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Yakima Railroad Area PCE Contamination

Groundwater Quality Monitoring, Data Summary, 2021

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Groundwater Quality Monitoring, Data Summary, 2021

by

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Abstract

During 2021, the Washington State Department of Ecology conducted two rounds of ongoing semi-annual sampling of the Yakima Railroad Area (YRRA) groundwater monitoring network. The YRRA is a six-square-mile area located along the railroad corridor in the cities of Yakima and Union Gap. Groundwater within the project area is contaminated with tetrachloroethene (PCE) which is attributed to many local sources. Since the YRRA project area was defined in 1991, cleanup activities have occurred at several of the source areas and appear to have been effective in reducing contaminant concentrations.

Of the 40 wells sampled during 2021, 17 wells had PCE concentrations higher than (not meeting) the Model Toxics Control Act (MTCA) cleanup level of 5 ug/L. The maximum PCE concentrations ranged from 5.33 to 16,200 ug/L.

The elevated PCE concentrations primarily occurred in shallow wells at three of the source areas: Cameron Yakima, Washington Central Railroad, and Frank Wear Cleaners. Two of the shallow Remedial Investigation (RI) wells located along the western portion of the YRRA also had elevated PCE concentrations. The source of contamination for the RI wells has not been identified.

PCE concentrations higher than the 5 ug/L cleanup level were also detected in the deeper Washington Central Railroad Roundhouse (WCRR) wells. PCE concentrations ranged from 11.2 ug/L in WDOE-3D, the deepest well in the cluster, to 14.1 ug/L in WDOE-3S. PCE concentrations in these wells indicate the contaminant plume has a vertical extent that reaches the lower confined water-bearing zone in this portion of the YRRA.

The 2021 groundwater data confirm that PCE and associated contaminants remain present in groundwater throughout the YRRA project area. Concentrations have decreased at some of the identified source areas; however, high PCE concentrations continue to be detected at sites located in the central portion of the YRRA.

Introduction

Background

During routine inspections of industrial facilities in the 1980s, tetrachloroethene (PCE)-contaminated soil and groundwater was discovered at many locations in the Yakima area (Secor, 1998). The U.S. Environmental Protection Agency (EPA) referred these findings to the State of Washington. After many investigations, the Washington State Department of Ecology (Ecology) defined the affected area as the Yakima Railroad Area (YRRA) in 1991.

Ecology identified 13 commercial and industrial facilities as potential sources of PCE contamination to groundwater within the YRRA. The YRRA encompasses about 6 square miles of mixed industrial/commercial and residential property adjacent to the rail corridor in the cities of Yakima and Union Gap (Figure 1). The identified PCE sources include dry cleaners, machine shops, a carbon regeneration facility, and a former pesticide formulation plant.

During the 1990s, cleanup activities were conducted at many of the facilities. An area-wide remedial investigation (RI) for the YRRA was completed in 1998 (Secor, 1998). From 1999 to 2012, 59 monitoring wells were routinely sampled during an ongoing program to characterize groundwater PCE concentrations in groundwater across the YRRA. Results indicated that the highest PCE concentrations continued to be found near known sources. There was also evidence that PCE was present in the shallow aquifer in areas where no known source has been identified.

In 2013, Ecology's Environmental Assessment Program (EAP) assumed responsibility for the area-wide monitoring program. In consultation with Ecology's Toxics Cleanup Program (TCP), a subset of 36 wells was selected for continued monitoring. In 2017, 10 additional wells located at the Frank Wear Cleaners site were added, and two wells were removed from the monitoring program. These two wells are at the north end of the project area.

The goal of the current 2021 monitoring is to provide TCP with groundwater quality data to assist in evaluating the effectiveness of remedial actions taken at the identified source areas under the Model Toxics Control Act (MTCA). These data may also be used to identify additional areas of contamination within the YRRA that require further source investigation and remedial action.

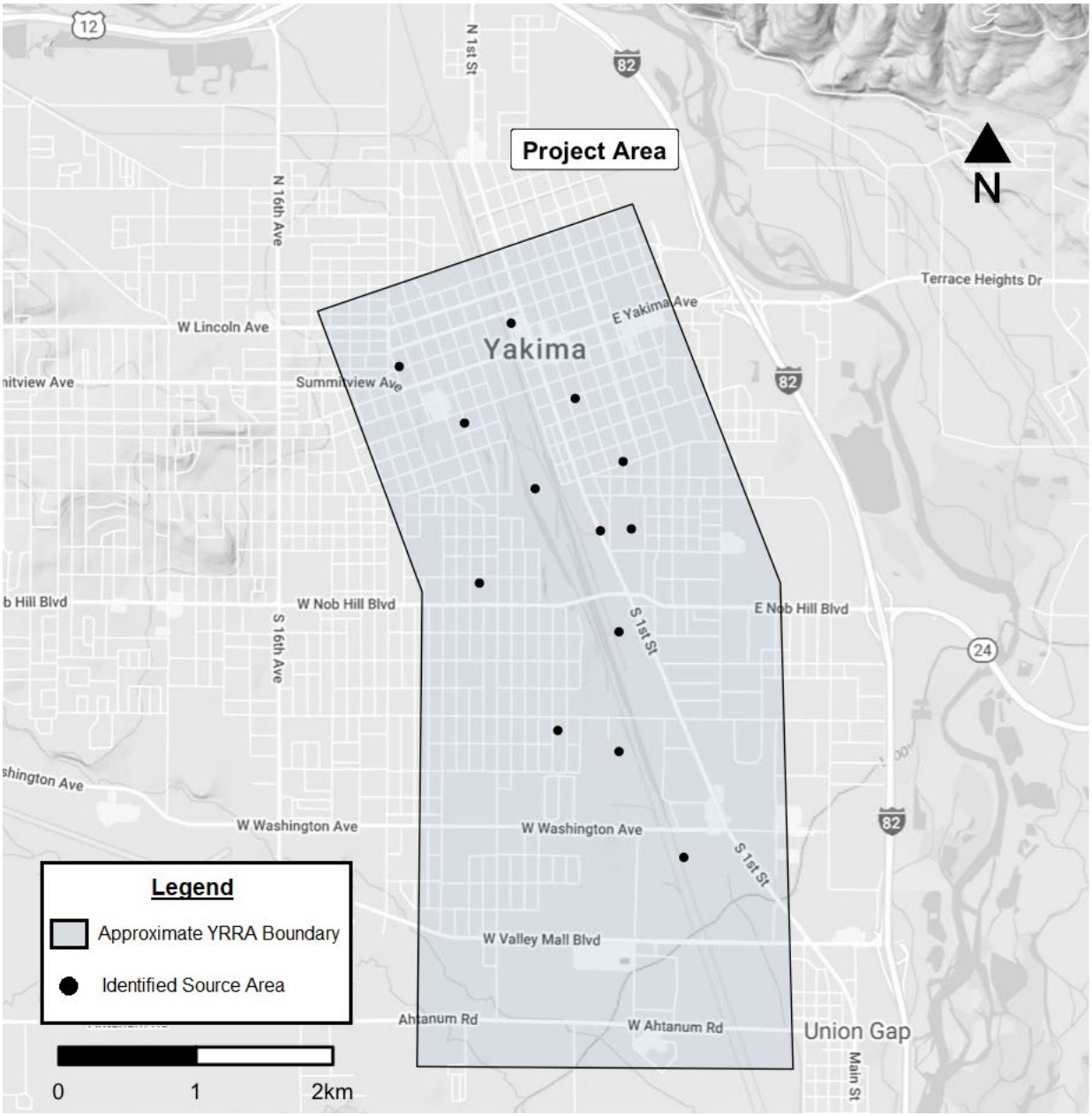

Figure 1. Yakima Railroad Area (YRRA) Project Location Map, Yakima, WA.

Physical Setting

The YRRA is located within the flood plain of the Yakima River and is underlain in most areas by Quaternary-age alluvium and unconsolidated terrace deposits. The alluvium is composed of unconsolidated silt, sand, gravel, and cobble. It ranges in thickness from 0 to 120 feet with an average thickness of 20 feet (USGS, 2009). The underlying terrace deposits consist of coarse-grained gravel with discontinuous layers of silt, clay, sand, or cemented gravel. The terrace gravels generally occur at the surface away from the river and beneath the alluvium adjacent to the river. The thickness of this unit ranges up to 350 feet, with an average thickness of 90 feet (USGS, 2009). These unconsolidated Quaternary deposits are overlain in some areas by artificial fill material up to 20 feet deep and underlain by consolidated Tertiary-age continental sediments of the Upper Ellensburg Formation.

PCE monitoring in the YRRA focuses on groundwater in the upper portion of the shallow, unconfined aquifer in the unconsolidated sands and gravels. This portion of the aquifer is highly permeable near the Yakima River; however, fine-grained material and cemented gravels are more prevalent in the north and west portions of the project area, resulting in geologic units of contrasting permeability. For this reason, both shallow and deep water-bearing zones were identified within the YRRA project area in the RI/Feasibility Study (Secor, 1998). The shallow and deep water-bearing zones appear to be hydraulically separate in the northern portion of the YRRA and interconnected in the southern portion of the project area.

Groundwater within the YRRA is encountered from about 3 to 30 feet below ground surface (bgs) depending on the topography, precipitation, and seasonal irrigation practices. The depth to groundwater is greatest to the north and least to the south in the YRRA. The Yakima Valley is heavily irrigated with surface water from area rivers during late March through early October. Accordingly, the water table is typically deeper in the spring before irrigation begins and shallower in the fall. Groundwater levels fluctuate seasonally, typically between 1 and 12 feet.

At the time of the RI, the direction of groundwater flow in the shallow water-bearing zone was characterized as being to the southeast with an approximate horizontal gradient of 0.005 ft/ft across the YRRA project area. The estimated direction of groundwater flow in the deep water-bearing zone is also primarily to the southeast, with an approximate gradient of 0.004 ft/ft across the YRRA. Overall, the vertical gradient across the project area is downward. The downward gradients between the shallow and deep water-bearing zones ranged from -0.278 ft/ft in the northern portion of the YRRA to -0.005 ft/ft in the southern portion of the project area (Secor, 1998).

Methods

Groundwater Sampling

Ecology samples groundwater in the YRRA twice a year, typically in April and October. This sampling interval is used to assess variation in contaminant concentration due to seasonal fluctuations of groundwater levels.

