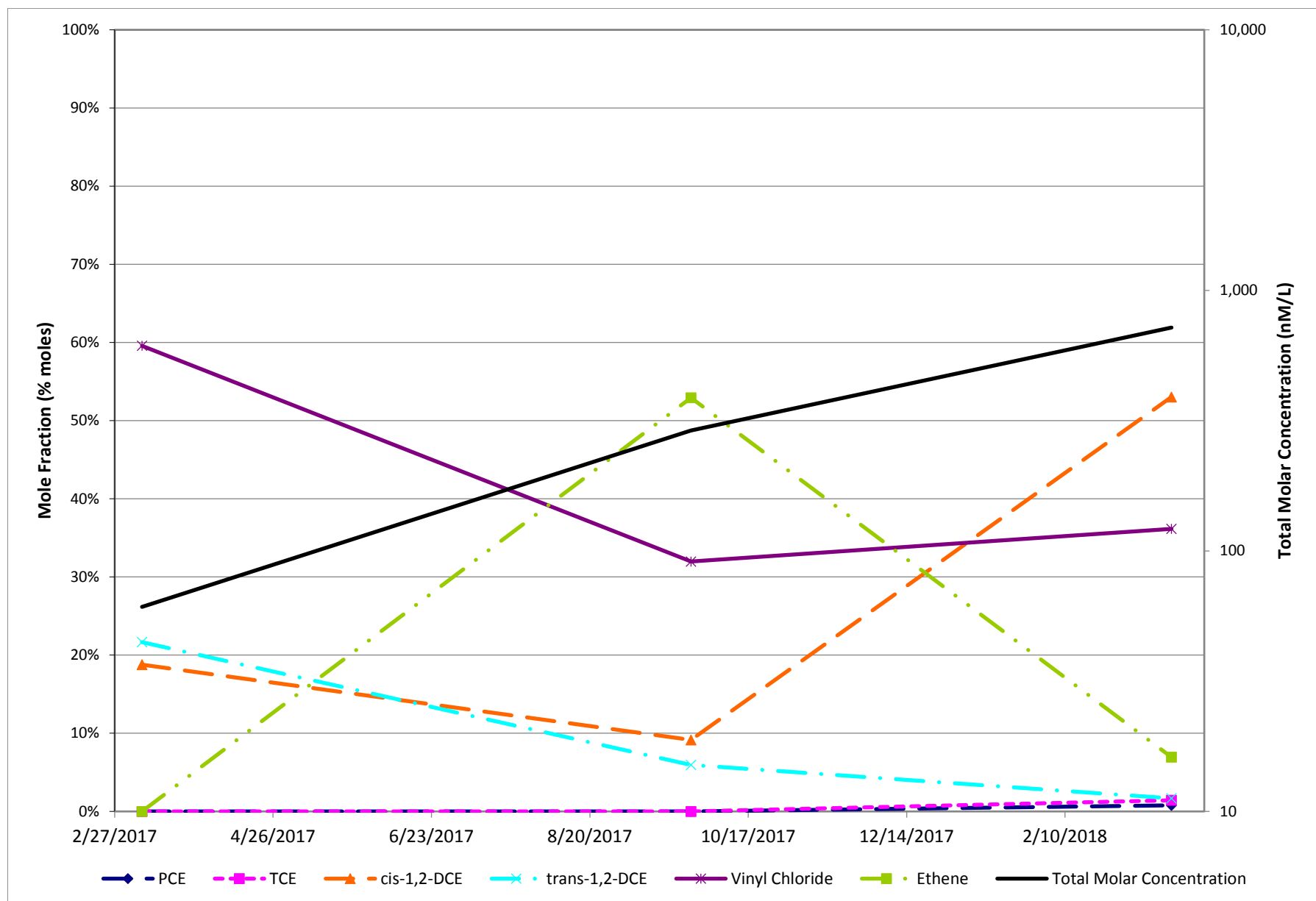


Figure 44.1.2 T1-3

**B-3 Bioreactor Trench 1 Sump 3 VOC Summary  
Mar 2017 - Mar 2018**

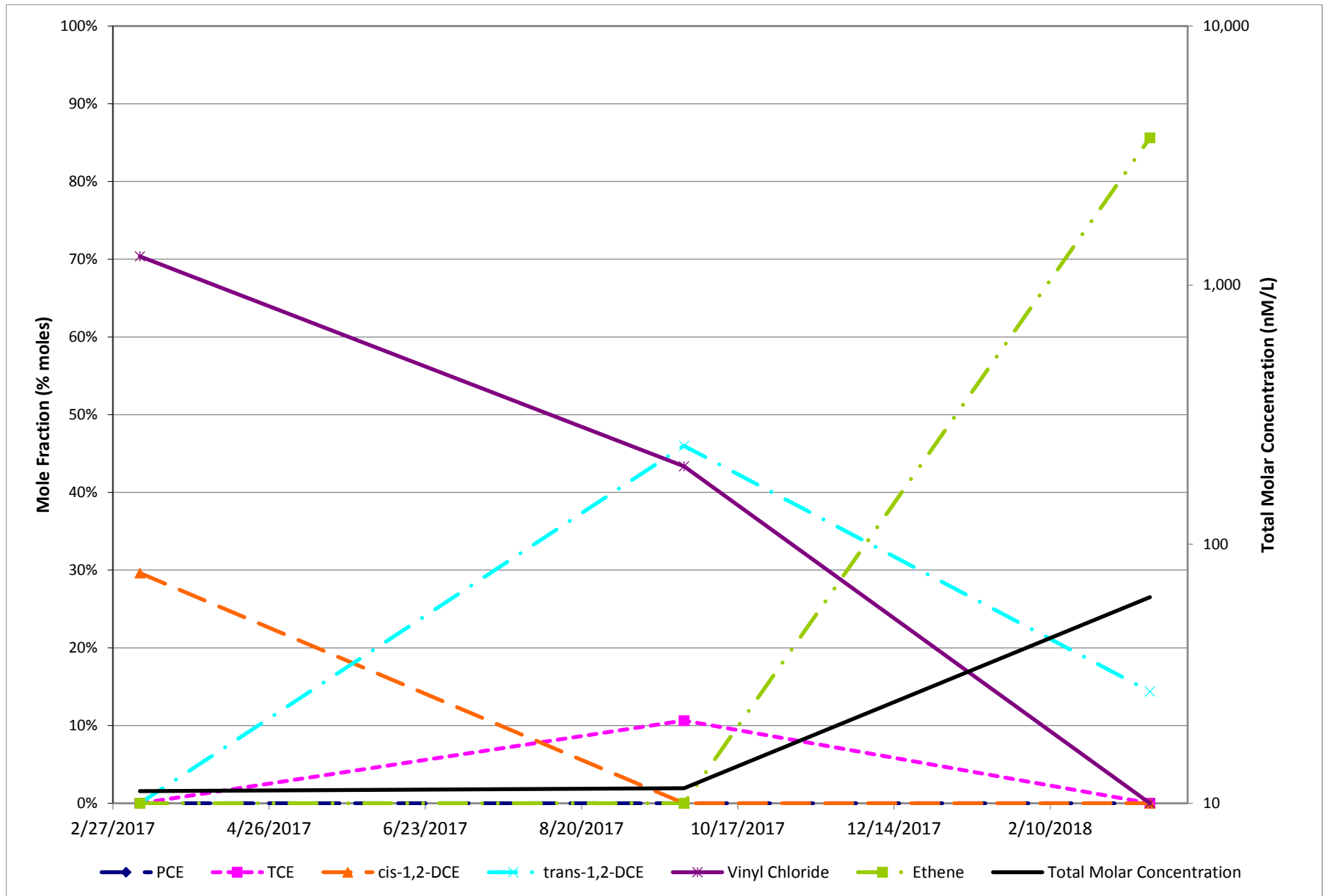


Figure 44.1.2 T2-1

### B-3 Bioreactor Trench 1 Sump 3 VOC Summary Mar 2017 - Mar 2018

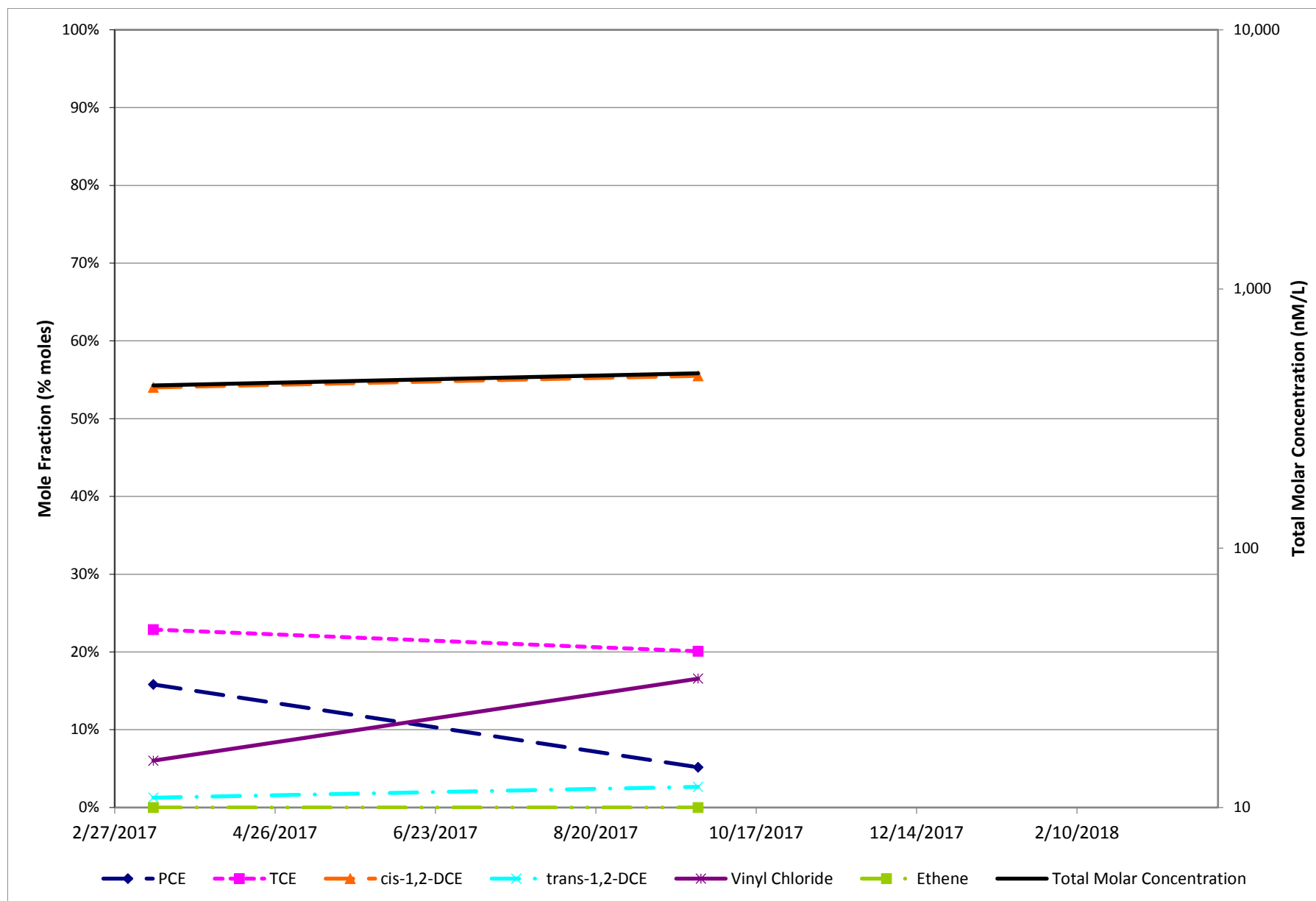


Figure 44.1.2 T2-2

**B-3 Bioreactor Trench 1 Sump 3 VOC Summary  
Mar 2017 - Mar 2018**

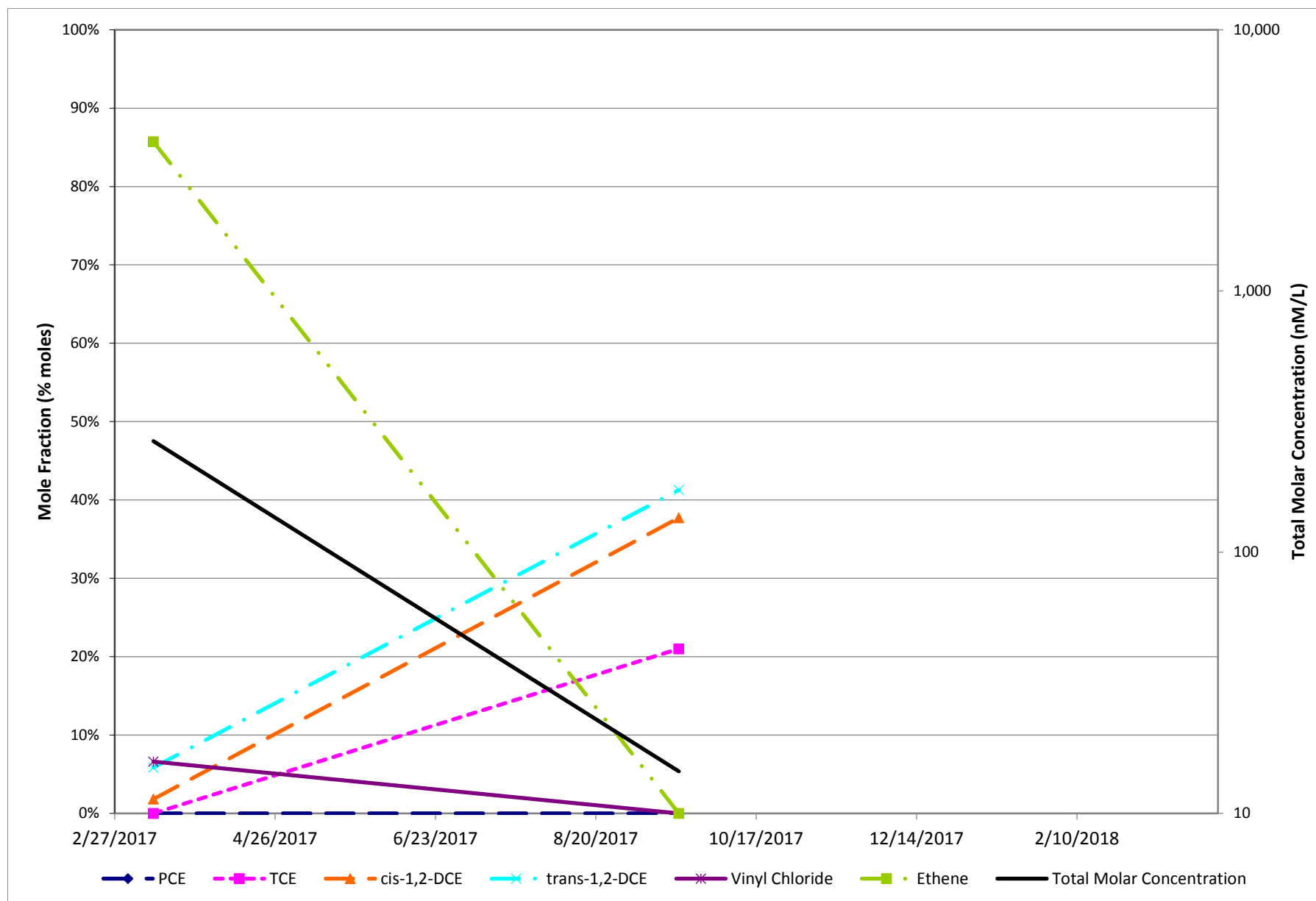


Figure 44.1.2 T3-1

B-3 Bioreactor Trench 1 Sump 3 VOC Summary  
Mar 2017 - Mar 2018

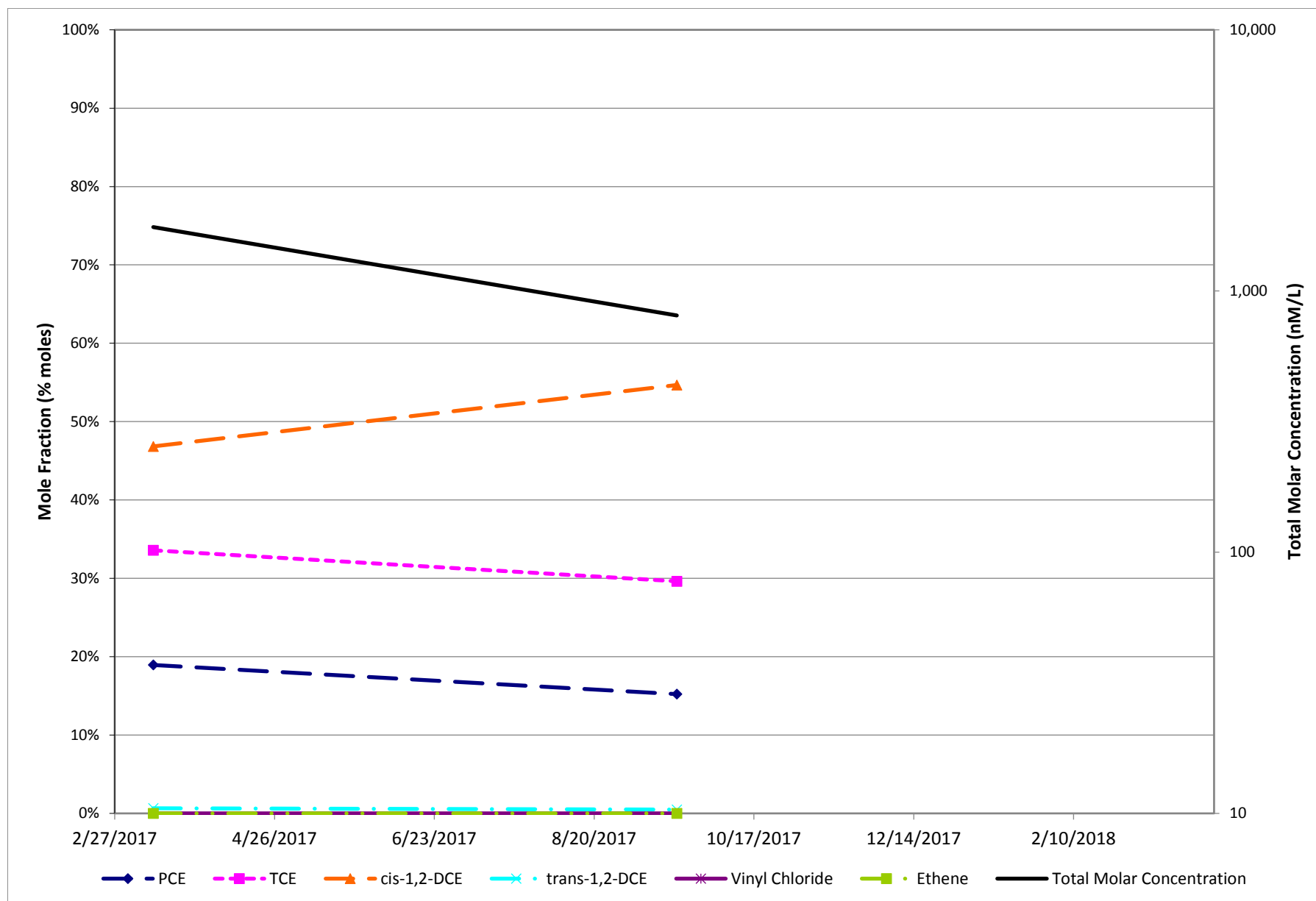


Figure 44.1.2 T3-2

B-3 Bioreactor Trench 1 Sump 3 VOC Summary  
Mar 2017 - Mar 2018

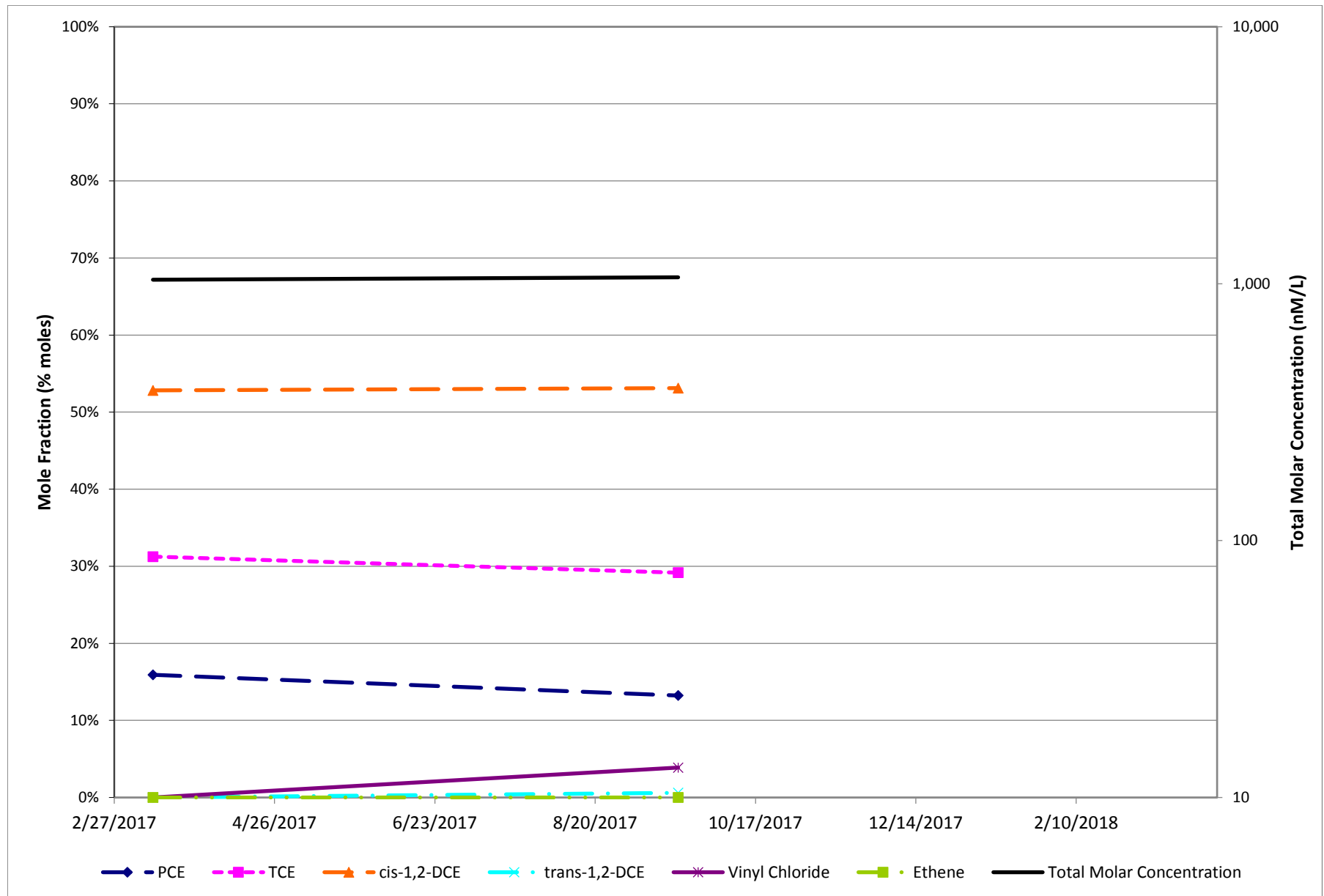




Figure 44.1.2 T4-1

**B-3 Bioreactor Trench 1 Sump 3 VOC Summary  
Mar 2017 - Mar 2018**

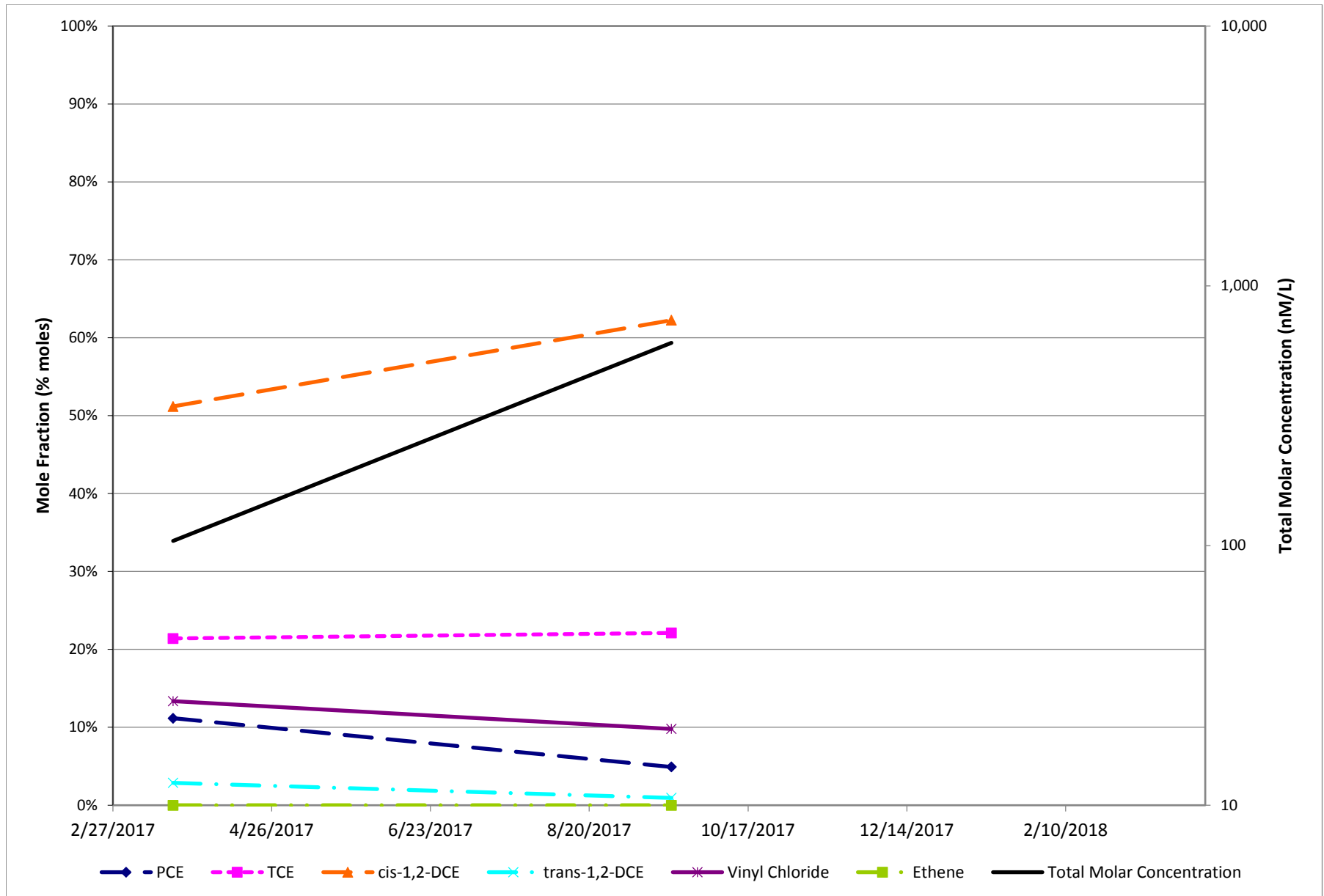


