Memo

ARCADIS

SUBJECT
Preliminary Monitored Natural Attenuation (MNA) Assessment
Former Chevron Station No. 9-8944
1323 Lee Boulevard
Richland, Benton County, WA 99352

TO
Eric Epple
Ada Hamilton

DATE
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PROJECT NUMBER
30064311

DEPARTMENT
Environment

NAME
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This *Preliminary Monitored Natural Attenuation (MNA) Assessment* was developed by Arcadis U.S., Inc. (Arcadis) for former Chevron Station No. 9-8944 located at 1323 Lee Boulevard in Richland, Washington (Site; State of Washington Department of Ecology [Ecology] Cleanup Site ID 5798; **Figure 1**). This memorandum provides a preliminary assessment of groundwater plume stability and contributing attenuation mechanisms in order to evaluate MNA as a remedy for residual concentrations of constituents of concern (COCs) in groundwater at the Site.

Site Background and Hydrogeology

The Site is the location of a former Standard Oil/Chevron gasoline service station that operated from approximately 1960 until 1976. The station was demolished in 1976, and the Site was redeveloped in 2000. Currently, the Site is occupied by a Subway® restaurant and associated parking areas. Excavation and underground storage tank (UST) removal were conducted in 1976 when the service station was demolished, though no records of this work are available.

Monitoring wells MW-1, MW-2, and MW-3 (**Figure 2**), installed in 1994 (AGRA 1994), were monitored for TPH-GRO, BTEX, and/or methyl tert-butyl ether (MTBE) from 1996 through 2004 and exceedances of TPH-GRO and/or BTEX Ecology Model Toxics Control Act (MTCA) Method A cleanup levels (CULs) were observed in one or more of the wells. In September 2007, MW-1, MW-2, and MW-3 were destroyed in preparation for property development activities and four new monitoring wells, MW-4 through MW-8, were installed (**Figure 2**; Conestoga-Rovers and Associates [CRA] 2007). Monitoring wells MW-4 through MW-8 were monitored periodically for TPH-GRO, TPH-diesel range organics (DRO), TPH-heavy oil range organics (HRO), BTEX, MTBE, lead, and/or carcinogenic polycyclic aromatic hydrocarbons (cPAHs) through 2013. During this period, concentrations of TPH-GRO, TPH-DRO, ethylbenzene, xylenes, naphthalene, and/or total lead exceeded the CULs in MW-4, MW-6, MW-7, and MW-8 with the greatest concentrations for each COC observed in MW-8. Wells MW-4 through MW-8 were monitored until reported concentrations were below CULs, with the exception of MW-8. In 2013, TPH-GRO in MW-8 was the only remaining analyte reported above CULs. Monitoring wells MW-4 through MW-8 were destroyed in May 2015.

Concentrations of TPH (GRO, DRO and HRO), BTEX, MTBE and cPAHs in soil were less than cleanup levels in samples collected in 1994, 1996, and 2007. In July 1994, soil samples were collected from 16 soil borings and analyzed for TPH-GRO, TPH-DRO, and TPH-HRO. Petroleum hydrocarbons were not detected above laboratory reporting limits in any of the soil samples (Technico 1994). In September 1994, two soil samples were collected from each of the borings for wells MW-1, MW-2, and MW-3, and analyzed for TPH-GRO, TPH-DRO, and BTEX. The analytical results for the soil samples indicated that concentrations of each were below their respective CULs

(AGRA 1994). In August 1996, one soil sample was collected from each of 12 direct-push soil borings (P-1 through P-12; **Figure 2**) and analyzed for TPH-GRO and BTEX, which were not detected in any of the soil samples (AGRA 1996). In September 2007, two soil samples were collected from each of the borings for wells MW-4 through MW-8 and concentrations of TPH-GRO, TPH-DRO, BTEX, MTBE, volatile organic compounds (VOCs), and cPAHs were below their respective CULs (CRA 2007). No light non-aqueous phase liquid (LNAPL) has been observed at the Site.

In April 2018, Ecology and Chevron U.S.A. Inc. entered into an Agreed Order for the Site. Monitoring wells MW-9, MW-10, and MW-11 were installed in 2018 (**Figure 2**) and samples have been analyzed for TPH-GRO, TPH-DRO, TPH-HRO, BTEX, naphthalene, and/or lead in October and December 2018, September 2019, and quarterly since February 2020 to re-evaluate a path forward for closure. During this time, concentrations of TPH-GRO, TPH-DRO, and/or TPH-HRO have exceeded the CULs in MW-9, MW-10, and MW-11.

Geology at the Site consists of silt and sandy gravels to 20 feet below ground surface (bgs). Lithology observed at monitoring wells MW-9, MW-10, and MW-11 was generally consistent with historical findings; silt was encountered at 5 to 5.5 feet bgs, silt and well graded gravel was encountered at 10 and 15 feet bgs, and poorly and well graded gravel was encountered at 18 to 20 feet bgs. Monitoring wells MW-9, MW-10, and MW-11 are each screened from 8 to 18 feet bgs, and were installed near former wells MW-8, MW-2, and MW-3, respectively. MW-8 was screened from 15 to 25 feet bgs, and MW-2 and MW-3 were each screened from 5 to 15 feet bgs. Depth to groundwater ranged from 13.37 to 13.68 feet below top of casing during the First Quarter 2021 groundwater monitoring event (Arcadis 2021).

The topography at the Site generally slopes to the east and southeast. The Yakima and Columbia Rivers intersect south-southeast of the Site. The general direction of groundwater flow beneath the Site is interpreted to follow the local topography toward the east-southeast.

Additional information about previous Site investigations and site history was provided in the 1Q 2020 Groundwater Monitoring Report (Arcadis 2020).

MNA Assessment

Natural attenuation is the reduction in concentrations of COCs in groundwater over time and distance due to naturally occurring physical, chemical, and biological processes. Natural attenuation processes include both destructive (e.g., biodegradation, abiotic degradation) and non-destructive (e.g., dispersion, dilution, adsorption, volatilization) processes. Destructive processes are generally preferred in support of natural attenuation because they transform potentially harmful COCs into innocuous end products. However, non-destructive processes may also play an important role in decreasing COC concentrations to levels that are acceptable.

The United States Environmental Protection Agency's (USEPA's) tiered lines of evidence approach (USEPA 1999) was applied to evaluate the viability of MNA as a remedy at the Site. The tiers of evidence for this approach include:

1. Historical groundwater data that demonstrate a clear and significant trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring points.
2. Hydrogeologic and geochemical data that can be used to demonstrate indirectly the types of natural attenuation processes active at a site, and the rate at which such processes will reduce contaminant concentrations to required levels.

3. Data from field or microcosm studies that directly demonstrate the occurrence of particular natural attenuation processes at a site and their ability to degrade COCs.

The first tier of evidence is the most critical, as it indicates whether attenuation processes, acting together, result in meaningful reduction of COCs in groundwater under site conditions. This line of evidence is established based on statistical analysis of concentration trends. The second tier of evidence is developed based on assessment of groundwater geochemical conditions to ascertain which attenuation processes the environment is conducive to and whether expected degradation products of specific reactions are observed. Rates at which attenuation processes are expected to reduce contaminant concentrations to required levels are assessed based on statistical trend analysis, as applicable. The third tier of evidence is not required in all cases, particularly when effective natural attenuation is firmly demonstrated based on the first two lines of evidence. If there is evidence that MNA is not proceeding as expected after full implementation of the MNA remedy, then additional data may be collected to fulfill the third line of evidence.

Ecology's *Guidance on Remediation of Petroleum-Contaminated Ground Water by Natural Attenuation* (Ecology 2005) was also used to develop this preliminary MNA evaluation and will guide implementation and assessment. This guidance stipulates evaluation of the following five factors:

1. Demonstration that, prior to relying solely on natural attenuation to achieve cleanup standards, the groundwater plume is stable or shrinking,
2. Demonstration that destructive mechanisms of natural attenuation (i.e., chemical or biological degradation) are occurring and are substantial contributors to contaminant reductions observed at the site,
3. Demonstration that the estimated restoration timeframe by natural attenuation is reasonable,
4. Demonstration that natural attenuation is protective of human health and the environment during the restoration time frame, and
5. Demonstration that source control is achieved to the maximum extent practicable.

This preliminary MNA evaluation is aimed at demonstrating the stability of COCs in groundwater and understanding the contributing attenuation mechanisms at the Site. The concentration trend evaluation in the following section provides a basis for determining if natural attenuation can decrease contaminant concentrations and mass to achieve cleanup standards within a reasonable restoration timeframe. Results from geochemical parameter sampling provide a line of evidence that natural attenuation is supported by destructive biodegradation. Protection of human health and the environment will be addressed with additional groundwater characterization included in an interim action work plan to be submitted under a separate cover. Source control is achieved based on removal of the primary sources (USTs and other service station infrastructure) and absence of any documented secondary source (concentrations of petroleum hydrocarbons in soil less than cleanup levels and absence of LNAPL).

Concentration Trend Evaluation

Petroleum hydrocarbon concentrations over time were initially qualitatively evaluated based on a comparison of results from current monitoring wells with nearby historical monitoring wells (**Table 1**). Although screened intervals between the historical and current monitoring wells do not match completely, there is sufficient overlap to make this qualitative comparison. This evaluation indicates the following:

- At former monitoring well MW-8, concentrations of TPH-GRO, TPH-DRO, ethylbenzene, and/or total xylenes were greater than CULs during one or more events between 2007 and 2013 and showed decreasing concentrations over time. Monitoring well MW-9 was installed near former monitoring well MW-8 and has shown TPH-GRO and TPH-DRO concentrations within but on the low end of the range measured at MW-8. Concentrations of BTEX at MW-9 have remained below CULs.

- At former monitoring well MW-2, concentrations of TPH-GRO and benzene were greater than CULs during multiple events between 1996 and 2004 and showed decreasing concentrations over time. Concentrations of both TPH-GRO and benzene were below CULs during the last two to four sampling events at this well. Monitoring well MW-10 was installed near former monitoring well MW-2. While TPH-GRO concentrations at monitoring well MW-10 have been generally stable but elevated relative to most of the monitoring history at MW-2, benzene has remained non-detect.
- At former monitoring well MW-3, concentrations of TPH-GRO and BTEX were measured during three events between 1996 and 2001 and TPH-GRO, benzene, ethylbenzene, and total xylenes exceeded CULs. Monitoring well MW-11 was installed near former monitoring well MW-3 and shows lower TPH-GRO concentrations and BTEX concentrations less than CULs.

Former monitoring wells also provide a basis for understanding delineation of petroleum hydrocarbon impacts in groundwater at the Site. Specifically, concentrations of each constituent analyzed at former monitoring wells MW-5 and MW-7 were less than CULs while these wells were monitored between 2007 and 2008. These results demonstrated delineation of petroleum hydrocarbons on the northeastern (MW-5) and southeastern (MW-7) property boundary.

To understand the current spatial and temporal distribution of COCs in groundwater at monitoring wells MW-9, MW-10, and MW-11, results from groundwater monitoring activities conducted since October 2018, including five consecutive quarterly sampling events conducted between February 2020 and February 2021, were quantitatively evaluated using statistical trend analysis (**Table 1**). The most recent COC concentrations, from February 2021, are shown on **Figure 3**.

Statistical Trend Analysis Methodology

COC concentrations over time were quantitatively evaluated using the Mann-Kendall statistical trend analysis method (Gilbert 1987). The Mann-Kendall trend test is a non-parametric test that determines trends based on ranked data. The basic Mann-Kendall trend test is performed by listing the concentrations of the constituent of interest in temporal order and computing the differences between a given measurement and earlier measurements (Gilbert 1987; USEPA 2009). The Mann-Kendall test statistic (sum of trend [S]) is the difference between the number of strictly positive differences and the number of strictly negative differences. If S is positive, an increasing trend is indicated; if S is negative, a decreasing trend is indicated; and if S is near zero, concentrations are stable, and no trend is apparent. Trends were accepted as statistically significant for p-values less than or equal to 0.1 (90% confidence level). Trend analyses were conducted for monitoring well and COC combinations that meet the following criteria:

- At least four data points were available for analysis,
- Concentrations were detected during at least 50% of sampling events, and
- Concentrations were greater than the CULs during at least one sampling event.