In 2013, when selecting the 36 wells for continued sampling, Ecology excluded wells that had consistently shown low or no detections for chlorinated volatile organic compounds (cVOCs) during prior sample collection. The cVOC compounds include PCE, as well as the metabolic breakdown products trichloroethene (TCE), cis-1,2-dichloroethene (DCE), and vinyl chloride.

In 2015, the frequency of monitoring the 36 wells was adjusted. Previously, all wells had been sampled twice a year. To improve cost-effectiveness of the monitoring program, the new sample frequency was determined by PCE concentration, seasonal pattern, and temporal trend for each well. Seven wells displayed higher PCE concentrations in the spring, 13 wells had higher PCE concentrations in the fall, and the remaining wells displayed no seasonal pattern.

In 2017, 10 additional wells were added to the monitoring network, and two wells were removed. The 10 new wells are located at the Frank Wear Cleaners site at the north end of the YRRA project area. At this time, these 10 wells are being sampled twice a year. Monitoring frequency for these wells may change if seasonal patterns or trends can be established. Additionally, two wells were removed from the monitoring program, including NMW-2 at the Nu-Way Cleaners site, which was decommissioned in 2016. Figure 2 shows the relative locations of the 44 remaining wells in the monitoring program.

During 2021, Ecology sampled 40 of the 44 wells in the monitoring network. Of the wells sampled, 31 are associated with known source area for contamination, including the following seven facilities: Goodwill - City of Yakima, Nu-Way Cleaners, Southgate Laundry, Fifth Wheel Truck Repair, Cameron Yakima, the Washington Central Railroad Roundhouse (WCRR), and Frank Wear Cleaners. Wells at these seven locations are monitored to evaluate the effectiveness of site-specific cleanup activities.

The nine remaining wells were installed during the YRRA Remedial Investigation (RI). RI wells selected for continued monitoring are primarily located in the western and southern areas of the YRRA. Data collected from these wells may be used to identify areas of groundwater contamination within the YRRA that require additional source investigation and remedial action.

Construction details for the sampled wells are provided in Appendix A (Table A-1).

Ecology sampled these wells in accordance with Ecology's Standard Operating Procedures (SOPs) EAP052 (Marti, 2018) and EAP078 (Marti, 2020), as well as the site-specific Quality Assurance Project Plan (Marti, 2013).

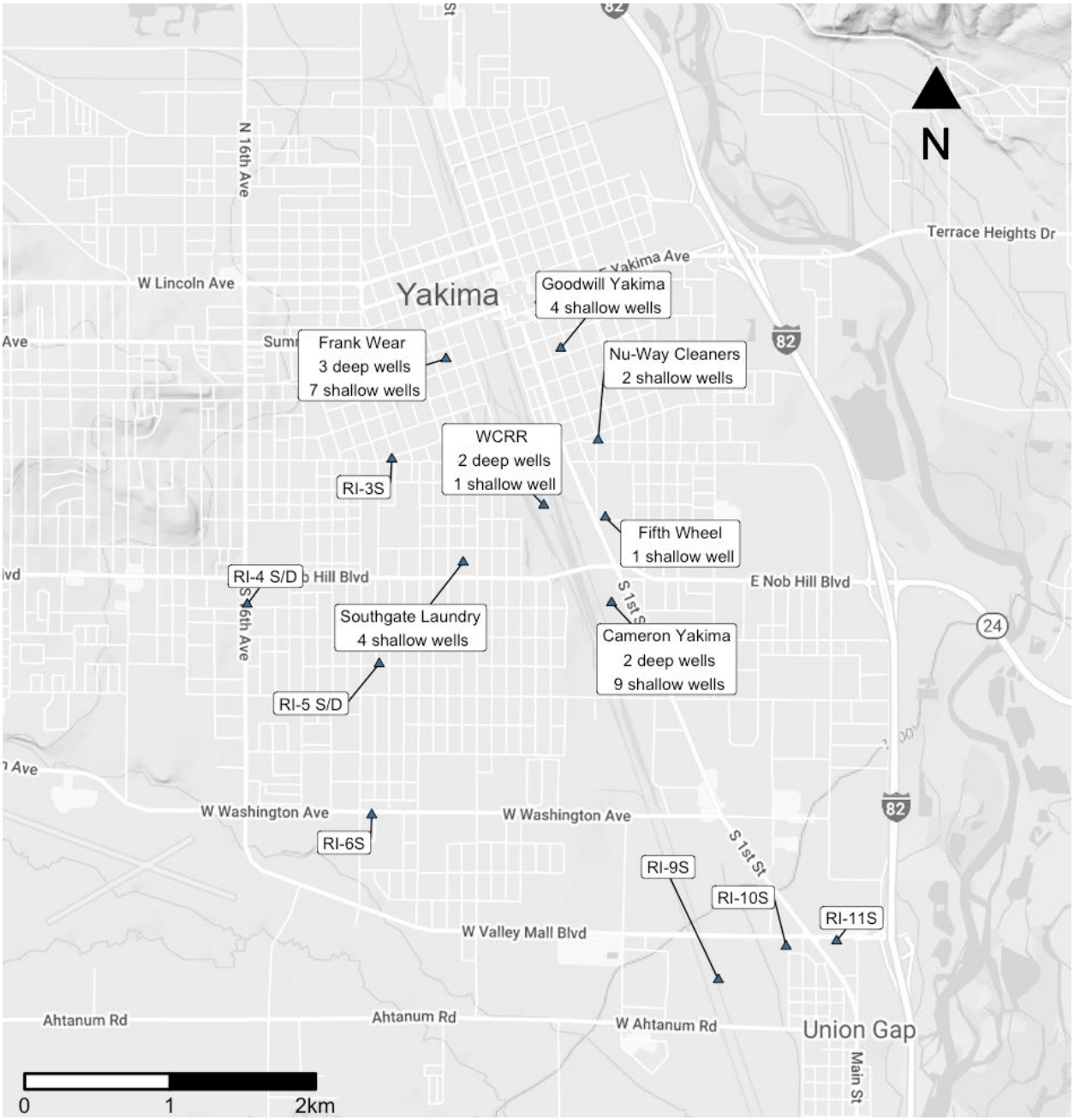

Figure 2. YRRA Groundwater Monitoring Locations, 2021.

Analysis

Samples were submitted to Ecology's Manchester Environmental Laboratory for analysis of volatile organic compounds (VOCs) to determine concentrations in groundwater throughout the YRRA project area. Samples were analyzed following a modification of EPA SW-846 Method 8260C.

Field Observations

Ecology measured depth-to-water in each of the 40 monitoring wells prior to purging. The end-of-purge temperature, pH, dissolved oxygen, oxidation-reduction potential (ORP), and specific conductance measurements are listed in Table A-2 in Appendix A.

In 2021, depth-to-water below ground surface (bgs) ranged from about 33.1 feet bgs at the northern end of the YRRA project area to about 10.8 feet bgs at the southern end of the area in the spring, and from about 27.1 to 5.4 feet bgs in the fall. Water levels in the YRRA are typically higher in the fall due to recharge caused by irrigation over the summer months.

In both spring and fall, the overall flow direction for the shallow groundwater appears to be consistently to the southeast, toward the Yakima River. There were not enough measurement points during a given sampling event to reliably determine the groundwater flow direction in the deep water-bearing zone, but previous investigations have described the groundwater flow as also being to the southeast (Kane, 2011).

Field measurement data for 2021 were within expected ranges (Table 1). Of special note are the dissolved oxygen measurements. Most of the wells had measurements that ranged from about 5 to 7 mg/L, indicating aerobic conditions in both the shallow and deep wells. In contrast, dissolved oxygen in three of the Frank Wear wells (FWMW-10, FWMW-16, and FWMW-20) and one Washington Central Railroad Roundhouse well (WDOE-3I) was below 1 mg/L during at least one sampling event in 2021. Dissolved oxygen concentrations below 1 mg/L indicate an anaerobic environment.

Table 1. Summary of YRRA Stable Field Measurements, 2021.

Parameter	Number of Observations	Minimum	Maximum	25th Percentile	Median	75th Percentile
Temperature (°C)	53	9.3	20.4	15.7	16.6	17.5
pH (Std Units)	53	6.4	8.01	6.6	6.7	7
Conductivity (uS/cm@25°C)	53	91	747	285	334	386
Dissolved Oxygen (mg/L)	53	0	11.4	4.3	6.4	6.9
Oxidation Reduction Potential (mV)	53	-69	319	100	143	195

Analytical Results

Of the 40 wells sampled in 2021, PCE was detected in all but one well during the April and October sampling events (Table 2). During April 2021, 22 of the 25 wells sampled had detectable PCE. Two Frank Wear wells (FWMW-17, FWMW-19) and one Goodwill well (GMW-4) had no detectable PCE. In the wells with detectable PCE, concentrations ranged from an estimated 0.21J ug/L to 10,100 ug/L. April 2021 PCE concentrations were higher than the 5 ug/L cleanup level in 8 of the 25 wells sampled.

During October 2021, 25 of the 27 wells sampled had detectable PCE, with concentrations ranging from an estimated 0.65J ug/L to 16,200 ug/L. PCE concentrations were higher than the 5 ug/L cleanup level in 14 of the 27 wells. One well at the Cameron site, CYIMW107S, had no detectable PCE. One Frank Wear well had a tentative detection for PCE at an estimated concentration of 0.6NJ ug/L.

The 2021 analytical results for PCE and the metabolic breakdown products TCE, DCE, and vinyl chloride in each well are presented in Table 2.

Potential sampling bias and overall analytical precision were assessed by collecting field quality control samples consisting of field replicates, equipment blanks, and transport blank samples. Appendix B presents the Quality Assurance data for the 2021 monitoring period (Tables B-1 through B-4).

In 2021, all replicate samples collected met the acceptance criteria for all analytes of concern.

During April 2021, PCE was detected in an equipment blank sample at 2.94 ug/L. The equipment blank was collected on 4/15/2021, the day after the wells at Frank Wear Cleaners with the highest PCE concentrations (FWMW-10 and FWMW-20) were sampled. Only one Cameron site well, CYIMW107S, was sampled on 4/15/2021 due to it being obstructed earlier in the week. The PCE result from this well is qualified “B”, due to the blank contamination. Non-detect results on 4/12/2021 and 4/13/2021 indicate that contamination was not occurring prior to sampling the high concentration wells at Frank Wear; therefore, no other results are qualified due to the blank contamination.

All data are considered to be of good quality and are usable as presented here without further qualification. Appendix B contains additional details about project quality assurance.