Figure 44.1.2 T5-1

B-3 Bioreactor Trench 1 Sump 3 VOC Summary  
Mar 2017 - Mar 2018

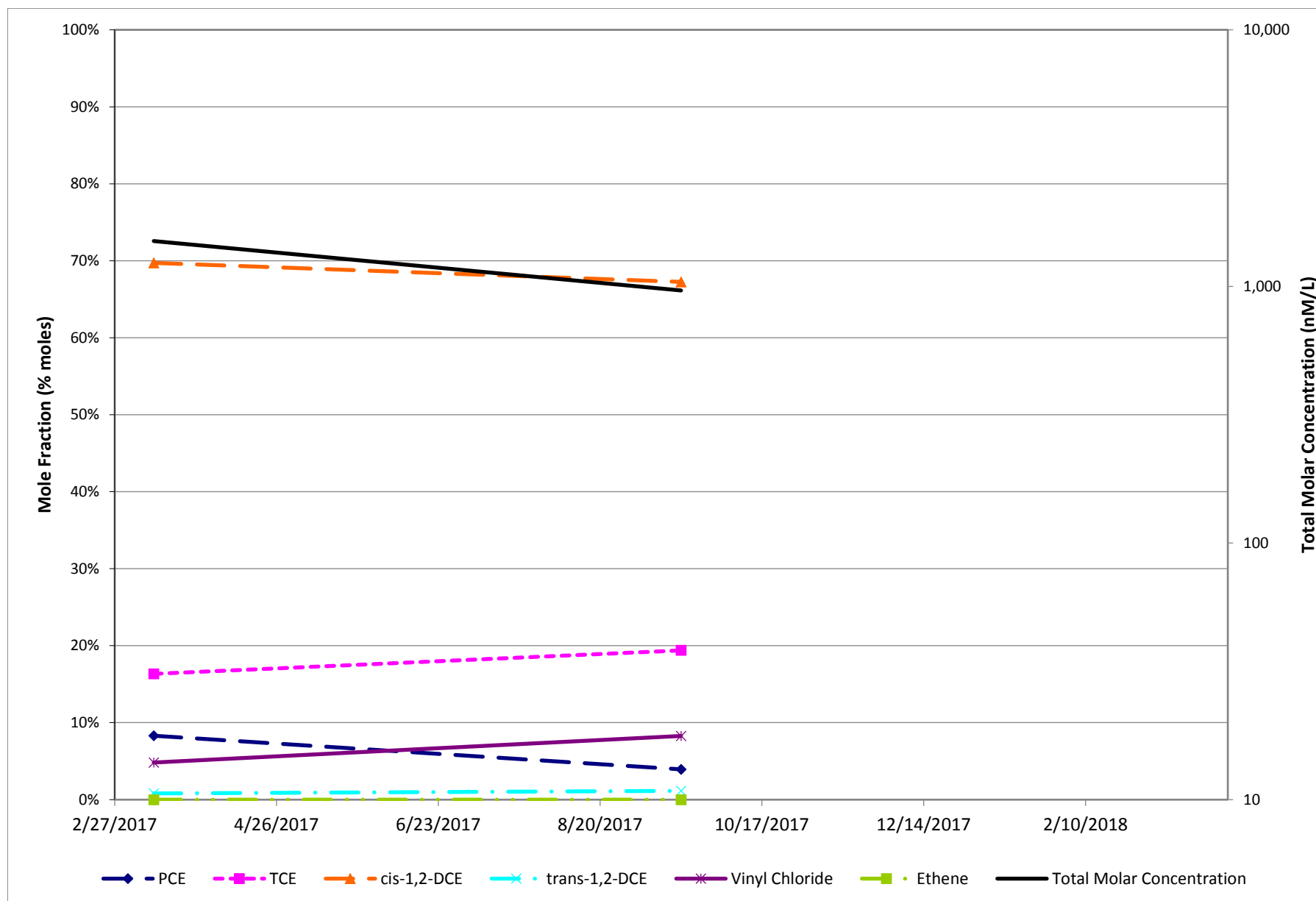


Figure 44.1.2 T5-2

### B-3 Bioreactor Trench 1 Sump 3 VOC Summary Mar 2017 - Mar 2018

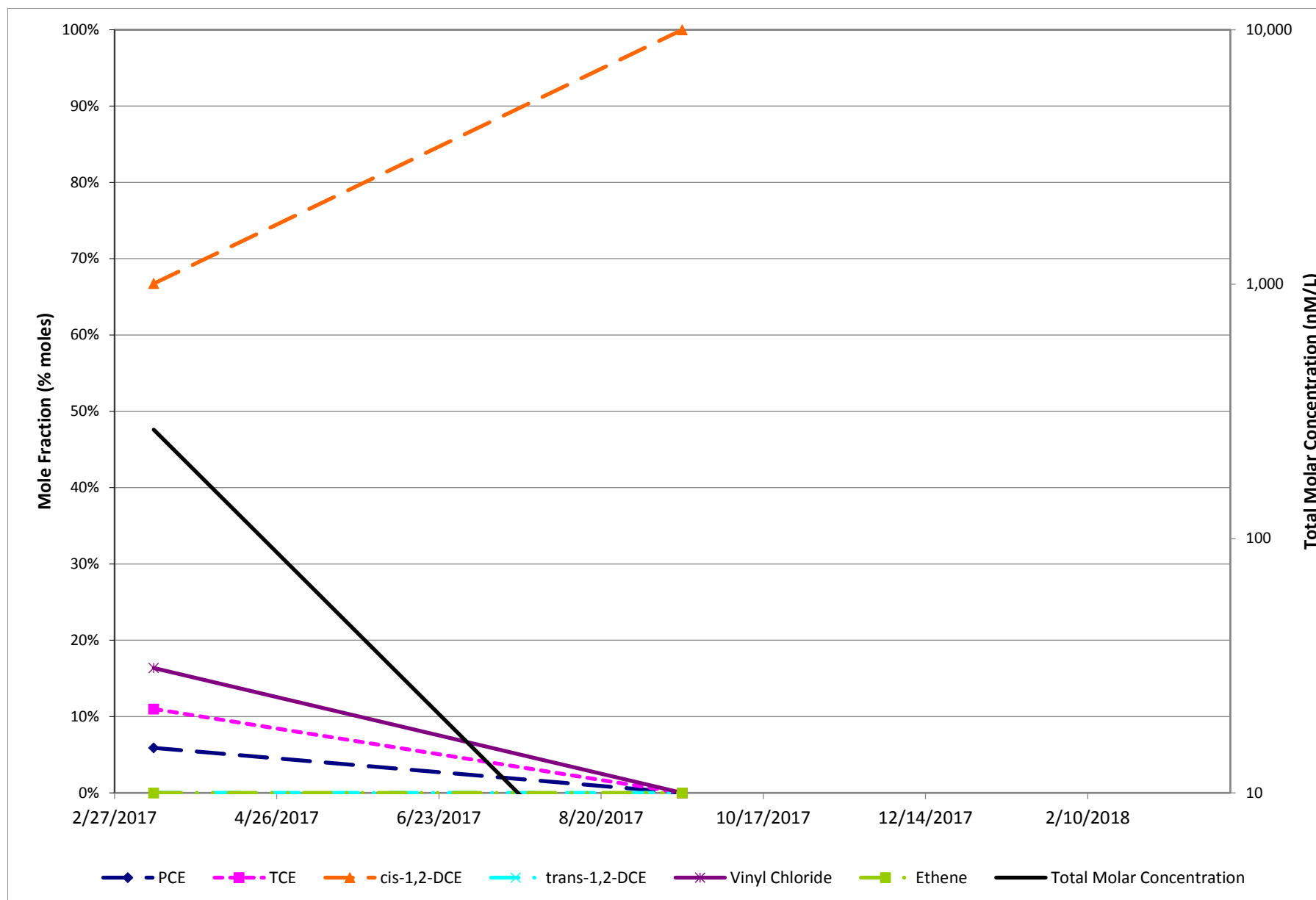


Figure 44.1.2 T6-1

**B-3 Bioreactor Trench 6 Sump 1 VOC Summary  
Mar 2017 - Mar 2018**

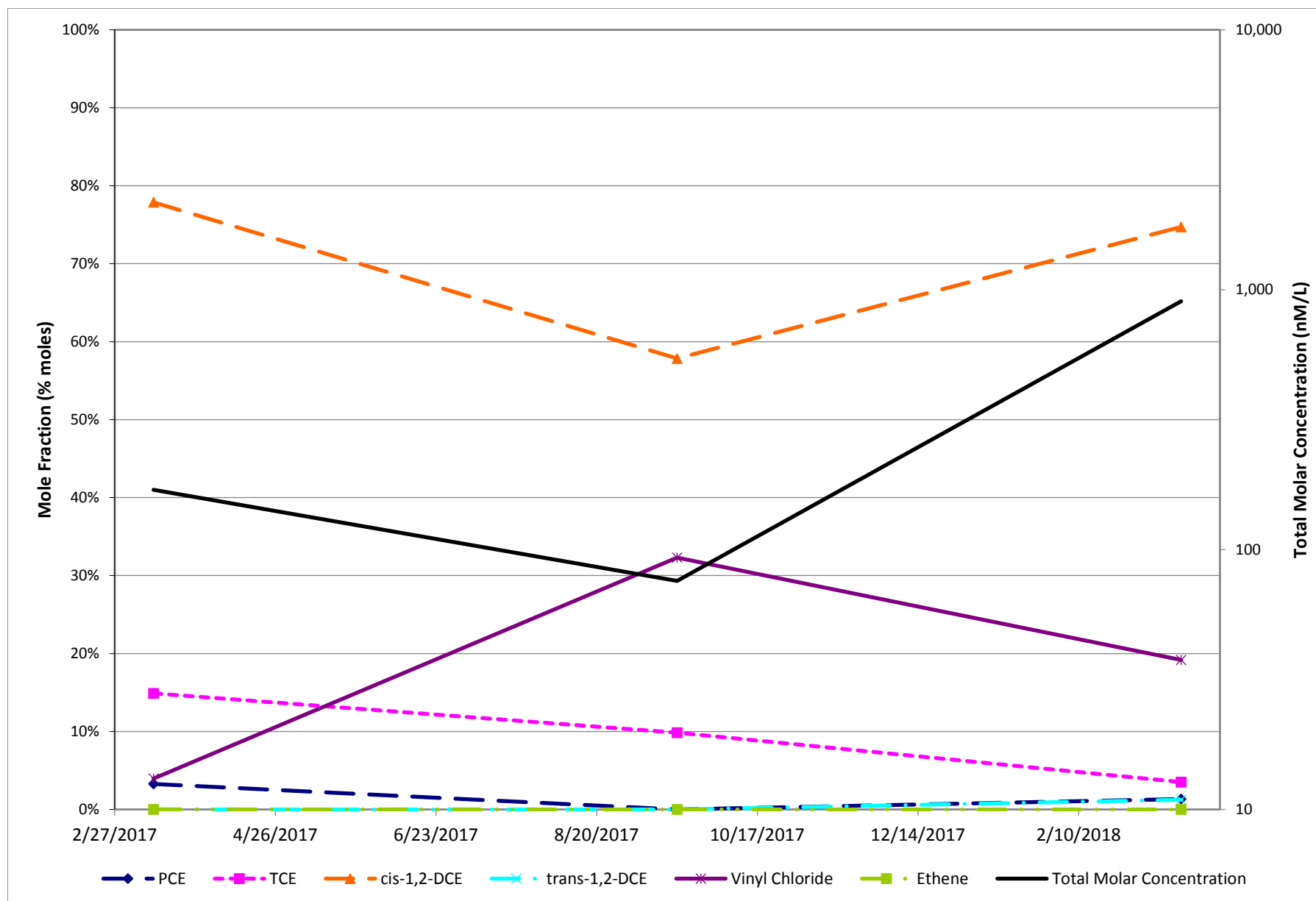


Figure 44.1.2 T6-2

**B-3 Bioreactor Trench 6 Sump 2 VOC Summary  
Mar 2017 - Mar 2018**

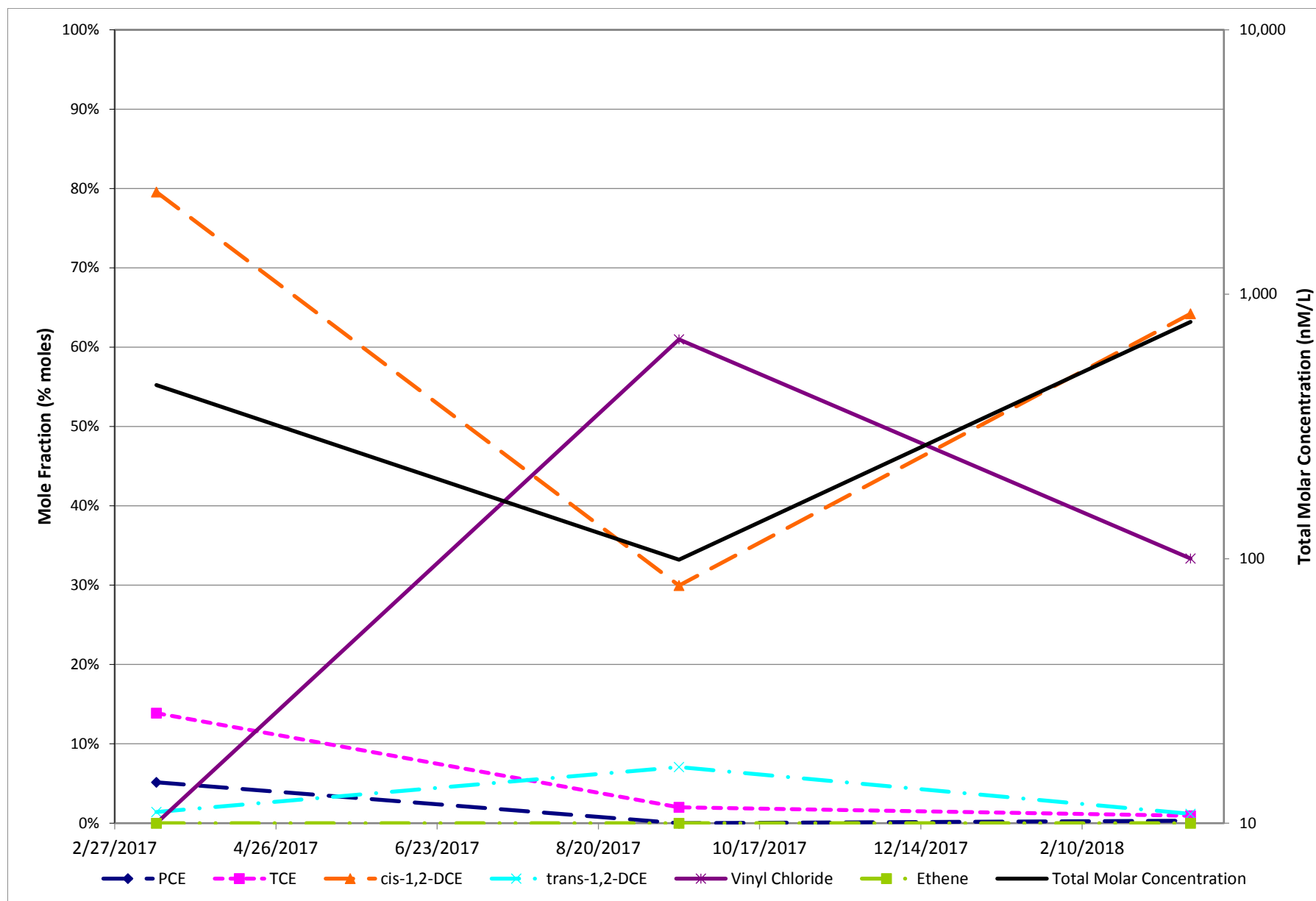


Figure 44.2.2a

CS-WB05-LGR03B VOC Summary  
Mar 2017 - Mar 2018

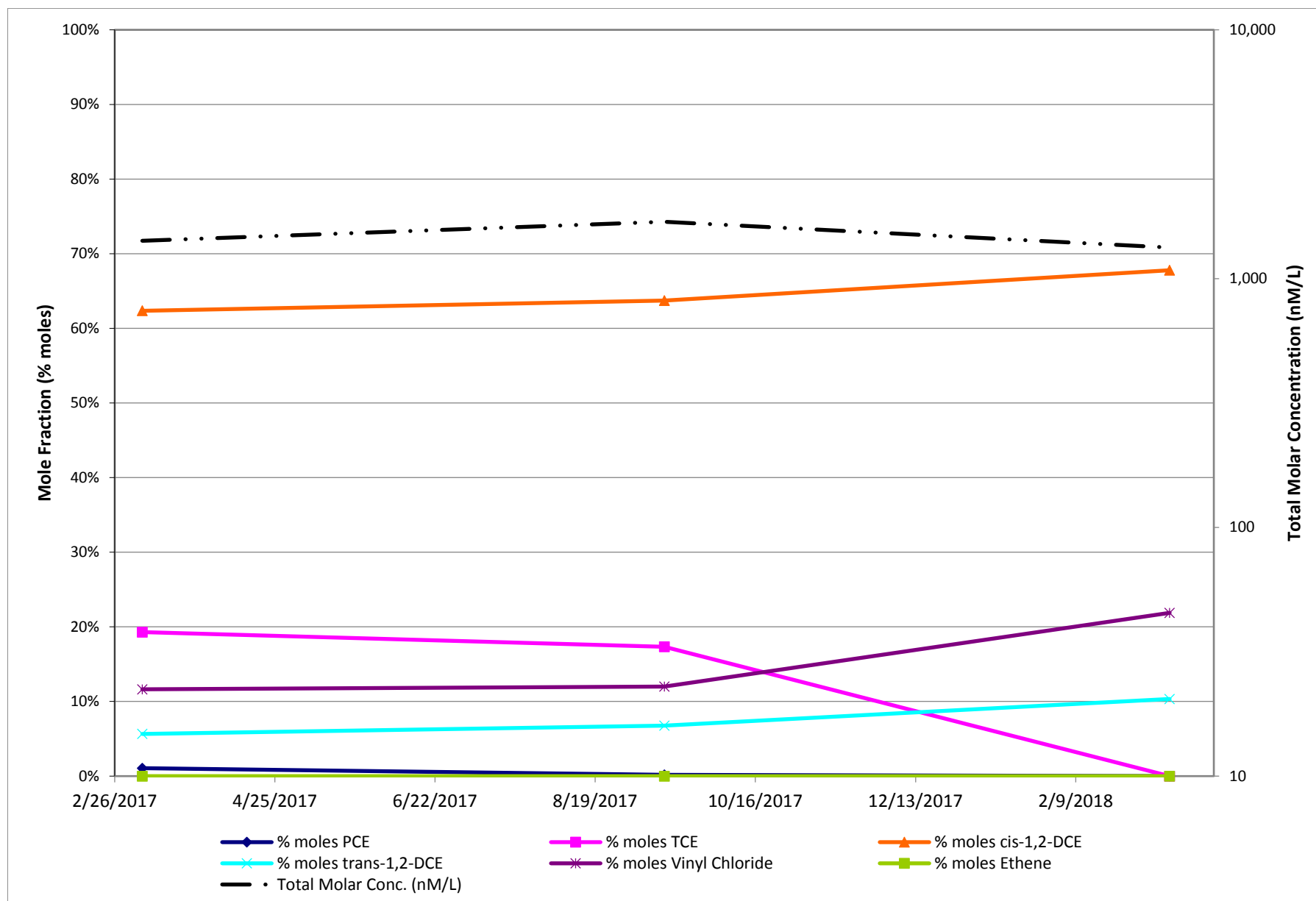


Figure 44.2.2b

CS-WB06-LGR03B VOC Summary  
Mar 2017 - Mar 2018

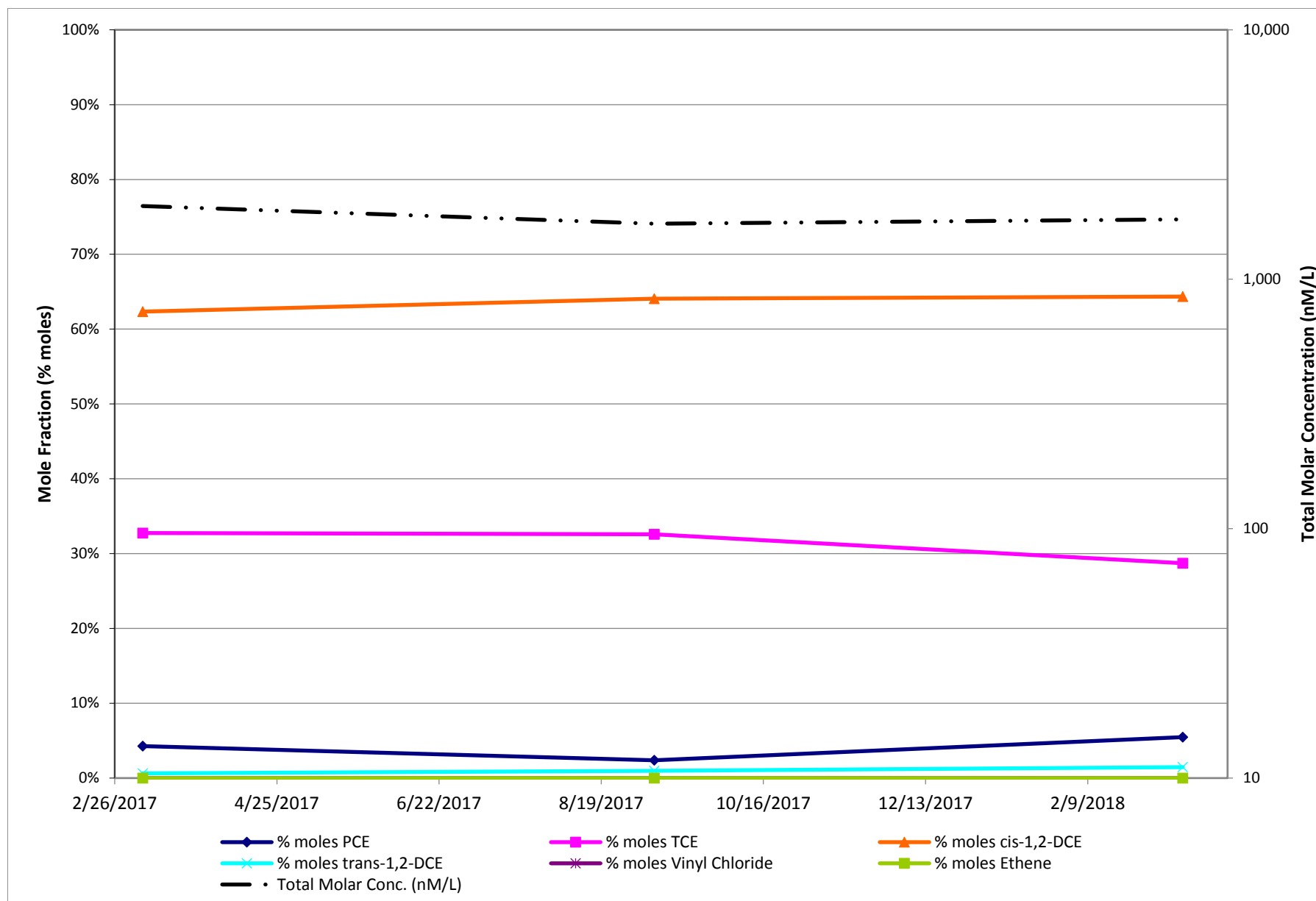


Figure 44.2.2c

CS-WB07-LGR03B VOC Summary  
Mar 2017 - Mar 2018

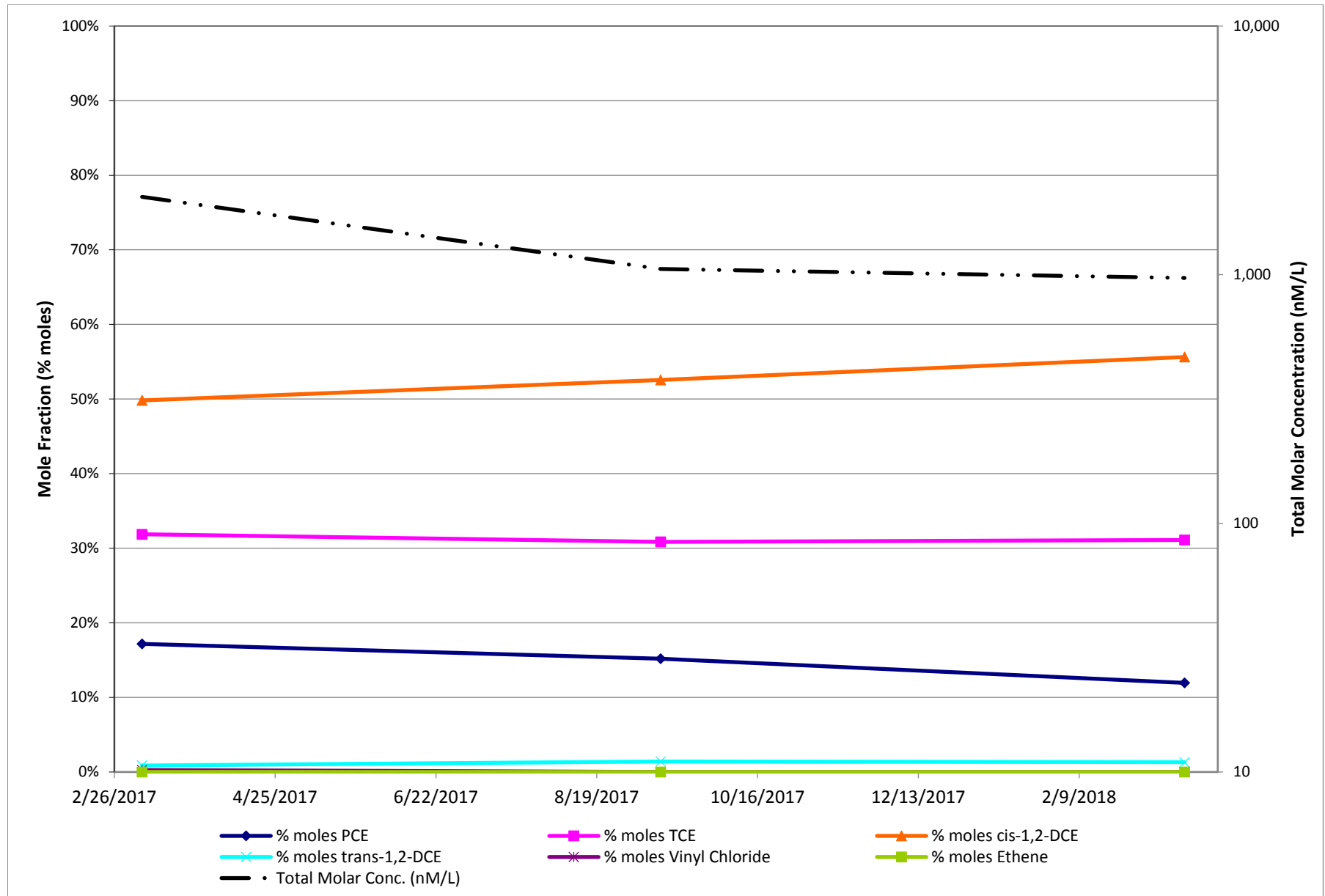




