

Seeds, Tena (ECY)

From: Seeds, Tena (ECY)
Sent: Tuesday, January 9, 2024 6:12 PM
To: Kristin Anderson
Cc: Kim Hempel; Pamela Osterhout; Lynn Grochala; Mike Ciserella; Douglas Ciserella
Subject: RE: Quarterly Groundwater Monitoring Summary for Time Oil Bulk Terminal, Q4 2023

Hi Kristin,

Thanks for the summary of sampling results through Q4 of 2023. I agree with your recommendations, but please also add sampling at contingency wells 01MW80 and 01MW89 for the February 2024 event so that we can assess current conditions at those locations, especially given the increased concentrations of TCE and VC from pre-remediation conditions observed at 01MW53, 01MW56, and 01MW85, and the increased VC observed at 01MW46 and 01MW15.

Tena Seeds, PE (she/her)

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 [Chat or call in Teams](#)

From: Kristin Anderson <Kristin.Anderson@floydsnider.com>
Sent: Thursday, January 4, 2024 2:02 PM
To: Seeds, Tena (ECY) <TSEE461@ECY.WA.GOV>
Cc: Kim Hempel <khempel@pioneerees.com>; Pamela Osterhout <Pamela.Osterhout@floydsnider.com>; Lynn Grochala <Lynn.Grochala@floydsnider.com>; Mike Ciserella <mike@cantera-group.com>; Douglas Ciserella <doug@cantera-group.com>
Subject: Quarterly Groundwater Monitoring Summary for Time Oil Bulk Terminal, Q4 2023

Hi Tena,

Attached are summary tables of the pre- and post-remediation groundwater IHS results including the latest Q4 results and MNA parameters, potentiometric maps for the shallow WBZ, and PFM results (Flux Tracer Report) for the Time Oil Bulk Terminal Site. Below is a summary of the Q4 groundwater monitoring results and a summary of recommendations for continued monitoring for 2024 that will be memorialized in the Annual Report, which we are drafting for submittal to you in March.

Groundwater Elevations

- Fewer water level measurements were collected during Q4 as approved by Ecology. Observations of the Shallow WBZ are consistent with prior measurements (potentiometric map of the shallow water bearing zone attached).
- On the Bulk Terminal, mounding was observed in the vicinity of 01MW12 consistent with the wetter season water levels measured during Q1 and Q2.
- On ASKO, shallow WBZ gradients remain relatively flat downgradient of the CAA-4 ISS monolith with steeper gradients between the CAA-4 and CAA-2 monoliths.

- On the East Waterfront, elevations were consistent throughout 2023 with a relatively flat gradient towards the shoreline and steeper gradients in the southern portion of the property.
- **Recommendations:** The current water level network has yielded sufficient data to understand groundwater flow without collecting extraneous measurements. We recommend continuing to collect water levels at the locations measured during Q4 2023 but at a reduced frequency of semi-annually in 2024 (e.g. Q1 and Q3, which would be representative of the wet and dry seasons).

Bulk Terminal

- Samples were collected from Shallow WBZ wells 01MW19R, 01MW35, and 01MW84.
- Generally, the chemistry was consistent with Q1 through Q3, including: TPH and benzene concentrations less than CULs at 01MW35, and benzene less than the CUL at 01MW84.
- **Recommendations:** Continue monitoring per the GMP from the designated “initial” short-term monitoring network with the following considerations in 2024:
 - Per the GMP, 01MW35 can be proposed for removal or decreased sampling frequency after three consecutive results less than CULs (to date, 4 consecutive results have been less than CULs). We recommend to discontinue sampling 01MW35 starting in 2024.
 - 01MW12, which is near the current construction on Parcel F, will be monitored per the plan. If the well is damaged by construction on Parcel F, it will be replaced after grading is completed.
 - If construction begins on any other portions of the property, monitoring will be transitioned to the “after redevelopment” short-term monitoring program as applicable (for example, unburying and decommissioning damaged wells or replacing wells with construction conflicts) in coordination with Ecology.

