

# Hanford Site RCRA Groundwater Quarterly Report for July through September 2019

Prepared for the U.S. Department of Energy  
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy  
under Contract 89303320DEM000030



**P.O. Box 1464  
Richland, Washington 99352**

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**APPROVED**

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Release Approval

Date

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## Terms

RCRA	<i>Resource Conservation and Recovery Act of 1976</i>
QC	quality control
WMA	waste management area

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## 1 Introduction

This report provides quarterly determinations of the concentration, rate of migration, and extent of dangerous waste constituents in groundwater at six single-shell tank waste management areas (WMAs). The report is based on the requirements for interim status facilities, as defined by the *Resource Conservation and Recovery Act of 1976* (RCRA), with regulations promulgated by the Washington State Department of Ecology in the *Washington Administrative Code* and the *Code of Federal Regulations* by reference (WAC 173-303-400, “Dangerous Waste Regulations,” “Interim Status Facility Standards”; 40 CFR 265, “Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities,” Subpart F, “Ground-Water Monitoring”). Under 40 CFR 265.93(d)(7)(i), “Preparation, Evaluation, and Response,” units monitored under groundwater quality assessment programs that have determined dangerous waste has entered the groundwater must determine the rate and extent of migration and the concentrations of the identified waste on a quarterly basis. This report presents results for July through September 2019.

The WMAs in this report (Figures 1 and 2) include the inactive single-shell tank farms at the Hanford Site that are part of an interim status dangerous waste management unit within Revision 8c of WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*. Groundwater monitoring plans for each WMA (Table 1) provide specific information on the monitoring networks and sampling programs. The WMAs and their associated dangerous waste constituents in groundwater are identified as follows:

- 200 East Area
  - WMA B-BX-BY – cyanide
  - WMA C – cyanide
- 200 West Area
  - WMA S-SX – chromium<sup>1</sup>
  - WMA T – chromium<sup>1</sup>
  - WMA TX-TY – chromium<sup>1</sup>
  - WMA U – chromium<sup>1</sup>

Other Hanford Site RCRA units monitored under assessment programs during the reporting quarter (216-A-29 Ditch, Nonradioactive Dangerous Waste Landfill, and WMA A-AX) are not included in this report because they were still in the “first determination” phase during the reporting quarter.

For each WMA, this report provides summary information of the well network, quarterly sample results of the associated dangerous waste constituent, a discussion of the extent of contamination, and an estimate of the rate and direction of contaminant migration. The rate of contaminant migration is assumed to equal the rate of groundwater flow because cyanide and hexavalent chromium (Cr(VI)) are highly mobile in groundwater.

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<sup>1</sup> Total chromium is the dangerous waste constituent specified in the assessment plans, and hexavalent chromium is a supporting constituent. Although total chromium and hexavalent chromium are analyzed by different methods, dissolved chromium in Hanford Site groundwater is almost entirely hexavalent, so filtered total chromium data effectively represent hexavalent chromium concentrations. Both types of data were used to create the plume maps included in this report. Unfiltered samples may include particulate chromium, which is typically not hexavalent. This report lists the specific type of analytical data required by the groundwater monitoring plans.