The coefficient of variation (CV) is a quantitative measure that can be used to evaluate if concentrations are stable in cases where a statistically significant trend is not apparent. CV values near or greater than 1 indicate variability in concentrations through time or suggest an underlying trend that is not statistically significant. Lower CV values indicate that concentrations are stable through time. Where no significant trend was found, the trend determination presented was based on the sign and magnitude of the S-statistic, the CV value, and qualitative assessment of concentrations through time.

Statistical Trend Analysis Results

Mann-Kendall trend test results are presented on **Table 2** and shown on **Figure 3**. Trend charts showing COC concentrations, depth to groundwater, and trend analysis results are included as **Attachment 1**. As shown, variability in COC concentrations may be seasonal and correlated to variability in groundwater elevations in some cases.

Trend analysis results indicate statistically significant decreasing concentrations of TPH-GRO at greater than 90% confidence in MW-11. Also of note is the statistically significant decreasing trend at 89% confidence for concentrations of TPH-GRO in MW-10. The following COC and monitoring well pairs do not show statistically significant trends: TPH-GRO in MW-9 and TPH-DRO in MW-9, MW-10, and MW-11. Concentrations at these wells are somewhat variable, with CV values between 0.43 and 0.68 (**Table 3**, **Attachment 1**).

TPH-GRO and TPH-DRO concentrations in MW-9 show a fluctuating pattern with minimum concentrations measured during the third quarter. Based on available data, the depth to groundwater is also lower during this time of year, suggesting a potential seasonal influence at this monitoring well. TPH-DRO concentrations in MW-10 and MW-11 do not show as clear of a pattern; however, in general lower concentrations and shallower depth to water were also measured during the third quarter.

Trend analysis results indicate statistically significant increasing concentrations of TPH-HRO at 93% confidence in MW-10. TPH-HRO concentrations in MW-10 do not correlate with other COC concentrations or depth to groundwater. In general, in contrast with other COCs, concentrations of TPH-HRO have been greater during the third quarter.

Groundwater Geochemistry Evaluation

Biodegradation of petroleum hydrocarbon constituents can proceed via aerobic or anaerobic microbial processes. Aerobic biodegradation occurs under oxygen-rich conditions, and anaerobic biodegradation occurs under oxygen-poor conditions. For many constituents, aerobic biodegradation occurs more rapidly than anaerobic biodegradation. During biodegradation, bacteria obtain energy for cell production and maintenance by facilitating reduction-oxidation (redox) reactions involving the transfer of electrons from electron donors (e.g., hydrocarbon constituents) to available electron acceptors. Electron acceptors in groundwater systems include oxygen, nitrate, manganese, iron, sulfate, and carbon dioxide. The use of available electron acceptors during biodegradation typically occurs in the following order, from greater energy availability to lesser energy availability: oxygen, nitrate, manganese oxides (manganese [IV] reduction), iron oxides (ferric iron reduction), sulfate, and carbon dioxide (methanogenesis). The relative importance of the various electron acceptors utilized during oxidation can be evaluated by assessing availability and changes in concentrations of these constituents and their reduced counterparts in groundwater. Aerobic degradation and nitrate reduction result in decreased concentrations of dissolved oxygen and nitrate (respectively) in groundwater. Reduction of iron and manganese oxides results in increased concentrations of dissolved iron and manganese in groundwater. Sulfate reduction results in decreased sulfate concentrations in groundwater. Methanogenesis results in increased concentrations of methane in groundwater.

Groundwater geochemical parameters were analyzed quarterly between second quarter 2020 and first quarter 2021 (**Table 3**). Geochemical parameters include field parameters (pH, dissolved oxygen, oxidation-reduction potential (ORP), conductivity, turbidity, and ferrous iron) and laboratory analytical parameters (nitrate, total and dissolved manganese, total and dissolved iron, sulfate, and methane). The limited amount of geochemical data indicates mixed and variable redox conditions, tending towards moderately to strongly reducing. A variety of electron acceptors are available that may contribute to petroleum hydrocarbon degradation. Generally, concentrations of dissolved oxygen are low (<1 mg/L), ORP is negative, nitrate is present at low to moderate concentrations, iron and manganese in groundwater are in the dissolved form, sulfate concentrations decreased over time, and concentrations of methane are variable. Although clear seasonality cannot be discerned from one year of monitoring, the apparent variability in the concentrations of electron acceptors provides evidence of conditions that are conducive to petroleum hydrocarbon degradation. Variability in dissolved oxygen, ORP, and nitrate suggests higher-energy electron acceptors are periodically refreshed. Decreasing sulfate concentrations over time at each well suggest that petroleum hydrocarbon biodegradation may be paired with sulfate reduction on an ongoing basis. The presence of methane at concentrations up to 3,200 µg/L at MW-9 in February 2021 provides evidence of anaerobic biodegradation of organic constituents.

Conclusions and Path Forward

This preliminary assessment of the available data indicates MNA may be a viable remedy at the Site. Based on historical removal of the primary sources (USTs and other service station infrastructure) and absence of any documented significant secondary source (concentrations of petroleum hydrocarbons in soil less than cleanup levels and absence of LNAPL), source control is achieved. In the absence of any additional remedial actions conducted at the Site, multiple lines of evidence indicate that natural attenuation has the ability to decrease contaminant concentrations and mass. These lines of evidence include:

- Qualitative observations of decreased petroleum hydrocarbon concentrations over the long term (based on comparison of concentrations at former monitoring wells and current monitoring wells installed nearby),
- BTEX concentrations remaining below CULs at current monitoring wells,
- Decreasing TPH-GRO concentrations at two of the three current monitoring wells, and
- Geochemical conditions that are conducive to multiple biodegradation pathways.

Based on available groundwater data for monitoring wells MW-9, MW-10, and MW-11 collected from October 2018 through February 2021 concentrations of TPH-GRO are decreasing in the north-northwest portion of the Site. Concentrations of TPH-GRO in MW-10 and MW-11 show statistically significant decreasing trends at 89% and 96% confidence, respectively. TPH-HRO at MW-10 was the only COC for which a statistically significant increasing trend was observed. Each of the other monitoring well and COC pairs evaluated did not show trends that are statistically significant at 90% confidence or greater.

There is some evidence for seasonal variability in TPH-GRO, TPH-DRO, and TPH-HRO concentrations, although the pattern for TPH-HRO appears to be the opposite of TPH-GRO and TPH-DRO. As a result of this seasonal variability, additional monitoring will be required to further demonstrate stable to decreasing concentrations over time. If seasonal variability persists, a trend analysis that incorporates this variability may be required (e.g., a seasonal Mann-Kendall analysis) to estimate the restoration timeframe.

Geochemical parameter results provide an indirect line of evidence that biodegradation of petroleum hydrocarbons in Site groundwater contributes to natural attenuation. Geochemical data collected quarterly between 2020 and 2021 indicates variable and mixed (tending toward moderately to strongly reducing) redox conditions. Evidence of an intermittent influx of oxygen and nitrate along with decreasing sulfate concentrations and variable methane concentrations indicate that biodegradation of petroleum hydrocarbons is supported by multiple pathways.

Additional data is required to fully to meet the requirements in Ecology's guidance (Ecology 2005). Specifically, as mentioned above, additional data are needed to demonstrate stable to decreasing concentrations over time and to estimate the restoration timeframe. Furthermore, the Site's monitoring well network currently does not meet Ecology's *Guidance on Remediation of Petroleum-Contaminated Ground Water by Natural Attenuation* (Ecology 2005), which states that a monitoring well network should include "at least: one monitoring well up-gradient of the plume outside the plume boundary to detect changes in background water quality; one or more monitoring wells within the source… or most impacted areas to determine changes in the source strength; two or more monitoring wells, depending on plume length, near the contaminated plume centerline to assess the ability of natural attenuation processes; and one sentinel well beyond the leading edge of the plume and within a one-to-two year ground water flow distance." Performance monitoring must adequately demonstrate that natural attenuation is both effective in reducing contaminant concentrations and protective of receptors (Ecology 2005).

Based on this evaluation, installation of additional groundwater monitoring wells upgradient and downgradient of the Site will be proposed in a work plan to be submitted to Ecology for review and approval. Once installed, the new groundwater wells will be included in the routine monitoring program for the Site and the final MNA evaluation can be completed and recommended as part of the remedial investigation (RI) and feasibility study (FS) process. In addition, a receptor evaluation to demonstrate that natural attenuation is protective of human health and the environment will be addressed following the additional groundwater characterization.

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Enclosures:

Tables

1 Groundwater Monitoring Data and Analytical Results
2 Trend Analysis Summary
3 Geochemical Parameters

Figures

1 Site Location Map
2 Site Plan
3 Groundwater Concentrations February 2021 and Trend Analysis Results

Attachment

1 Mann-Kendall Trend Test Results

TABLES

Table 1
Groundwater Monitoring Data and Analytical Results
Chevron Site No. 9-8944
Richland, Washington

