

**THIRD QUARTER 2020 PROGRESS REPORT / SECOND QUARTER 2020  
GROUNDWATER PERFORMANCE MONITORING REPORT  
SITE: FORMER BP HARBOR ISLAND TERMINAL  
CLEANUP SITE ID: 4426  
1652 SW LANDER STREET  
SEATTLE, WASHINGTON**

**CONSENT DECREE NO. 00-2-05714-8SEA**

**OCTOBER 2020**

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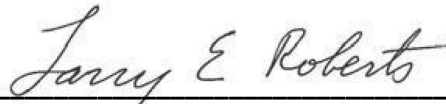
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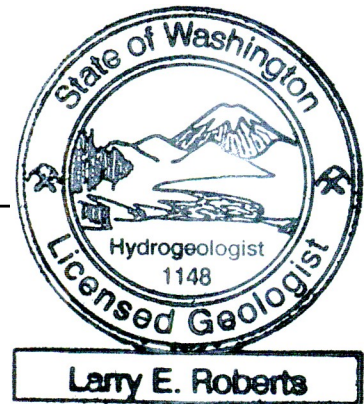
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## 1. INTRODUCTION

TLP Management Services LLC is submitting this report prepared by TechSolve Environmental, Inc. (TechSolve) to summarize the Second Quarter 2020 Groundwater Monitoring event and operation and maintenance of the waterfront remediation system during the third quarter (July through September) of 2020 for the Former BP Harbor Island Terminal Site. Groundwater monitoring and remediation system reporting periods are staggered due to the time required to receive and validate laboratory reports from groundwater monitoring events. The combination of these two summary reports was based upon the recommendation of the Washington State Department of Ecology (Ecology) project manager (Ecology, 2004a). This progress report satisfies reporting schedule submittal requirements pursuant to Ecology Consent Decree No. 00-2-05714-8SEA, entered into court March 24, 2000 (Ecology, 2000b).

## 2. REMEDIATION SYSTEM OPERATIONS

Remediation systems were installed and completed at the Site in accordance with specifications outlined in the Engineering Design Report (EDR) (TechSolv and AG&M, 2000) and Cleanup Action Plan (CAP) (Ecology, 1999). Throughout 2020, a waterfront groundwater/Light Non-Aqueous Phase Liquid (LNAPL) remediation system has operated to remove free-phase LNAPL and dissolved petroleum hydrocarbons from groundwater at Plant 1 (Figure 1).

### 2.1. WATERFRONT SYSTEM OPERATIONS

Installation and startup of the final waterfront remediation system was completed in 2002 and operational testing was conducted through 2003. Standard operation began once testing showed the system operated as designed and per Consent Decree and EDR requirements. Reports were submitted to Ecology summarizing both construction and operation & maintenance (O&M) of the remediation system. The Construction Completion Report (CCR) (TechSolve, 2003b) summarized construction, installation, and startup testing of the final remediation system, and documented that systems met design criteria, attained desired capture, and hydraulic control along the waterfront. The Final O&M Manual (TechSolve, 2003c) contains procedures to operate and maintain systems, vendor-supplied manuals for components, and health and safety practices. Ecology stated that the CCR and O&M Manual complied with the requirements of the Consent Decree, the Groundwater Compliance Monitoring and Contingency Program (GWCMCP) (TechSolve, 1999), and the Model Toxics Control Act (WAC 173-340-400) and, as such, were approved (Ecology, 2004b). The O&M Manual is updated as practices or procedures change, or as systems are altered.

O&M activities are conducted on systems to ensure they operate as designed and in accordance with applicable permits. These activities include, but are not limited to:

- Weekly checks of groundwater recovery system pumping rates.
- Weekly inspections of system components and waste storage containers for integrity per the requirements of WAC 173-303-320.

- Monthly sampling of recovered groundwater influent and effluent streams to ensure compliance with King County Department of Natural Resources and Parks (KCDNR) Discharge Permit 7592-05 for discharge A43262.
- Monthly monitoring and calculation of system LNAPL recovery.
- Monthly sampling of system flow rates and hydrocarbon concentrations.

Additional maintenance activities are conducted as needed to maintain system operational integrity and to ensure discharges are within permitted ranges.

Operation of waterfront air sparging and SVE systems were discontinued in May 2008, as the bulk of available hydrocarbons had been recovered. System data collected during 5 years of operation prior to shutdown were presented in previous reports, and support system shutdown. These findings were presented to Ecology in the 2008 5-year Review meeting and summarized in the 2008 Annual Site Report (TechSolve, 2009).

Combined LNAPL recovery (free-phase, residual, and dissolved) from final SVE and groundwater/LNAPL recovery systems is approximately 14,556 gallons (October 2002 to October 2020) (Table 1). Interim systems, operating from 1992 through 2002, recovered an additional 15,223 gallons of LNAPL, for a combined LNAPL recovery from interim and final remediation systems of 29,780 gallons. The majority of LNAPL recovered by interim remediation systems was free-phase LNAPL. The majority of LNAPL recovered by final remediation systems was from enhanced biodegradation, calculated from SVE vapor sampling for CO<sub>2</sub>. SVE system shutdown in 2008 was based, in part, on concentrations of CO<sub>2</sub> reaching atmospheric (background) levels.

Effluent discharges from the groundwater/LNAPL recovery system to the sanitary sewer have been within KCDNR's permitted ranges (Table 1) in 2020. Average monthly effluent flow rates ranged from 1.35 to 0.81 gallons per minute (gpm) in 2020, below KCDNR's maximum permitted flow of 17.5 gpm, consistent with past rates that have decreased over time.

Maintenance and repair activities of remediation systems and wells are conducted to maintain integrity, effective operation, capture, and hydraulic control along the waterfront. Notable activities conducted in the third quarter of 2020 include:

- Cleanout and service of remediation system groundwater treatment system process equipment.
- Piping and system back flushing and preventative maintenance to maintain conveyance piping and pumping wells.

Data show that the system continues to operate as designed and in accordance with permit requirements.

Groundwater/LNAPL recovery system data presented in Table 1 show influent concentrations of dissolved phase indicator hazardous substances (IHSs): benzene, diesel, and gasoline, in recovered groundwater (i.e., untreated water pumped from recovery wells screened in shallow groundwater) fluctuate slightly throughout the year and have decreased over time. In 2020, influent

concentrations of dissolved benzene, diesel, and gasoline in all monitoring events were below associated surface water cleanup levels (CULs), which are applicable to confirmational monitoring wells screened where groundwater and surface water exchange is occurring. Table 1 also shows that measurable volumes of free LNAPL have not been generated since 2008, which was the last time enough LNAPL was recovered to warrant off-site shipment. These data correspond with the lack of free LNAPL observed in recovery wells used by the groundwater/LNAPL recovery system. Lack of free LNAPL in wells and limited free LNAPL recovery by the groundwater/LNAPL recovery system indicate that the recovery system has captured most available free LNAPL. Evaluations conducted during 2019 (TechSolve, 2020a) and detailed in the 2019 Annual Site Report (TechSolve, 2020b) determined that free and recoverable LNAPL appears to no longer be present and LNAPL has been recovered to the extent practicable. Negotiations are ongoing with Ecology regarding the need for continued operation of the groundwater/LNAPL recovery system.