Figure 44.2.2d

### CS-WB08-LGR03B VOC Summary Mar 2017 - Mar 2018

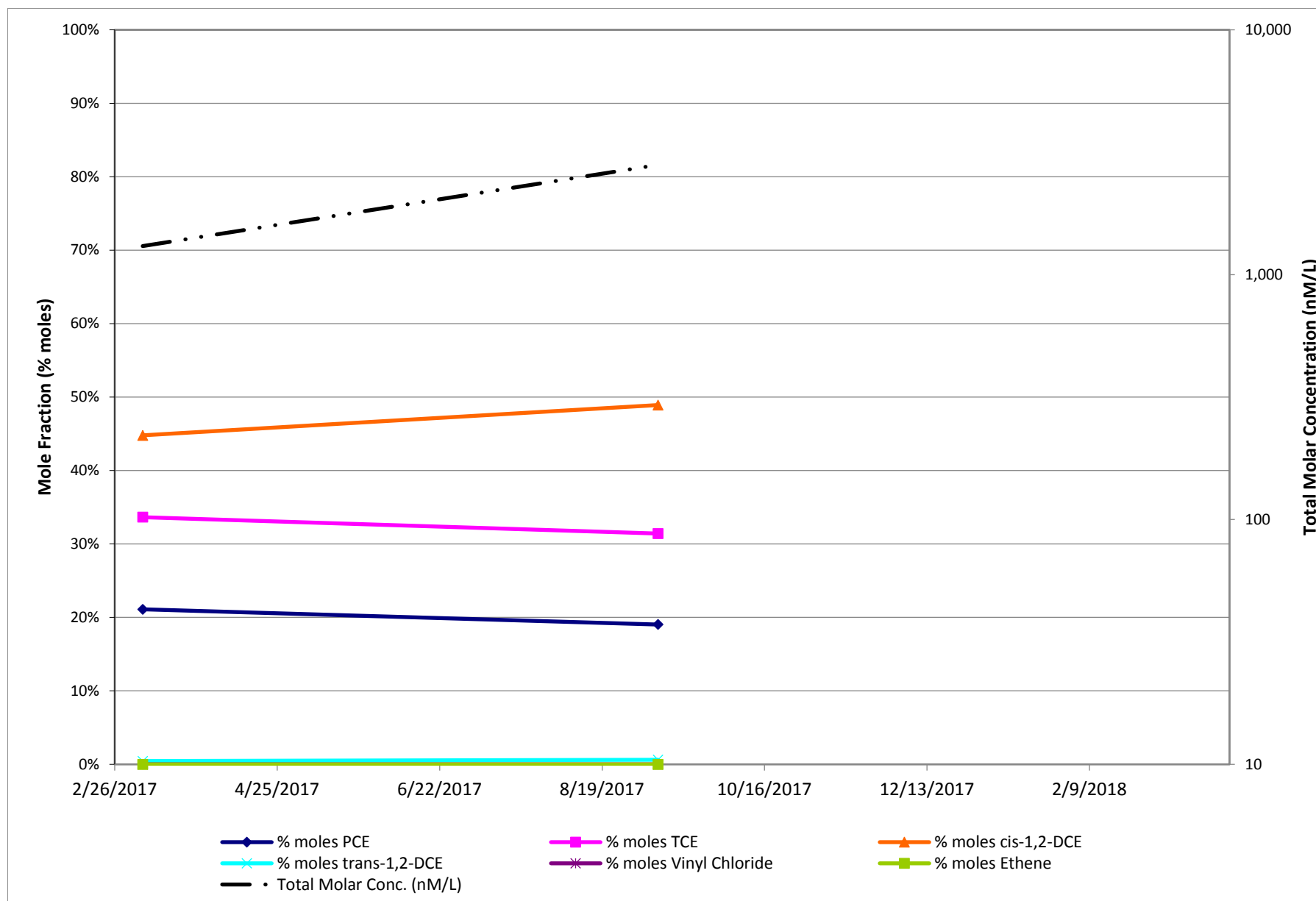
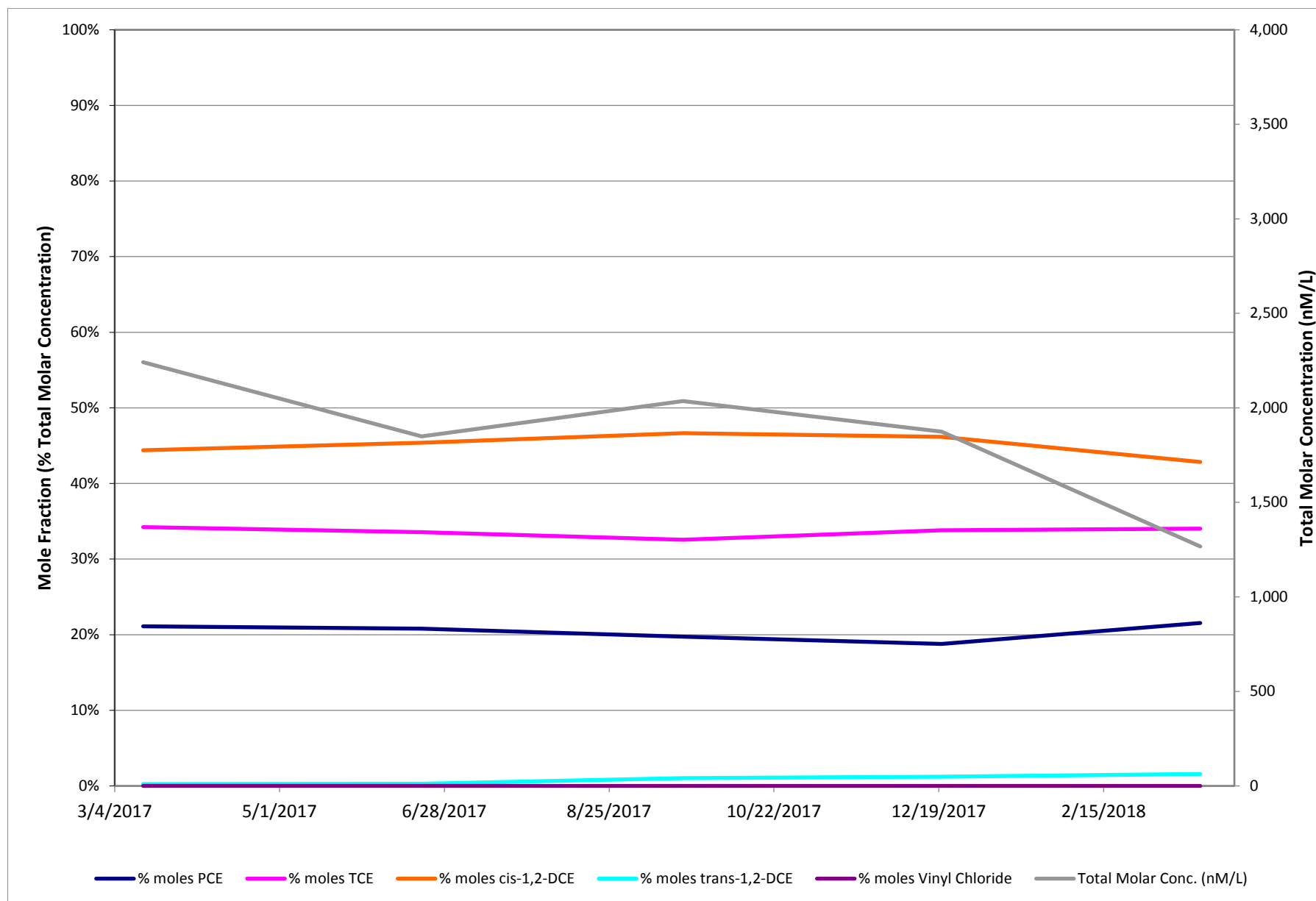


Figure 44.5.2

**Changes in Mole Fraction and Total Molar Concentration at Storage Tank (UIC)  
Mar 2017 - Mar 2018**



## Tables

Table 44.1.2

**B-3 Bioreactor Trench VOC Summary**  
Mar 2017 - Mar 2018

Q44 Date	T1-1			T1-2			T1-3			T2-1		T2-2		T3-1	
	3/9/2017	9/27/2017	3/19/2018	3/9/2017	9/26/2017	3/21/2018	3/9/2017	9/27/2017	3/19/2018	3/13/2017	9/26/2017	3/13/2017	9/19/2017	3/13/2017	9/19/2017
PCE (µg/L)	0	0	0	0	0	0.93	0	0	0	11	4.1	0	0	55	20
TCE (µg/L)	0.61	0.21	0	0	0	1.4	0	0.16	0	13	12	0	0.40	77	31
cis-1,2-DCE (µg/L)	2.7	8.0	12	1.1	2.6	37	0.32	0	0	22	25	0.47	0.53	80	43
trans-1,2-DCE (µg/L)	0	0.88	0.79	1.3	1.7	1.2	0	0.51	0.87	0.52	1.2	1.5	0.58	1.1	0.38