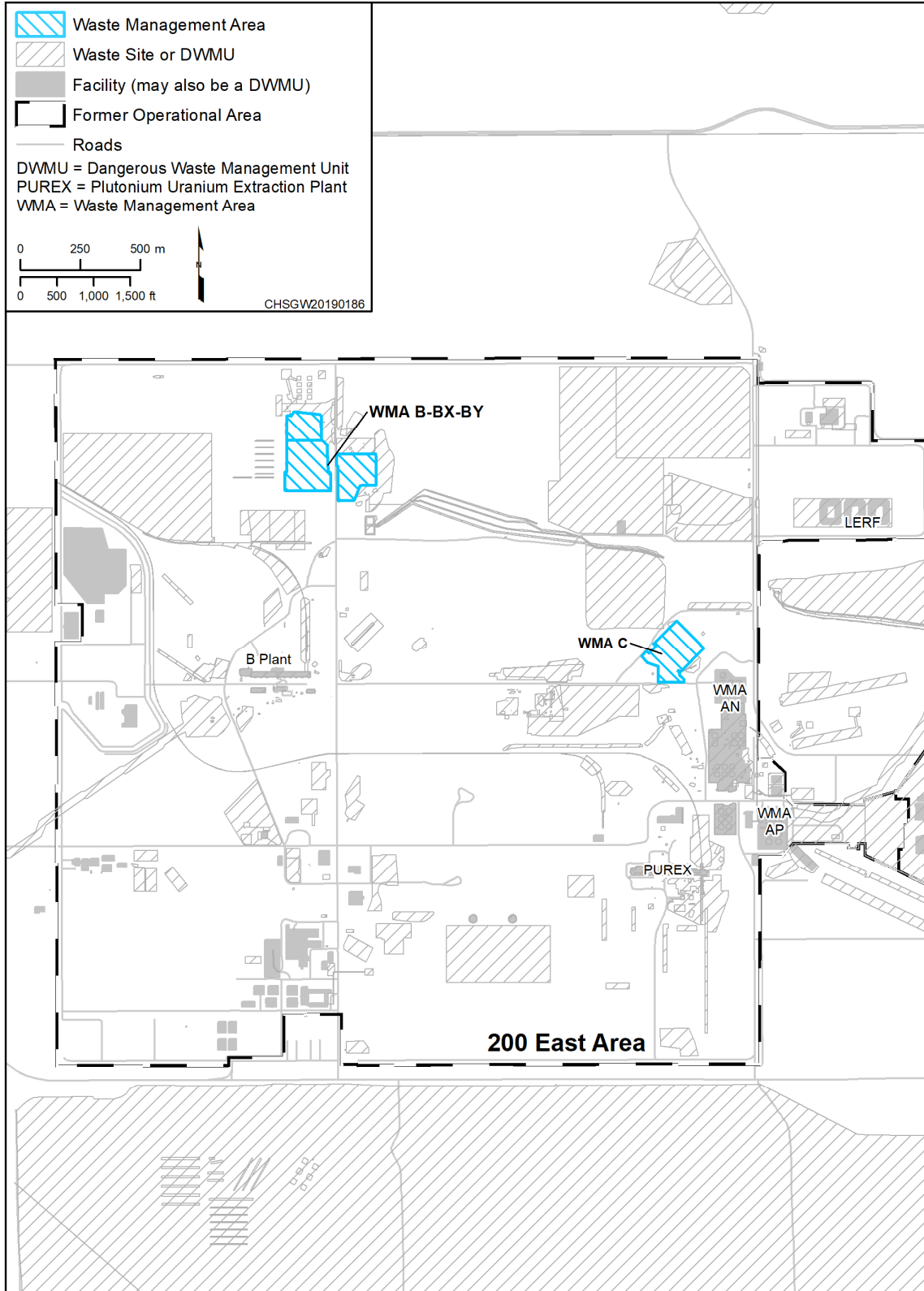


Figure 1. 200 East Area WMAs

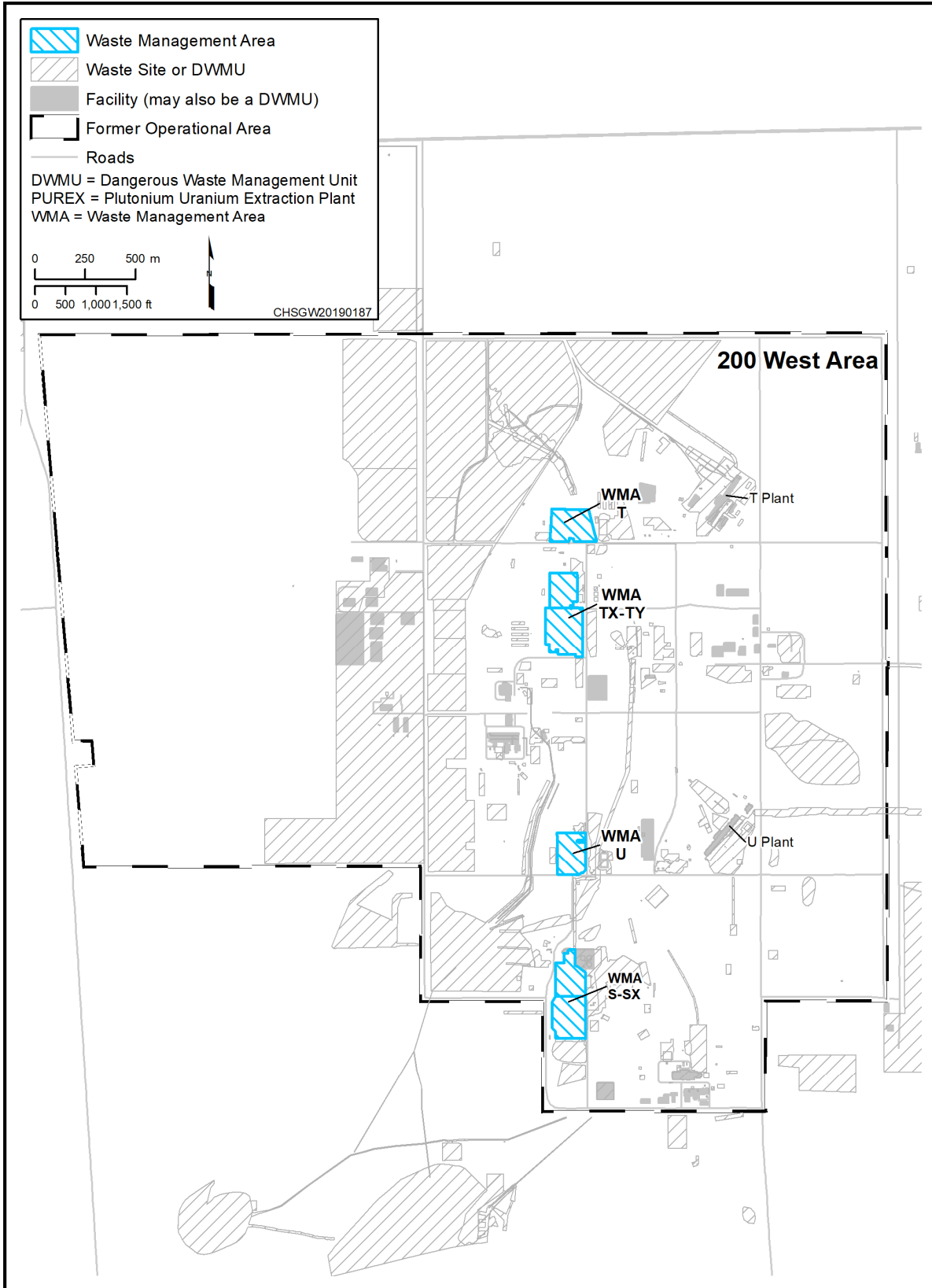


Figure 2. 200 West Area WMAs

**Table 1. Groundwater Monitoring Plans and Engineering Evaluation Reports  
Associated with Single-Shell Tank WMAs**

WMA	Groundwater Quality Assessment Monitoring Plan	Engineering Evaluation Report for Groundwater Monitoring
<b>200 West Area</b>		
WMA S-SX	DOE/RL-2009-73, Rev. 1	SGW-60577
WMA T	DOE/RL-2009-66, Rev. 2	SGW-60575
WMA TX-TY	DOE/RL-2009-67, Rev. 2	SGW-60576
WMA U	DOE/RL-2009-74, Rev. 2	SGW-60578
<b>200 East Area</b>		
WMA B-BX-BY	DOE/RL-2012-53, Rev. 1	SGW-60587
WMA C	DOE/RL-2009-77, Rev. 1	SGW-60588

Note: Complete reference citations are provided in Chapter 8.