### **2.1.1. RECOVERY WELL MONITORING**

Voluntary groundwater monitoring of individual recovery wells has been conducted semi-annually since 2003 and was conducted in July 2020. Recovery well monitoring evaluates for free LNAPL and trends in dissolved phase IHS concentrations in shallow groundwater. Monitoring recovery wells for LNAPL presence helps evaluate the attainment of the associated performance criterion for groundwater/LNAPL recovery system shutdown, which is if LNAPL been recovered to the extent practicable. Monitoring for dissolved phase IHSs evaluates for elevated dissolved concentrations, which are an indicator of LNAPL above residual saturation levels that may be recoverable or threaten deeper groundwater. The dissolved phase IHS performance criterion for groundwater/LNAPL recovery system shutdown is attainment of groundwater CULs at conditional points of compliance, which are Confirmation Monitoring Wells AMW-01 through AMW-05 that are screened in deeper groundwater where groundwater and surface water exchange occurs (Section 3). Dissolved phase IHS CULs are not required to be met in shallow screened recovery wells for the discontinuation of groundwater/LNAPL recovery system operations.

July 2020 recovery well monitoring (Table 2) for LNAPL presence showed no measurable recoverable LNAPL in any of the 10 recovery wells (Figure 2), no sheen on groundwater was detectable in 7 recovery wells, a slight sheen as detected in 2 wells (RW-2 and RW-9), and a moderate sheen was detected in 1 well (RW-4). Monitoring of shallow groundwater for dissolved phase IHSs showed 7 of the 10 recovery wells were below the IHS CULs for benzene, gasoline (TPH-G), diesel (TPH-D) and oil (TPH-O) that are applicable at the deeper point of compliance. Shallow groundwater samples from two wells (RW-4 and RW-9) exceeded the diesel CUL. Groundwater from a single well (RW-2) exceeded the benzene and gasoline CULs. These data have been consistent over the past several years and are also consistent with the results of the Waterfront Probing Investigation (TechSolve, 2020a), which show no recoverable LNAPL remaining and that dissolved phase IHSs in shallow groundwater are not likely to cause exceedances of IHS CULs in deeper groundwater where groundwater and surface water exchange occurs.

### **2.2. INLAND SYSTEM OPERATIONS**

An Inland SVE system operated from 2008 through 2014 to improve soil and groundwater conditions along the southern boundary of Plant 1. The SVE system was shut down in December 2014 as data indicated the system no longer recovered measurable concentrations of petroleum hydrocarbons and induced airflow was no longer affecting biodegradation. Additional information regarding shutdown of the Inland SVE system was provided in the 2015 Annual Site Report

(TechSolve, 2016). In 2018, a plan (TechSolve, 2018) was submitted to and approved by Ecology (Ecology 2018) to decommission the mechanical and electrical components of the Inland SVE System that required ongoing maintenance. These components were subsequently decommissioned. The in-ground SVE piping and control manifold for this system remain onsite as a contingency in case operation of the system is warranted in the future.

Groundwater monitoring data collected along Plant 1's southern boundary indicate the system improved groundwater conditions in this area of the Site, as discussed in the following section.

### **2.3. CONTAINMENT BOOM MONITORING**

Oil sorbent booms have been maintained on the West Duwamish Waterway adjacent to Plant 1 to contain oil sheens that have appeared on surface water. Two booms, the Northern Warehouse Boom and the Southern Warehouse Boom, are currently located alongside the warehouse (Figure 2). Boom locations are selected to best contain occasional sheens historically observed on the Western Duwamish Waterway directly adjacent to the Site. Booms and the waterway are monitored weekly, at a minimum, for the presence of oil sheens and boom integrity, and augmented by checks made by Terminal personnel. Booms are replaced, as necessary.

No sheen has been observed on the waterway in 2020. The last observed sheen on the waterway occurred in August 2019, as documented in the 2019 Annual Site Report (TechSolve, 2020b). The lack of an observable sheen on the waterway for more than one year indicates that the performance criterion has been met for there to be no persistent sheens associated with the terminal. Waterway sheen monitoring results will be further detailed in the 2020 Annual Site Report, which is due to Ecology in April 2021.

## **3. SUMMARY OF GROUNDWATER PERFORMANCE MONITORING PROGRAM**

The Second Quarter 2020 Groundwater Monitoring Event was conducted in accordance with requirements of the Consent Decree, CAP, and GWCMCP. The GWCMCP describes the monitoring well network, sampling frequency, and analytes. Some revisions to the monitoring plan were included in the EDR, per Ecology's approval. Additional revisions have been made with Ecology's approval, as highlighted below. The current groundwater monitoring schedule is summarized in Table 3. Monitoring well locations are shown on Figure 2 for Plant 1.

In 2005, Wells MW-1-T9, MW-2-T9, MW-3-T9, and MW-4-T9 were installed along the southern property boundary of Plant 1 (Figure 2) to evaluate groundwater trends due to CUL exceedances in Monitoring Well AR-03. These wells were monitored quarterly from December 2005 through March 2018, which aided in evaluating the effectiveness of the Inland SVE system in meeting cleanup objectives. In 2018, a monitoring revision plan (TechSolve, 2018a) was submitted to and approved by Ecology (Ecology 2018) to eliminate monitoring of Well MW-4-T9 and reduce the monitoring frequency in Wells AR-03, GM-15S, MW-1-T9, MW-2-T9, and MW-3-T9 from quarterly to semi-annual. Contingency actions were detailed in the plan to resume quarterly monitoring of Wells AR-03, GM-15S, MW-1-T9, MW-2-T9, and MW-3-T9 for specified periods if CULs are exceeded in these wells.

Well GM-14S was historically used to monitor for sheens on groundwater, as discussed below. As sheens are no longer detected in GM-14S, quarterly groundwater monitoring for indicator hazardous substances (IHSs) was initiated in this well in 2007.

Wells GM-16S and GM-17S are hydraulically upgradient from Plant 1. These wells were removed from most of the monitoring program with approval from Ecology in March 2000 (Ecology, 2000a) as sufficient upgradient data had been collected. Monitoring for hydrocarbons was voluntarily reinitiated in these wells in September 2007, as recommended by Ecology, to monitor for petroleum hydrocarbon migration onto the property from upgradient, off-site sources.

Revisions to the groundwater monitoring program approved by Ecology in 2009 (Ecology, 2009), reduced monitoring frequencies and required analyses. These revisions reduced the monitoring frequency from Wells GM-16S, and 17S from quarterly to semi-annual. The monitoring frequency from 16S, and 17S was reduced due to consistent monitoring data for total petroleum hydrocarbons (TPH) and benzene below CULs. Additionally, the voluntary monitoring frequency of sampling for carcinogenic polynuclear aromatic hydrocarbons (cPAHs) was set to an annual basis in waterfront wells (AMW-01 through AMW-05) as extensive historical sampling does not indicate any significant detection trends. Ecology agreed that analysis for cPAHs from these wells is voluntary until cleanup objectives are met (Ecology, 2003). Sampling for cPAHs was last conducted in the fourth quarter of 2019 and the results were provided in the 2019 Annual Site Report (TechSolve, 2020b).