Vinyl chloride (µg/L)	0.54	11	2.4	2.3	5.8	16	0.49	0.31	0	1.6	4.9	1.1	0	0	0
Ethene (µg/L)	0	3.1	0	0	4.3	1.4	0	0	1.5	0	0	6.4	0	0	0
PCE (nM/L)	0.000	0.000	0.000	0.000	0.000	5.608	0.000	0.000	0.000	67.177	24.483	0.000	0.000	332.690	122.716
TCE (nM/L)	4.643	1.598	0.000	0.000	0.000	10.275	0.000	1.218	0.000	97.192	95.061	0.000	3.044	589.771	238.831
cis-1,2-DCE (nM/L)	28.262	82.207	122.537	11.449	26.509	381.743	3.301	0.000	0.000	229.397	262.610	4.848	5.467	822.795	440.743
trans-1,2-DCE (nM/L)	0.000	9.077	8.149	13.203	17.225	12.068	0.000	5.260	8.974	5.364	12.584	15.575	5.982	11.449	3.920
Vinyl chloride (nM/L)	8.639	180.291	37.914	36.314	92.625	260.278	7.839	4.959	0.000	25.596	78.387	17.597	0.000	0.000	0.000
Ethene (nM/L)	0.000	110.517	0.000	0.000	153.298	49.911	0.000	0.000	53.476	0.000	0.000	228.164	0.000	0.000	0.000