Historical groundwater data for the wells in the monitoring program are available in Appendix C (Tables C-1 through C-9). Long-term project data are also presented in the Appendix C timeseries plots (Figures C-1 through C-51) of contaminant concentrations in individual wells for the duration of the monitoring program.

The following section, Discussion by Source Area, presents a summary of the 2021 results by the seven contaminant source areas.

Table 2. Analytical Results for 2021.

Well	April PCE	April TCE	April DCE	April VC	Oct. PCE	Oct. TCE	Oct. DCE	Oct. VC
5WMW-2	--	--	--	--	**3.03**	1U	1U	0.2U
CYIMW102S	--	--	--	--	**9.96**	**0.92J**	**0.61J**	0.2U
CYIMW103D	**2.09**	1U	1U	0.2U	--	--	--	--
CYIMW103S	**8.06**	**0.72J**	**0.65NJ**	0.2U	**8.99**	**0.59J**	**0.28J**	0.2U
CYIMW106S	--	--	--	--	**6.61**	**0.34J**	**0.16J**	0.2U
CYIMW107S	**2.87B**	1U	1U	0.2U	1U	1U	1U	0.2U
CYIMW108S	--	--	--	--	**2.91**	**0.5NJ**	1U	0.2U
CYIMW111S	--	--	--	--	**4.85**	**0.22J**	**0.13J**	0.2U
CYIMW113D	**2.71**	1U	1U	0.2U	--	--	--	--
CYIMW113S	**7.67**	**0.58J**	1U	0.2U	--	--	--	--
CYIMW114S	--	--	--	--	**5.5**	**0.27J**	1U	0.2U
FWMW-4	**26.1**	**1.89**	**44.6**	0.2U	**4.89**	**0.11J**	1U	0.2U
FWMW-5	**2.74**	**0.63J**	**1.38**	0.2U	**1.99**	**0.12J**	1U	0.2U
FWMW-6	**2.34**	1U	1U	0.2U	**5.33**	**1.57**	**3.14**	0.2U
FWMW-10	**5600**	**434**	**118**	**54.8**	**6270**	**192**	**69.4J**	**62.3J**
FWMW-16	**34.9**	**20.1**	**35.9**	**28.2**	**39.6**	**6.63**	**47.2**	**8.86**
FWMW-17	1U	1U	1U	0.2U	**0.65J**	1U	1U	0.2U
FWMW-18	**2.81**	**0.41J**	1U	0.2U	**1.4J**	**0.59J**	1U	0.2U
FWMW-19	1U	1U	1U	0.2U	**0.6NJ**	1U	1U	0.2U
FWMW-20	**10100**	**1460**	**512**	**124**	**16200**	**657**	**268**	**98.9J**
FWMW-24	**34.9**	**3.65**	**4.37**	0.2U	**63.3**	**2.19**	**1.29**	0.2U
GMW-1	**0.78J**	1U	1U	0.2U	--	--	--	--
GMW-2	**0.78J**	1U	1U	0.2U	**5.4**	1U	1U	0.2U
GMW-4	1U	1U	1U	0.2U	--	--	--	--
NMW-1	**0.65J**	1U	1U	0.2U	--	--	--	--
RMW-3D	--	--	--	--	**11.2**	**3.88**	**2.16**	0.2U
RMW-3I	--	--	--	--	**13.5**	**3.35**	**4.03**	**2.55**
RMW-3S	--	--	--	--	**14.1**	**0.58J**	**0.42J**	0.2U
SGMW-1	--	--	--	--	**0.71J**	1U	1U	0.2U
SGMW-2	--	--	--	--	**1.58**	1U	1U	0.2U
SGMW-3	--	--	--	--	**1.68**	1U	1U	0.2U
RI-3S	**0.21J**	1U	1U	0.2U	--	--	--	--
RI-4D	**1.76**	1U	1U	0.2U	--	--	--	--
RI-4S	**12.6**	1U	1U	0.2U	--	--	--	--
RI-5D	**1.34**	1U	1U	0.2U	--	--	--	--
RI-5S	**3.11**	1U	1U	0.2U	--	--	--	--
RI-6S	--	--	--	--	**7.75J**	1U	1U	0.2U
RI-9S	--	--	--	--	**1.41**	**0.47NJ**	1U	0.2U
RI-10S	**1.14**	1U	1U	0.2U	--	--	--	--
RI-11S	--	--	--	--	**1.13**	1U	1U	0.2U

PCE: Tetrachloroethene
TCE: Trichloroethene
DCE: cis-1,2-dichloroethene
VC: Vinyl chloride
Bold: Analyte was detected.
Bold and Underlined: Analyte was detected at concentration above cleanup level
U: Analyte was not detected at or above the reported value.
J: Analyte was positively identified. The associated numerical result is an estimate.
NJ: Reported result for the tentatively identified analyte is an estimate.
B: Analyte detected in sample and equipment blank.

Discussion by Source Area

During 2021, four of the seven source areas sampled in the YRRA had PCE concentrations higher than the 5 ug/L cleanup level in at least one well. Those sites are Goodwill, WCRR, Cameron Yakima, and Frank Wear Cleaners. The three remaining source areas, Nu-Way Cleaners, Southgate Laundry, and Fifth Wheel Truck repair, have all gone many years without PCE detections above the 5 ug/L cleanup level. Two of the nine RI wells sampled during 2021 (RI-4S and RI-6S) had PCE concentrations above the cleanup level. These two RI wells are on the western side of the study area and do not have a known source area.

1. Goodwill - City of Yakima

The Goodwill - City of Yakima site is located at the northern end of the YRRA project area. This site is the present location of the City of Yakima Police and Justice Center (Figure 3).. In 1995, contaminated soil was removed from this site during an interim action (Huntingdon Engineering, 1995).

During the 2021 monitoring, PCE was the only chlorinated solvent detected (Figure 3). The other contaminants of concern –TCE, DCE, and vinyl chloride (VC) – were not detected.

During both monitoring events in 2021, PCE was detected in downgradient well GMW-2. In April, PCE was detected at an estimated concentration of 0.73 ug/L, below the MTCA Method A cleanup level of 5 ug/L. In October, PCE was detected at a concentration of 5.4 ug/L, higher than the cleanup level.

Wells GMW-1 and GMW-4 are sampled on an annual rotation during the spring. During April 2021, PCE in GMW-1 was detected below the 1 ug/L reporting limit, with an estimated concentration of 0.73 J ug/L. PCE was not detected in GMW-4.

PCE concentrations in GMW-2 have generally decreased since 2018, when PCE was detected at an estimated 24J ug/L. Since 2020, PCE in GMW-2 has been near or below the 5 ug/L cleanup level. PCE concentrations in GMW-1 and GMW-4 have consistently been below the 5 ug/L cleanup level, with the exception of an outlier detection in GMW-1 during 2018 (Appendix C Table C-1, Figures C-1 to C-3).

Figure 3. Goodwill - City of Yakima Well Locations and cVOC Results (ug/L), 2021.

2. Nu-Way Cleaners

The Nu-Way Cleaners site is about 0.5 miles southeast of the Goodwill site (Figure 2). In 1996, source removal activities occurred at this site (Enviros, 1996).

During 2021, only well NMW-1 was sampled. PCE was detected below the 1 ug/L reporting limit at an estimated concentration of 0.65J ug/L (Figure 4). None of the remaining target analytes were detected.

Monitoring well NMW-3 was covered by a vehicle. Monitoring well NMW-2 was decommissioned in 2016 and is no longer part of the monitoring program.

Since regular monitoring began in 1997, with a few exceptions, PCE concentrations have consistently been below the cleanup level in all three of the Nu-Way wells (Appendix C Table C-2, Figures C-4 – C-6). PCE concentrations have ranged from less than 1 to 5.5 ug/L (Table C-2). Downgradient PCE concentrations at this site have been consistent with upgradient conditions, indicating that this site is no longer a significant source of PCE contamination to the larger YRRA plume.

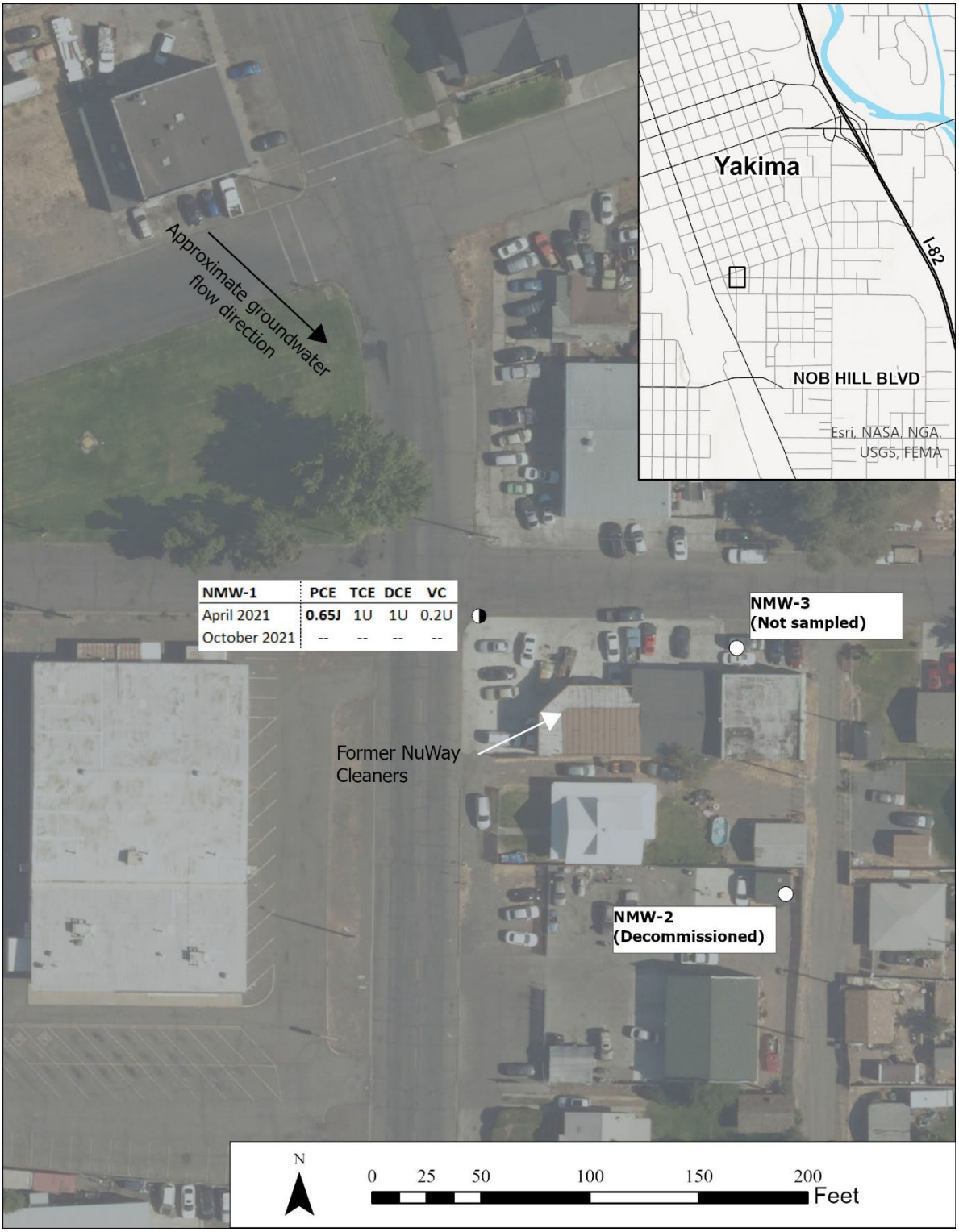

Figure 4. Nu-Way Cleaners Well Locations and cVOC Results (ug/L), 2021.