Wells monitored on a semi-annual basis are sampled in the first and third quarter, which typically correspond with seasonal groundwater highs and lows, respectively. As such, Wells AR-03, GM-15S, GM-16S, GM-17S, MW-1-T9, MW-2-T9, and MW-3-T9 were not sampled in the second quarter of 2020. These wells will next be sampled in the third quarter of 2020.

The Second Quarter 2020 Groundwater Monitoring event was conducted on June 10<sup>th</sup>, 2020. Overall, second quarter 2020 groundwater elevations (Table 4) were lower compared to elevations measured in the first quarter of 2020. These data indicate that the seasonal groundwater high occurred in early 2020, which corresponds with historic trends showing groundwater elevations rise to seasonal highs in the winter and spring and then fall to seasonal lows in the summer and autumn.

Second Quarter 2020 Groundwater Monitoring Event samples were submitted to ALS Laboratories of Everett, Washington (Ecology Accreditation # C601) for laboratory analysis of IHSs. The IHSs include TPH as gasoline (TPH-G), TPH as diesel (TPH-D), TPH as oil (TPH-O), and benzene.

Petroleum hydrocarbon monitoring results for the Second Quarter 2020 Groundwater Monitoring Event are included in Table 5 and Figure 2. The only detection of an IHS (benzene, TPH-G, TPH-D, or TPH-O) above a CUL in the second quarter of 2020 was gasoline (TPH-G) in well GM-14S. Concentrations of IHSs from all other samples analyzed in the second quarter of 2020 were below associated CULs. Data trend evaluations will be presented in the 2020 Annual Site Report, in accordance with Consent Decree requirements.

Three wells (GM-11S, GM-12S, and GM-13S) have been examined monthly for the presence of LNAPL (free product) and sheens. Historically, gauging for free LNAPL at Plant 1 was conducted at four wells; however, gauging of Well GM-14S was discontinued in 2004, with concurrence from



Ecology (Ecology, 2004c), and converted to a monitoring well in 2007, as it has been free of LNAPL since 1999.

No sheen or measurable LNAPL have been detected in Wells GM-11S, GM-12S, and GM-13S in 2020. LNAPL and sheen monitoring results are presented in Table 6. The results of LNAPL and sheen monitoring for 2020 and 2019 (TechSolve, 2020b) indicate that these wells met both the GWCMCP's LNAPL performance standard of no measurable LNAPL and the LNAPL cleanup standard for confirmational monitoring of no visible sheen for a period of 1 year. The GWCMCP stipulates that once the performance standard has been met in these wells, groundwater shall be sampled for concentrations of IHSs. As such, these wells are being evaluated for addition to the quarterly IHS monitoring program. These three wells will continue to be gauged for sheen and LNAPL in 2020, until Ecology concurs that the GWCMCP product performance standard has been met.

#### **4. SUMMARY OF DATA VALIDATION**

Laboratory analytical results were reported with associated laboratory quality assurance/quality control data (QA/QC). Analytical reports were reviewed, and data were validated. During this quarter, limited data were qualified with J (the associated value is approximate) qualifier. A summary of the data qualified during validation, qualifiers assigned, and reasons for data qualification are provided in Table 7. All laboratory reports are retained at the TechSolve office.

#### **5. ADDITIONAL ACTIVITIES**

Onsite work activities during the third quarter of 2020 were limited due to the 2019 Novel Coronavirus (COVID-19) outbreak. Work activities were limited to conducting and completing compliance driven tasks only. Work conducted at the site during the third quarter was conducted in accordance with Washington State Department of Labor and Industries requirements and planned voluntary work activities will resume as allowed by state and federal requirements.

A work plan was submitted to Ecology in 2019 (TechSolve, 2019) to conduct a hydraulic evaluation of how a new seawall, installed along the Plant 1 waterfront in 2018, has affected site hydrology. The hydraulic evaluation work plan proposes conducting a background water level assessment as the first step in satisfying a regulatory driven (Ecology, 2015) evaluation. Negotiations are ongoing with Ecology relating to the scope of the hydraulic evaluation.

#### **6. SUMMARY**

This report summarizes operation of remediation systems during the third quarter of 2020 (July through September 2020) and the Second Quarter 2020 Groundwater Monitoring Event. In accordance with the Consent Decree, the Fourth Quarter 2020 Progress Report / Third Quarter 2020 Groundwater Monitoring Report will be the next report submitted to Ecology. This report will be submitted to Ecology by January 15, 2021.

## 7. REFERENCES

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## **TABLES**

**Table 1. Waterfront Groundwater System Petroleum Hydrocarbon Recovery Rates**  
**Site: Former BP Harbor Island Terminal**