Well ID	Date	TOC	DTW	GWE	TPH-GRO	TPH-DRO	TPH-HRO	B	T	E	X	Dissolved Lead	Total Lead	MTBE by SW8020	MTBE by SW8260B	Naphthalene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenz(a,h)anthracene
MTCA Method A Cleanup Levels					800/1000	500	500	5	1,000	700	1,000	NA	15	NA	20	160	NA	NA	NA	NA	NA	NA	NA
	Units	ft	ft	ft-elev.	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-1	8/11/1994	93.98	7.03	86.95	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-1	8/25/1994	93.98	7.00	86.98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-1	9/23/1994	93.98	7.00	86.98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-1	8/12/1996	93.98	7.29	86.69	**14,400**	--	--	**94.4**	15.5	325	978	--	--	--	--	--	--	--	--	--	--	--	--
MW-1	2/27/2000	93.98	8.58	85.40	**16,200**	--	--	**11.7**	<8.00	439	504	--	--	<25.0	--	--	--	--	--	--	--	--	--
MW-1	2/21/2001	93.98	8.66	85.32	**6,320**	--	--	**38.3**	9.30	194	64.1	--	--	15.4	<4.00	--	--	--	--	--	--	--	--
MW-1	05/22/2001[1]	93.98	9.95	84.03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-1	8/11/2001	93.98	9.14	84.84	**8,450**	--	--	**48.4**	11.8	410	356	--	--	<50.0	<50.0	--	--	--	--	--	--	--	--
MW-1	11/10/2001	93.98	9.85	84.13	**6,650**	--	--	**49.2**	11.0	340	97.9	--	--	16.8	<5.00	--	--	--	--	--	--	--	--
MW-1	2/4/2002	93.98	10.71	83.27	**1,480**	--	--	1.81	<1.00	71.6	3.81	--	--	--	<5.00	--	--	--	--	--	--	--	--
MW-1	08/24/2002[2]	93.98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-1	2/20/2003	93.98	10.55	83.43	91	--	--	<0.50	<0.50	<1.0	<3.0	--	--	<2.5	--	--	--	--	--	--	--	--	--
MW-1	8/21/2003	93.98	11.26	82.72	78	--	--	<0.5	<0.5	<0.5	<1.5	--	--	<2.5	--	--	--	--	--	--	--	--	--
MW-1	02/19/2004[1]	93.98	11.79	82.19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-1	08/10/2004[1]	93.98	10.97	83.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-1	12/03/2004[1]	93.98	11.39	82.59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-1	02/21/2006[3]	93.98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-1	10/23/2007[4]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-2	8/11/1994	93.21	6.10	87.11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-2	8/25/1994	93.21	6.11	87.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-2	9/23/1994	93.21	6.11	87.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-2	8/12/1996	93.21	6.40	86.81	**17,400**	--	--	**152**	39.2	306	**1,120**	--	--	--	--	--	--	--	--	--	--	--	--
MW-2	2/27/2000	93.21	7.77	85.44	**7,500**	--	--	**99.8**	13.0	175	453	--	--	<10.0	--	--	--	--	--	--	--	--	--
MW-2	2/21/2001	93.21	7.84	85.37	**1,510**	--	--	**20.1**	5.43	31.9	67.2	--	--	<5.00	<2.00	--	--	--	--	--	--	--	--
MW-2	5/22/2001	93.21	8.14	85.07	**4,310**	--	--	**34.9**	7.91	109	211	--	--	11.6	<5.00	--	--	--	--	--	--	--	--
MW-2	8/11/2001	93.21	8.35	84.86	**1,870**	--	--	**14.6**	2.90	16.6	20.5	--	--	<25.0	<5.00	--	--	--	--	--	--	--	--
MW-2	11/10/2001	93.21	9.10	84.11	**4,320**	--	--	**51.0**	6.44	53.0	91.5	--	--	25.1	<5.00	--	--	--	--	--	--	--	--
MW-2	2/4/2002	93.21	9.96	83.25	**4,500**	--	--	**33.3**	2.80	74.5	97.6	--	--	--	<5.00	--	--	--	--	--	--	--	--
MW-2	8/24/2002	93.21	9.18	84.03	**3,400**	--	--	**17**	2.10	25	56	--	--	<2.5	--	--	--	--	--	--	--	--	--
MW-2	2/20/2003	93.21	9.78	83.43	**2,600**	--	--	**7.3**	1.80	47	32	--	--	<2.5	--	--	--	--	--	--	--	--	--
MW-2	8/21/2003	93.21	10.52	82.69	**840**	--	--	2.1	<2.0	2.9	<3.0	--	--	<2.5	--	--	--	--	--	--	--	--	--
MW-2	2/19/2004	93.21	11.06	82.15	**950**	--	--	<5.0	<0.5	3.0	<5.0	--	--	<2.5	--	--	--	--	--	--	--	--	--
MW-2	8/10/2004	93.21	10.16	83.05	<50	--	--	<0.5	<0.5	<0.5	<1.5	--	--	<2.5	--	--	--	--	--	--	--	--	--
MW-2	12/3/2004	93.21	10.68	82.53	<48	--	--	<0.5	<0.5	<0.5	<1.5	--	--	<2.5	--	--	--	--	--	--	--	--	--
MW-2	02/21/2006[1]	93.21	11.52	81.69	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-2	10/23/2007[4]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	8/11/1994	94.57	7.63	86.94	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	8/25/1994	94.57	7.59	86.98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	9/23/1994	94.57	7.59	86.98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	8/12/1996	94.57	7.89	86.68	**37,700**	--	--	**84.6**	77.1	**1,190**	**3,800**	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	2/27/2000	94.57	9.18	85.39	**30,700**	--	--	**42.4**	60.1	**1,160**	**3,250**	--	--	<25.0	--	--	--	--	--	--	--	--	--
MW-3	2/21/2001	94.57	9.23	85.34	**6,090**	--	--	**29.9**	6.07	182	293	--	--	8.75	<4.00	--	--	--	--	--	--	--	--
MW-3	05/22/2001[1]	94.57	9.52	85.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	08/11/2001[5]	94.57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Well ID	Date	TOC	DTW	GWE	TPH-GRO	TPH-DRO	TPH-HRO	B	T	E	X	Dissolved Lead	Total Lead	MTBE by SW8020	MTBE by SW8260B	Naphthalene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenz(a,h)anthracene
MTCA Method A Cleanup Levels					800/1000	500	500	5	1,000	700	1,000	NA	15	NA	20	160	NA	NA	NA	NA	NA	NA	NA
	Units	ft	ft	ft-elev.	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-3	11/10/2001[2]	94.57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	02/04/2002[2]	94.57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	08/24/2002[3]	94.57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	02/20/2003[2]	94.57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	08/21/2003[3]	94.57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	02/19/2004[3]	94.57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	08/10/2004[3]	94.57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	12/03/2004[4]	94.57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	02/21/2006[3]	94.57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	10/23/2007[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-4	10/23/2007	359.19	12.69	346.50	**2,800**	**610**	<250	0.17	0.48	78	17.1	<2.0	**20**	--	<0.14	2.3	<0.010	<0.010	<0.010	<0.010	<0.021	<0.010	<0.010
MW-4	3/24/2008	359.19	14.00	345.19	**1,700**	**560**	<240	<1.0	<1.0	89	28.9	<2.0	**24**	--	<1.0	--	--	--	--	--	--	--	--
MW-4	5/12/2008	359.19	14.21	344.98	570	110	<95	<0.5	<0.5	46	<0.5	--	0.21	--	<0.5	--	--	--	--	--	--	--	--
MW-4	7/28/2008	359.19	13.02	346.17	460	**570**	<96	<0.5	<0.5	5	<0.5	--	0.16	--	<0.5	--	--	--	--	--	--	--	--
MW-4	11/3/2008	359.19	13.54	345.65	63	48	<74	<0.5	<0.5	<0.5	<0.5	--	0.18 J	--	<0.5	--	--	--	--	--	--	--	--
MW-4	2/11/2009	359.19	13.91	345.28	**2,600 J**	**2,600**	<150	--	--	--	--	--	0.18	--	--	--	--	--	--	--	--	--	--
MW-4	8/11/2010	359.19	13.67	345.52	200	<130	<250	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-4	9/9/2011	359.19	13.78	345.41	180	<29	<67	--	--	--	--	--	0.15	--	--	--	--	--	--	--	--	--	--
MW-4	8/27/2012	359.19	13.72	345.47	<50	<30	<70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-4	9/23/2013	359.19	13.69	345.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-5	10/23/2007	359.07	12.42	346.65	51	<120	<250	<0.10	<0.066	0.49	0.799	<2.0	6.9	--	<0.14	0.020	<0.010	<0.010	<0.010	<0.010	<0.020	<0.010	<0.010
MW-5	3/24/2008	359.07	13.73	345.34	<50	<120	<240	<1.0	<1.0	<1.0	<2.0	<2.0	27	--	<1.0	--	--	--	--	--	--	--	--
MW-5	5/12/2008	359.07	13.93	345.14	110	<77	<96	<0.5	<0.5	<0.5	<0.5	--	0.11	--	<0.5	--	--	--	--	--	--	--	--
MW-5	7/28/2008	359.07	12.78	333.51	<50	<76	<95	<0.5	<0.5	<0.5	<0.5	--	0.34	--	<0.5	--	--	--	--	--	--	--	--
MW-5	11/3/2008	359.07	13.30	345.77	<50	<29	<67	<0.5	<0.5	<0.5	<0.5	--	0.18 J	--	<0.5	--	--	--	--	--	--	--	--
MW-5	2/10/2009	359.07	13.61	345.46	--	--	--	--	--	--	--	--	0.44	--	--	--	--	--	--	--	--	--	--
MW-5	8/11/2010	359.07	13.35	345.72	--	--	--	--	--	--	--	--	-	--	--	--	--	--	--	--	--	--	--
MW-5	9/9/2011	359.07	13.35	345.72	--	--	--	--	--	--	--	--	0.16	--	--	--	--	--	--	--	--	--	--
MW-5	9/23/2013	359.07	13.31	345.76	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-6	10/23/2007	358.85	12.14	346.71	**3,400**	**670**	<260	<0.10	<0.066	0.41	0.57	3.0	**27**	--	<0.14	2.8	<0.010	<0.010	<0.010	<0.010	<0.020	<0.010	<0.010
MW-6	3/24/2008	358.85	13.42	345.43	**1,100**	**830**	<240	<1.0	<1.0	<1.0	<2.0	<2.0	**67**	--	<1.0	--	--	--	--	--	--	--	--
MW-6	5/12/2008	358.85	13.69	345.16	500	330	<96	<0.5	<0.5	<0.5	<0.5	--	2.0	--	<0.5	--	--	--	--	--	--	--	--
MW-6	7/28/2008	358.85	12.53	333.79	700	170	<96	<0.5	<0.5	<0.5	<0.5	--	1.5	--	<0.5	--	--	--	--	--	--	--	--
MW-6	11/3/2008	358.85	13.03	345.82	790	150	<67	<0.5	<0.5	<0.5	<0.5	--	0.92	--	<0.5	--	--	--	--	--	--	--	--
MW-6	2/11/2009	358.85	13.34	345.51	470	100	<65	--	--	--	--	--	0.76	--	--	--	--	--	--	--	--	--	--
MW-6	8/11/2010	358.85	13.20	345.65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-6	9/9/2011	358.85	13.18	345.67	610	44	<68	--	--	--	--	--	0.77	--	--	--	--	--	--	--	--	--	--
MW-6	9/23/2013	358.85	13.06	345.79	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-7	10/23/2007	359.01	12.63	346.38	73	<130	<260	<0.10	<0.066	0.14	.26	<2.0	13	--	<0.14	0.031	<0.010	<0.010	<0.010	<0.010	<0.021	<0.010	<0.010
MW-7	3/24/2008	359.01	14.00	345.01	<50	<120	<240	<1.0	<1.0	<1.0	<2.0	<2.0	**33**	--	<1.0	--	--	--	--	--	--	--	--
MW-7	5/12/2008	359.01	14.19	344.82	<50	<76	<95	<0.5	<0.5	<0.5	<0.5	--	0.070	--	<0.5	--	--	--	--	--	--	--	--
MW-7	7/28/2008	359.01		333.15	<50	<78	<97	<0.5	<0.5	<0.5	<0.5	--	11.2	--	<0.5	--	--	--	--	--	--	--	--

Table 1
Groundwater Monitoring Data and Analytical Results
Chevron Site No. 9-8944
Richland, Washington