3. Southgate Laundry

The Southgate Laundry site is west of the railroad tracks along Nob Hill Road (Figure 2). In 1997, contaminated soils were removed from this site as part of an interim action (Maxim Technologies, 1998).

During 2021, PCE was the only contaminant detected at this site (Figure 5). PCE concentrations were below the cleanup level of 5 ug/L in both downgradient wells SGMW-2 (1.58 ug/L) and SGMW-3 (1.68 ug/L). In well SGMW-1, PCE was detected below the reporting limit at an estimated concentrations of 0.71 J ug/L.

The historic results for upgradient well SGMW-1 show that PCE concentrations have consistently been below the MTCA cleanup level (Figure C-7). Until 2005, PCE concentrations in downgradient wells SGMW-2 (Figure C-8) and SGMW-3 (Figure C-9) were often higher than the cleanup level, with concentrations ranging from about 2 to 29 ug/L (Table C-3).

At this site, PCE concentrations have decreased since 2006, ranging from less than 1 ug/L to 4.5 ug/L. This suggests that past source-removal activities have been successful in reducing PCE in groundwater (Table C-3).

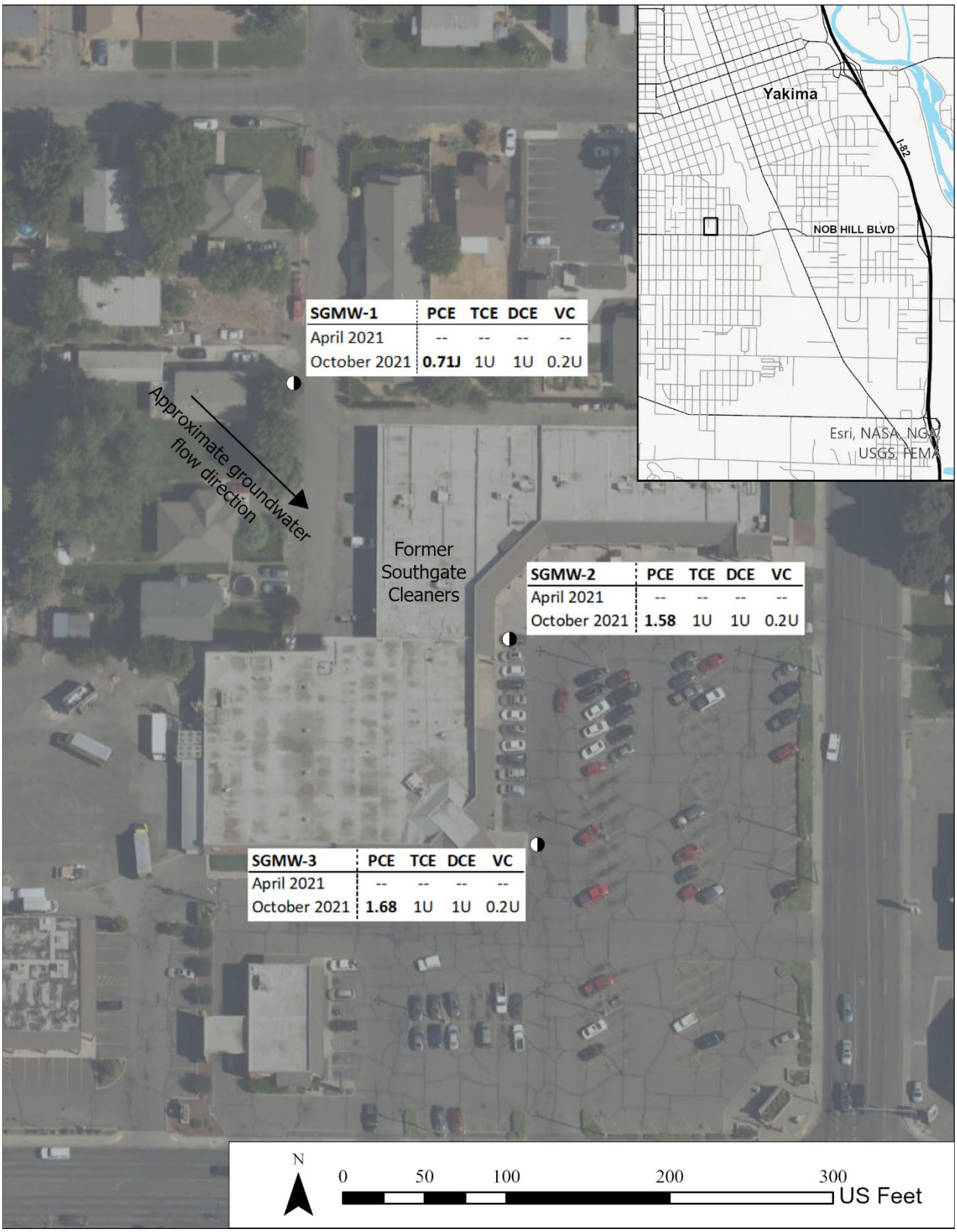

Figure 5. Southgate Laundry Well Locations and cVOC Results (ug/L), 2021.

4. Washington Central Railroad Roundhouse (WCRR)

The WCRR site is in the central portion of the YRRA study area (Figure 2). There is no record of direct remediation at this site to address PCE contamination. The three WCRR wells are clustered (Figure 6) and are completed at about 30 feet (WDOE-3S), 58 feet (WDOE-3I), and 100 feet (WDOE-3D) bgs. These wells continue to have elevated concentrations of PCE and corresponding breakdown products (Table C-4), indicating that the WCRR site is still a significant source of groundwater contamination.

Shallow Well WDOE-3S

PCE was detected above the cleanup level at 14.1 ug/L (Figure C-10). TCE (0.58J ug/L) and DCE (0.48J ug/L) were detected at estimated concentrations below the reporting limits.

Deep Wells WDOE-3I and WDOE-3D

In well WDOE-3I, the PCE concentration was 13.5 ug/L (Figure C-11). In well WDOE-3D, the PCE concentration was 11.2 ug/L (Figure C-12). PCE concentrations were higher than (exceeded)the 5 ug/L cleanup level in both wells.

PCE metabolic breakdown products were also detected in WDOE-3I and WDOE-3D.

- TCE was detected in WDOE-3I at a concentration of 3.35 ug/L. The TCE concentration in WDOE-3D was 3.88 ug/L. In both wells, the TCE concentration was below the 5 ug/L cleanup level. During 2009-2014, increasing TCE concentrations in WDOE-3I were observed (Figure C-13), reaching a local maximum of 15 ug/L in October 2014. TCE has not been detected in wells WDOE-3I and WDOE-3D at concentrations above the 5 ug/L cleanup level since October 2014 (Table C-4).
- DCE was detected at concentrations below the 70 ug/L cleanup level in both WDOE-3I (4.03 ug/L) and WDOE-3D (2.16 ug/L).
- Vinyl chloride was detected in WDOE-3I at a concentration of 2.55 ug/L, higher than the 0.2 ug/L cleanup level.

Contaminant concentrations in wells WDOE-3I and WDOE-3D indicate that the plume has a vertical extent that reaches the deep-water-bearing zone in this portion of the YRRA. The data indicate that the WCRR facility continues to act as a significant source of groundwater contamination, including to deeper portions of the aquifer system.