ASKO

- Samples were collected from Shallow WBZ wells 01MW46, 01MW53, 01MW85, and 01MW107. The contingency well 01MW107 was sampled during Q3 and Q4 due to previous IHS exceedances observed at upgradient wells 01MW53 and 01MW85.
- We collected another sample for dissolved gases at 01MW85 during Q4 to achieve lower reporting limits to support further evaluation of the increased TCE concentrations observed at this location. The results of the dissolved gases show decreased methane and a detection of ethene. Ethane was non-detect. The presence of ethene and methane is a line of evidence that biological transformation of chlorinated solvents is occurring.
- Benzene and cVOC concentrations across the property have generally decreased relative to pre-remediation conditions in the vicinity of the CAA-4 source area (01MW46); however, there are a few notable results in cVOC concentrations at the following locations:
 - Vinyl chloride concentrations continue to increase slightly at 01MW46 relative to pre-remediation conditions. This is expected as TCE continues to degrade.
 - TCE concentrations at 01MW85 decreased relative to the anomalous spike (of 110 ug/L) observed during Q3, but TCE continues to be present at greater concentrations relative to pre-remediation conditions and previous monitoring results from Q1 and Q2.
 - 01MW53 continues to purge dry and be a stagnant groundwater well with relatively stable cVOC concentrations greater than pre-remediation conditions and greater than cleanup levels.
 - cVOC concentrations continue to be non-detect at 01MW107, downgradient of 01MW53 and 01MW85.
- A passive flux meter was deployed in 01MW85 for 4 weeks to evaluate groundwater conditions downgradient of the treatment barrier in this well and further assess the TCE spike observed during the Q3 monitoring event. Summary of results are as follows:
 - Overall groundwater velocity is relatively low, consistent with our expectations and water level observations.
 - TCE was not detected at the detection limit for the PFMs of ~10 ug/L (generally consistent with the groundwater sample result of 13 ug/L).
 - There is high flux of DCE especially in the bottom intervals, indicating a high mass of TCE coming into the barrier and being converted to DCE.

- The presence of DCE and vinyl chloride and a non-detect result for ethane suggest that partial abiotic degradation is occurring within the barrier.
- **Recommendations:** Continue monitoring per the GMP from the designated “initial” short-term monitoring network with the following considerations in 2024.
 - Retain the contingency well 01MW107, downgradient of 01MW53 and 01MW85, for the Q1 2024 monitoring event
 - If construction begins on any portions of the property, monitoring will be transitioned to the “after redevelopment” short-term monitoring program as applicable (for example, unburying and decommissioning damaged wells or replacing wells with construction conflicts) in coordination with Ecology.
- **Additional Recommendations based on PFM results:**
 - Keep monitoring trends and sampling dissolved gases semiannually at 01MW85.
 - Replace nitrate/nitrite analysis (which has not yielded useful data) with total and dissolved iron analysis to monitor how much ZVI is available in the saturated zone at wells downgradient of the barrier which are designated for MNA parameter analysis.
 - Review BNSF RI data with these results to provide more site-wide context on the source of elevated TCE at 01MW85.

East Waterfront

- Samples were collected from Shallow WBZ wells 02MW04R, 02MW07, and 02MW19.
- TPH, benzene, and arsenic results at all locations were less than CULs this quarter.
 - Benzene at 02MW04R was non-detect during Q4 after an anomalous exceedance was observed during Q3. No contingency sampling is recommended for the East Waterfront property.
- Monitoring will be performed per the GMP with no changes in Q1 of 2024.

Please let us know if you agree with the proposed program for Q1 2024 tentatively scheduled to occur on February 7th and 8th.

Thanks!

Kristin Anderson, LHG Senior Geologist (she/her)

FLOYD | SNIDER

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Preliminary Draft
Pre- and Post-Remediation Groundwater Results for Indicator Hazardous Substances