Well ID	Date	TOC	DTW	GWE	TPH-GRO	TPH-DRO	TPH-HRO	B	T	E	X	Dissolved Lead	Total Lead	MTBE by SW8020	MTBE by SW8260B	Naphthalene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenz(a,h)anthracene
MTCA Method A Cleanup Levels					800/1000	500	500	5	1,000	700	1,000	NA	15	NA	20	160	NA	NA	NA	NA	NA	NA	NA
	Units	ft	ft	ft-elev.	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-7	11/3/2008	359.01	13.54	345.47	<50	<29	<67	<0.5	<0.5	<0.5	<0.5	--	1.3	--	<0.5	--	--	--	--	--	--	--	--
MW-7	2/10/2009	359.01	13.89	345.12	--	--	--	--	--	--	--	--	0.49	--	--	--	--	--	--	--	--	--	--
MW-7	8/11/2010	359.01	13.61	345.40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-7	9/9/2011	359.01	13.71	345.30	--	--	--	--	--	--	--	--	0.60	--	--	--	--	--	--	--	--	--	--
MW-7	9/23/2013	359.01	13.70	345.31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-8	10/23/2007	359.29	12.79	346.50	**33,000**	**4,000**	270	0.12	16	**1,300**	**2,280**	<2.0	**22**	--	<0.14	**190**	<0.010	<0.010	<0.010	<0.010	<0.021	<0.010	<0.010
MW-8	3/24/2008	359.29	14.01	345.28	**13,000**	**3,000**	<240	<1.0	15	610	821	<2.0	**54**	--	<1.0	**320**	--	--	--	--	--	--	--
MW-8	5/12/2008	359.29	14.31	344.98	**18,000 J**	**4,600**	<970	<1	17	640	**1,100**	--	0.44	--	<1	**410**	--	--	--	--	--	--	--
MW-8	7/28/2008	359.29	13.13	346.16	**16,000**	**8,000**	<490	<0.5	9	**800**	**1,300**	--	1.2	--	<0.5	**500**	--	--	--	--	--	--	--
MW-8	11/3/2008	359.29	13.65	345.64	**15,000**	**6,900**	<670	<0.5	10	**760**	520	--	1.6	--	<0.5	**410**	--	--	--	--	--	--	--
MW-8	2/11/2009	359.29	13.92	345.37	**4,800**	**550**	<66	<0.5	0.8	200	70	--	0.24	--	--	110	--	--	--	--	--	--	--
MW-8	8/11/2010	359.29	13.74	345.55	**9,900**	**1,000**	<250	<2.0	2.9	620	973	--	--	--	--	**300**	--	--	--	--	--	--	--
MW-8	9/9/2011	359.29	13.85	345.44	**2,100 [2,200]**	130 [120]	<67 [<67]	<0.5 [<0.5]	0.5 [0.6]	45 [46]	4 [4]	--	0.29 [0.31]	--	--	24 [24]	--	--	--	--	--	--	--
MW-8	8/27/2012	359.29	13.83	345.46	**3,000 [2,900]**	200 [360]	<67 [<69]	<0.5 [<0.5]	<0.5 [0.5]	39 [34]	24 [23]	--	--	--	--	31 [29]	--	--	--	--	--	--	--
MW-8	9/23/2013	359.29	13.60	345.69	**4,000**	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-9	10/9/2018	--	13.73	--	**7,800**	**960**	<100	<1.0	2.0	240	19	<1.1	<1.1	--	--	--	--	--	--	--	--	--	--
MW-9	12/12/2018	--	14.07	--	**7,600**	**760**	<100	<0.20	3.0	59	21	<1.1	<1.1	--	--	--	--	--	--	--	--	--	--
MW-9	9/19/2019	--	13.28	--	620	370	<350	--	--	--	--	--	<4.0	--	--	--	--	--	--	--	--	--	--
MW-9	2/19/2020	--	14.33	--	**4,400**	**1,400**	160 J	<0.53	1.2J	28	11	--	<1.0	--	--	--	--	--	--	--	--	--	--
MW-9	5/20/2020	--	14.64	--	**2,600**	**1,300**	160 J *	<0.24	<0.39	1.5 J	<0.39	--	<1.0	--	--	--	--	--	--	--	--	--	--
MW-9	8/27/2020	--	13.78	--	770	450	280 J B	<0.24	<0.39	<0.50	<0.39	--	<1.0	--	--	<0.93	--	--	--	--	--	--	--
MW-9	11/5/2020	--	13.75	--	**3,700**	**1,400**	170 J	<0.24	0.69 J	1. 6 J	1.9 J	--	<1.0	--	--	4.1 *	--	--	--	--	--	--	--
MW-9	2/24/2021	--	13.68	--	**4,200**	**1,400**	150 J	<0.24	1.1 J	59	11	--	--	--	--	150 *+	--	--	--	--	--	--	--
MW-10	10/9/2018	--	13.47	--	**9,500 [9,400]**	**740 [680]**	<110 [<100]	<1.0 [<1.0]	<1.0 [<1.0]	91 [86]	<5.0 [<5.0]	8.3 [8.6]	7.6 [8.2]	--	--	--	--	--	--	--	--	--	--
MW-10	12/12/2018	--	13.72	--	**8,000 [7,900]**	**540 [540]**	<100 [<100]	<0.20 [<0.20]	0.40 [0.50]	81 [85]	4.0 [4.0]	2.0 [1.8]	2.2 [2.1]	--	--	--	--	--	--	--	--	--	--
MW-10	9/19/2019	--	12.88	--	190 J [250]	290 J [290 J]	290 J [320 J]	--	--	--	--	--	<1.4 J [1.3 J]	--	--	--	--	--	--	--	--	--	--
MW-10	2/19/2020	--	13.98	--	**4,600 [4,500]**	**1,300 [1,200]**	150 J [150 J]	<0.53 [<0.53]	<0.39 [<0.39]	31 [33]	1.8J [2.0 J]	--	1.1 J	--	--	--	--	--	--	--	--	--	--
MW-10	5/20/2020	--	14.31	--	**4,900 [4,700]**	**2,100 [2,400]**	270 J * [280 J *]	<0.24 [<0.24]	0.45 J [0.46 J]	47 [49]	2.5 J [2.4 J]	--	2.0 J [1.9 J]	--	--	--	--	--	--	--	--	--	--
MW-10	8/27/2020	--	13.32	--	**1,100 [1,000]**	**810 [1000]**	**670 B [910 B]**	<0.24 [<0.24]	<0.39 [0.42 J]	5.4[6.0]	<0.39[<0.39]	--	2.0 J [1.7 J]	--	--	12 [13]	--	--	--	--	--	--	--
MW-10	11/5/2020	--	13.46	--	**3,300[2,900]**	**1,100[1,200]**	500[**540**]	<0.24 [<0.24]	0.88 J[0.88 J]	21[21]	1.2 J[1.2 J]	--	<1.0[<1.0]	--	--	27 *[28 *]	--	--	--	--	--	--	--
MW-10	02/24/2021	--	13.37	--	**3,300[3,400]**	**1,000[1,200]**	220 J[240 J]	<0.24 [<0.24]	0.65 J[0.63 J]	27[28]	1.7 J[1.6 J]	--	--	--	--	62 *+[46 *+]							
MW-11	10/9/2018	--	13.63	--	**7,800**	**740**	200	<0.20	<0.20	2.0	<1.0	3.2	3.4	--	--	--	--	--	--	--	--	--	--
MW-11	12/12/2018	--	13.81	--	**4,100**	270	<100	<0.20	<0.20	0.70	<1.0	<1.1	<1.1	--	--	--	--	--	--	--	--	--	--
MW-11	9/19/2019	--	12.95	--	470	310	120 J	--	--	--	--	--	<4.0	--	--	--	--	--	--	--	--	--	--
MW-11	2/19/2020	--	14.09	--	**2,100**	460	<110	<0.53	<0.39	<0.50	<0.39	--	1.4 J	--	--	--	--	--	--	--	--	--	--
MW-11	5/20/2020	--	14.33	--	**2,100**	**1,600**	130 J *	<0.24	0.77 J	<0.50	<0.39	--	<1.0	--	--	--	--	--	--	--	--	--	--
MW-11	8/27/2020	--	13.59	--	**1,600**	**1,100**	400 B	<0.24	0.88 J	<0.50	<0.39	--	<1.0	--	--	1.9 J	--	--	--	--	--	--	--
MW-11	11/5/2020	--	13.34	--	**1,800**	**920**	370	<0.24	0.71 J	<0.50	<0.39	--	<1.0	--	--	<0.93 *	--	--	--	--	--	--	--
MW-11	02/24/2021	--	13.45	--	**1,000**	430	120 J	<0.24	<0.39	<0.50	<0.39	--	--	--	--	6.9 *+	--	--	--	--	--	--	--

Table 1
Groundwater Monitoring Data and Analytical Results
Chevron Site No. 9-8944
Richland, Washington

Well ID	Date	TOC	DTW	GWE	TPH-GRO	TPH-DRO	TPH-HRO	B	T	E	X	Dissolved Lead	Total Lead	MTBE by SW8020	MTBE by SW8260B	Naphthalene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenz(a,h)anthracene
MTCA Method A Cleanup Levels					800/1000	500	500	5	1,000	700	1,000	NA	15	NA	20	160	NA	NA	NA	NA	NA	NA	NA
	Units	ft	ft	ft-elev.	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L

LEGEND:
MTCA = Model Toxics Control Act Cleanup Regulations [WAC 173-340-720(2)(a)(1), as amended February 2001]
NA = No applicable MTCA Method A cleanup level
TOC = Top of Casing
DTW = Depth to Water
GWE = Groundwater elevation
(ft-elev) = Feet Above Elevation
ft = Feet
µg/L = Micrograms per Liter
TPH-DRO = Total Petroleum Hydrocarbons - Diesel Range Organics
TPH-GRO = Total Petroleum Hydrocarbons - Gasoline Range Organics
TPH-HRO = Total Petroleum Hydrocarbons - Oil Range Organics
BTEX = Benzene, toluene, ethylbenzene, xylenes
VOCs = Volatile organic compounds
MTBE = Methyl tertiary butyl ether
-- = Not available / not applicable
< = Not detected above laboratory method detection limit
J = Result is < RL but ≥ to the MDL and the concentration is an approximate value
B = Compound was found in the blank and sample
H = Sample was prepped or analyzed beyond the specified holding time
[1] = Not sampled due to insufficient water
[2] = Inaccessible
[3] = Dry
[4] = Destroyed
[5] = Inaccessible - Paved over
+ = LCS and/or LCSD is outside acceptance limits, high biased.

NOTES:
Monitoring wells MW-9, MW-10 and MW-11 have not been surveyed.
Concentrations in bold exceed MTCA Method A Cleanup Levels

Table 2
Trend Analysis Summary
Chevron Site No. 9-8944
Richland, Washington

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Monitoring Well ID	Analyte	MTCA Method A Cleanup Level (µg/L)	Start Date	End Date	Summary Statistics							Mann-Kendall Results			
					n	% Detections	Minimum	Maximum	Most Recent	Average	CV	S-Statistic	p-value[1]	Trend Determination	Trend Significance
MW-9	TPH-GRO	800/1000 [2]	10/9/2018	2/24/2021	8	100	620	7,800	4,200	3,961	0.68	-8	0.20	No significant trend	NS
MW-9	TPH-DRO	500	10/9/2018	2/24/2021	8	100	370	1,400	1,400	1,005	0.43	9	0.17	No significant trend	NS
MW-10	TPH-GRO	800/1000 [2]	10/9/2018	2/24/2021	8	100	190	9,500	3,300	4,361	0.73	-11	0.11	No significant trend	NS
MW-10	TPH-DRO	500	10/9/2018	2/24/2021	8	100	290	2,100	1,000	985	0.56	8	0.20	No significant trend	NS
MW-10	TPH-HRO	500	10/9/2018	2/24/2021	8	75	100	670	220 J	289	0.69	13	0.07	Increasing	Significant (93%)
MW-11	TPH-GRO	800/1000 [2]	10/9/2018	2/24/2021	8	100	470	7,800	1,000	2,621	0.89	-15	0.04	Decreasing	Significant (96%)
MW-11	TPH-DRO	500	10/9/2018	2/24/2021	8	100	270	1,600	430	729	0.63	6	0.27	No significant trend	NS

LEGEND:

[1] Statistically significant trend defined as having p-value ≤ 0.1 (90 percent confidence).

[2] The MTCA Method A Cleanup Level for TPH-GRO is 800 µg/L if benzene is present and 1000 µg/L if benzene is not present. For all three monitoring wells, benzene was not detected above the reporting limit during the monitoring period (October 2018 through February 2021).

CV = coefficient of variation

MTCA = Model Toxics Control Act Cleanup Regulations [WAC 173-340-720(2)(a)(1), as amended February 2001]

NS = not significant

TPH-DRO = Total Petroleum Hydrocarbons - Diesel Range Organics

TPH-GRO = Total Petroleum Hydrocarbons - Gasoline Range Organics

TPH-HRO = Total Petroleum Hydrocarbons - Oil Range Organics

Table 3
Geochemical Parameters
Chevron Site No. 9-8944
Richland, Washington

Well ID	Date	pH[1]	Dissolved Oxygen[1]	ORP[1]	Conductivity[1]	Turbidity[1]	Ferrous Iron[1]	Methane	Nitrate	Sulfate	Total Manganese	Dissolved Manganese	Total Iron	Dissolved Iron
	Units	s.u.	mg/L	mV	mS/cm	NTU	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-9	2/19/2020	6.76	3.16	83.9	0.665	9	--	--	--	--	--	--	--	--
MW-9	5/20/2020	7.04	0.58	-74.9	0.939	7	0.0	51	570	79,000	1,600	--	--	--
MW-9	8/27/2020	7.17	1.02	7.5	0.579	16	0.0	--	<20	19,000 F1	560	580	1,300	1000
MW-9	11/5/2020	7.23	0.51	-80.9	0.929	16	--	1,200	<20	1,000 J	1,600	1,700	2,200	2,000
MW-9	2/24/2021	7.30	0.63	-105.7	0.56	14	0.8	3,200	560	830 J	1,200	1,300	1,400 J	1,600 J
MW-10	2/19/2020	4.30	2.56	158.3	0.824	11	--	--	--	--	--	--	--	--
MW-10	5/20/2020	6.85	0.3	-90.1	1.925	17	0.0	980 [1,200]	600 [640 H]	410,000 [380,000]	3,500 [3,400]	--	--	--
MW-10	8/27/2020	7.16	0.27	12.5	1.62	8	0.0	--	4,800 [4,600]	170,000 [160,000]	520 [780]	950 [890]	560 J [810 J]	760 J [670 J]
MW-10	11/5/2020	7.11	0.44	-103.4	1.91	10	--	280[280]	2,100[2,200]	79,000[80,000]	760[740]	790[760]	1,200[1,200]	1,300[1,200]
MW-10	02/24/2021	7.05	0.9	-67.6	0.814	48	2.4	520[470]	1,100[1,100]	56,000[56,000]	920[970]	1,000[1,100]	2,500[2,600]	2,800[2,700]
MW-11	2/19/2020	4.60	2.63	168.1	0.946	31	--	--	--	--	--	--	--	--
MW-11	5/20/2020	6.94	0.31	-90.9	1.48	61	0.0	1400	740	97,000	2,900	--	--	--
MW-11	8/27/2020	7.09	0.22	-83.2	1.45	10	0.0	--	1,100	52,000	1,900	2,000	4,500	3,900
MW-11	11/5/2020	7.19	0.49	-56.7	1.40	11	--	460	<20	23,000	2,000	1,900	3,200	2,900
MW-11	2/24/2021	7.07	0.69	-90	0.743	14	0.6	390	790	18,000	1,500	1,500	2,200 J	2,000 J

LEGEND:

[1] Field parameters include pH, dissolved oxygen, ORP, conductivity, turbidity, and ferrous iron.