Total Molar Conc. (nM/L)	41.54	383.69	168.60	60.97	289.66	719.88	11.14	11.44	62.45	424.72	473.12	266.18	14.49	1756.71	806.21
% moles PCE	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	0.0%	0.0%	0.0%	15.8%	5.2%	0.0%	0.0%	18.9%	15.2%
% moles TCE	11.2%	0.4%	0.0%	0.0%	0.0%	1.4%	0.0%	10.6%	0.0%	22.9%	20.1%	0.0%	21.0%	33.6%	29.6%
% moles cis-1,2-DCE	68.0%	21.4%	72.7%	18.8%	9.2%	53.0%	29.6%	0.0%	0.0%	54.0%	55.5%	1.8%	37.7%	46.8%	54.7%
% moles trans-1,2-DCE	0.0%	2.4%	4.8%	21.7%	5.9%	1.7%	0.0%	46.0%	14.4%	1.3%	2.7%	5.9%	41.3%	0.7%	0.5%
% moles Vinyl Chloride	20.8%	47.0%	22.5%	59.6%	32.0%	36.2%	70.4%	43.4%	0.0%	6.0%	16.6%	6.6%	0.0%	0.0%	0.0%
% moles Ethene	0.0%	28.8%	0.0%	0.0%	52.9%	6.9%	0.0%	0.0%	85.6%	0.0%	0.0%	85.7%	0.0%	0.0%	0.0%
sum % moles	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: 0 sample indicates a non-detect analyte value