Analyte Class		Total Metals	TPH		VOCs	cVOCs		SVOCs	
Analyte		Arsenic	GRO	Total DRO + ORO	Benzene	TCE	cis-1,2-DCE	Vinyl Chloride	Penta
CAS No.		7440-38-2	--	-- (U=0)	71-43-2	79-01-6	156-59-2	75-01-4	87-86-5
Unit		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Cleanup Level		5.0	800	500	0.44	0.50		0.20	0.20
Parcel	Location	Sample Date							
Bulk Terminal	01MW12								
	Pre-remediation	4/30/2019		100 U	590 ⁽¹⁾	3.0			
	Post-remediation	1/31/2023		100 U	1,000 ⁽¹⁾	0.35 U			
		6/28/2023		110	1,200 ⁽¹⁾	1.3			
	01MW19/01MW19R								
	Pre-remediation	4/30/2019		10,000	1,900 ⁽¹⁾	2,600	1.0 U	1.0 U	0.20 U
	Post-remediation	1/31/2023		990	910 ⁽¹⁾	5.2			
		4/7/2023		1,100	700 ⁽¹⁾	4.4			
		6/28/2023		1,300	810 ⁽¹⁾	2.1			
		10/10/2023		1,200	890 ⁽¹⁾	1.6			
				1,300	920 ⁽¹⁾	1.8			
	01MW35								
	Pre-remediation	5/1/2019		100 U	550 ⁽¹⁾	0.35 UJ			
	Post-remediation	1/31/2023		100 U	110 ⁽¹⁾	0.35 U			
		4/7/2023		100 U	120 ⁽¹⁾	0.35 U			
		6/28/2023		100 U	76 ⁽¹⁾	0.35 U			
		10/10/2023		100 U	56 ⁽¹⁾	0.35 U			
	01MW40								
	Pre-remediation	4/30/2019			1,100 ⁽¹⁾	0.35 UJ			
	Post-remediation	1/31/2023		100 U	5,300 ⁽¹⁾	0.73			
		6/28/2023		100 U	620 ⁽¹⁾	0.35 U			
	01MW49/01MW49R								
	Pre-remediation	5/1/2019		100 U	850 ⁽¹⁾	0.35 UJ			
	Post-remediation	1/31/2023		100 U	260 ⁽¹⁾	0.35 U			
		6/29/2023		100 U	160 ⁽¹⁾	0.35 U			
	01MW51								
	Pre-remediation	5/26/2016		370	1,800 ⁽¹⁾	1.0 U			
	Post-remediation	4/7/2023		100 U	250 U	0.35 U			
01MW66									
Pre-remediation	4/30/2019		100 U	250	0.35 UJ			3.6	
Post-remediation	1/31/2023							1.9	

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Analyte Class		Total Metals	TPH		VOCs	cVOCs		SVOCs	
Analyte		Arsenic	GRO	Total DRO + ORO	Benzene	TCE	cis-1,2-DCE	Vinyl Chloride	Penta
CAS No.		7440-38-2	--	-- (U=0)	71-43-2	79-01-6	156-59-2	75-01-4	87-86-5
Unit		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Cleanup Level		5.0	800	500	0.44	0.50		0.20	0.20
Parcel	Location	Sample Date							
Bulk Terminal (cont.)	01MW84								
	Pre-remediation	5/1/2019		8,400	2,800 ⁽¹⁾	5.0 U			
	Post-remediation	1/31/2023		2,300	810 ⁽¹⁾	0.35 U			
		4/7/2023		2,200	830 ⁽¹⁾	0.35 U			
		6/28/2023		5,500	1,500 ⁽¹⁾	0.35 U			
				4,600	1,400 ⁽¹⁾	0.35 U			
		10/10/2023		4,300	1,300 ⁽¹⁾	0.35 U			
				3,500	1,500 ⁽¹⁾	0.35 U			
	01MW87								
	Pre-remediation	5/26/2019		100 U		1.0 U			
5/1/2019				110					
Post-remediation	4/7/2023		100 U	250 U	0.35 U				
ASKO	01MW15								
	Pre-remediation	5/2/2019		100 U	220 ⁽¹⁾	0.41	0.50 U	1.7	7.2
	Post-remediation	2/1/2023					0.50 U	6.4	36
		6/28/2023					0.50 U	5.7	28
	01MW46								
	Pre-remediation	5/2/2019			280 ⁽¹⁾	14	880	220	11
	Post-remediation	2/1/2023				3.8	240	140	17
		4/7/2023				3.5 U	140	110	9.3
		6/28/2023				4.3	280	260	25
		10/10/2023				4.8	300	400	36
	01MW53								
	Pre-remediation	5/2/2019			94 ⁽¹⁾	0.35 U	0.50 U	4.4	0.26
	Post-remediation	2/1/2023					2.9	5.4	0.57
		4/7/2023					2.1	3.2	0.36
		6/28/2023					2.0	2.9	0.51
10/10/2023						1.5	2.4	0.59	
01MW56									
Pre-remediation	5/2/2019			1,000 ⁽¹⁾	0.35 U	0.50 U	1.0 U	0.61	
Post-remediation	2/1/2023					0.81	1.0 U	0.99	
	6/28/2023					0.62	1.0 U	0.97	