-- = Not available / not applicable

(ft-elev) = Feet Above Elevation

< = Not detected above laboratory method detection limit

µg/L = Micrograms per Liter

DTW = Depth to Water

ft = Feet

GWE = Groundwater elevation

J = Result is < RL but $\geq$ to the MDL and the concentration is an approximate value

mg/L = Milligrams per liter

mS/cm = milliSiemens per centimeter

mV = millivolts

NTU = Nephelometric Turbidity Unit

ORP = Oxidation-Reduction Potential

s.u. = standard units

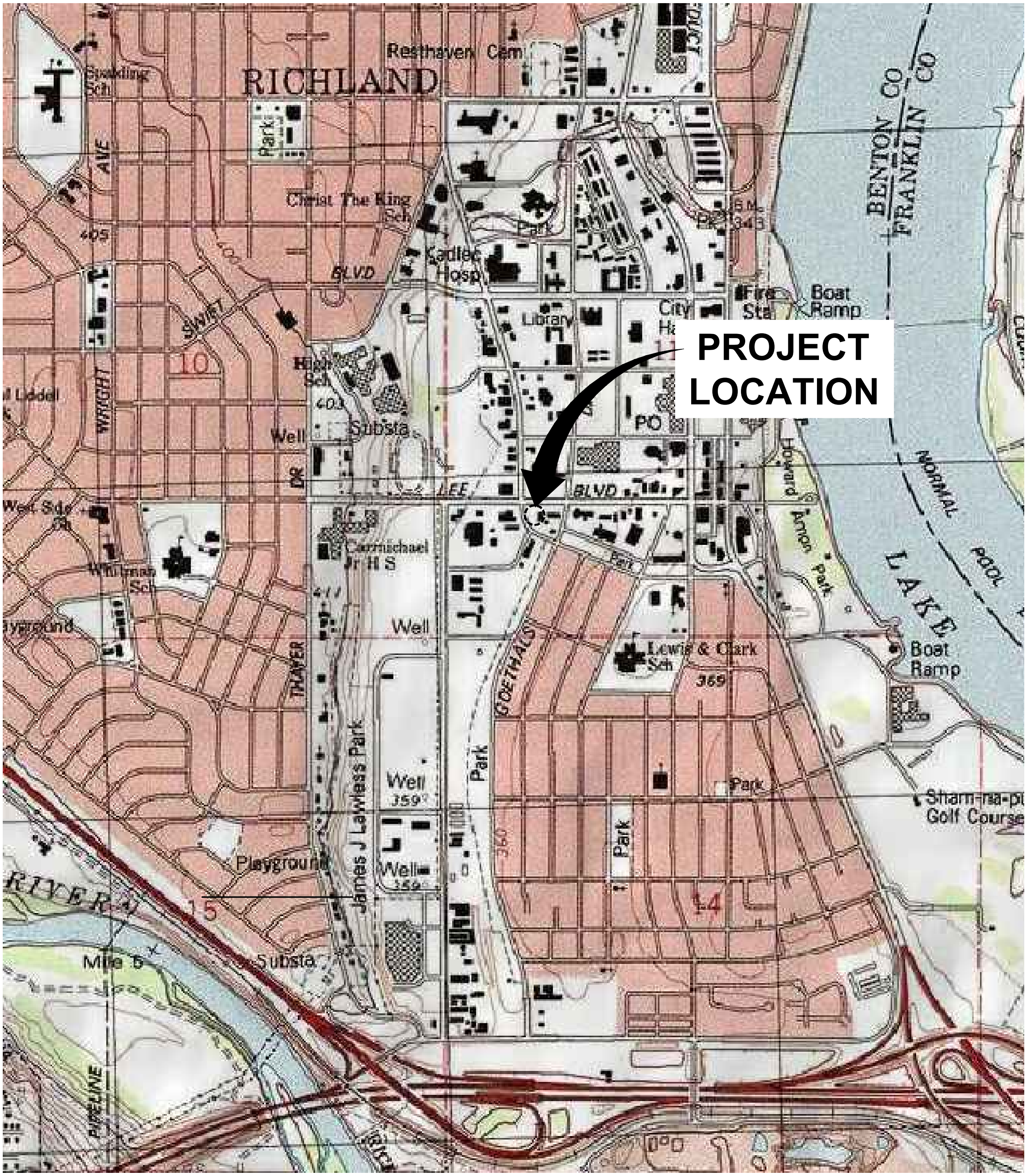
TOC = Top of Casing

NOTES:

Monitoring wells MW-9, MW-10 and MW-11 have not been surveyed.

FIGURES

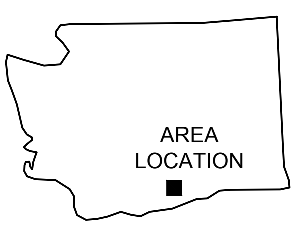
CITY:IRVINE DIV/GROUP:ENV LD:ENVCAD PIC: PM JANET NEWMAN TM: LYR:(Opt)ON=*;OFF=*REF* LAYOUT: 1 SAVED: 11/2/2011 11:33 AM ACADVER: 18.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 11/2/2011 11:34 AM BY: MURESAN, ELENA
G:\ENVCAD\CostaMesa\ACT\B0040000\B0047580\0000\LTM Site 9-8944 Kennewick, WA\B0047580.0000 Site 9-8944 Kennewick-WA.dwg



REFERENCE: BASE MAP CREATED WITH TOPO! - RICHLAND, US TOPO.

0 1500' 3000'

Approximate Scale: 1 in. = 1,500 ft.



CHEVRON SITE NO. 9-8944
RICHLAND, WASHINGTON

SITE LOCATION MAP

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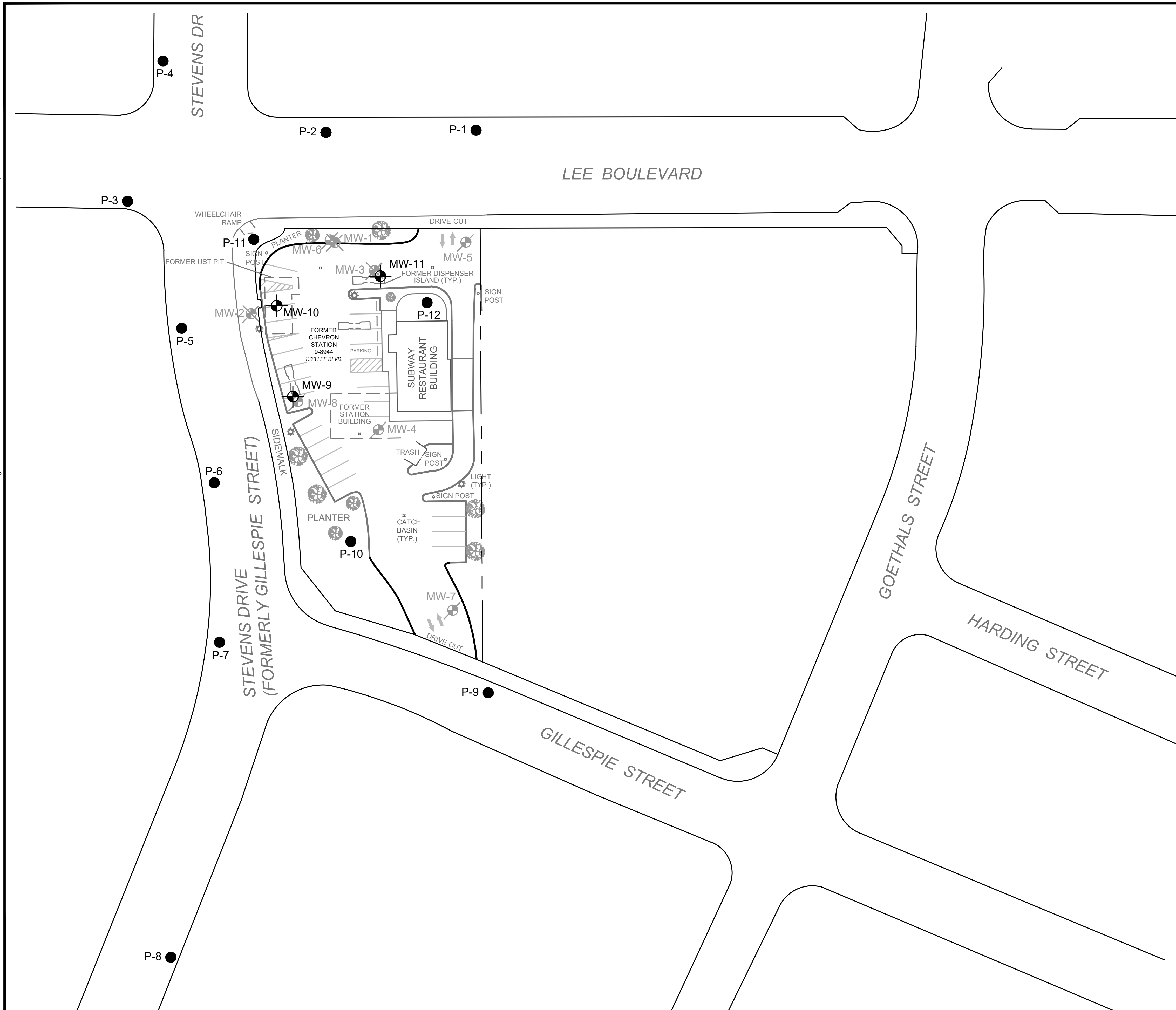
FIGURE 1



LEGEND:

MW-10 — MONITORING WELL LOCATION AND IDENTIFICATION

MW-3 — ABANDONED WELL LOCATIONS

MW-2 — DESTROYED MONITORING WELL LOCATION

P-1 — HISTORICAL GEOPROBE LOCATIONS

NOTES:

1. MODIFIED FROM BASE MAP PROVIDED BY CONESTOGA-ROVERS & ASSOCIATES, DATED 11/3/2008, AT A SCALE OF 1"=30'; AND HISTORICAL SAMPLE MAP FROM AGRA EARTH & ENVIRONMENTAL.
2. ALL SITE FEATURES AND LOCATIONS ARE APPROXIMATE.