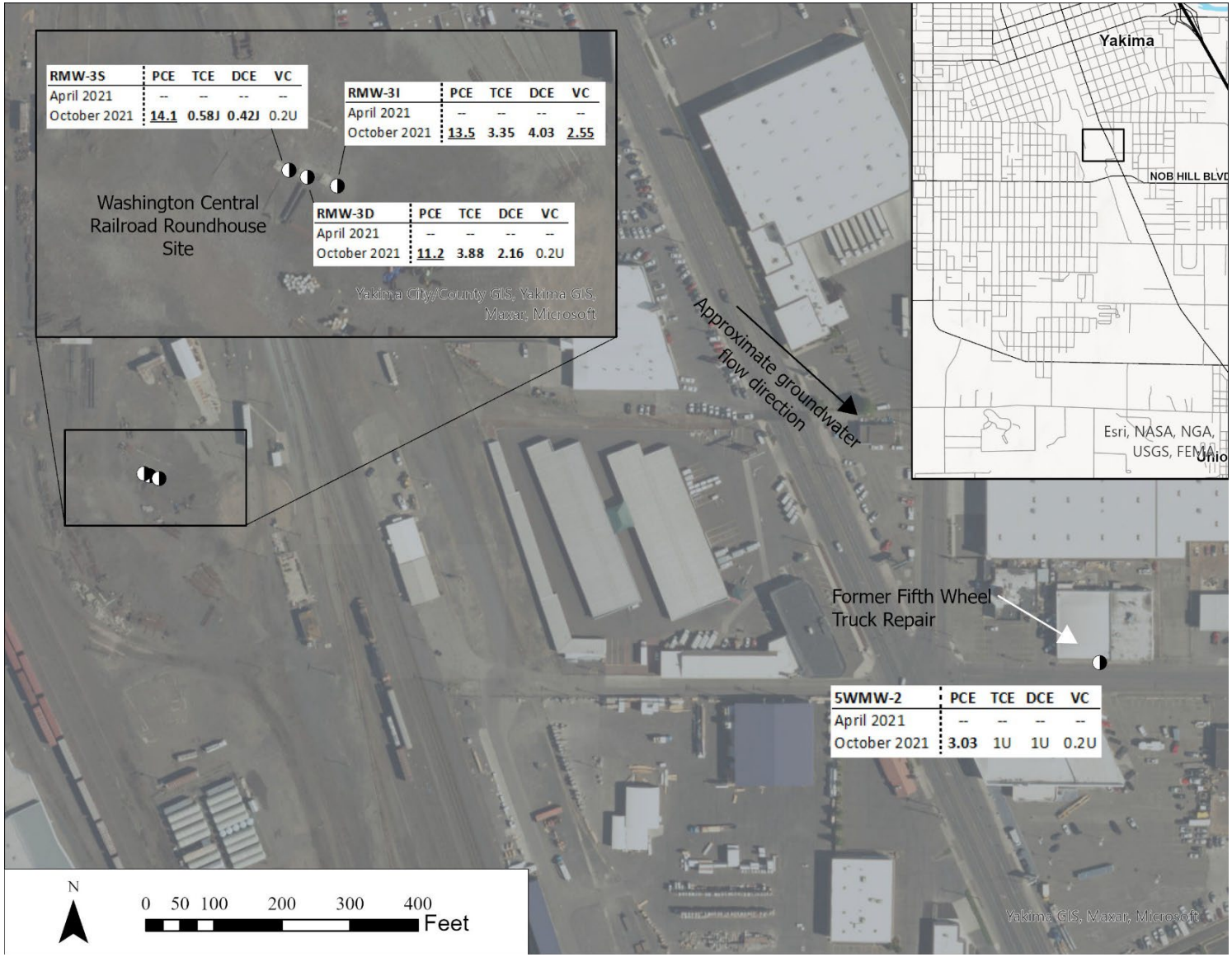

Figure 6. Washington Central Railroad Roundhouse and Fifth Wheel Truck Repair Well Locations and cVOC Results (ug/L), 2021.

5. Fifth Wheel Truck Repair

Fifth Wheel Truck Repair is about 0.3 miles east (cross-gradient) of the WCRR wells (Figure 2). From 1991 to 2001, cleanup activities at this site occurred (Maxim Technologies, 1996).

During 2021, Ecology sampled one downgradient well (5WMW-2) at the site. PCE was detected at a concentration of 3.03 ug/L below the 5 ug/L cleanup level. DCE, TCE, and vinyl chloride were not detected (Figure 4).

The groundwater quality data record for well 5WMW-2 spans from 1999 to the present. During that time, PCE concentrations have ranged from less than 1 ug/L to 11 ug/L, with higher concentrations consistently occurring in the fall. PCE concentrations appear to be gradually decreasing and have not been higher than the 5 ug/L cleanup level since October 2016 (Figure C-14).

6. Cameron Yakima

The Cameron Yakima site is in the central portion of the YRRA, about 0.5 miles southeast (downgradient) of the WCRR wells (Figure 2). Cleanup activities occurred at this site from 1998 to 2001.

During 2021, Ecology collected groundwater samples from 10 wells on the Cameron Yakima site. PCE was detected in all 10 wells at concentrations ranging from 2.09 ug/L in CYIMW103D during April to 9.96 ug/L in CYIMW102S during October (Figure 7). Historical results for the Cameron Yakima monitoring wells are presented in Table C-6 and Figures C-16 – C-28.

TCE and DCE were detected in seven of the 10 wells at concentrations below the applicable reporting limits and were within the range of historical data collected since 1997 (Figure 6, Table C-6).

Vinyl chloride has remained undetected since sampling began in 1997 (Table C-6).

Wells CYIMW106S and CYIMW107S

PCE was detected in both upgradient wells, CYIMW106S and CYIMW107S (Figure 6). During April 2021, PCE was detected in CYMW107S at an estimated concentration of 2.87 B ug/L. This sample result has been qualified (B) because it is associated with a positive detection of PCE in an equipment blank. PCE was not detected in the October 2021 sample from well CYIMW107S.CYIMW106S was sampled only in October. PCE exceeded the cleanup level with a concentration of 6.61 ug/L. TCE and DCE were detected in CYIMW106S, below the 1 ug/L reporting limit.

Since the 2000 cleanup activities, PCE concentrations have been decreasing in these two wells but do not consistently fall below the cleanup level (Figures C-19 and C-20). PCE concentrations are consistently higher in the fall than in the spring for CYIMW106S. No seasonal pattern is seen in CYIMW107S. Consistently elevated PCE concentrations in both upgradient wells may indicate continued groundwater contamination from sources upgradient from the Cameron site.

Wells CYIMW102S, CYIMW103S, and CYIMW103D

These three wells are in the northwest corner of the Cameron site (Figure 6).

In 2021, PCE concentrations in the two shallow wells ranged from 8.06 ug/L in CYIMW103S to 9.96 ug/L in CYIMW102S. PCE in both wells is consistently above the 5 ug/L cleanup level. However, PCE concentrations in these two wells are substantially lower than the levels measured prior to soil removal activities (Figures C-16 and C-17). In September 1999, prior to soil removal, these wells had some of the highest PCE concentrations in the YRRA, at about 72 ug/L (CYIMW102S) and 139 ug/L (CYIMW103S) (Table C-6). Although PCE concentrations continue to exceed the cleanup level in the two shallow wells, post-2006 concentrations of PCE in groundwater are consistently lower, often below 10 ug/L (Figures C-16 and C-17).

PCE was detected at a concentration of 2.09 ug/L in the deep well (CYIMW103D) and has consistently been below the 5 ug/L cleanup level (Figure C-18).

The metabolites TCE and DCE were detected in the shallow wells, CYIMW102S and CYIMW103S, at concentrations below the 1 ug/L reporting limit. None of the PCE metabolites were detected in the deep well, CYIMW103D.

Wells CYIMW108S and CYIMW111S

These two wells are in the northeast corner of the site (Figure 6). During October 2021, PCE concentrations in these wells were below the 5 ug/L cleanup level. PCE was detected at a concentration of 2.91 ug/L in CYIMW108S and 4.85 ug/L in CYIW111S. The metabolites TCE and DCE were detected below the 1 ug/L reporting limit in CYIMW111S. In CYIMW108S, TCE was tentatively identified as below the reporting limit.

PCE concentrations in these two wells have typically been lower than in the other site monitoring wells. In August 1998, PCE in CYIMW108S (Figure C-21) reached a maximum concentration of 7.8 J ug/L and has been between 0.13 J and 5.9 ug/L after source removal, with only two detections above the cleanup level since the 2000 cleanup.

Similarly, PCE concentrations in CYIMW111S (Figure C-24) reached a maximum of 9.4 J ug/L prior to the 2000 cleanup. Concentrations have typically been below the 5 ug/L cleanup level post-source removal, with sporadic exceedances, with the most recent exceedance during October 2009, at a concentration of 5.5 ug/L.

Wells CYIMW112S, CYIMW113S, and CYIMW114S

These three wells (Figures C-25, C-26, and C-28) are on the southeast corner of the property (Figure 6). In 2021, only CYIMW113S and CYIMW114S were sampled. During April 2021, the PCE concentration in CYIMW113S was 7.67 ug/L, above the 5ug/L cleanup level. During October 2021, the PCE concentration in CYIMW114S was 5.5 ug/L near the cleanup level. TCE was detected in CYIMW113S and CYIMW114S at concentrations below the 1 ug/L reporting limit. Well CYIMW112S was not sampled in 2021.

During December 2000 and March 2001, PCE concentrations in wells CYIMW112S, CYIMW113S, and CYIMW114S exceeded the cleanup level, with concentrations ranging from 8 to 11.6 ug/L in CYIMW112S, from 9.8 to 10.3 ug/L in CYIMW113S, and from 15 to 19.1 ug/L in CYIMW114S.

PCE concentrations in these three wells gradually decreased after the 2000 cleanup activities but increased in 2009 and have remained near or above the 5 ug/L cleanup level since (Figures C-25, C-26, and C-28). The elevated PCE concentrations along the downgradient boundary of the site indicate possible off-site migration of the contaminant plume.

Deep well CYIMW113D

Monitoring well CYIMW113D is a deep well paired with the shallow well CYIMW113S. During April 2021, the PCE concentration in this well was 2.71 ug/L, below the 5 ug/L cleanup level. This concentration is slightly below the historical range. During 1998 through 2019, PCE concentrations in this well have remained within an approximate range of 3 to 6 ug/L (Figure C-27). Since March 2001, PCE concentrations have exceeded the cleanup level once, at 6.1 ug/L in June 2011.

Figure 7. Cameron Yakima Well Locations and cVOC Results (ug/L), 2021.

7. Frank Wear Cleaners

In 2017, the Frank Wear Cleaners site was added to the YRRA monitoring program. Frank Wear is located at the northern end of the YRRA project area, about 0.7 miles upgradient of the WCRR wells (Figure 2).

The dry-cleaning facility had a history of dangerous waste violations and was identified as a PCE source to the YRRA in 1991. In 1995, site soils and groundwater were found to be highly contaminated with PCE (Maxim, 1996). In 1995, a series of cleanup activities were initiated: (1) removal of contaminated soil, (2) removal of the Frank Wear building in 2001, (3) installation of a soil vapor extraction (SVE) system in 2012, and (4) installation of a groundwater recirculation system (GRS) in 2014. The SVE unit remains operational, but the GRS was shut down in 2016 due to financial constraints.

During 2021, Ecology collected groundwater samples from 10 of the 24 wells at this site: seven shallow wells and three deep wells (Figure 8).

PCE was detected in all 10 wells at concentrations ranging from an estimated 0.6 to 16,200 ug/L. Additionally, April samples from two deep wells (FWMW-17 and FWMW-19) had no detectable PCE. TCE was detected in eight wells at concentrations ranging from an estimated 0.12 to 1,460 ug/L. DCE was also detected in nine wells at concentrations ranging from 1.29 to 512 ug/L. Vinyl chloride was detected in three at concentrations ranging from 8.86 to 124 ug/L.

Shallow well FWMW-16 and deep well FWMW-17

These two wells are in the northwest corner of the Frank Wear site.

During 2021, PCE and the metabolic breakdown products TCE, DCE, and vinyl chloride were all detected in FWMW-16 during both April and October.