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Analyte Class		Total Metals	TPH		VOCs	cVOCs		SVOCs	
Analyte		Arsenic	GRO	Total DRO + ORO	Benzene	TCE	cis-1,2-DCE	Vinyl Chloride	Penta
CAS No.		7440-38-2	--	-- (U=0)	71-43-2	79-01-6	156-59-2	75-01-4	87-86-5
Unit		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Cleanup Level		5.0	800	500	0.44	0.50		0.20	0.20
Parcel	Location	Sample Date							
ASKO (cont.)	01MW85								
	Pre-remediation	5/3/2019			450 ⁽¹⁾		0.50 U	2.4	7.9
	Post-remediation	1/31/2023					5.7	1,200	13
		4/7/2023					6.2	1,200	17
		6/28/2023					110	1,000	13
		10/10/2023					13	1,100	18
	01MW107								
	Pre-remediation	5/6/2019					0.50 U	1.0 U	0.020 U
	Post-remediation	6/28/2023					0.50 U	1.0 U	0.020 U
	Post-remediation	10/10/2023					0.50 U	1.0 U	0.020 U
	01MW108								
	Pre-remediation	5/3/2019					0.50 U	1.0 U	0.33
	Post-remediation	2/1/2023					0.50 U	1.0 U	0.27
		6/29/2023					0.50 U	1.0 U	0.065
	MW05								
	Pre-remediation	5/3/2019		140	310 ⁽¹⁾	1.0	240	120	27
	Post-remediation	2/1/2023				1.4	140	360	6.8
		6/28/2023				1.5 J	160	360	6.9
	MW06								
	Pre-remediation	5/3/2019			370 ⁽¹⁾	2.6	330	31	2.8
Post-remediation	2/1/2023				0.35 U	0.50 U	1.0 U	2.6	
East Waterfront	02MW04/02MW04R								
	Pre-remediation	5/18/2016		3,100	2,000 ⁽¹⁾	19			
		5/3/2019				3.7			
	Post-remediation	2/1/2023		100 U	69 ⁽¹⁾	0.35 U			
		4/7/2023		100 U	250 U	0.35 U			
		6/29/2023		100 U	65 ⁽¹⁾	29			
10/10/2023			100 U	250 U	0.35 U				

Preliminary Draft
Pre- and Post-Remediation Groundwater Results for Indicator Hazardous Substances

Analyte Class		Total Metals	TPH		VOCs	cVOCs		SVOCs		
Analyte		Arsenic	GRO	Total DRO + ORO	Benzene	TCE	cis-1,2-DCE	Vinyl Chloride	Penta	
CAS No.		7440-38-2	--	-- (U=0)	71-43-2	79-01-6	156-59-2	75-01-4	87-86-5	
Unit		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Cleanup Level		5.0	800	500	0.44	0.50		0.20	0.20	
Parcel	Location	Sample Date								
East Waterfront (cont.)	02MW07									
	Pre-remediation	5/19/2016		100 U	160 ⁽¹⁾	1.0 U				
		5/3/2019			670 ⁽¹⁾					
		7/25/2019	3.9							
	Post-remediation	2/1/2023	1.0 U	100 U	86 ⁽¹⁾	0.35 U				
		4/7/2023	1.0 U	100 U	250 U	0.35 U				
		6/29/2023	1.1	100 U	76 ⁽¹⁾	0.35 U				
		10/10/2023	1.2	100 U	73 ⁽¹⁾	0.35 U				
	02MW19									
	Pre-remediation	5/6/2019		100 U	380 ⁽¹⁾					
		7/25/2019	14							
	Post-remediation	2/1/2023	3.3	100 U	150 ⁽¹⁾	0.35 U				
		4/7/2023	4.7	100 U	76 ⁽¹⁾	0.35 U				
			4.8	100 U	84 ⁽¹⁾	0.35 U				
		6/29/2023	4.2	100 U	76 ⁽¹⁾	0.35 U				
10/10/2023	3.1	100 U	81 ⁽¹⁾	0.35 U						

Notes:

Blanks are intentional. Data not collected for specific analyte.

BOLD Detected exceedance of cleanup level.

Italic Reporting limit exceeds cleanup level.

1 Laboratory noted that the sample chromatographic pattern does not resemble the fuel standard used for quantitation for one or more of the detected concentrations in the sum.

Abbreviations:

- CAS Chemical Abstracts Service
- cVOC Chlorinated volatile organic compound
- DCE Dichloroethene
- DRO Diesel-range organics
- GRO Gasoline-range organics
- µg/L Micrograms per liter
- ORO Oil-range organics
- Penta Pentachlorophenol
- SVOC Semivolatile organic compound
- TCE Trichloroethene
- TPH Total petroleum hydrocarbons
- VOC Volatile organic compound

Qualifiers:

- J Analyte was detected; concentration is an estimate.
- U Analyte was not detected at the given reporting limit.
- UJ Analyte was not detected at the given reporting limit, which is considered estimated.