0 60' 120'

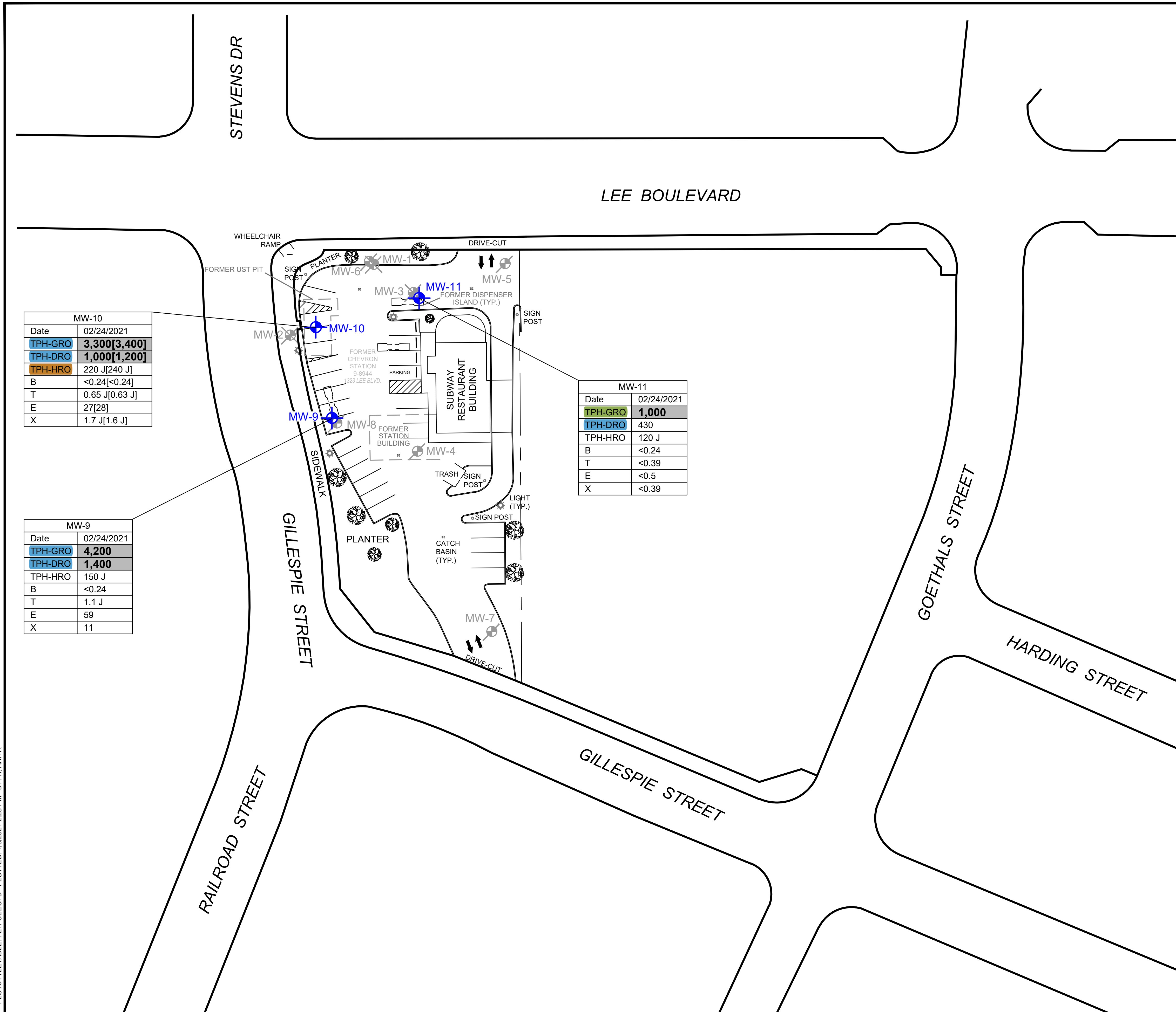
GRAPHIC SCALE

CHEVRON SITE NO. 9-8944
RICHLAND, WASHINGTON

SITE PLAN

ARCADIS Design & Consultancy for natural and built assets

FIGURE 2



MW-10	
Date	02/24/2021
TPH-GRO	**3,300[3,400]**
TPH-DRO	**1,000[1,200]**
TPH-HRO	220 J[240 J]
B	<0.24[<0.24]
T	0.65 J[0.63 J]
E	27[28]
X	1.7 J[1.6 J]

MW-9	
Date	02/24/2021
TPH-GRO	**4,200**
TPH-DRO	**1,400**
TPH-HRO	150 J
B	<0.24
T	1.1 J
E	59
X	11

MW-11	
Date	02/24/2021
TPH-GRO	**1,000**
TPH-DRO	430
TPH-HRO	120 J
B	<0.24
T	<0.39
E	<0.5
X	<0.39

LEGEND:

- MW-10 GROUNDWATER MONITORING WELL LOCATION
- MW-3 ABANDONED WELL LOCATIONS
- MW-2 DESTROYED MONITORING WELL LOCATION
- [3,400] DUPLICATE SAMPLE CONCENTRATIONS (μg/L)
- <0.39 CONCENTRATIONS NOT DETECTED ABOVE LABORATORY METHOD DETECTION LIMIT
- J ESTIMATED VALUE
- **BOLD** BOLD AND HIGHLIGHTED VALUES ARE GREATER THAN THEIR RESPECTIVE MTCA METHOD A CLEANUP LEVEL
- 1 ECOLOGY MODEL TOXICS CONTROL ACT (MTCA) METHOD A CLEANUP LEVELS (CULS) FOR GROUNDWATER, WAC CHAPTER 173-340-900, TABLE 720-1
- 800/1,000 GRO MTCA METHOD A CUL WITH B PRESENT IS 800 (μg/L) AND WITHOUT IS 1,000 (μg/L)
- TPH TOTAL PETROLEUM HYDROCARBONS

Well ID		
Constituent	MTCA CULs	
TPH-GRO	TPH as gasoline	**800/1,000**
TPH-DRO	TPH as diesel	**500**
TPH-HRO	TPH as motor oil	**500**
B	Benzene	**5**
T	Toluene	**1,000**
E	Ethylbenzene	**700**
X	Xylenes (total)	**1,000**

Highlighted COC name indicates Mann-Kendall Trend Analysis was performed and results are as follows:

- Blue = no significant trend*
- Green = decreasing trend*
- Orange = increasing trend*
- *at 90% confidence level

NOTES:

1. BASE MAP PROVIDED BY CONESTOGA-ROVERS & ASSOCIATES, DATED 11/3/2008, AT A SCALE OF 1"=30'.
2. ALL SITE FEATURES AND LOCATIONS ARE APPROXIMATE.
3. ALL VALUES REPORTED IN MICROGRAMS PER LITER (μg/L).

0 60' 120'
GRAPHIC SCALE

CHEVRON SERVICE STATION 9-8944
RICHLAND, WASHINGTON

GROUNDWATER CONCENTRATIONS FEBRUARY 2021 AND TREND ANALYSIS RESULTS

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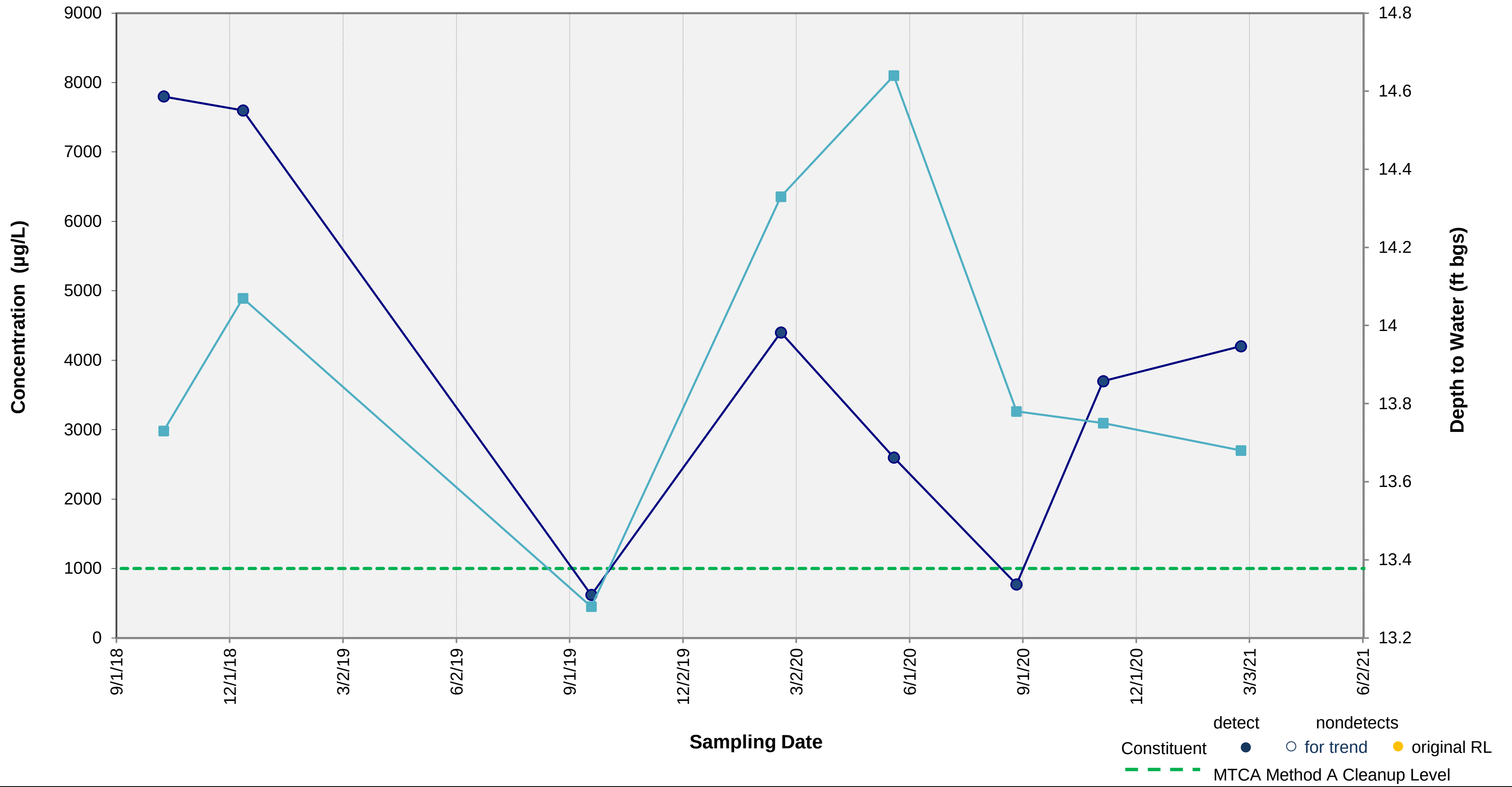
FIGURE 3

CITY:IRVINE DIV/GROUP:ENVCAD DB:E.MURESAN PIC:K. ABBOTT PM: A. JUST TM: J. NEWMAN
LAYOUT: 3 SAVED: 4/9/2021 2:23 PM ACADVER: 23.1S (LMS TECH) PAGESETUP: ----
PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 4/9/2021 2:23 PM BY: R, ANITA

ATTACHMENT 1

Mann-Kendall Trend Test Results



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.199 Note: p value < 0.1 indicates a statistically significant trend (90% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = -4.2E+00 µg/L per day