PCE concentrations in FWMW-16 were 34.9 ug/L in April and 39.6 ug/L in October, far above the 5 ug/L cleanup level. The TCE concentration in FWMW-16 was above the 5 ug/L cleanup level during both April (20.1 ug/L) and October (6.63 ug/L). The DCE concentration in FWMW-16 was below the 70 ug/L cleanup level in both April (35.9 ug/L) and October (47.2 ug/L). Vinyl chloride was detected at concentrations far above the 0.2 ug/L cleanup limit in both April (28.2 ug/L) and October (8.86 ug/L).

PCE concentrations in FWMW-16 reached 100 ug/L while the SVE and GRS operated at the site. More recent results are significantly lower (Figure C-37). TCE and vinyl chloride concentrations in FWMW-16 have typically been above their respective cleanup levels since 2016 (Figure C-38). DCE has not been detected in FWMW-16 above the 70 ug/L cleanup limit, but concentrations have been increasing since 2016 (Figure C-38).

During April 2021, PCE was not detected in the deep well FWMW-17. During October 2021, the PCE concentration in FWMW-17 an estimated 0.65 J ug/L, below the 5 ug/L cleanup level. The metabolites TCE, DCE, and vinyl chloride were not detected in FWMW-17 during 2021.

Figure 8. Frank Wear Cleaners Well Locations and cVOC Results (ug/L), 2021.

Well FWMW-5 and Well FWMW-6

Wells FWMW-5 and FWMW-6 are also located in the northwest edge of the Frank Wear Cleaners site. During 2021, PCE concentrations in FWMW-5 were below the 5 ug/L cleanup level, ranging from 1.99 ug/L in October to 2.74 ug/L in April. TCE in FWMW-5 was detected at estimated concentrations below the reporting limit during both April and October 2021. DCE was detected only during April 2021 at a concentration of 1.38 ug/L far below the 70 ug/L cleanup level. Vinyl chloride was not detected in FWMW-5 during 2021.

PCE concentrations in FWMW-6 were below the 5 ug/L cleanup limit at a concentration of 2.34 ug/L in April 2021, but above the cleanup limit in October at a concentration of 5.33 ug/L.

TCE concentrations in FWMW-6 did not exceed the 5 ug/L cleanup limit during 2021. TCE was not detected in the sample collected in April. In October, TCE was detected at a concentration of 1.57 ug/L. DCE concentrations in FWMW-6 did not exceed the 70 ug/L cleanup limit during 2021. DCE was not detected in the sample collected in April. In October, TCE was detected at a concentration of 3.14 ug/L. Vinyl chloride was not detected in FWMW-6 during 2021.

Prior to 2018, concentrations of metabolic breakdown products TCE, DCE, and vinyl chloride in FWMW-5 and FWMW-6 exceeded the applicable cleanup levels (Table C-7). More recently, results for these metabolites have been either non-detect or below 5 ug/L. In 2014, monitoring data show a spike in contaminant concentrations in both FWMW-5 (Figures C-40, C-41) and FWMW-6 (Figures C-42, C-43), which may be associated with the operation of the GRS.

Deep Well FWMW-19 and Shallow Well FWMW-20

These two wells are located in the adjacent parking lot to the south of the former dry-cleaning facility. The shallow well FWMW-20 consistently has elevated concentrations of PCE and metabolic breakdown products that exceed the applicable cleanup levels (Figures C-39 and C-40). The 2021 concentrations were the highest detected in the YRRA.

PCE concentrations in FWMW-20 were far above the 5 ug/L cleanup level during all of 2021. The PCE concentration was 10,100 ug/L in April and 16,200 ug/L in October. TCE concentrations were 1,460 ug/L in April, and 657 ug/L in October. These concentrations are far above the cleanup level of 5 ug/L. DCE concentrations were 512 ug/L in April and 268 ug/L in October, far above the 70 ug/L cleanup level. In April, the vinyl chloride concentration was 124 ug/L, and in October the concentration was an estimated 98.9J ug/L. These values are far above the 0.2 ug/L cleanup level.

FWMW-19 is completed in the lower aquifer and has low concentrations of PCE that generally do not exceed the applicable cleanup levels (Table C-8).

PCE was tentatively detected at an estimated concentration of 0.6 NJ ug/L in October 2021. PCE was not detected in this well during April 2021. TCE, DCE, and vinyl chloride were not detected during 2021.

Wells FWMW-4 and FWMW-24

These two wells are about 265 feet (FWMW-4) and 640 feet (FWMW-24) downgradient from the former dry-cleaning facility (Figure 8).

During April 2021, the PCE concentration in FWMW-4 was 26.1 ug/L, above the 5 ug/L cleanup level. During October 2021, the PCE concentration was 4.89 ug/L, just below the cleanup level.

The metabolic breakdown products TCE and DCE were both detected below the applicable cleanup levels during April 2021. No breakdown products were detected in October 2021.

FWMW-24 is the furthest downgradient well at the Frank Wear site. PCE concentrations were far above the 5 ug/L cleanup level during both April 2021 (34.9 ug/L) and October 2021 (63.3 ug/L). TCE and DCE were detected at concentrations below the applicable cleanup limits in both April and October. Vinyl chloride was not detected in FWMW-24 during 2021.

Wells FWMW-10 and FWMW-18

These two wells are located on the north wall of the former dry-cleaning facility (Figure 8).

FWMW-10 consistently has some of the highest concentrations of PCE and breakdown products (Table C-7, Figures C-35 and C-36). During 2021, PCE concentrations in FWMW-10 ranged from 5,600 ug/L in April to 6,270 ug/L in October, far above the 5 ug/L cleanup level. TCE concentrations were far above the 5 ug/L cleanup level during both April (434 ug/L), and October (192 ug/L). The DCE concentration was 118 ug/L in April, above the 70 ug/L cleanup level. In October, the DCE concentration was an estimated 69.4J ug/L, just below the cleanup level. Vinyl chloride concentrations were far above the 0.2 ug/L cleanup limit in both April (54.8 ug/L) and October (62.3J ug/L).

FWMW-18 is completed in the deeper water bearing zone and typically has PCE concentrations below the 5 ug/L cleanup limit (Table C-8). PCE concentrations in this well were 2.81 ug/L in April 2021 and an estimated 1.4J ug/L in October 2021, below the 5 ug/L cleanup level. TCE was detected below the reporting limit in both April and October. DCE and vinyl chloride were not detected in FWMW-18.

Operation of the remediation systems appears to have substantially reduced contaminant concentrations at the site. During the operation of the GRS, consultants from Hart Crowser (2015) noted that there was evidence that PCE had been mobilized from the soil matrix, and that reducing conditions had been propagated to enhance reductive de-chlorination of cVOCs in groundwater and soil beneath the site.

Despite significant improvement in groundwater quality achieved with remedial action, high concentrations of PCE, TCE, and vinyl chloride remain present in the shallow onsite wells and the downgradient off-site wells. Concentrations of cVOCs in groundwater beneath the site continue to exceed the applicable cleanup levels. Additionally, monitoring data indicate that the PCE plume extends beyond the boundaries of the YRRA monitoring network, and the full extent of groundwater contamination from the site is not fully delineated.

YRRA Remedial Investigation Wells

During 2021, nine Remedial Investigation (RI) wells were sampled: seven shallow and two deep. Ecology installed these RI wells throughout the YRRA to determine the extent of PCE contamination in groundwater away from known source areas. These RI wells were installed as shallow and deep pairs to characterize groundwater quality in the upper and lower water-bearing zones. Nine wells were selected for continued monitoring; these are primarily located along the western and southern edges of the YRRA (Figure 2).

During 2021n PCE was detected in all nine RI wells. In two of the nine wells (RI-4S and RI-6S), PCE concentrations were above the 5 ug/L cleanup level. Concentrations ranged from an estimated 0.21J ug/L in RI-3S to 12.6 ug/L in RI-4S (Figure 9).

Well RI-3S

RI-3S is the farthest upgradient RI well currently being sampled (Figure 9).

During April 2021, PCE was detected in this well at an estimated concentration of 0.21J ug/L, below the reporting limit of 1 ug/L. Low concentrations of PCE (ranging from 0.2 to 2.5 ug/L) have been detected in this well since monitoring began in 1999 (Figure C-43). Because PCE is not naturally occurring, the data indicate that a low-level source of PCE is contaminating the shallow aquifer at the upgradient end of the YRRA study area.

Wells RI-4S and RI-4D

These two wells are located along the western boundary of the YRRA (Figure 9).

RI-4S continues to have the highest PCE concentrations of the RI wells, and consistently has concentrations above the 5 ug/L cleanup level (Table C-9, Figure C-44). During April 2021, the PCE concentration in RI-4S was 12.6 ug/L.

During April, PCE was also detected in the deep well (RI-4D) at 1.76 ug/L.

Although concentrations have been fairly stable since 2018, they appear to have increased since 2009 (Figure C-45). The source of contamination in these wells is uncertain. Data from these wells indicate that the western extent of the YRRA PCE plume is still undefined.

Wells RI-5S and RI-5D

These two wells are in a residential area, about 0.7 miles southeast (downgradient) of RI-4S and RI-4D (Figure 9).

During April 2021, PCE was detected in both wells at concentrations below the 5 ug/L cleanup level. PCE was detected at a concentration of 3.11 ug/L in the shallow well RI-5S and 1.34 ug/L in the deep well RI-5D. Concentrations in both wells generally increased between 2009 and 2017. Since 2017, PCE concentrations have decreased in RI-5S and remained fairly stable in RI-5D (Figures C-46 and C-47). Because these wells are in a residential area, the low PCE levels are most likely from an upgradient source.

Well RI-6S

This well is in the southeast portion of the YRRA project area (Figure 9).

PCE continues to be detected above the 5 ug/L cleanup level, with an estimated concentration of 7.75J ug/l during October 2021. PCE concentrations have a seasonal pattern with higher concentrations occurring in the fall (Figure C-48). Currently, there is no known source for the contamination in this well. The extent of PCE contamination in the shallow aquifer needs to be better characterized in this portion of the YRRA.

Wells RI-9S, RI-10S, and RI-11S

These three wells are at the southern boundary of the YRRA study area and are the farthest downgradient wells being sampled (Figure 9) during 2021.

These wells continue to have low levels of PCE below the 5 ug/L cleanup level. During 2021, concentrations in these wells ranged from 1.13 to 1.41 ug/L (Figure C-49, C-50, C-51). TCE was tentatively identified in RI-9S at an estimated concentration of 0.47NJ ug/L. No other metabolic breakdown products were detected in these wells during 2021.