**GROUNDWATER SYSTEM EFFICIENCIES**

SAMPLE DATE	UNITS	Influent Benzene	Effluent Benzene	% Reduction	Influent Diesel	Effluent Diesel	% Reduction	Influent Ethylbenzene	Effluent Ethylbenzene	% Reduction	Influent Gasoline	Effluent Gasoline	% Reduction	Influent Oil	Effluent Oil	% Reduction	Influent Toluene	Effluent Toluene	% Reduction	Influent Xylenes	Effluent Xylenes	% Reduction
2002 Averages	µg/L	225.3	14.3	91%	7,315	7,020	4%	55.2	6.2	75%	1,770	336	82%	831	804	5%	17.0	2.5	88%	88.8	9.9	87%
2003 Averages	µg/L	137.7	19.5	76%	4,945	4,648	-1%	44.5	12.9	69%	1,854	678	62%	760	763	0%	42.7	5.4	61%	154.1	50.3	68%
2004 Averages	µg/L	93.5	3.2	82%	10,285	9,342	-6%	76.8	4.7	79%	4,383	840	59%	762	1,026	-8%	116.6	2.2	82%	356.6	23.0	75%
2005 Averages	µg/L	76.7	14.5	84%	4,162	5,987	-9%	170.8	45.4	81%	10,090	3,229	70%	864	750	15%	566.9	121.0	84%	1,327.7	367.9	78%
2006 Averages	µg/L	38.9	1.2	89%	11,263	2,174	42%	42.1	0.9	90%	4,944	202	94%	665	666	0%	55.6	0.8	77%	485.1	5.2	96%
2007 Averages	µg/L	8.8	1.5	60%	1,223	906	18%	6.6	0.8	56%	407	115	63%	598	598	0%	1.0	0.5	21%	19.8	1.9	50%
2008 Averages	µg/L	10.0	1.1	70%	540	468	6%	5.5	0.7	39%	279	76	61%	505	504	0%	0.7	0.5	40%	10.6	1.6	65%
2009 Averages	µg/L	5.2	1.0	48%	369	561	8%	4.1	1.6	31%	407	182	46%	497	489	2%	0.8	0.7	44%	15.2	7.4	33%
2010 Averages	µg/L	3.9	0.7	76%		2,193	NA	6.8	1.7	78%	915	336	65%		410	NA	0.9	0.9	NA	26.3	6.7	69%
2011 Averages	µg/L	3.2	0.5	80%		1,714	NA	2.4	1.0	53%	439	89	69%		492	NA	1.0	1.0	NA	7.1	3.0	29%
2012 Averages	µg/L	3.6	1.3	48%		2,787	NA	1.9	1.2	37%	362	144	61%		636	NA	1.0	1.0	NA	5.7	3.4	48%
2013 Averages	µg/L	1.0	0.5	45%		1,333	NA	1.1	0.5	49%	356	124	57%		433	NA	0.5	0.5	NA	2.4	1.0	78%
2014 Averages	µg/L	1.7	0.3	61%		1,699	NA	0.6	0.3	46%	539	122	79%		236	NA	0.5	0.3	NA	1.5	0.5	61%
2015 Averages	µg/L	2.3	0.4	66%		5,175	NA	1.6	0.4	60%	1,146	406	64%		396	NA	0.5	0.4	NA	2.8	0.5	74%
2016 Averages	µg/L	2.2	0.6	76%		2,292	NA	2.3	0.5	81%	1,282	582	50%		248	NA	0.4	0.4	NA	2.9	1.0	62%
2017 Averages	µg/L	1.9	0.4	74%		4,325	NA	1.0	0.4	63%	1,421	641	56%		349	NA	0.5	0.4	NA	1.0	0.7	55%
2018 Averages	µg/L	1.1	0.7	60%		1,673	NA	0.7	0.7	7%	359	136	62%		346	NA	0.5	0.5	NA	1.3	0.9	30%
2019 Averages	µg/L	0.5	0.4	50%		1,539	NA	0.7	0.7	NA	231	68	60%		584	NA	0.7	0.7	NA	2.0	2.0	NA
1/23/2020	µg/L	0.68	0.5	NA		500	NA	1.0	1.0	NA	50	50	NA		750	NA	1.0	1.0	NA	3.0	3.0	NA
2/20/2020	µg/L	0.5	0.5	NA		540	NA	1.0	1.0	NA	50	50	NA		750	NA	1.0	1.0	NA	3.0	3.0	NA
3/24/2020	µg/L	0.5	0.5	NA		520	NA	1.0	1.0	NA	50	50	NA		750	NA	1.0	1.0	NA	3.0	3.0	NA
4/23/2020	µg/L	0.5	0.5	NA		940	NA	1.0	1.0	NA	50	50	NA		750	NA	1.0	1.0	NA	3.0	3.0	NA
5/28/2020	µg/L	0.86	0.5	NA		490	NA	1.0	1.0	NA	210	50	NA		750	NA	1.0	1.0	NA	3.0	3.0	NA
6/18/2020	µg/L	0.78	0.5	NA		280	NA	1.0	1.0	NA	160	50	NA		750	NA	1.0	1.0	NA	3.0	3.0	NA
7/23/2020	µg/L	0.5	0.5	NA		460	NA	1.0	1.0	NA	130	50	NA		750	NA	1.0	1.0	NA	3.0	3.0	NA
8/20/2020	µg/L	0.5	0.5	NA		500	NA	1.0	1.0	NA	96	50	NA		750	NA	1.0	1.0	NA	3.0	3.0	NA
9/24/2020	µg/L	0.5	0.5	NA		330	NA	1.0	1.0	NA	50	50	NA		750	NA	1.0	1.0	NA	3.0	3.0	NA
SURFACE WATER CLEANUP LEVELS		71 µg/L			10,000 µg/L			NA			1,000 µg/L			10,000 µg/L			NA			NA		
KCDNR DISCHARGE LIMITS			70 µg/L			100,000 µg/L			1,700 µg/L			NA			100,000 µg/L			1,400 µg/L			NA	
2019 Averages:		.6 µg/L	.5 µg/L	#DIV/0!	NA	507 µg/L	NA	1. µg/L	1. µg/L	NA	94 µg/L	50 µg/L	#DIV/0!	NA	750 µg/L	NA	1. µg/L	1. µg/L	NA	3. µg/L	3. µg/L	NA

**METRO DISCHARGE DATA**

Observation Date	Days Operational since last monitoring reading	Average flow (GPM)	Total Flow Between Observation dates (gallons)	Pounds of Benzene Removed	Pounds of Gasoline Removed	Pounds of Diesel Removed	Pounds of Oil Removed	Pounds of Toluene Removed	Pounds of Ethylbenzene Removed	Pounds of Xylenes Recovered	Total Gallons Gas, Diesel, and Oil
2002 Totals and Averages	65	4.18	322,785	0.62	4.99	19.42	2.30	0.05	0.13	0.22	3.90
2003 Totals and Averages	361	8.03	4,114,867	4.43	62.20	169.14	26.05	1.18	1.47	5.05	37.76
2004 Totals and Averages	338	9.58	4,570,461	3.54	175.70	419.25	28.95	5.35	3.16	14.66	92.43
2005 Totals and Averages	359	11.17	5,827,144	3.43	447.43	155.78	41.55	25.29	7.69	59.98	100.52
2006 Totals and Averages	365	6.40	3,220,733	0.80	192.72	663.65	19.09	2.85	1.89	20.04	128.92
2007 Totals and Averages	360	3.17	1,599,607	0.15	9.08	18.30	8.40	0.02	0.11	0.48	5.20
2008 Totals and Averages	363	3.19	1,645,810	0.14	3.95	7.21	6.95	0.01	0.08	0.15	2.59
2009 Totals and Averages	369	2.98	1,569,390	0.07	5.75	7.81	6.40	0.01	0.06	0.22	2.89
2010 Totals and Averages	372	2.17	1,185,127	0.037	8.62	18.84	4.26	0.01	0.05	0.19	4.66
2011 Totals and Averages	356	1.90	949,880	0.026	5.13	17.55	3.54	0.01	0.03	0.13	3.81
2012 Totals and Averages	371	1.89	948,600	0.034	3.97	25.92	3.47	0.01	0.02	0.04	4.81
2013 Totals and Averages	365	1.33	700,450	0.014	2.26	8.80	3.43	0.003	0.01	0.02	2.08
2014 Totals and Averages	332	1.62	761,480	0.010	3.43	10.95	1.55	0.003	0.00	0.01	2.33
2015 Totals and Averages	358	1.71	874,680	0.015	6.56	36.53	2.92	0.004	0.01	0.02	6.68
2016 Totals and Averages	370	1.90	999,770	0.021	13.12	20.02	1.94	0.004	0.03	0.03	5.26
2017 Totals and Averages	364	1.65	866,030	0.014	11.96	33.39	2.62	0.004	0.01	0.01	7.52
2018 Totals and Averages	371	1.20	641,740	0.006	2.16	9.61	1.79	0.002	0.004	0.007	1.96
2019 Totals and Averages	357	1.26	611,500	0.002	1.30	8.72	2.89	0.003	0.003	0.009	1.84
January-20	43	1.03	63,800	0.0004	0.03	0.24	0.40	0.0005	0.0005	0.0016	0.09
February-20	28	1.35	54,520	0.0003	0.02	0.24	0.34	0.0005	0.0005	0.0014	0.08
March-20	33	0.91	43,030	0.0002	0.02	0.19	0.27	0.0004	0.0004	0.0011	0.07
April-20	30	0.81	35,110	0.0001	0.01	0.21	0.22	0.0003	0.0003	0.0009	0.06
May-20	35	1.15	57,820	0.0003	0.06	0.34	0.36	0.0005	0.0005	0.0014	0.11
June-20	21	1.24	37,380	0.0003	0.06	0.12	0.23	0.0003	0.0003	0.0009	0.06
July-20	35	1.12	56,230	0.0003	0.07	0.17	0.35	0.0005	0.0005	0.0014	0.08
August-20	28	1.12	45,230	0.0002	0.04	0.18	0.28	0.0004	0.0004	0.0011	0.07
September-20	35	1.08	54,590	0.0002	0.03	0.19	0.34	0.0005	0.0005	0.0014	0.08
2020 Totals and Averages	288	1.09	447,710	0.002	0.35	1.89	2.80	0.004	0.004	0.011	0.69
<b>TOTALS:</b>			<b>31,857,764 gal</b>	<b>13.4</b>	<b>960.7</b>	<b>1652.8</b>	<b>170.9</b>	<b>34.8</b>	<b>14.8</b>	<b>101.3</b>	
<b>Maximum permitted GPM:</b>		<b>17.5</b>		<b>Gallons Gas, Diesel, &amp; Oil Recovered:</b>	<b>156.2</b>	<b>236.8</b>	<b>22.4</b>	<b>TOTAL GALLONS RECOVERED:</b>	<b>415.84</b>		