WMA = waste management area

A suite of groundwater monitoring engineering evaluation reports (Table 1) was prepared to support the Part B (final status) permit application for the future Revision 9 of WA7890008967. The engineering evaluation reports contain comprehensive background information as well as the geology, hydrogeology, and conceptual contaminant migration models.

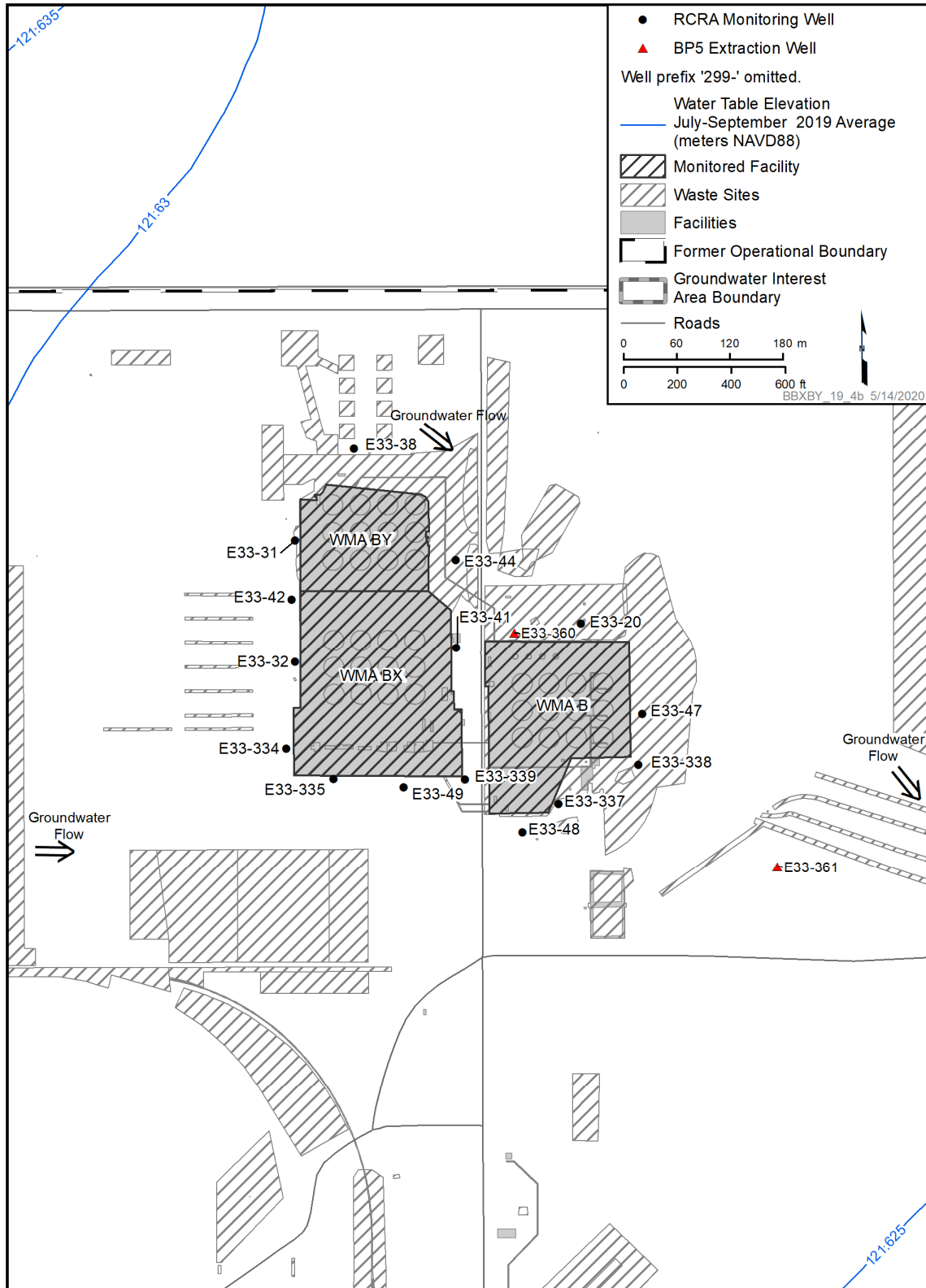
## 2 Waste Management Area B-BX-BY

WMA B-BX-BY, which includes the single-shell tanks and ancillary equipment of the 241-B, 241-BX, and 241-BY Tank Farms, is located in the north-central portion of the 200 East Area (Figure 1). Figure 3 presents the monitoring network with a water table map.