**Preliminary Draft
Monitored Natural Attenuation and Field Parameters**

Analyte Class		Primary MNA Parameters				Secondary MNA Parameters			
		Field Measurement				Dissolved Gases			
Analyte		Dissolved Oxygen	Specific Conductance	ORP	pH	Temperature	Ethane	Ethene	Methane
CAS No.	--	--	--	--	--	--	74-84-0	74-85-1	74-82-8
Unit	mg/L	µS/cm	mV	pH	°C	µg/L	µg/L	µg/L	
Location Name	Date								
Bulk Terminal									
01MW19R	10/10/2023	0.28	173	10.4	6.79	15.7			
01MW35	10/10/2023	0.68	77.2	97.1	6.38	18.6			
01MW84	10/10/2023	0.26	84.3	50.8	6.46	16.7			
ASKO									
01MW46	10/10/2023	0.20	366	3.7	6.74	14.9			
01MW53	10/10/2023	0.23	528	-12.5	6.57	16.3			
01MW85	1/31/2023	2.41	577	-57.7	6.89	14.9	15 U	15 U	1,800
	10/10/2023	0.29	476	34.5	6.78	14.9	0.22 U	2.7 J	320 J
01MW107	10/10/2023	1.00	237	73.7	6.14	14.7			
East Waterfront									
02MW04R	10/10/2023	1.04	298	99.9	6.76	16.9			
02MW07	10/10/2023	0.79	536	89.6	5.92	17.3			
02MW19	10/10/2023	0.16	339	-16.5	6.48	15.7			

Notes:

- Blanks are intentional. Data not collected for specific analyte.
- Field measurements are presented to the decimal places reported on the field meters.

Abbreviations:

- CAS Chemical Abstracts Service
- °C Degrees Celsius
- µg/L Micrograms per liter
- µS/cm Microsiemens per centimeter
- mg/L Milligrams per liter
- MNA Monitored natural attenuation
- mV Millivolt
- NTU Nephelometric turbidity units
- ORP Oxidation–reduction potential

Qualifiers:

- J Analyte was detected; concentration is an estimate.
- U Analyte was not detected at the associated reporting limit.