Observation Date	Monthly LNAPL Recovery (gal)
February-03	19.6
April-03	6.9
May-03	2.5
July-03	2
December-03	20
January-04	25
June-04	35
August-04	50
September-04	8
November-04	10
December-04	3.5
January-05	0
February-05	35
July-05	110
February-06	5
March-06	2
December-06	30
March-08	30
<b>Total Gallons LNAPL Recovered</b>	<b>395</b>

TOTAL PETROLEUM RECOVERY	
Total lbs. Dissolved Gas, Diesel, and Oil Recovered in Groundwater (2002-Present)	2,784 lbs
<b>Total Gallons Dissolved Gas, Diesel, and Oil Recovered in Groundwater (2002-Present)*</b>	<b>416 gal</b>
<b>Total Gallons LNAPL Recovered by Final Recovery System (2002-Present)</b>	<b>395 gal</b>
<b>Total Gallons LNAPL Recovered by Interim Recovery System (1992-2002)</b>	<b>9,312 gal</b>
<b>Total Gallons of TPH Vapor Recovered by Final SVE System (2003-2008)**</b>	<b>2,334 gal</b>
<b>Total Gallons of TPH Vapor Recovered by Interim SVE System (1996-2002)**</b>	<b>1,248 gal</b>
<b>Total Gallons TPH Recovered from Final SVE System due to Biodegradation (2003-2008)***</b>	<b>11,411 gal</b>
<b>Total Gallons TPH Recovered from Interim SVE System due to Biodegradation (1996-2002)***</b>	<b>4,664 gal</b>
<b>Total Gallons Recovered by Final Recovery Systems (2002-Present)</b>	<b>14,556 gal</b>
<b>Total Gallons Recovered by Interim Recovery Systems (1992-2002)</b>	<b>15,223 gal</b>
<b>Total Gallons of Petroleum Removed (1992-Present)</b>	<b>29,780 gal</b>

**Definitions:**

gal - gallons  
GPM - Gallons per minute  
NA - Not available  
LNAPL - Light non-aqueous phase liquid (oil)  
SVE - Soil vapor extraction  
TPH - Total petroleum hydrocarbons  
µg/L - micrograms per liter

**Notes:**

LNAPL Recovery is recorded periodically when sufficient product has been accumulated to be transported off-site for disposal.  
Influent diesel and oil samples are no longer analyzed, as influent and effluent samples are collected before and after, respectively, a diffused air stripper, which is not intended or effective at removing diesel or oil.  
Effluent sample data are representative of the outflow water to King County Metro sanitary sewer.  
The average µg/L of the preceding month and the month of reference are used to calculate pounds of compound removed.  
Data presented in *italicized text* represent non-detections. The *italicized result* is reported at the laboratory reporting limit  
If influent concentrations are below the laboratories reporting limit, the percent reduction is calculated using the reporting limit. The actual percent reduction is ≥ the reported value.

\* Calculation of lbs. of Recovered Product:

To convert µg/L to lbs./gallon - (µg/L) x (3.785/gal) = ug/gal, (ug/gal) x (ug/(2.2046x10-9lbs)) = lbs./gal  
lbs./gal of chemical constituent x total gallons recovered = lbs. of chemical recovered  
Density of Gasoline utilized for conversions from pounds to gallons is 6.15 lbs./gal  
Density of Diesel utilized for conversions from pounds to gallons 6.98 lbs./gal  
Density of Oil utilized for conversions from pounds to gallons 7.63 lbs./gal  
Benzene, toluene, ethylbenzene, and xylenes volumes are not included in the Total Gallons calculations, as they are assumed to be included in TPH as gasoline.

\*\* / \*\*\* SVE Recovery Calculations for TPH and Biodegradation, which are maintained in separate tables.

C = Average Influent TPH concentration (ppmv)  
Q = Influent Flow Rate (SCFM)  
Mc = Molecular wt. of Carbon Dioxide = 44  
Mg = Molecular wt. of Gasoline = 87  
Density of Gasoline for conversions is 6.15 lbs./gal

\*\* TPH recovered by SVE system was calculated in lbs./hr. = C x Q x Mg x 1.583 x 10<sup>-7</sup>  
1.583 x 10<sup>-7</sup> is a constant and is derived as follows:  
10<sup>6</sup> ppmv x 60min/1hr x 1 lb. Mole/379 cu.ft.

Table 2. Groundwater/LNAPL Recovery Well Performance Monitoring  
 July 2020  
 Site: Former BP Harbor Island Terminal

Well	Date	Measurable LNAPL (>0.01')	Sheen on Groundwater (No, SS, MS, HS)	TPH-G WTPH-G (mg/L)	TPH-D WTPH-DX (mg/L)	TPH-O WTPH-DX (mg/L)	Benzene (µg/L)
RW-1	7/8/2020	No	No	0.15	1.3	ND	0.54
RW-2	7/8/2020	No	<b>SS</b>	<b>1.80</b>	9.4	ND	<b>91</b>
RW-4	7/8/2020	No	<b>MS</b>	ND	<b>390</b>	ND <38	27
RW-5	7/8/2020	No	No	0.32	0.59	ND	2.5
RW-6	7/8/2020	No	No	0.081	0.26	ND	0.51
RW-7	7/8/2020	No	No	ND	ND	ND	ND
RW-8	7/8/2020	No	No	0.087	1.1	ND	ND
RW-9	7/8/2020	No	<b>SS</b>	ND	<b>11</b>	ND <3.8	ND
RW-10	7/8/2020	No	No	0.062	1.80	1.0	ND
GM-11S	7/8/2020	No	No	0.99	3.0	ND	2.5
Cleanup Level		No	No*	1*	10*	10*	71*
Method Reporting Limit				0.05	0.25	0.75	0.5

Note: \* Listed cleanup levels and values in **bold** that exceed these levels are applicable at conditional points of compliance (CPOCs). Recovery wells are not CPOCs for parameters with a "\*" and values above listed cleanup levels are not exceedances.

mg/L Milligrams per liter.