Previous releases from WMA B-BX-BY, along with the other waste sites, have contributed to groundwater contamination with the dangerous waste constituent cyanide. The WMA is monitored under DOE/RL-2012-53, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area B-BX-BY*. Table 2 lists July through September 2019 sampling results for cyanide at WMA B-BX-BY.

Evaluation of July through September 2019 water levels indicates that groundwater beneath WMA B-BX-BY flowed to the southeast at 0.15 m/d (0.49 ft/d) (ECF-HANFORD-19-0132, *Hydraulic Gradient and Average Linear Groundwater Velocity Calculation - Quarter 3 Calendar Year 2019*). The impacts of extraction wells 299-E33-360 and 299-E33-361, which operate adjacent to WMA B-BX-BY (Figure 3), are not easily discerned from water-level data alone because the hydraulic gradient is so low ( $2 \times 10^{-6}$  during the reporting quarter). Computer modeling and groundwater chemistry data indicate the extraction wells capture groundwater contaminants at WMA B-BX-BY.

Figure 4 illustrates the 2018 interpretation of the cyanide plume. During the reporting quarter, cyanide concentrations were within previously established ranges (Table 2). In most wells, concentrations were about the same in August as in May 2019. However, concentrations increased 29% in well 299-E33-38 and 17% in well 299-E33-47 between May and August. With continued groundwater extraction from well 299-E33-360, the cyanide plume is expected to decrease in size.



Reference: ECF-200E-19-0130, *Groundwater Elevation Mapping for 200 East Area - Quarter 3 Calendar Year 2019.*

**Figure 3. WMA B-BX-BY Monitoring Well Network and July-September 2019 Water Table**

**Table 2. WMA B-BX-BY Sample Results for July-September 2019**

Well Name	Sample Date	Cyanide (Total) (µg/L)	Comment
299-E33-20 <sup>a,b</sup>	8/19/2019	80.4	
		79.3	Duplicate sample
299-E33-31 <sup>a</sup>	8/19/2019	41.3	
		42.8	Duplicate sample
299-E33-32 <sup>a</sup>	8/19/2019	16.3	
299-E33-38	8/20/2019	324 D	
299-E33-41	8/21/2019	17.7	
299-E33-42 <sup>a</sup>	8/20/2019	32.2	
299-E33-44	8/20/2019	999 D	
		894 D	Duplicate sample
299-E33-47	8/16/2019	795 D	
299-E33-48	8/16/2019	3.17 B	
299-E33-49	8/16/2019	3.94 B	
299-E33-334 <sup>a</sup>	8/20/2019	6.51	
299-E33-335	8/16/2019	5.03	
299-E33-337	8/16/2019	84.3	
299-E33-338	8/19/2019	6.15	
299-E33-339	8/16/2019	4.26 B	