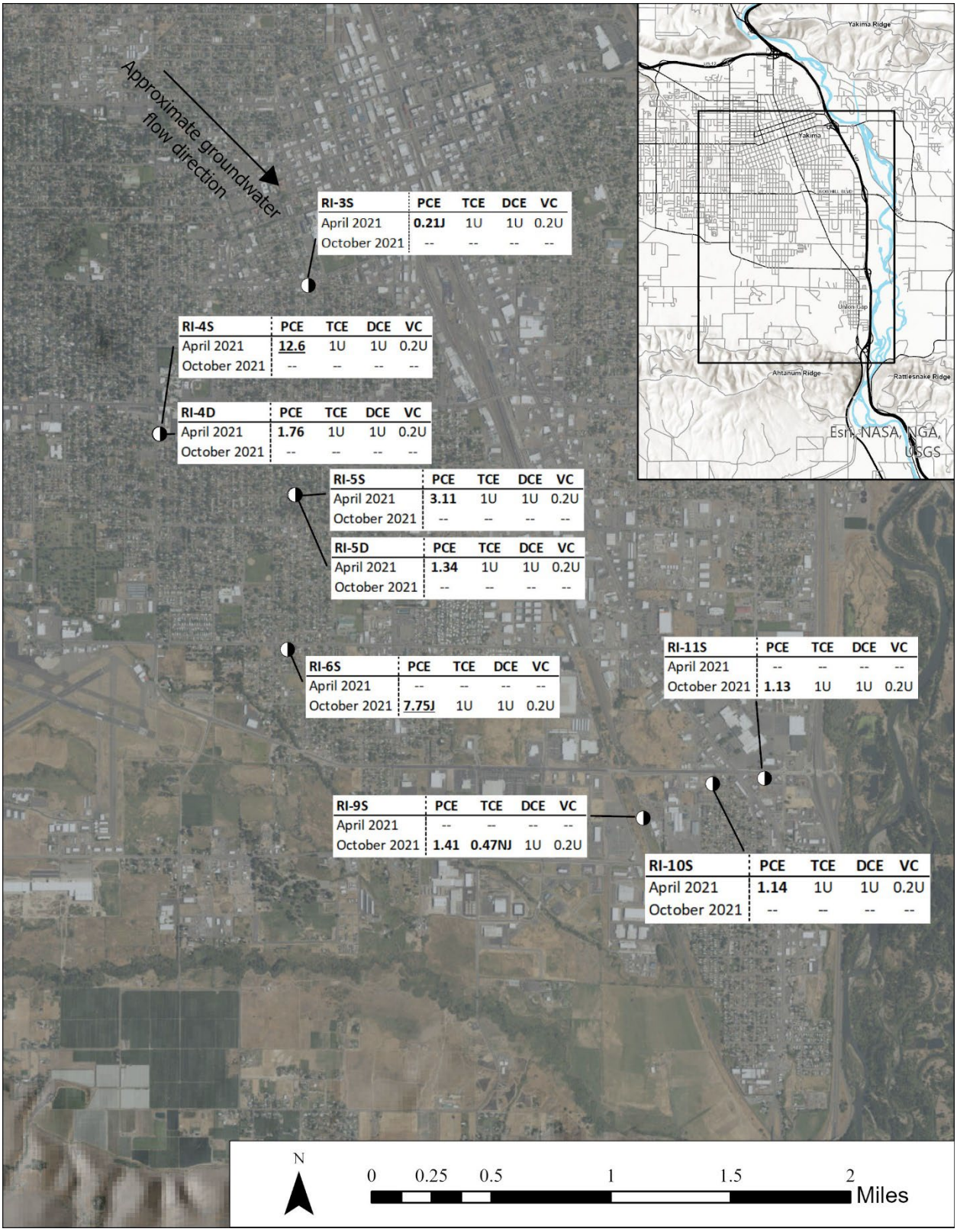

Figure 9. YRRA Remedial Investigation Well Locations and cVOC Results (ug/L) 2021.

Summary

Of the 40 wells sampled during 2021, 17 (42%) had PCE concentrations above the MTCA Method A cleanup level of 5 ug/L. Wells with PCE concentrations higher than the cleanup level were located at six sites: Goodwill, Frank Wear Cleaners, Washington Central Railroad Roundhouse (WCRR), and Cameron Yakima as well as two Remedial Investigation wells (RI-4S and RI-6S) located along the western edge of the YRRA study area.

Table 3 summarizes the maximum annual PCE concentrations at each site during 2021. Most of the wells with elevated PCE are screened in the shallow, water-bearing zone, ranging in depth from 26 to 40 feet below ground surface (bgs). The maximum PCE concentrations in these wells ranged from 5 to 16,200 ug/L.

The Frank Wear Cleaners site, added to the monitoring program in 2017, has the highest concentrations of PCE, TCE, DCE, and vinyl chloride in the YRRA. This site continues to be a significant source of cVOC contamination in groundwater across the study area.

At the WCRR site, PCE, TCE, DCE, and vinyl chloride have been consistently detected. Contamination is present in all three wells (shallow, intermediate, and deep).

At the Cameron Yakima site, PCE breakdown products were observed at concentrations below the MTCA cleanup levels.

Monitoring data from the Frank Wear, WCRR, and Cameron wells confirm that the shallow groundwater in the central portion of the YRRA remains contaminated with PCE. It is not clear whether the contaminant plumes are separate or co-mingled.

Table 3. Summary of 2021 Cleanup Level Exceedances.

Site	Well	April PCE	April TCE	April DCE	April VC	Oct. PCE	Oct. TCE	Oct. DCE	Oct. VC
Cameron Yakima	CYIMW102S	--	--	--	--	**9.96**	**0.92J**	**0.61J**	0.2U
	CYIMW103S	**8.06**	**0.72J**	**0.65NJ**	0.2U	**8.99**	**0.59J**	**0.28J**	0.2U
	CYIMW106S	--	--	--	--	**6.61**	**0.34J**	**0.16J**	0.2U
	CYIMW113S	**7.67**	**0.58J**	1U	0.2U	--	--	--	--
	CYIMW114S	--	--	--	--	**5.5**	**0.27J**	1U	0.2U
Frank Wear Cleaners	FWMW-4	**26.1**	**1.89**	**44.6**	0.2U	**4.89**	**0.11J**	1U	0.2U
	FWMW-6	**2.34**	1U	1U	0.2U	**5.33**	**1.57**	**3.14**	0.2U
	FWMW-10	**5600**	**434**	**118**	**54.8**	**6270**	**192**	**69.4J**	**62.3J**
	FWMW-16	**34.9**	**20.1**	**35.9**	**28.2**	**39.6**	**6.63**	**47.2**	**8.86**
	FWMW-20	**10100**	**1460**	**512**	**124**	**16200**	**657**	**268**	**98.9J**
	FWMW-24	**34.9**	**3.65**	**4.37**	0.2U	**63.3**	**2.19**	**1.29**	0.2U
Goodwill	GMW-2	**0.78J**	1U	1U	0.2U	**5.4**	1U	1U	0.2U
WCRR	RMW-3D	--	--	--	--	**11.2**	**3.88**	**2.16**	0.2U
	RMW-3I	--	--	--	--	**13.5**	**3.35**	**4.03**	**2.55**
	RMW-3S	--	--	--	--	**14.1**	**0.58J**	**0.42J**	0.2U
RI Wells	RI-4S	**12.6**	1U	1U	0.2U	--	--	--	--
	RI-6S	--	--	--	--	**7.75J**	1U	1U	0.2U
Cleanup Level (ug/L)		*5*	*5*	*70*	*0.2*	*5*	*5*	*70*	*0.2*

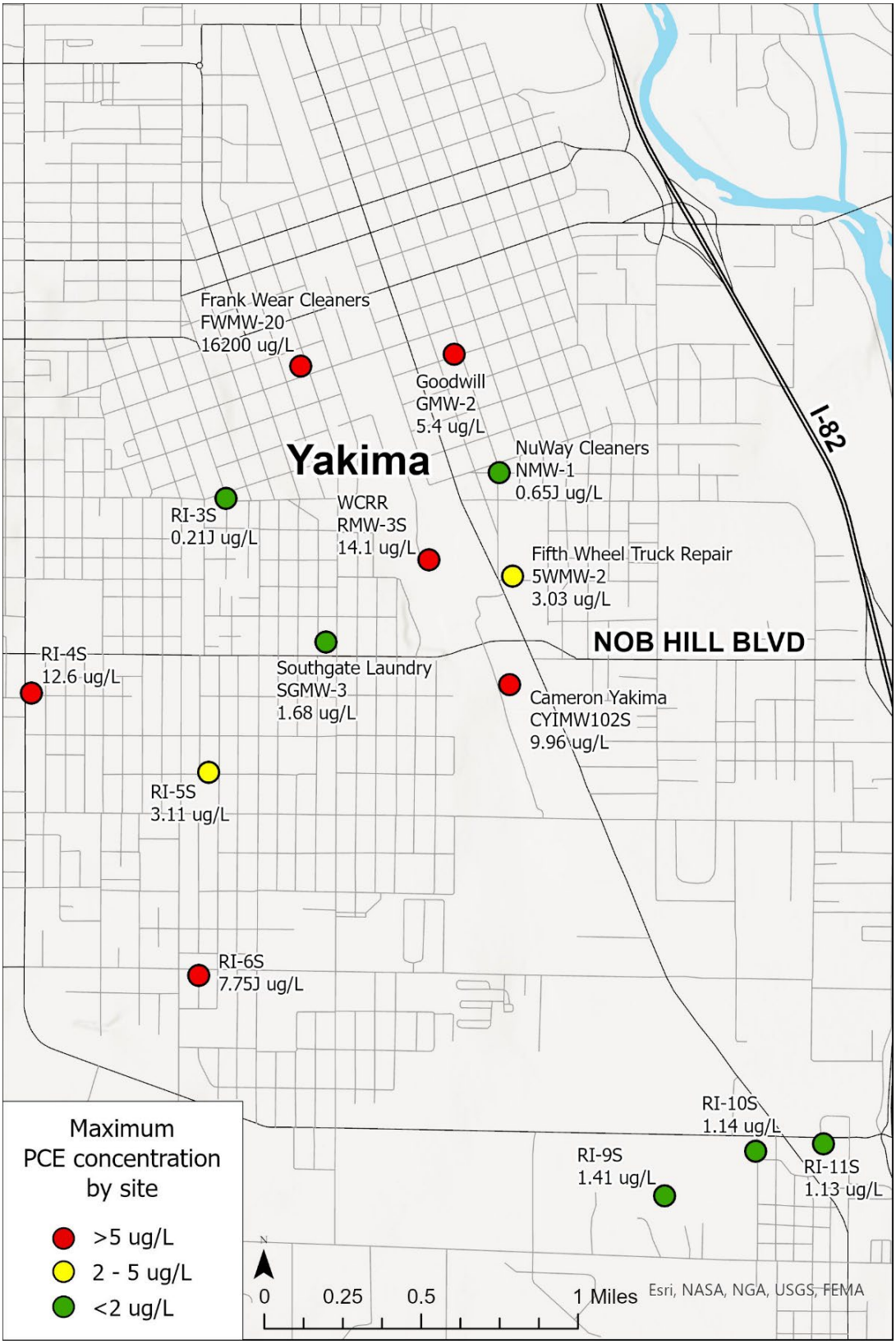

Figure 10. Shallow Zone Maximum PCE Concentrations by site, 2021

Conclusions

Dissolved tetrachloroethene (PCE) remains present in the shallow, unconfined aquifer throughout the Yakima Railroad Area (YRRA) project area. Remediation performed at individual sites over the years appears to have been effective in reducing contaminant concentrations in groundwater at many of the identified source areas; however, there continue to be areas where contaminant concentrations are higher than (exceed) the established MTCA cleanup levels.