µg/L Micrograms per liter.

ND Constituent not detected above laboratory reporting limit. A < value indicates a ND at the listed value.

TPH Total petroleum hydrocarbons.

TPH-D Total petroleum hydrocarbons as diesel.

TPH-G Total petroleum hydrocarbons as gasoline.

TPH-O Total petroleum hydrocarbons as oil.

WTPH-DX Washington State Method for Analysis of Diesel in Soil and Water - Extended.

WTPH-G Washington State Method for Analysis of Gasoline in Soil and Water.

SS Slight sheen observed on groundwater.

MS Medium sheen observed on groundwater.

HS Heavy sheen observed on groundwater.

Table 3. Groundwater Performance Monitoring Schedule  
 Site: Former BP Harbor Island Terminal

Analyses Conducted by Quarter				
Well	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
<b>Plant 1</b>				
MW-1-T9	Benzene, TPH-G, TPH-D, TPH-O	(1)	Benzene, TPH-G, TPH-D, TPH-O	(1)
MW-2-T9	Benzene, TPH-G, TPH-D, TPH-O	(1)	Benzene, TPH-G, TPH-D, TPH-O	(1)
MW-3-T9	Benzene, TPH-G, TPH-D, TPH-O	(1)	Benzene, TPH-G, TPH-D, TPH-O	(1)
GM-14S	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O
GM-15S	Benzene, TPH-G, TPH-D, TPH-O	(1)	Benzene, TPH-G, TPH-D, TPH-O	(1)
GM-16S	Benzene, TPH-G, TPH-D, TPH-O		Benzene, TPH-G, TPH-D, TPH-O	
GM-17S	Benzene, TPH-G, TPH-D, TPH-O		Benzene, TPH-G, TPH-D, TPH-O	
<b>GM-24S</b>	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O
AR-03	Benzene, TPH-G, TPH-D, TPH-O	(1)	Benzene, TPH-G, TPH-D, TPH-O	(1)
<b>AMW-01</b>	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O, cPAHs
AMW-02	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O, cPAHs
AMW-03	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O, cPAHs
AMW-04	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O, cPAHs
AMW-05	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O, cPAHs
<b>Plant 2</b>				
All Plant 2 monitoring has been discontinued.				

Notes: Field Duplicate and QA/QC samples collected from wells highlighted in bold.  
 TPH-G - Gasoline Range organics utilizing NWTPH-Gx method  
 TPH-D - Diesel Range Organics utilizing NWTPH-Dx  
 TPH-O - Extended Range Organics (Motor Oil) utilizing NWTPH-Dx  
 Benzene is analyzed for utilizing EPA 8021 or 8260B.  
 cPAHs - Carcinogenic Polycyclic Aromatic Hydrocarbons utilizing EPA 8270SIM  
 Field Parameters (pH, Temperature, Conductivity, Turbidity, Water Level, & Product Level) are recorded from all wells sampled  
 (1) - If a groundwater cleanup level exceedance occurs in first or third quarter in any of these highlighted wells, all (1) wells will be sampled the following quarter. Wells exceeding cleanup levels will continue quarterly monitoring until four consecutive quarters below cleanup level are achieved.

Table 4. Groundwater Performance Monitoring Groundwater Elevations  
 Second Quarter 2020  
 Site: Former BP Harbor Island Terminal

Well	Date	TOC Elevation (ft msl)	Depth to Water (ft below TOC)	Groundwater Elevation (ft msl)
<b>Plant 1</b>				
GM-14S	6/10/2020	8.57	4.31	4.26
GM-24S	6/10/2020	7.62	3.52	4.10
AMW-01	6/10/2020	8.88	5.51	3.37
AMW-02	6/10/2020	12.14	8.72	3.42
AMW-03	6/10/2020	12.07	8.84	3.23
AMW-04	6/10/2020	8.00	5.59	2.41
AMW-05	6/10/2020	8.14	4.84	3.30

Definitions and Notes:

ft Feet

msl Mean sea level

NA Not available. Well elevations have not been surveyed.

NM Not measured. Well was not gauged or sampled due to inaccessibility caused by the Island redevelopment activities.

TOC Top of casing

Elevations measurements are calculated using NGVD29 Datum.



Table 5. Summary of Analytical Results for Groundwater - TPH-G, TPH-D, TPH-O, and Benzene  
 Second Quarter 2020  
 Site: Former BP Harbor Island Terminal

Well	Date	TPH-G WTPH-G (µg/L)	TPH-D WTPH-DX (µg/L)	TPH-O WTPH-DX (µg/L)	Benzene (µg/L)
<b>Plant 1</b>					
GM-14S	6/10/2020	<b>1,200</b>	1,300	ND	ND
GM-24S	6/10/2020	870 J	470	ND	ND
AMW-01	6/10/2020	ND	420	ND	ND
AMW-02	6/10/2020	ND	330	ND	28.0
AMW-03	6/10/2020	ND	ND	ND	ND
AMW-04	6/10/2020	ND	ND	ND	ND
AMW-05	6/10/2020	ND	ND	ND	ND
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Note: Values in **bold** exceed the cleanup level.

µg/L Micrograms per liter.

ND Constituent not detected above reporting limit.

NR Not required. Well was not tested for these analyses, as per Ecology approval. redevelopment activities.

TPH Total petroleum hydrocarbons.

TPH-D Total petroleum hydrocarbons as diesel.

TPH-G Total petroleum hydrocarbons as gasoline.

TPH-O Total petroleum hydrocarbons as oil.

WTPH-DX Washington State Method for Analysis of Diesel in Soil and Water - Extended.

WTPH-G Washington State Method for Analysis of Gasoline in Soil and Water.

J Estimated value.

UJ Not detected at an estimated value.

R Rejected value.

Table 6. Summary of Free Product Measurement Results for Groundwater  
 2020 Monitoring Data  
 Site: Former BP Harbor Island Terminal

Well	Date	Free Product (feet)
<b>Plant 1</b>		
GM-11S	1/23/2020	None
GM-11S	2/20/2020	None
GM-11S	3/24/2020	None
GM-11S	4/23/2020	None
GM-11S	5/28/2020	None
GM-11S	6/18/2020	None
GM-11S	7/23/2020	None
GM-11S	8/20/2020	None
GM-11S	9/24/2020	None
GM-12S	1/23/2020	None
GM-12S	2/20/2020	None
GM-12S	3/24/2020	None
GM-12S	4/23/2020	None
GM-12S	5/28/2020	None
GM-12S	6/18/2020	None
GM-12S	7/23/2020	None
GM-12S	8/20/2020	None
GM-12S	9/24/2020	None
GM-13S	1/23/2020	None
GM-13S	2/20/2020	None
GM-13S	3/24/2020	None
GM-13S	4/23/2020	None
GM-13S	5/28/2020	None
GM-13S	6/18/2020	None
GM-13S	7/23/2020	None
GM-13S	8/20/2020	None
GM-13S	9/24/2020	None
Cleanup Level		No Sheen

Notes: Values in **bold** exceed the cleanup level.