Legend

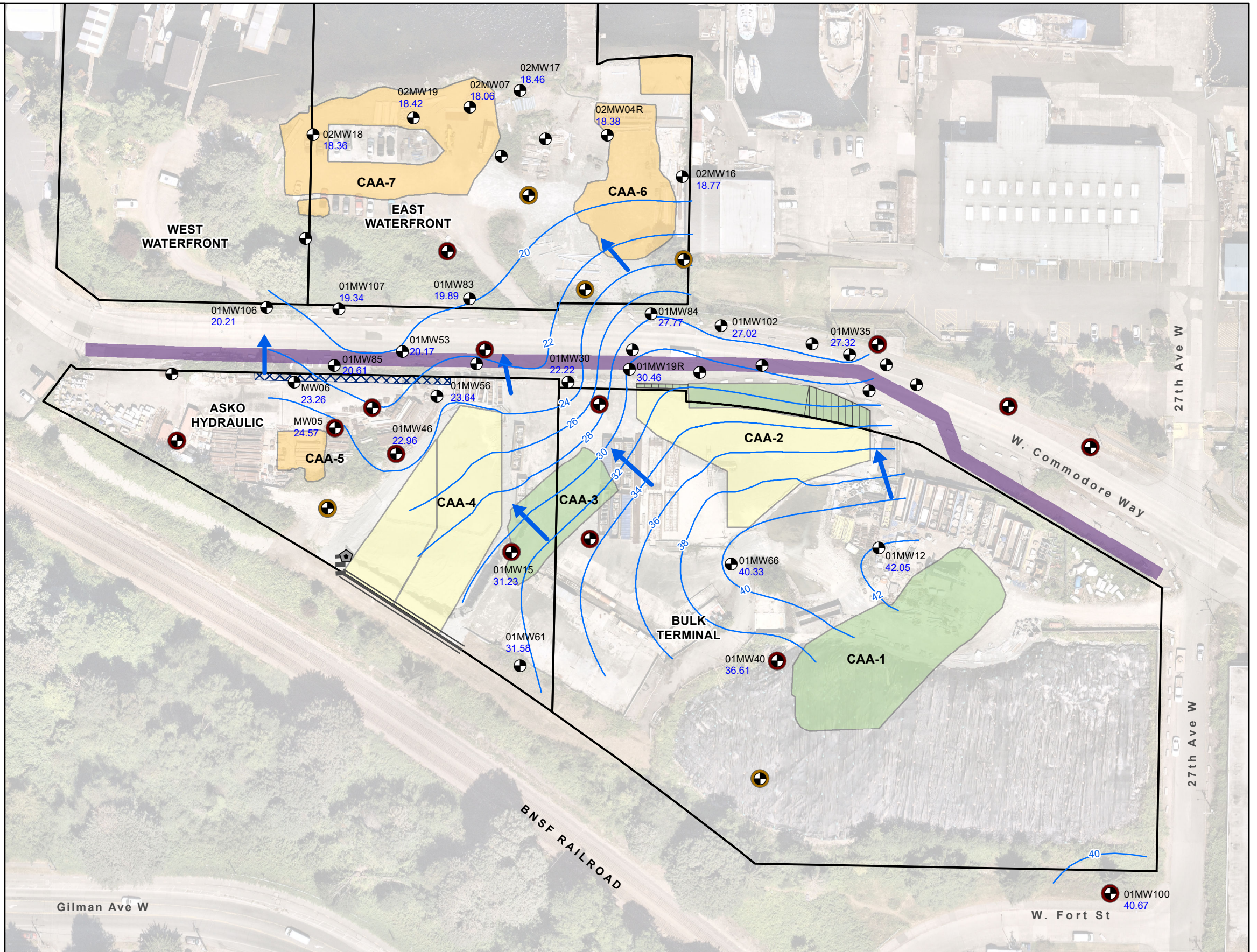
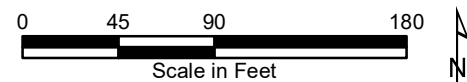
- Groundwater Contour (feet NAVD 88)
- Shallow WBZ Groundwater Flow Direction
- Existing Monitoring Well Locations**
- Shallow WBZ Monitoring Well
- Well Decommissioning Plan**
- Damaged—Decommission Required
- Decommission During Redevelopment
- Cleanup Action Components**
- Excavated to CULs
- Excavated to RELs
- In Situ Stabilization/Solidification
- PlumeStop Injection
- ORC-A Treatment
- Interceptor Trench
- PRB Wall for Trench
- Gravity Well
- Other Site Features**
- Property Boundary for the Former TOC Seattle Terminal
- Conditional Point of Compliance

Notes:

- Depth to water measurements not collected at select wells that were inaccessible because they are located within the W. Commodore Way right of way or buried by gravel or vegetation.
- Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:

- CUL = Cleanup level
- ORC-A = Oxygen Release Compound Advanced
- NAVD 88 = North American Vertical Datum of 1988
- NM = Not measured
- PRB = Permeable reactive barrier
- REL = Remediation level
- TOC = TOC Holdings Co. and any predecessor entity including Time Oil Company
- WBZ = Water-bearing zone



Flux Tracer Report

Site Name	Time Oil Cantera
Location	Commodore
Client	Floyd Snider
Contact	Kristin Anderson
Well ID	01MW85
Report prepared by:	Josh Moreno
Deployment length (ft)	27
Date deployed	10/10/23 11:33
Date recovered	11/7/23 9:30

TABLE 1

Darcy velocity and contaminant fluxes

Depth below top of well casing (ft)	Darcy speed (cm/day)	PCE (mg/m ² /day)	TCE (mg/m ² /day)	cDCE (mg/m ² /day)
22.5	<2.0	<1	<0.9	1
23.5	<2.0	<1	<0.9	5
24.5	3.4	<1	<0.9	6
25.5	4.5	<1	<0.9	33
26.5	4.4	<1	<0.9	10

TABLE 2

Flux-derived concentrations

Depth Below Casing (ft)	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)
22.5	N/A	N/A	N/A
23.5	N/A	N/A	N/A
24.5	N/A	N/A	180
25.5	N/A	N/A	730
26.5	N/A	N/A	230

Notes:

Deployment length is defined as the length of the device from the top of the casing to the bottom of the device.

Data is collected in the bottom 10 ft of the Flux Tracer in 1 ft intervals

Darcy speeds below 2.0 cm/d are not accurately distinguishable by this or other passive methods.

Contaminants listed as "J" were present at concentrations below what is needed for accurate flux estimates

A non-applicable (N/A) is applied to the intervals where either the Darcy velocity, contaminant of concern, or both is less than the reporting limit.