Date	T3-2		T4-1		T5-1		T5-2		T6-1		T6-2			
	3/13/2017	9/19/2017	3/21/2017	9/19/2017	3/13/2017	9/18/2017	3/13/2017	9/18/2017	3/13/2017	9/18/2017	3/19/2018	3/14/2017	9/18/2017	3/21/2018
PCE (µg/L)	27	23	1.9	4.9	21	6.3	2.6	0	0.92	0	2.0	3.9	0	0.41
TCE (µg/L)	43	41	2.9	18	32	25	3.9	0	3.3	0.98	4.2	8.3	0.26	0.97
cis-1,2-DCE (µg/L)	53	55	5.2	36	102	63	17	0.22	13	4.2	65	35	2.9	49
trans-1,2-DCE (µg/L)	0	0.62	0.29	0.55	1.2	1.1	0	0	0	0	1.1	0.62	0.68	0.90
Vinyl chloride (µg/L)	0	2.6	0.87	3.7	4.5	5.0	2.7	0	0.42	1.5	11	0	3.8	16
Ethene (µg/L)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PCE (nM/L)	164.928	140.083	11.638	29.609	124.766	37.991	15.799	0.000	5.548	0.000	12.061	23.397	0.000	2.472
TCE (nM/L)	323.845	308.852	22.300	133.343	245.529	187.001	29.454	0.000	25.268	7.459	31.738	62.942	1.979	7.383
cis-1,2-DCE (nM/L)	547.292	562.455	53.326	375.348	1047.550	648.788	178.752	2.269	132.130	43.837	674.884	361.011	29.706	504.796
trans-1,2-DCE (nM/L)	0.000	6.395	2.991	5.673	12.171	11.037	0.000	0.000	0.000	0.000	11.243	6.395	7.014	9.283
Vinyl chloride (nM/L)	0.000	41.113	13.918	59.031	72.468	79.827	43.833	0.000	6.719	24.476	173.092	0.000	60.470	262.358
Ethene (nM/L)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Molar Conc. (nM/L)	1036.07	1058.90	104.17	603.00	1502.48	964.64	267.84	2.27	169.67	75.77	903.02	453.75	99.17	786.3
% moles PCE	15.9%	13.2%	11.2%	4.9%	8.3%	3.9%	5.9%	0.0%	3.3%	0.0%	1.3%	5.2%	0.0%	0.3%
% moles TCE	31.3%	29.2%	21.4%	22.1%	16.3%	19.4%	11.0%	0.0%	14.9%	9.8%	3.5%	13.9%	2.0%	0.9%
% moles cis-1,2-DCE	52.8%	53.1%	51.2%	62.2%	69.7%	67.3%	66.7%	100.0%	77.9%	57.9%	74.7%	79.6%	30.0%	64.2%
% moles trans-1,2-DCE	0.0%	0.6%	2.9%	0.9%	0.8%	1.1%	0.0%	0.0%	0.0%	0.0%	1.2%	1.4%	7.1%	1.2%
% moles Vinyl Chloride	0.0%	3.9%	13.4%	9.8%	4.8%	8.3%	16.4%	0.0%	4.0%	32.3%	19.2%	0.0%	61.0%	33.4%
% moles Ethene	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
sum % moles	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: 0 sample indicates a non-detect analyte value



Table 44.2.2

**Upper Saturated Zone (Zone 03B) VOC Summary**  
**Mar 2017 - Mar 2018**

Q44 Date	CS-WB05-LGR03B			CS-WB06-LGR03B			CS-WB07-LGR03B			CS-WB08-LGR03B	
	3/8/2017	9/13/2017	3/15/2018	3/8/2017	9/7/2017	3/15/2018	3/8/2017	9/11/2017	3/19/2018	3/8/2017	9/8/2017
PCE (µg/L)	2.5	0.46	0	14	6.6	16	59	27	19	46	89
TCE (µg/L)	36	39	0	85	71	66	86	43	40	58	116
cis-1,2-DCE (µg/L)	86	105	88	119	104	108	99	54	52	57	133
trans-1,2-DCE (µg/L)	7.8	11	13	1.2	1.6	2.5	1.7	1.4	1.2	0.57	1.7
Vinyl chloride (µg/L)	10	13	18	0	0	0	0.35	0	0	0	0
Ethene (µg/L)	0	0	0	0	0	0	0	0	0	0	0
PCE (nM/L)	15.136	2.774	0.000	84.062	39.739	95.037	353.133	160.345	115.902	276.247	534.523
TCE (nM/L)	274.070	293.477	0.000	643.809	543.953	498.592	655.377	325.367	301.697	440.292	882.411
cis-1,2-DCE (nM/L)	885.508	1077.978	903.559	1225.374	1069.624	1117.277	1024.239	554.203	539.763	586.178	1373.698
trans-1,2-DCE (nM/L)	80.248	114.595	137.803	12.378	16.400	25.374	17.844	14.853	12.893	5.879	17.535
Vinyl chloride (nM/L)	165.254	203.167	291.633	0.000	0.000	0.000	5.599	0.000	0.000	0.000	0.000
Ethene (nM/L)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Molar Conc. (nM/L)	1420.21	1691.99	1332.99	1965.62	1669.72	1736.28	2056.19	1054.77	970.26	1308.60	2808.2
% moles PCE	1.1%	0.2%	0.0%	4.3%	2.4%	5.5%	17.2%	15.2%	11.9%	21.1%	19.0%
% moles TCE	19.3%	17.3%	0.0%	32.8%	32.6%	28.7%	31.9%	30.8%	31.1%	33.6%	31.4%
% moles cis-1,2-DCE	62.4%	63.7%	67.8%	62.3%	64.1%	64.3%	49.8%	52.5%	55.6%	44.8%	48.9%
% moles trans-1,2-DCE	5.7%	6.8%	10.3%	0.6%	1.0%	1.5%	0.9%	1.4%	1.3%	0.4%	0.6%
% moles Vinyl Chloride	11.6%	12.0%	21.9%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
% moles Ethene	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
sum % moles	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: 0 sample indicates a non-detect analyte value

Table 44.2.3a

**B-3 Bioreactor Multi-Port Well CS-WB05 Analytical Summary**  
**Mar 2017 - Mar 2018**

Q44		CS-WB05																	
Well ID		CS-WB05-LGR-01		CS-WB05-LGR03B				CS-WB05-LGR-04A		CS-WB05-LGR-04B		CS-WB05-BS-01		CS-WB05-CC-01		CS-WB05-CC-02			
Sample Date		9/13/2017		3/8/2017		9/13/2017		3/15/2018		9/13/2017		9/14/2017		9/13/2017		9/12/2017		9/12/2017	
Compound	Units	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag
Total Organic Carbon	mg/L	1.1		1.4		0.90	F	1.5		1.1		1.3		0.88	F	0.84	F	2.9	
Methane	µg/L	1.4		0		38		10		368		1,010		20		2.7		19	
Ethene	µg/L	0		0		0		0		0		3.6		0		0		0	
Ethane	µg/L	0		0		0		0		0		0		0		0		0	
Carbon Dioxide	µg/L	20,000		1,350		15,500		8,210		11,200		26,000		9,130		10,100		17,400	
Sulfate	mg/L	95		44		41		42		22		8.5		30		81		91	
Chloride	mg/L	13		11		10		11		11		12		11		17		19	
Ferrous Iron	mg/L	0		0.16	F	0				0.46	F	0.39	F	0		0.25	F	0.21	F
Manganese	µg/L	2.0	F	0		0		0		4.0	F	33		0		0		0	
Sulfide	mg/L	0		0		0		0		0		0		0		0		0	
Total Dissolved Solids	mg/L	645		374		444		412		414		367		385		476		494	
Benzene	µg/L	0		0		0		0		0		0		0		0		0	
Bromodichloromethane	µg/L	0		0		0		0		0		0		0		0		0	
Bromoform	µg/L	0		0		0		0		0		0		0		0		0	
Chloroform	µg/L	0		0		0		0		0		0		0		0		0	
Dibromochloromethane	µg/L	0		0		0		0		0		0		0		0		0	
Dichlorodifluoromethane	µg/L	0		0		0		0		0		0		0		0		0	
Dichloroethene, 1,1-	µg/L	0		0		0		0		0		0		0		0		0	
Dichloroethene, cis-1,2-	µg/L	4.5		86		105		88		367		344		24		0.78	F	7.1	
Dichloroethene, trans-1,2-	µg/L	1.2		7.8		11		13		14		18		0.27	F	0.72		4.4	
Methylene chloride	µg/L	0		0		0		0		0		0		0		0		0	
Naphthalene	µg/L	0		0		0		0		0		0		0		0		0	
Tetrachloroethene	µg/L	0.45	F	2.5		0.46	F	0		0		86		0		0		0	
Toluene	µg/L	0		0		0		0		0		0		0		0		0	
Trichloroethene	µg/L	0.79	F	36		39		0		0.44	F	198		0		0		0	
Vinyl chloride	µg/L	0		10		13		18		59		80		2.9		0		0	
Arsenic	µg/L	0		0.60	F	2.1	F	0		9.0	F	11	F	3.2	F	0		0	
		Q42-Month 125		Q40-Month 119		Q42-Month 125		Q44-Month 131		Q42-Month 125		Q42-Month 125		Q42-Month 125		Q42-Month 125		Q42-Month 125	

Note: 0 sample indicates a non-detect analyte value

Table 44.2.3b

**B-3 Bioreactor Multi-Port Well CS-WB06 Analytical Summary**  
**Mar 2017 - Mar 2018**

Q44		CS-WB06															
Well ID		CS-WB06-UGR-01		CS-WB06-LGR-01		CS-WB06-LGR-02		CS-WB06-LGR03A		CS-WB06-LGR03B				CS-WB06-LGR-04			
Sample Date		9/7/2017		9/7/2017		9/7/2017		9/7/2017		3/8/2017		9/7/2017		3/15/2018		9/7/2017	
Compound	Units	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag
Total Organic Carbon	mg/L	6.6		2.3		1.0		0.94	F	1.1		0.94	F	1.3		1.1	
Methane	µg/L	1,790		0		6.8		0		1.2		1.0		2.2		0	
Ethene	µg/L	0		0		0		0		0		0		0		0	
Ethane	µg/L	0		0		0		0		0		0		0		0	
Carbon Dioxide	µg/L	89,500		38,700		7,640		5,930		17,100		9,250		9,610		30,700	
Sulfate	mg/L	2.5		12		27		24		25		25		23		13	
Chloride	mg/L	14		13		9.2		11		12		11		12		14	
Ferrous Iron	mg/L	3.3		0.20	F	0.28	F	0.21	F	0		0.19	F	0		0.20	F
Manganese	µg/L	1,310		56		4.0	F	0		0		2.0	F	0		4.0	F
Sulfide	mg/L	0		0		0		0		0		0		0		0	
Total Dissolved Solids	mg/L	556		471		357		375		342		375		362		421	
Benzene	µg/L	0		0		0		0		0		0		0		0	
Bromodichloromethane	µg/L	0		0		0		0		0		0		0		0	
Bromoform	µg/L	0		0		0		0		0		0		0		0	
Chloroform	µg/L	0		0		0		0		0		0		0		0	
Dibromochloromethane	µg/L	0		0		0		0		0		0		0		0	
Dichlorodifluoromethane	µg/L	0		0		0		0		0		0		0		0	
Dichloroethene, 1,1-	µg/L	0		0		0		0		0		0		0		0	
Dichloroethene, cis-1,2-	µg/L	0.84	F	5.1		12		109		119		104		108		89	
Dichloroethene, trans-1,2-	µg/L	0.64		0.20	F	0.23	F	1.4		1.2		1.6		2.5		1.0	
Methylene chloride	µg/L	0		0		0		0		0		0		0		0	
Naphthalene	µg/L	0		0		0		0		0		0		0		0	
Tetrachloroethene	µg/L	0		3.5		0		11		14		6.6		16		39	
Toluene	µg/L	0		0		0		0		0		0		0		0	
Trichloroethene	µg/L	0.21	F	3.6		0.62	F	74		85		71		66		34	
Vinyl chloride	µg/L	0		0		0		0		0		0		0		0	
Arsenic	µg/L	12	F	11	F	14	F	9.9	F	0		13	F	0		1.7	F
		Q42-Month 125		Q42-Month 125		Q42-Month 125		Q42-Month 125		Q40-Month 119		Q42-Month 125		Q44-Month 131		Q42-Month 125	

Note: 0 sample indicates a non-detect analyte value



Table 44.2.3c

B-3 Bioreactor Multi-Port Well CS-WB07 Analytical Summary  
Mar 2017 - Mar 2018

Q44		CS-WB07											
Well ID		CS-WB07-LGR-01		CS-WB07-LGR-02		CS-WB07-LGR03B						CS-WB07-LGR-04	
Sample Date		9/11/2017		9/11/2017		3/8/2017		9/11/2017		3/19/2018		9/11/2017	
Compound	Units	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag
Total Organic Carbon	mg/L	3.1		1.4		1.1		0.87	F	1.3		1.1	
Methane	µg/L	1,780		162		0		0		1.6		16	
Ethene	µg/L	2.8	F	0		0		0		0		0	
Ethane	µg/L	3.3		0		0		0		0		0	
Carbon Dioxide	µg/L	70,000		12,500		16,900		9,090		7,920		17,300	
Sulfate	mg/L	2.3		32		19		19		20		9.3	
Chloride	mg/L	15		13		11		10		10		12	
Ferrous Iron	mg/L	2.5		0.70	F	0		0.18	F	0		0.32	F
Manganese	µg/L	988		24		2.0	F	4.0	F	32		79	
Sulfide	mg/L	0		0		0		0		0		0	
Total Dissolved Solids	mg/L	465		430		328		350		353		366	
Benzene	µg/L	0		0		0		0		0		0	
Bromodichloromethane	µg/L	0		0		0		0		0		0	
Bromoform	µg/L	0		0		0		0		0		0	
Chloroform	µg/L	0		0		0		0		0		0.25	F
Dibromochloromethane	µg/L	0		0		0		0		0		0	
Dichlorodifluoromethane	µg/L	0		0		0		0		0		0	
Dichloroethene, 1,1-	µg/L	0		0		0		0		0		0.32	F
Dichloroethene, cis-1,2-	µg/L	73		6.7		99		54		52		341	
Dichloroethene, trans-1,2-	µg/L	2.3		0.42	F	1.7		1.4		1.2		0.87	
Methylene chloride	µg/L	0		0		0		0		0		0	
Naphthalene	µg/L	0		0		0		0		0		0	
Tetrachloroethene	µg/L	0		1.0	F	59		27		19		176	
Toluene	µg/L	0		0		0		0		0		0	
Trichloroethene	µg/L	0.41	F	1.0		86		43		40		234	
Vinyl chloride	µg/L	12		3.5		0.35	F	0		0		1.9	
Arsenic	µg/L	11	F	0		0.70	F	6.1	F	0		1.2	F
		Q42-Month 125		Q42-Month 125		Q40-Month 119		Q42-Month 125		Q44-Month 131		Q42-Month 125	