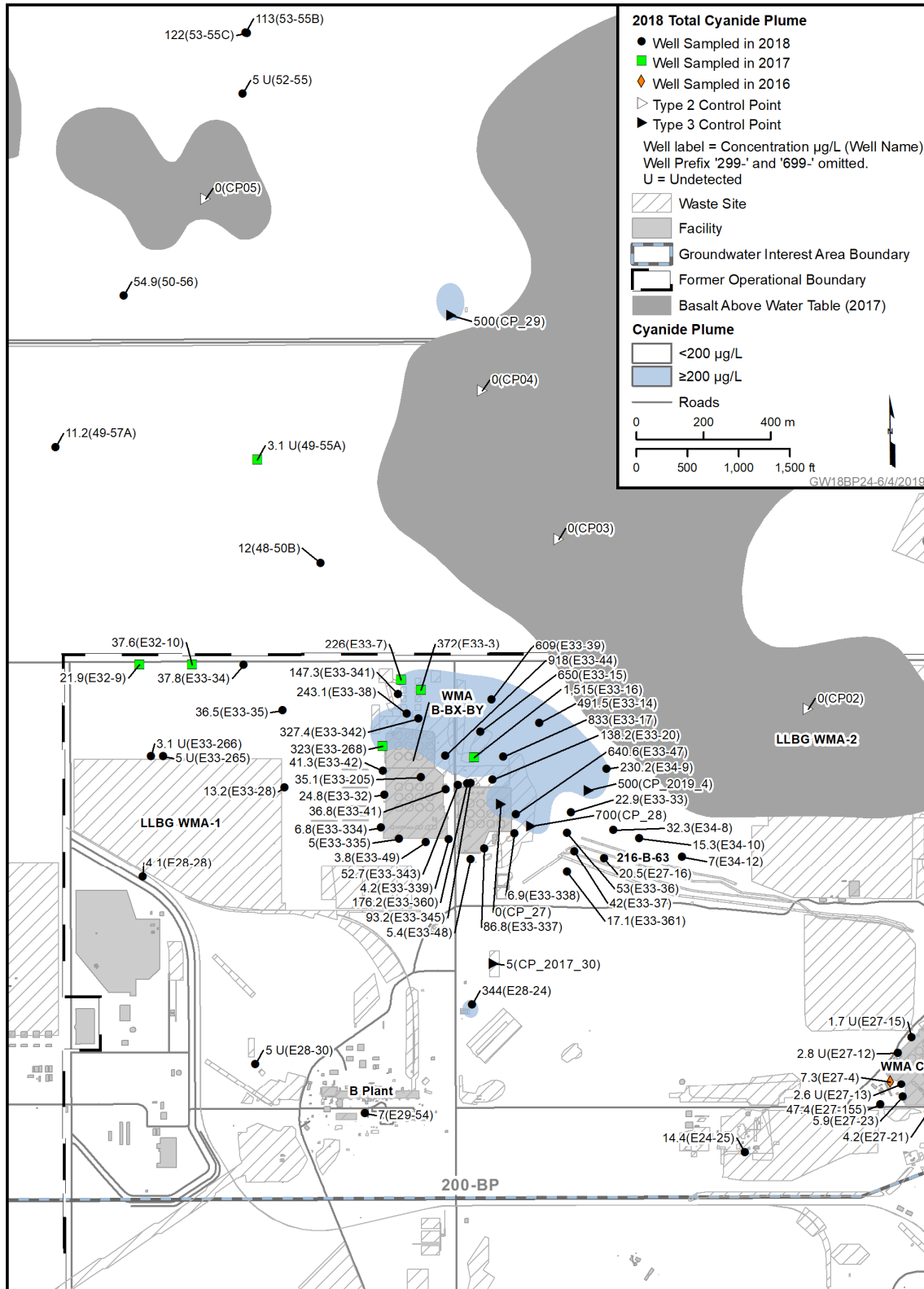
Note: Practical quantitation limit for cyanide by Methods 335.4, 9012, 9014, and 4500: 10.5 µg/L (ECF-HANFORD-18-0058, *Practical Quantitation Limits for Groundwater Environmental Samples*).

a. Identified as an upgradient well in DOE/RL-2012-53, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area B-BX-BY*.

b. Well is not compliant with the construction standards in WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," and a replacement in kind well will be proposed.

B = Detected at a value less than the required detection limit (e.g., practical quantitation limit) but greater than or equal to the method detection limit.

D = Reported at a secondary dilution factor.