90% Confidence Interval = -1.0E+01 to 5.3E+00 µg/L per day

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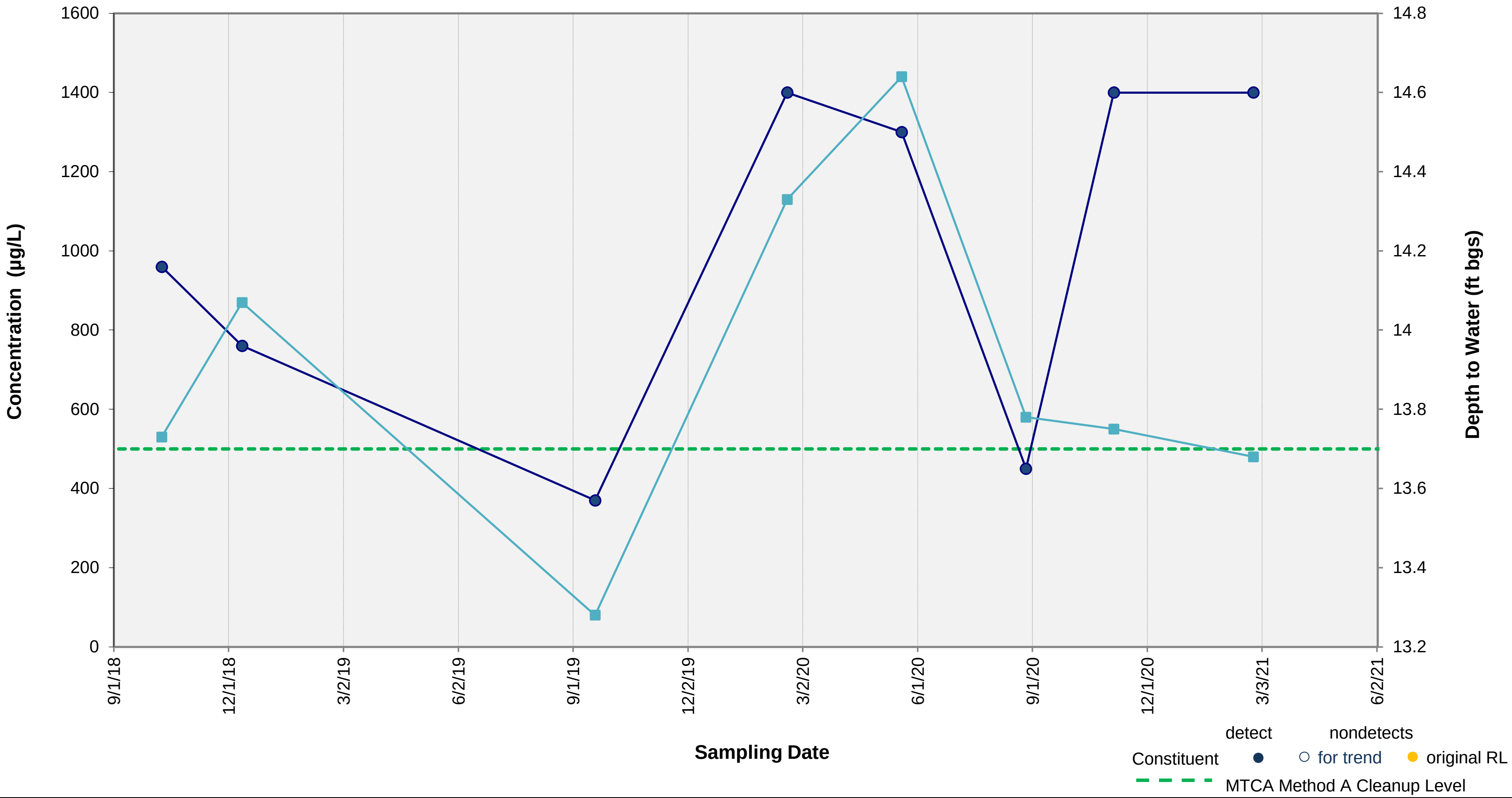
Concentration vs. Time Plot – TPH-GRO in MW-9

Chevron Station 98944, Richland, WA

Figure A-1



Results of Mann-Kendall Test for Trend:	**No Significant Trend**			
	p value =	0.169	Note: p value < 0.1 indicates a statistically significant trend (90% confidence level).	
Results of Sen's Estimator of Slope:	**No Significant Trend**			
	Median Slope Estimate =	5.4E-01	µg/L per day	
	90% Confidence Interval =	-6.1E-01	to 9.7E-01	µg/L per day

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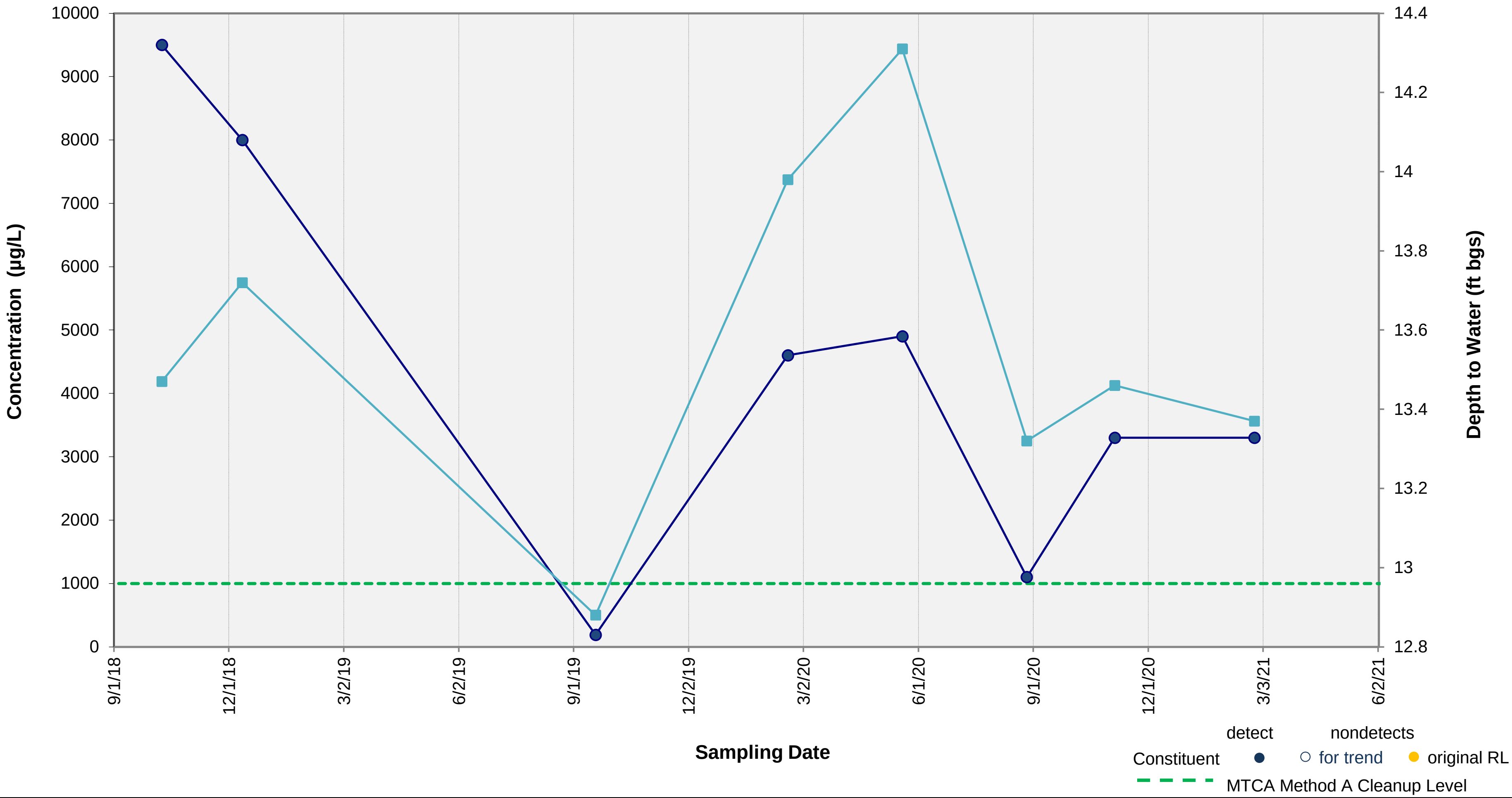
Concentration vs. Time Plot – TPH-DRO in MW-9

Chevron Station 98944, Richland, WA

Figure A-2



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.114 Note: p value < 0.1 indicates a statistically significant trend (90% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = -6.3E+00 µg/L per day

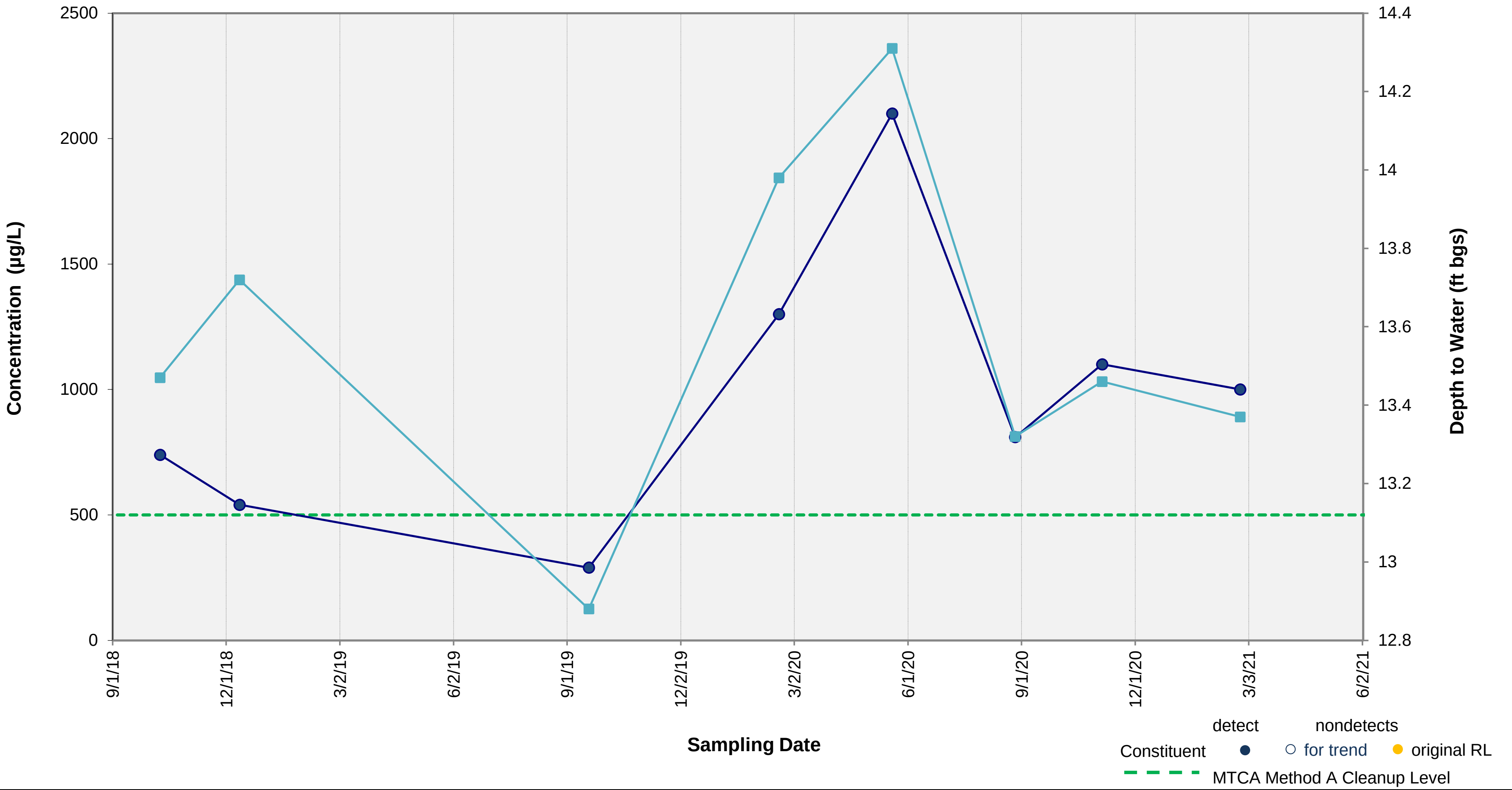
90% Confidence Interval = -1.1E+01 to 1.6E+00 µg/L per day