Note: 0 sample indicates a non-detect analyte value

Table 44.2.3d

B-3 Bioreactor Multi-Port Well CS-WB08 Analytical Summary  
Mar 2017 - Mar 2018

Q44		CS-WB08											
Well ID		CS-WB08-UGR-01		CS-WB08-LGR-01		CS-WB08-LGR-02		CS-WB08-LGR03B				CS-WB08-LGR-04	
Sample Date		9/8/2017		9/8/2017		9/8/2017		3/8/2017		9/8/2017		9/8/2017	
Compound	Units	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag
Total Organic Carbon	mg/L	3.8		1.2		1.1		1.2		1.1		2.3	
Methane	µg/L	1,450		0		33		0		56		0	
Ethene	µg/L	26		0		0		0		0		0	
Ethane	µg/L	8.4		0		0		0		0		0	
Carbon Dioxide	µg/L	64,600		18,700		18,100		8,020		9,930		42,400	
Sulfate	mg/L	2.8		100		100		20		17		3.1	
Chloride	mg/L	15		11		11		11		11		25	
Ferrous Iron	mg/L	6.9		0		0.32	F	0.26	F	0		0.19	F
Manganese	µg/L	1,800		4.0	F	0		0		2.0	F	161	
Sulfide	mg/L	0		0		0		0		0		0	
Total Dissolved Solids	mg/L	482		593		599		350		381		475	
Benzene	µg/L	0		0		0		0		0		0	
Bromodichloromethane	µg/L	0		0		0		0		0		0	
Bromoform	µg/L	0		0		0		0		0		0	
Chloroform	µg/L	0		0		0		0		0.13	F	0	
Dibromochloromethane	µg/L	0		0		0		0		0		0	
Dichlorodifluoromethane	µg/L	0		0		0		0		0		0	
Dichloroethene, 1,1-	µg/L	0		0		0		0		0		0	
Dichloroethene, cis-1,2-	µg/L	33		19		15		57		133		4.0	
Dichloroethene, trans-1,2-	µg/L	3.0		1.1		0.36	F	0.57	F	1.7		0	
Methylene chloride	µg/L	0		0		0		0		0		0	
Naphthalene	µg/L	0		0		0		0		0		0	
Tetrachloroethene	µg/L	0		0		5.9		46		89		1.7	
Toluene	µg/L	0		0		0		0		0		0	
Trichloroethene	µg/L	0.29	F	0.25	F	4.9		58		116		2.0	
Vinyl chloride	µg/L	23		0		0		0		0		0	
Arsenic	µg/L	8.0	F	3.1	F	8.0	F	0		8.8	F	4.3	F
		Q42-Month 125		Q42-Month 125		Q42-Month 125		Q40-Month 119		Q42-Month 125		Q42-Month 125	

Note: 0 sample indicates a non-detect analyte value

Table 44.3.3

**B-3 Bioreactor Monitoring Well Analytical Summary**  
**Mar 2017 - Mar 2018**

Q44		Monitoring Wells																	
Well ID		CS-MW1-LGR						CS-D		CS-B3-MW02		CS-B3-MW04		CS-MW5-LGR					
Sample Date		3/7/2017		10/3/2017		3/5/2018		3/6/2017		3/21/2017		3/28/2017		3/6/2017		10/3/2017		3/21/2018	
Compound	Units	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag
Total Organic Carbon	mg/L	0.88	F	0.87	F	1.1		0.80	F	1.7		3.8		0.84	F	1.0	F	1.6	
Methane	µg/L	0		0		0		0		2.6		815		0		0		0	
Ethene	µg/L	0		0		0		0		0		0		0		0		0	
Ethane	µg/L	0		0		0		0		0		0.90	F	0		0		0	
Carbon Dioxide	µg/L	24,500		17,300		10,800		19,800		16,300		313	F	23,700		4,460		17,300	
Sulfate	mg/L	24		16		34		18		20		21		15		15		15	
Chloride	mg/L	10		9.0		11		10		12		15		8.7		8.6		8.0	
Ferrous Iron	mg/L	0		0		0		0.21	F	0		0.44	F	0		0.95	F	0.28	F
Manganese	µg/L	0		0		15		0		50		7.0		0		33		36	
Hydrogen	nM	1.5	n	18	n	4.6	n												
Sulfide	mg/L	0		0		0		0		0		0		0		0		0	
Total Dissolved Solids	mg/L	333		326		344		310		366		592		307		309		338	
Benzene	µg/L	0		0		0		0		0		0.21	F	0		0		0	
Bromodichloromethane	µg/L	0		0		0		0		0		0		0		0		0	
Bromoform	µg/L	0		0		0		0		0		0		0		0		0	
Chloroform	µg/L	0		0.080	F	0		0		0		0		0		0		0	
Dibromochloromethane	µg/L	0		0		0		0		0		0		0		0		0	
Dichlorodifluoromethane	µg/L	0		0		0		0		0		0		0		0		0	
Dichloroethene, 1,1-	µg/L	0		0		0		0		0		0		0		0		0	
Dichloroethene, cis-1,2-	µg/L	26		19		10		6.6		39		16		11		8.2		4.3	
Dichloroethene, trans-1,2-	µg/L	0.61		0.28	F	0		0		0.25	F	0.81		0.46	F	3.0		1.0	
Methylene chloride	µg/L	0		0		0		0		0		0		0		0		0	
Naphthalene	µg/L	0		0		0		0		0		0		0		0		0	
Tetrachloroethene	µg/L	17		13		8.9		8.1		17		2.0		5.6		0.20	F	0.81	F
Toluene	µg/L	0		0		0		0		14		771		0		0		0	
Trichloroethene	µg/L	17		25		13		10		22		3.5		12		1.4		2.5	
Vinyl chloride	µg/L	0		0		0		0		0		4.5		0		0		0	
Arsenic	µg/L	0.30	F	0		0		4.7	F	13	F	28	F	2.4	F	1.2	F	8.0	F
Mercury	µg/L					0													

Note: 0 sample indicates a non-detect analyte value

Table 44.4.4

SWMU B-3 Microbial Data Summary  
Mar 2017 - Mar 2018

Trench Sump				
<b>B3-T1-2</b>	<b>Sample Date:</b>	<b>3/9/2017</b>	<b>9/26/2017</b>	<b>3/21/2018</b>
<b>Dechlorinating Bacteria</b>	<b>Units</b>			
Dehalococcoides spp (1)	cells/mL	1.13E+03	7.78E+02	1.79E+02
<b>Functional Genes</b>	<b>Units</b>			
TCE R-Dase (1)	cells/mL	1.86E+02	5.67E+02	5.15E+01
BAV1 VC R-Dase (1)	cells/mL	6.87E+02	1.13E+02	9.47E+01
VC R-Dase	cells/mL	2.96E+02	9.25E+02	5.95E+01
<b>B3-T2-1</b>	<b>Sample Date:</b>	<b>3/13/2017</b>	<b>9/26/2017</b>	<b>Not Sampled</b>
<b>Dechlorinating Bacteria</b>	<b>Units</b>			
Dehalococcoides spp (1)	cells/mL	1.82E+01	5.60E+00	--
<b>Functional Genes</b>	<b>Units</b>			
TCE R-Dase (1)	cells/mL	3.40E+00	3.97E+01	--
BAV1 VC R-Dase (1)	cells/mL	2.80E+00	3.60E+00	--
VC R-Dase	cells/mL	1.60E+01	3.77E+01	--
<b>B3-T3-1</b>	<b>Sample Date:</b>	<b>3/13/2017</b>	<b>9/19/2017</b>	<b>Not Sampled</b>
<b>Dechlorinating Bacteria</b>	<b>Units</b>			
Dehalococcoides spp (1)	cells/mL	< 5.00E-01	2.06E+02	--
<b>Functional Genes</b>	<b>Units</b>			
TCE R-Dase (1)	cells/mL	< 5.00E-01	1.70E+00	--
BAV1 VC R-Dase (1)	cells/mL	< 5.00E-01	< 5.00E-01	--
VC R-Dase	cells/mL	< 5.00E-01	4.76E+01	--
<b>B3-T4-1</b>	<b>Sample Date:</b>	<b>3/21/2017</b>	<b>9/19/2017</b>	<b>Not Sampled</b>
<b>Dechlorinating Bacteria</b>	<b>Units</b>			
Dehalococcoides spp (1)	cells/mL	3.70E+01	6.28E+02	--
<b>Functional Genes</b>	<b>Units</b>			
TCE R-Dase (1)	cells/mL	2.01E+01	1.85E+02	--
BAV1 VC R-Dase (1)	cells/mL	4.40E+00	5.00E-01	--
VC R-Dase	cells/mL	8.00E+00	1.57E+02	--
<b>B3-T5-1</b>	<b>Sample Date:</b>	<b>3/13/2017</b>	<b>9/18/2017</b>	<b>Not Sampled</b>
<b>Dechlorinating Bacteria</b>	<b>Units</b>			
Dehalococcoides spp (1)	cells/mL	1.04E+02	8.38E+02	--
<b>Functional Genes</b>	<b>Units</b>			
TCE R-Dase (1)	cells/mL	2.89E+01	2.77E+02	--
BAV1 VC R-Dase (1)	cells/mL	2.16E+01	6.00E-01	--
VC R-Dase	cells/mL	9.56E+01	3.76E+02	--
<b>B3-T6-2</b>	<b>Sample Date:</b>	<b>3/14/2017</b>	<b>9/18/2017</b>	<b>3/21/2018</b>
<b>Dechlorinating Bacteria</b>	<b>Units</b>			
Dehalococcoides spp (1)	cells/mL	2.33E+02	9.20E+01	9.67E+01
<b>Functional Genes</b>	<b>Units</b>			
TCE R-Dase (1)	cells/mL	6.63E+01	3.83E+02	1.46E+01
BAV1 VC R-Dase (1)	cells/mL	2.28E+02	7.38E+01	5.56E+01
VC R-Dase	cells/mL	8.43E+01	6.23E+02	2.46E+01

Extraction Wells				
<b>CS-MW16-LGR</b>	<b>Sample Date:</b>	<b>9/5/2017</b>	<b>Not Sampled</b>	<b>Not Sampled</b>
<b>Dechlorinating Bacteria</b>	<b>Units</b>			
Dehalococcoides spp (1)	cells/mL	< 5.00E-01	--	--
<b>Functional Genes</b>	<b>Units</b>			
TCE R-Dase (1)	cells/mL	< 5.00E-01	--	--
BAV1 VC R-Dase (1)	cells/mL	< 5.00E-01	--	--
VC R-Dase	cells/mL	< 5.00E-01	--	--
<b>B3-EXW01</b>	<b>Sample Date:</b>	<b>9/5/2017</b>	<b>Not Sampled</b>	<b>Not Sampled</b>
<b>Dechlorinating Bacteria</b>	<b>Units</b>			
Dehalococcoides spp (1)	cells/mL	4.08E+01	--	--
<b>Functional Genes</b>	<b>Units</b>			
TCE R-Dase (1)	cells/mL	2.07E+01	--	--
BAV1 VC R-Dase (1)	cells/mL	< 5.00E-01	--	--
VC R-Dase	cells/mL	1.73E+01	--	--

Monitoring Wells				
<b>CS-MW1-LGR</b>	<b>Sample Date:</b>	<b>3/7/2017</b>	<b>10/3/2017</b>	<b>3/5/2018</b>
<b>Dechlorinating Bacteria</b>	<b>Units</b>			
Dehalococcoides spp (1)	cells/mL	< 5.00E-01	1.94E+02	2.00E-01 F
<b>Functional Genes</b>	<b>Units</b>			
TCE R-Dase (1)	cells/mL	< 5.00E-01	6.05E+01	< 5.00E-01
BAV1 VC R-Dase (1)	cells/mL	< 5.00E-01	1.05E+01	< 5.00E-01
VC R-Dase	cells/mL	< 5.00E-01	1.26E+02	< 5.00E-01

Westbay Multi-Port Wells				
<b>CS-WB05-LGR-04B</b>	<b>Sample Date:</b>	<b>9/14/2017</b>	<b>Not Sampled</b>	<b>Not Sampled</b>
<b>Dechlorinating Bacteria</b>	<b>Units</b>			
Dehalococcoides spp (1)	cells/mL	5.00E+00	--	--
<b>Functional Genes</b>	<b>Units</b>			
TCE R-Dase (1)	cells/mL	4.00E-01 F	--	--
BAV1 VC R-Dase (1)	cells/mL	1.00E-01 F	--	--
VC R-Dase	cells/mL	7.00E-01	--	--

Table 44.5.1

B3-UIC Analytical Results  
March 2017 - March 2018

Sample ID Sample Date Sample Type Sampling Method Lab ID	B3-UIC 03/14/17 N1 Grab AZ51790			B3-UIC 06/20/17 N1 Grab AZ57124			B3-UIC 09/20/17 N1 Grab AZ61292			B3-UIC 12/20/17 N1 Grab AZ66191			B3-UIC 03/21/18 N1 Grab AZ70369		
	Lab MDL	Lab PQL	B3-UIC Criteria (RCRA Haz.)	Results	Flags	Dilution	Results	Flags	Dilution	Results	Flags	Dilution	Results	Flags	Dilution
<b>SW8260B (µg/L)</b>															
cis-DCE	0.07	1.2	--	96		1	81		1	92		1	84		1
trans-DCE	0.08	0.6	--	0.53	F	1	0.49	F	1	2.1		1	2.2		1
TCE	0.05	1.0	500	101		1	82		1	87		1	83		1
PCE	0.06	1.4	700	79		1	64		1	67		1	58		1
Toluene	0.06	1.1	--	0.06	U	1	0.06	U	1	0.06	U	1	0.06	U	1
Vinyl chloride	0.08	1.1	200	0.08	U	1	0.08	U	1	0.08	U	1	0.08	U	1
<b>EPA 160.1 (mg/L)</b>															
TDS	4.4	10	--	350		1	388		1	371		1	380		1

Tables present all laboratory results for analytes.