There have been 59 wells in this long-term YRRA monitoring program.

- In 2013, Ecology selected a subset of 36 wells for continued monitoring. Wells were removed from the active monitoring program if they consistently showed low or no detections of the contaminants of concern, primarily PCE.
- In 2017, the network of 36 wells was augmented with an additional 10 wells at the Frank Wear site, and two wells were discontinued: (1) a well at Agri-Tech, a former pesticide formulations plant, and (2) a well at the Nu-Way Cleaners site that was decommissioned in 2016.

During 2021, Ecology collected groundwater samples from 40 of the 44 wells that remain in the monitoring network. The selected subset of wells continues to provide data to evaluate groundwater conditions throughout the YRRA project area.

Existing Cleanup Sites

A total of 35 of the 44 wells that remain in the monitoring network are associated with seven identified source areas.

- Six of the source areas – Goodwill, Nu-Way Cleaners, Southgate Laundry, Fifth Wheel, Cameron Yakima, and Frank Wear Cleaners – have undergone some level of remedial action to address PCE contamination. Remediation at these sites appears to have reduced the impact or eliminated sources of PCE contamination in groundwater.

  Three of those six source sources areas – Nu-Way Cleaners, Southgate Laundry, and Fifth Wheel – have consistently had PCE concentrations below the 5 ug/L cleanup level in recent years. The last time PCE was detected above the cleanup level at Southgate Laundry was in 2005. At Nu-Way cleaners, PCE has not been above the cleanup level since June 2011. And at Fifth Wheel, PCE was last detected above the cleanup level in October 2016, though in October 2018, the PCE concentration was 5 ug/L, the same as the cleanup level.

- At the seventh source area – Washington Central Railroad Roundhouse (WCRR) – there is no record of any direct remediation. The three wells at this site were installed as a well cluster of varying depths.

  PCE concentrations in the WCRR shallow and deep wells indicate that the contaminant plume has a vertical component that reaches the deep water-bearing zone in this portion of the YRRA. Also present in the two deeper wells are PCE metabolic breakdown products, including TCE and DCE, that are typically detected at concentrations above the cleanup level. The WCRR site continues to act as a significant source of groundwater contamination by cVOCs that include the deeper portions of the aquifer system.

In 2017, the Frank Wear Cleaners site was added to the YRRA monitoring program. Ecology collected groundwater samples from 10 of the 24 site wells, seven shallow wells and three deep wells. Although in-situ remediation at the site has reduced the contaminant mass, this site continues to be a substantial source of PCE contamination to the YRRA project area. PCE metabolic breakdown products also occur at concentrations above the associated cleanup levels. Elevated cVOC concentrations in both the shallow onsite and downgradient off-site wells indicate that the full extent of the plume beyond the monitoring well network is still unknown. cVOCs were detected at concentrations near or below the reporting limit in two of the deep wells, suggesting limited vertical migration.

The 2021 monitoring data show that the highest contaminant concentrations continue to occur in the central portion of the YRRA, at Frank Wear Cleaners, WCRR, and Cameron Yakima. Although cleanup activities have occurred at two of these locations, the lateral and vertical extent of the contaminant plume is still poorly defined. Further investigation is needed at these three sites to determine the full extent of the PCE plumes and whether the plumes have comingled.

Remedial Investigation Wells

In 1997, 29 wells were installed for the YRRA Remedial Investigation (RI). These RI wells were installed as shallow and deep pairs at 15 locations throughout the YRRA project area to characterize aquifer properties and to determine the lateral and vertical extent of PCE contamination in groundwater.

Nine RI wells, RI-10S, RI-11S, RI-3S, RI-4D, RI-4S, RI-5D, RI-5S, RI-6S, and RI-9S, are currently included in the monitoring program. These are primarily located along the western and southern boundaries of the YRRA.

- In seven of the nine RI wells, PCE was detected at concentrations below the MTCA cleanup level. Because PCE is not naturally occurring, the low concentrations detected in these wells indicate low-level sources of PCE exist and are contributing to the contamination in the YRRA.
- The other two wells, RI-4S and RI-6S, located on the western edge of the YRRA, consistently have elevated PCE concentrations above the 5 ug/L cleanup level. The sources of PCE contamination in these wells are still unknown and require remedial action.

Contaminant Impacts to Deep Water-Bearing Zones

During 2021, nine of the 40 wells sampled in the YRRA project area are screened in the deeper zone (60 -120 feet bgs). Only two deep wells (WDOE-3I and WDOE-3D) have contaminant concentrations that are higher than (exceed) the MTCA cleanup level.

PCE concentrations in the seven other deep wells are consistently below the cleanup levels and have remained fairly constant over the 1997-2021 monitoring period. Three of these seven wells are located at the Frank Wear Cleaners site, two are at the Cameron Yakima site, and two are RI wells on the western boundary of the YRRA.

Recommendations

Because groundwater within the Yakima Railroad Area (YRRA) project area continues to be contaminated by both identified and unidentified sources, cleanup activities and investigations continue to be conducted across the area.

Based on the 2021 monitoring results for the YRRA, the following recommendations are provided:

- Additional investigations should continue at sites where the full lateral and vertical extent of the contamination plume is poorly defined: Washington Central Railroad Roundhouse, Cameron Yakima, and Frank Wear Cleaners.
- Investigation should continue into the sources of PCE contamination detected in Remedial Investigation wells RI-4S/4D and RI-6S on the western edge of the project area.
- A detailed study of water-level data over the course of an entire year may identify changes to the approximate groundwater flow direction assumed over the project area. Variation of the hydrologic gradient, either spatially or over time, may identify contaminant transport to areas not currently monitored in the project area.
- PCE concentrations at several sites, including Nu-Way Cleaners, Southgate Laundry, and Fifth Wheel, have recently been consistently below the cleanup level. Removing some, or all, of the wells associated with these sites may improve the cost-effectiveness of this project.
- Data from the Frank Wear Cleaners site should be evaluated for seasonal patterns in concentrations. Wells that exhibit strong seasonal variation may be reduced to annual sampling during the season when contaminant concentrations are highest.
- Based on seasonally fluctuating PCE concentrations, monitoring of the well network within the project area should continue.

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Glossary, Acronyms, and Abbreviations

Glossary

Analyte: Water quality constituent being measured (parameter).

Conductivity: A measure of water's ability to conduct an electrical current. Conductivity is related to the concentration and charge of dissolved ions in water.

Dissolved oxygen: A measure of the amount of oxygen dissolved in water.

Groundwater: Water in the subsurface that saturates the rocks and sediment in which it occurs. The upper surface of groundwater saturation is commonly termed the water table.

Method Detection Limit: This definition for detection was first formally advanced in 40CFR 136, October 26, 1984 edition. MDL is defined there as the minimum concentration of an analyte that, in a given matrix and with a specific method, has a 99% probability of being identified, and reported to be greater than zero. (Federal Register, October 26, 1984).

Oxidation-reduction Potential: A measure of the oxidizing or reducing potential of water. Values greater than 0 indicate oxidizing conditions. Values less than zero indicate reducing conditions.

Parameter: Water quality constituent being measured (analyte). A physical, chemical, or biological property whose values determine environmental characteristics or behavior.

pH: A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

Reporting limit: The minimum value of the calibration range. Analyte detections between the method detection limit and the reporting limit are reported as having estimated concentrations.

Specific conductance: A measure of water's ability to conduct an electrical current. Specific conductance is related to the concentration and charge of dissolved ions in water.

Unconfined aquifer: An aquifer containing water that is not under pressure; the water level in a well is the same as the water table outside the well.

Acronyms and Abbreviations

DCE	Cis-1,2-dichloroethene
Dup	Duplicate
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
FS	Feasibility study
GRS	Groundwater recirculation system
LDPE	Low Density Polyethylene

MEL	Manchester Environmental Laboratory
MSL	Mean Sea Level
MTCA	Model Toxics Control Act
MQO	Measurement Quality Objective
MW	Monitoring well
ORP	Oxidation-reduction potential
PCE	Tetrachloroethene
PVC	Polyvinyl chloride
RI	Remedial investigation
RPD	Relative percent difference
SOP	Standard operating procedure
SVE	Soil vapor extraction
TCE	Trichloroethene
TOC	Top of casing
USGS	U.S. Geological Survey
VC	Vinyl chloride
VOA	Volatile Organic Analysis
cVOC	chlorinated Volatile Organic Compounds
WAC	Washington Administrative Code
YRRA	Yakima Railroad Area (the project area)

Units of Measurement

°C	degrees centigrade
ft	feet
mg/L	milligrams per liter
mV	milli volts
s.u.	standard units
ug/L	micrograms per liter (parts per billion)
umhos/cm	micromhos per centimeter
uS/cm	microsiemens per centimeter, a unit of conductivity

Appendices

The following Appendices are linked to this report at https://apps.ecology.wa.gov/publications/SummaryPages/2303012.html.

Appendix A. Well Construction Details and Field Measurement Data

Appendix B. Quality Assurance Review

Appendix C. Project Results, December 1997 – October 2021