ARCADIS

Concentration vs. Time Plot – TPH-GRO in MW-10

Chevron Station 98944, Richland, WA

Figure A-3



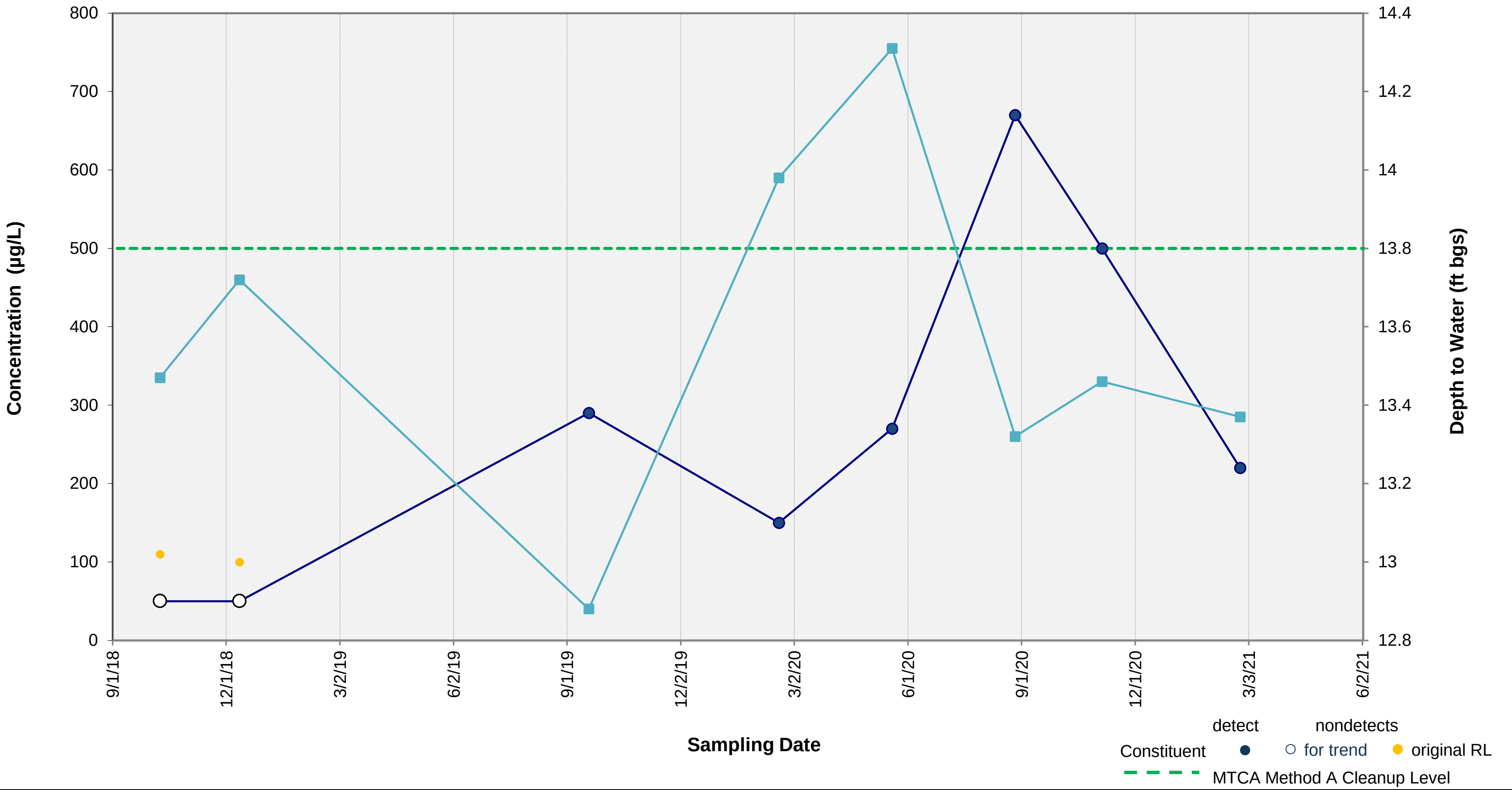
Results of Mann-Kendall Test for Trend:	**No Significant Trend**			
	p value =	0.199	Note: p value < 0.1 indicates a statistically significant trend (90% confidence level).	
Results of Sen's Estimator of Slope:	**No Significant Trend**			
	Median Slope Estimate =	5.2E-01	µg/L per day	
	90% Confidence Interval =	-9.0E-01	to 1.7E+00	µg/L per day

ARCADIS

Concentration vs. Time Plot – TPH-DRO in MW-10

Chevron Station 98944, Richland, WA

Figure A-4



Results of Mann-Kendall Test for Trend: **INCREASING TREND**

p value = 0.072 Note: p value < 0.1 indicates a statistically significant trend (90% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = 4.0E-01 µg/L per day

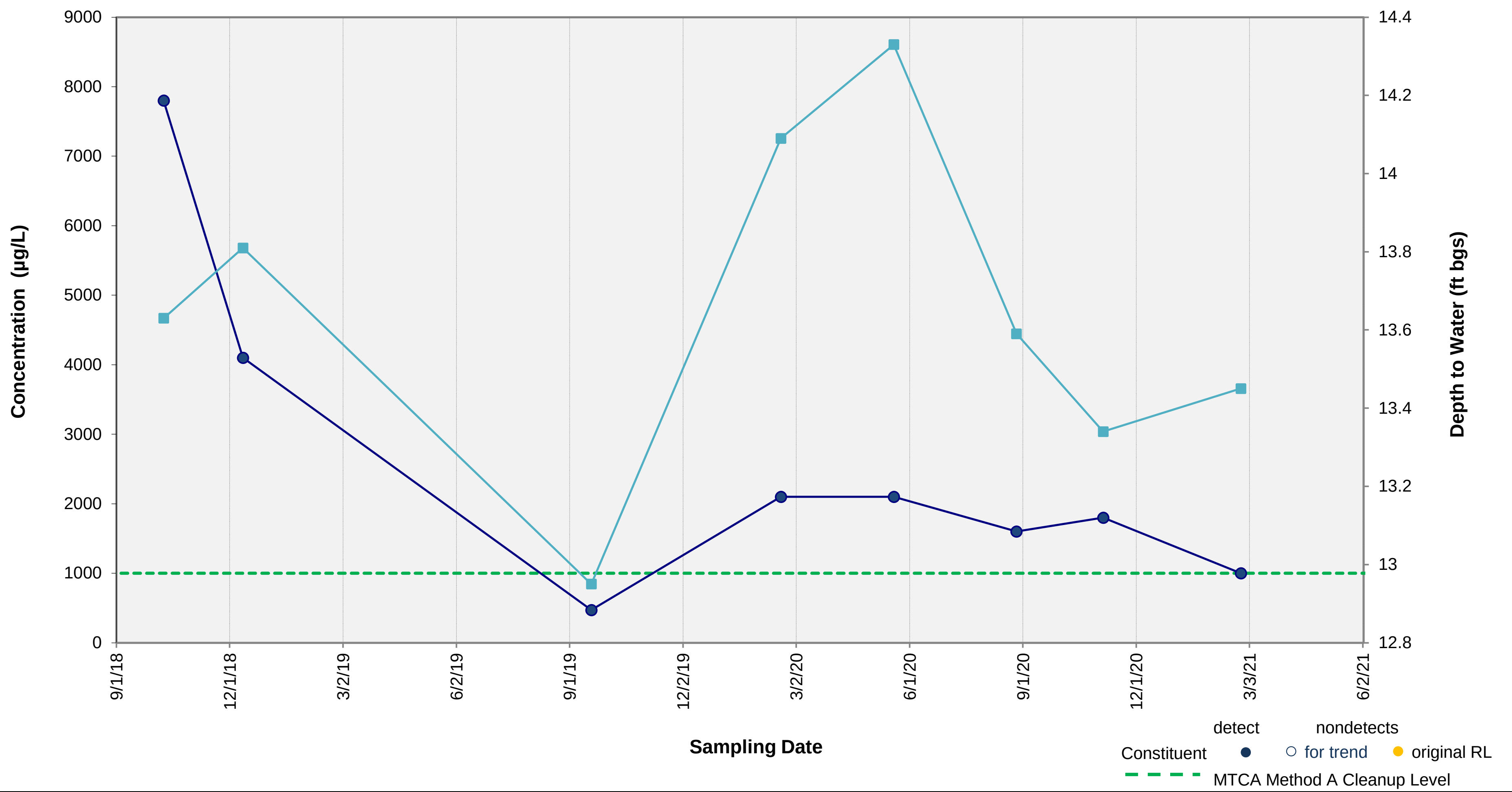
90% Confidence Interval = -4.9E-02 to 8.8E-01 µg/L per day

ARCADIS

Concentration vs. Time Plot – TPH-HRO in MW-10

Chevron Station 98944, Richland, WA

Figure A-5



Results of Mann-Kendall Test for Trend: **DECREASING TREND**

p value = 0.043 Note: p value < 0.1 indicates a statistically significant trend (90% confidence level).

Results of Sen's Estimator of Slope: **DECREASING TREND**

Median Slope Estimate = -3.8E+00 µg/L per day

90% Confidence Interval = -7.9E+00 to -1.4E+00 µg/L per day

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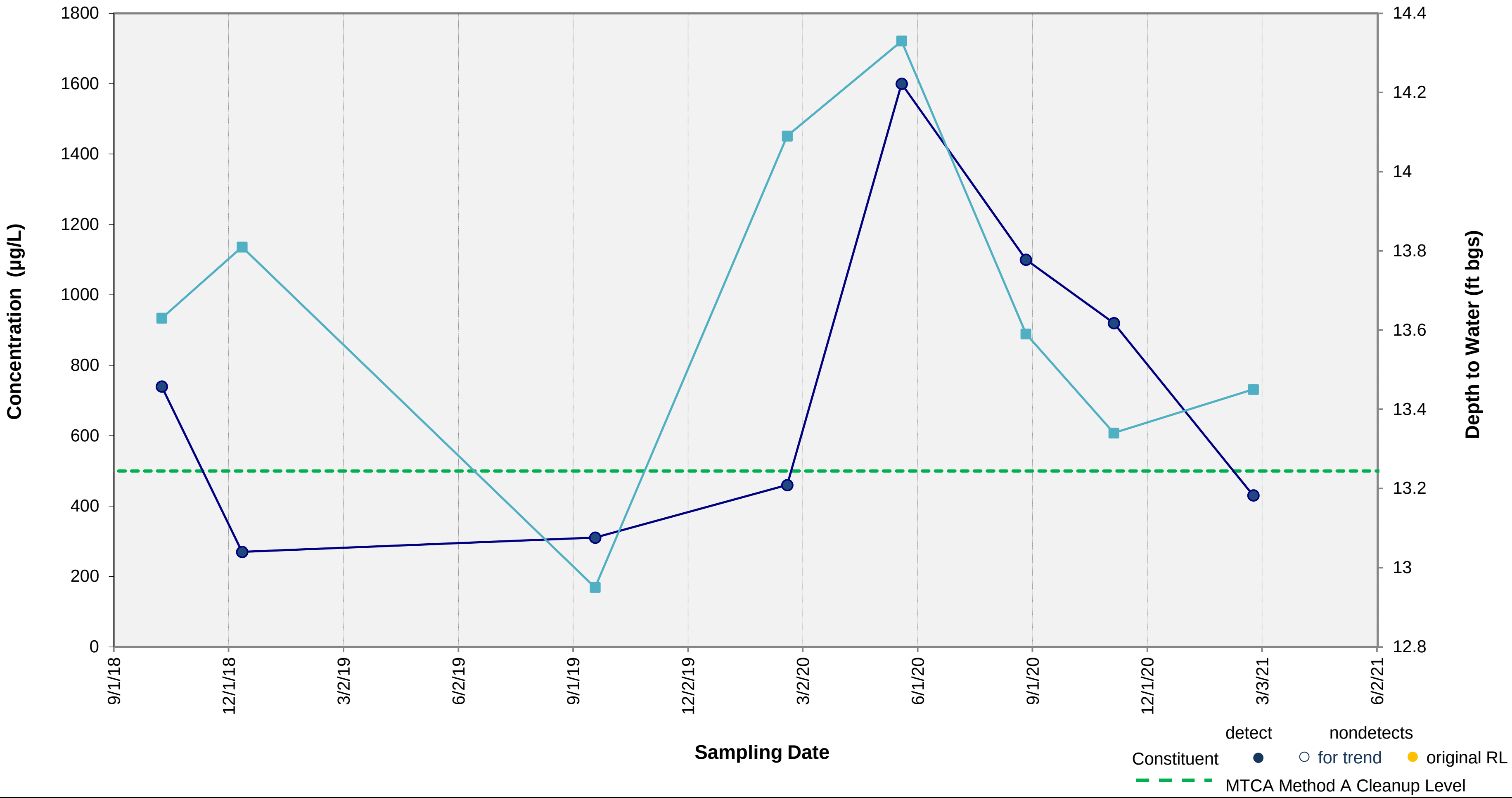
Concentration vs. Time Plot – TPH-GRO in MW-11

Chevron Station 98944, Richland, WA

Figure A-6



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.274 Note: p value < 0.1 indicates a statistically significant trend (90% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = 2.3E-01 µg/L per day

90% Confidence Interval = -2.1E+00 to 1.4E+00 µg/L per day

ARCADIS

Concentration vs. Time Plot – TPH-DRO in MW-11

Chevron Station 98944, Richland, WA

Figure A-7