Data packages for laboratory results are presented in Attachment 1.

All samples were analyzed by APPL Laboratory Services.

pH results reported were field measured.

UIC criteria specified in 40 CFR 261.24 Table 1.

**Data Qualifiers:**

F - The analyte was positively identified, but the quantitation is an estimate.

U - The analyte was analyzed for, but not detected. The associated numeric:

**Abbreviations:**

- MDL Method Detection Limit
- PQL Practical Quantitation Limit
- N1 Environmental Sample
- UIC Underground Injection Control

Table 44.5.2

**Storage Tank (UIC) VOC Summary**  
**Mar 2017 - Mar 2018**

Q44 Date	B3-UIC				
	3/14/2017	6/20/2017	9/20/2017	12/20/2017	3/21/2018
PCE (µg/L)	79	64	67	58	45
TCE (µg/L)	101	82	87	83	57
cis-1,2-DCE (µg/L)	96	81	92	84	53
trans-1,2-DCE (µg/L)	0.53	0.49	2.1	2.2	1.9
Vinyl chloride (µg/L)	0	0	0	0	0
Ethene (µg/L)	0	0	0	0	0
<b> </b>					
PCE (nM/L)	473.437	384.611	401.918	351.927	272.990
TCE (nM/L)	767.334	620.443	662.836	633.762	431.007
cis-1,2-DCE (nM/L)	995.358	839.195	949.768	865.395	542.754
trans-1,2-DCE (nM/L)	5.467	5.054	21.248	22.898	20.010
Vinyl chloride (nM/L)	0.000	0.000	0.000	0.000	0.000
Ethene (nM/L)	0.000	0.000	0.000	0.000	0.000
<b>Total Molar Conc. (nM/L)</b>	<b>2241.6</b>	<b>1849.3</b>	<b>2035.8</b>	<b>1874.0</b>	<b>1266.8</b>
<b> </b>					
% moles PCE	21.1%	20.8%	19.7%	18.8%	21.6%
% moles TCE	34.2%	33.6%	32.6%	33.8%	34.0%
% moles cis-1,2-DCE	44.4%	45.4%	46.7%	46.2%	42.8%
% moles trans-1,2-DCE	0.2%	0.3%	1.0%	1.2%	1.6%
% moles Vinyl Chloride	0.0%	0.0%	0.0%	0.0%	0.0%
% moles Ethene	0.0%	0.0%	0.0%	0.0%	0.0%
sum % moles	100.0%	100.0%	100.0%	100.0%	100.0%

Note: 0 sample indicates a non-detect analyte value

Table 44.5.3

**SWMU B3-UIC Analytical Summary Table**  
**Mar 2017 - Mar 2018**

Q44		B3-UIC									
Well ID											
Sample Date		3/14/2017		6/20/2017		9/20/2017		12/20/2017		3/21/2018	
Compound	Units	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag
Total Dissolved Solids	mg/L	350		388		371		380		375	
Benzene	µg/L	0		0		0		0		0	
Bromodichloromethane	µg/L	0		0		0		0		0	
Bromoform	µg/L	0		0		0		0		0	
Chloroform	µg/L	0		0.14	F	0		0		0	
Dibromochloromethane	µg/L	0		0		0		0		0	
Dichlorodifluoromethane	µg/L	0		0		0		0		0	
Dichloroethene, 1,1-	µg/L	0		0		0		0		0	
Dichloroethene, cis-1,2-	µg/L	96		81		92		84		53	
Dichloroethene, trans-1,2-	µg/L	0.53	F	0.49	F	2.1		2.2		1.9	
Methylene chloride	µg/L	0		0		0		0		0	
Naphthalene	µg/L	0		0		0		0		0	
Tetrachloroethene	µg/L	79		64		67		58		45	
Toluene	µg/L	0		0		0		0		0	
Trichloroethene	µg/L	101		82		87		83		57	
Vinyl chloride	µg/L	0		0		0		0		0	

Table 42.6.2

**B-3 Bioreactor Extraction Well VOC Summary**  
**Sep 2017 - Sep 2017**

Q42	16-LGR	16-CC	EXW01	EXW02	EXW03	EXW04	EXW05
Date	9/5/2017	9/5/2017	9/5/2017	9/5/2017	9/5/2017	9/5/2017	9/5/2017
PCE (µg/L)	47	0	110	0	49	105	55
TCE (µg/L)	60	0	138	80	61	146	79
cis-1,2-DCE (µg/L)	56	12	160	60	56	153	73
trans-1,2-DCE (µg/L)	0.52	6.5	0.74	0.58	0.41	1.1	0.54
Vinyl chloride (µg/L)	0	0	0	0	0	0	0
Ethene (µg/L)	0	0	0	0	0	0	0
PCE (nM/L)	285.292	0.000	661.943	0.000	296.689	632.033	333.595
TCE (nM/L)	455.895	0.000	1054.038	610.016	464.952	1109.978	599.817
cis-1,2-DCE (nM/L)	579.165	124.085	1654.771	620.939	576.380	1575.451	749.149
trans-1,2-DCE (nM/L)	5.364	67.354	7.633	5.982	4.229	11.037	5.570
Vinyl chloride (nM/L)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ethene (nM/L)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Molar Conc. (nM/L)	1325.7	191.44	3378.38	1236.94	1342.25	3328.50	1688.13
% moles PCE	21.5%	0.0%	19.6%	0.0%	22.1%	19.0%	19.8%
% moles TCE	34.4%	0.0%	31.2%	49.3%	34.6%	33.3%	35.5%
% moles cis-1,2-DCE	43.7%	64.8%	49.0%	50.2%	42.9%	47.3%	44.4%
% moles trans-1,2-DCE	0.4%	35.2%	0.2%	0.5%	0.3%	0.3%	0.3%
% moles Vinyl Chloride	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% moles Ethene	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
sum % moles	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: 0 sample indicates a non-detect analyte value



Table 44.6.3

**B-3 Bioreactor Extraction Well Analytical Summary**  
**Mar 2017 - Mar 2018**

Q44		Extraction Wells													
Well ID		CS-MW16-LGR		CS-MW16-CC		B3-EXW01		B3-EXW02		B3-EXW03		B3-EXW04		B3-EXW05	
Sample Date		9/5/2017		9/5/2017		9/5/2017		9/5/2017		9/5/2017		9/5/2017		9/5/2017	
Compound	Units	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag
Total Organic Carbon	mg/L	0.94	F	0.92	F	0.95	F	0.92	F	1.7		0.80	F	0.74	F
Methane	µg/L	0		23		6.0		0		0		0		0	
Ethene	µg/L	0		0		0		0		0		0		0	
Ethane	µg/L	0		0		0		0		0		0		2.8	
Carbon Dioxide	µg/L	27,800		7,470		40,700		25,200		64,900		39,100		18,100	
Sulfate	mg/L	19		73		12		12		11		8.8		15	
Chloride	mg/L	9.6		16		12		12		14		12		9.1	
Ferrous Iron	mg/L	0.18	F	1.3		0.16	F	0.20	F	0		0		0.40	F
Manganese	µg/L	4.0	F	5.0		5.0		0		74		55		7.0	
Hydrogen	nM	4.1	n			3.4	n								
Sulfide	mg/L	0		0		0		0		0		0		0	
Total Dissolved Solids	mg/L	333		421		374		356		416		355		327	
Benzene	µg/L	0		0		0		0		0		0		0	
Bromodichloromethane	µg/L	0		0		0		0		0		0		0	
Bromoform	µg/L	0		0		0		0		0		0		0	
Chloroform	µg/L	0		0		0		0.16	F	0		0.15	F	0.17	F
Dibromochloromethane	µg/L	0		0		0		0		0		0		0	
Dichlorodifluoromethane	µg/L	0		0		0		0		0		0		0	
Dichloroethene, 1,1-	µg/L	0		0		0		0		0		0		0	
Dichloroethene, cis-1,2-	µg/L	56		12		160		60		56		153		73	
Dichloroethene, trans-1,2-	µg/L	0.52	F	6.5		0.74		0.58	F	0.41	F	1.1		0.54	F
Methylene chloride	µg/L	0		0		0		0		0		0		0	
Naphthalene	µg/L	0		0		0		0		0		0		0	
Tetrachloroethene	µg/L	47		0		110		0		49		105		55	
Toluene	µg/L	0		0		0		0		0		0		0	
Trichloroethene	µg/L	60		0		138		80		61		146		79	
Vinyl chloride	µg/L	0		0		0		0		0		0		0	
Arsenic	µg/L	7.5	F	3.0	F	1.1	F	0.70	F	12	F	10	F	10	F

Note: 0 sample indicates a non-detect analyte value

Table 44.7.3

**B-3 Bioreactor UGR Well Analytical Summary**  
**Mar 2017 - Mar 2018**

Q44		Shallow UGR Wells															
Well ID		B3-MW26-UGR		B3-MW27-UGR		B3-MW29-UGR		B3-MW30-UGR		B3-MW31-UGR		B3-MW32-UGR		B3-MW33-UGR		B3-MW34-UGR	
Sample Date		9/6/2017		9/6/2017		9/6/2017		9/6/2017		9/6/2017		9/6/2017		9/6/2017		9/6/2017	
Compound	Units	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag	Value	Flag
Total Organic Carbon	mg/L	9.2		4.6		5.1		6.1		2.4		17		4.8	F	7.3	
Methane	µg/L	1,580		4,260		11		0		0.70	F	15		1,180		1,260	
Ethene	µg/L	2.3	F	4.2		0		0		0		0		1.4	F	2.4	F
Ethane	µg/L	6.4		9.3		0		0		0		0		3.7		1.2	F
Carbon Dioxide	µg/L	87,600		115,000		77,800		73,300		84,400		62,000		82,800		98,600	
Sulfate	mg/L	9.3		1.4				22		23		14		13		9.2	
Chloride	mg/L	15		14				9.4		8.9		11		14		17	
Ferrous Iron	mg/L	1.6		1.9				0.16	F	0.71	F	0.48	F	8.0		12	
Manganese	µg/L	669		516		242		27		70		481		2,840		425	
Sulfide	mg/L	0		0		0		0		0		0		0		0	
Total Dissolved Solids	mg/L	434		478				480		466		415		447		449	
Benzene	µg/L	0		0		0		0		0		0		0		0.33	F
Bromodichloromethane	µg/L	0		0		0		0		0		0		0		0	
Bromoform	µg/L	0		0		0		0		0		0		0		0	
Chloroform	µg/L	0		0		0		0		0		0		0		0	
Dibromochloromethane	µg/L	0		0		0		0		0		0		0		0	
Dichlorodifluoromethane	µg/L	0		0		0		0		0		0		0		0	
Dichloroethene, 1,1-	µg/L	0		0		0		0		0		0		0		0	
Dichloroethene, cis-1,2-	µg/L	3.6		0.24	F	0		0		8.4		3.6		0.60	F	7.6	
Dichloroethene, trans-1,2-	µg/L	1.4		0.99		0		0		0.61		0.19	F	0.68		0.79	
Methylene chloride	µg/L	0		0		0		0		0		0		0		0	
Naphthalene	µg/L	0		0		0		0		0		0		0		0	
Tetrachloroethene	µg/L	0.27	F	0		0.34	F	2.8		3.0		0.87	F	0		0	
Toluene	µg/L	0		0		0		0		0		0.28	F	0		0.17	F
Trichloroethene	µg/L	0.30	F	0		0.22	F	0.43	F	2.8		1.1		0		0	
Vinyl chloride	µg/L	4.4		0		0		0		0		0		0		7.3	
Arsenic	µg/L	14	F	24	F	11	F	4.5	F	12	F	17	F	13	F	22	F

Note: 0 sample indicates a non-detect analyte value