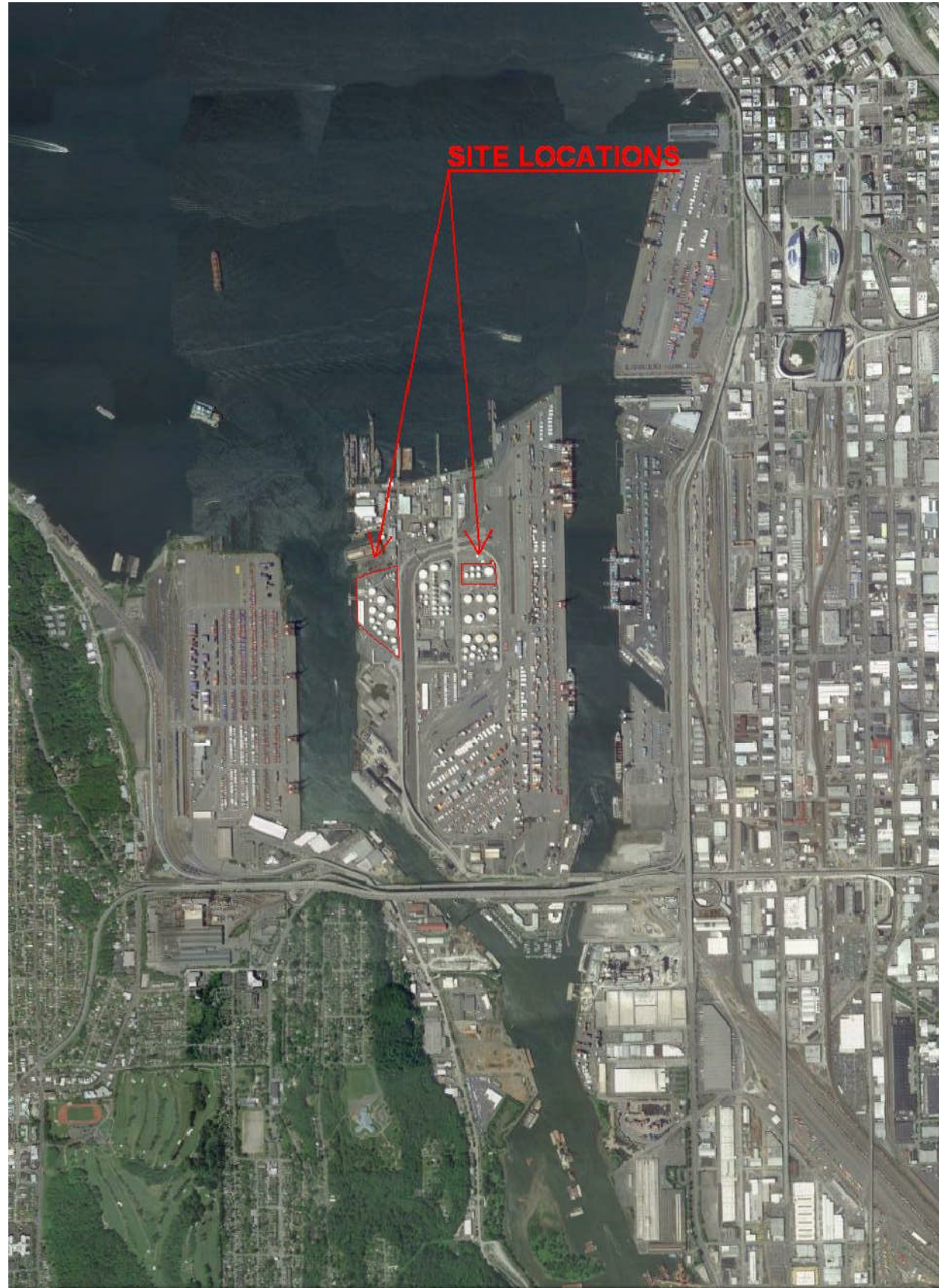
Table 7. Summary of Data Validation Results  
 Groundwater Performance Monitoring  
 Second Quarter 2020  
 Site: Former BP Harbor Island Terminal

Sample ID	Constituent	Qualifier	Reason
P1-GWGM-24S-220 P1-GWGM-224S-220	Gasoline	J	The RPD for gasoline in the field duplicate pair P1-GWGM-24S-220 / P1-GWGM-224S-220 is greater than 20%. Results for these samples are, therefore, qualified as estimated values (J).

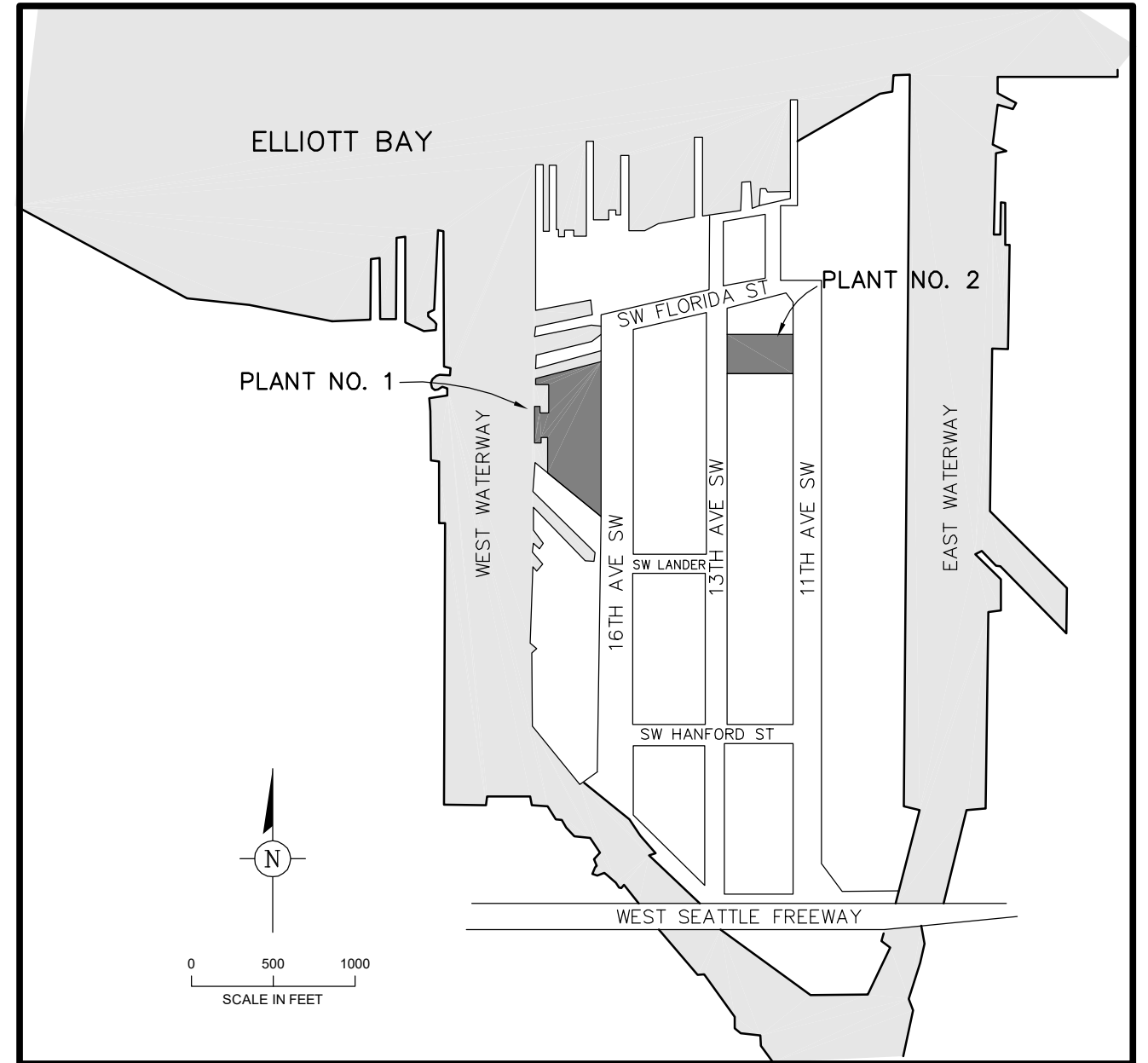
Definitions:

- CCV Continuing calibration verification sample
- J The associated value is approximate.
- LCS/LCSD Laboratory control sample / Laboratory control sample duplicate
- MS/MSD Matrix spike / Matrix spike duplicate
- RPD Relative Percent Difference
- UJ The result is qualified as undetected at an approximate quantitation limit.

## FIGURES



AREA PLAN



SITE PLAN

\\server\ServerData\data\Project\ARCO 21\Drawings and CAD files\Autocad files: Plant 1 GWM Figs. dwg April 11, 2019

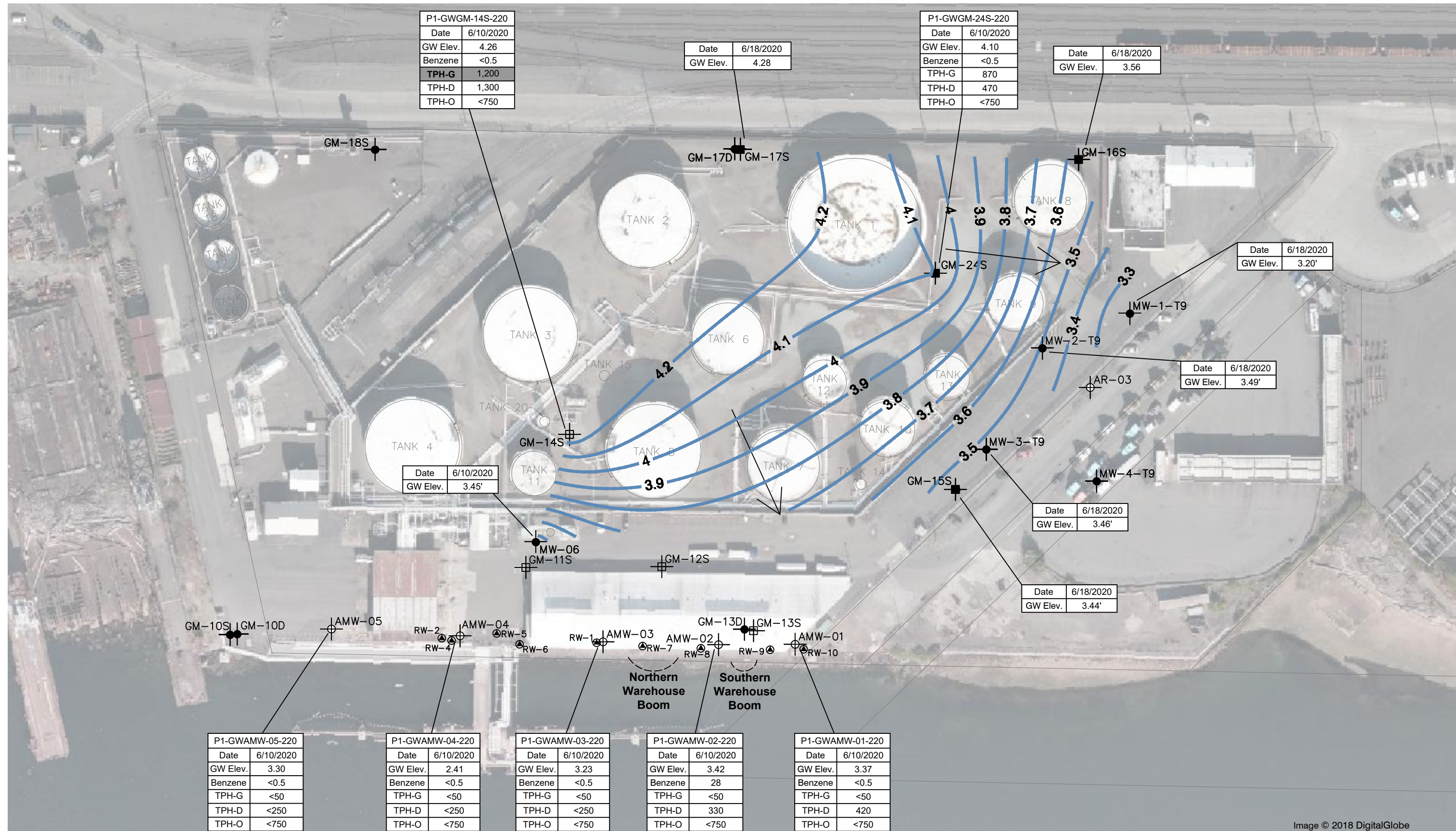


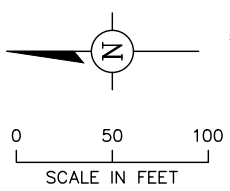
Image © 2018 DigitalGlobe

**LEGEND**

- GM-16S Monitoring Well
- ⊕ AMW-01 Performance/Confirmation Well
- GM-13D Performance Well
- GM-13S Product Performance Well
- ⊕ RW-5 Recovery Well

Sample ID	
Date	Date Sample Collected
GW Elev.	Groundwater Elevation in Feet Mean Sea Level (MSL)
Benzene	Benzene (EPA 8260) in µg/L
TPH-G	Total Petroleum Hydrocarbons as Gasoline (NWTPH-GX) in µg/L
TPH-D	Total Petroleum Hydrocarbons as Diesel (NWTPH-DX) in µg/L
TPH-O	Total Petroleum Hydrocarbons as Oil (NWTPH-OX) in µg/L

Notes: **Bold** - Detected concentration exceeds site specific cleanup level  
 < = Not detected at listed laboratory reporting limit



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 ENVIRONMENTAL

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**Plant 1 Second Quarter 2020  
 Groundwater Monitoring Analytical Results**

Site: Former BP Harbor Island Terminal  
 1652 Southwest Lander Street  
 Seattle, WA 98134