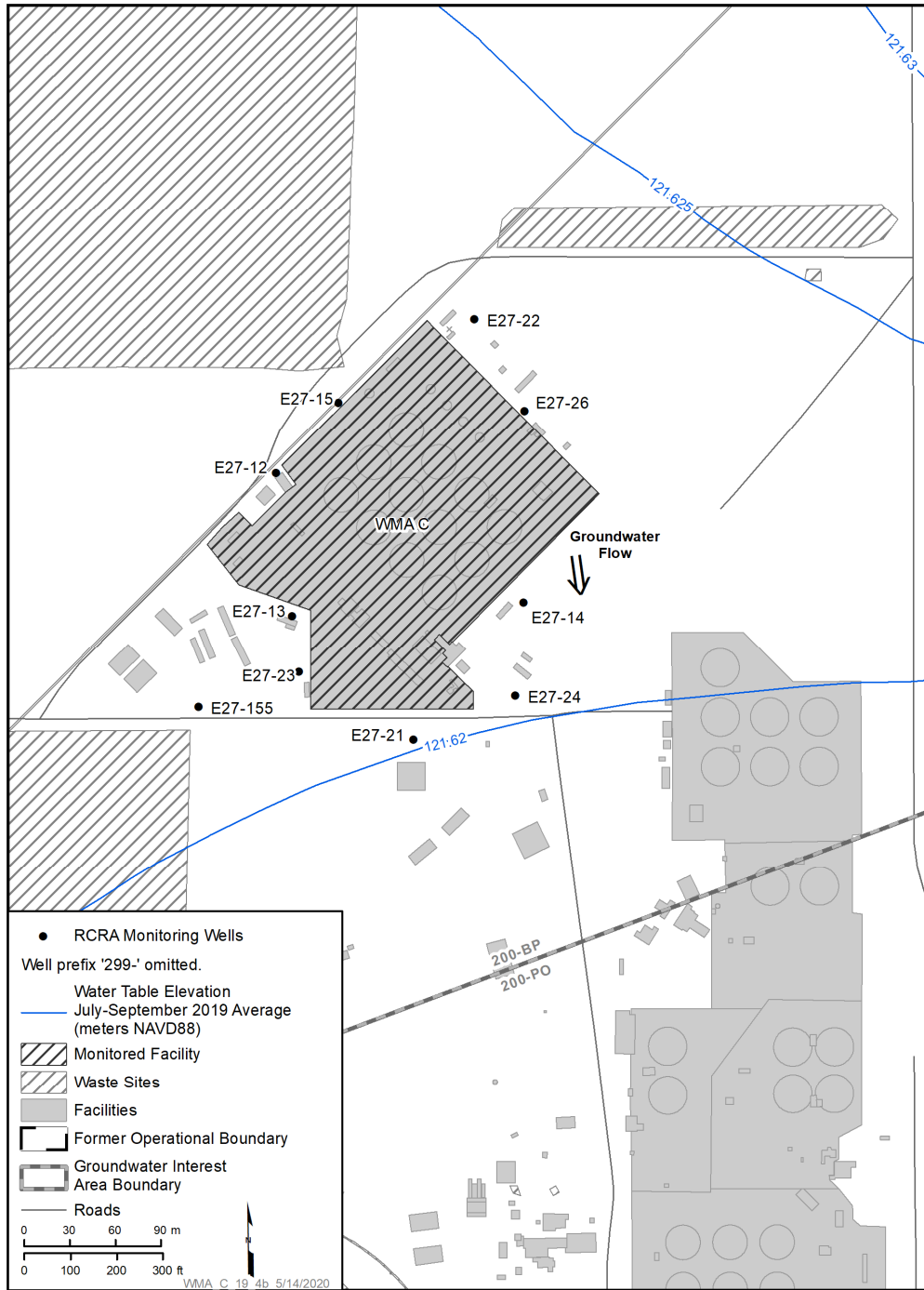


Source: DOE/RL-2018-66, Hanford Site Groundwater Monitoring Report for 2018.

Figure 4. Total Cyanide Plume Near WMA B-BX-BY, 2018

### 3 Waste Management Area C

WMA C, which includes the single-shell tanks and ancillary equipment of the 241-C Tank Farm, is located in the east-central portion of the 200 East Area (Figure 1). Figure 5 presents the monitoring network with a water-table map.



Reference: ECF-200E-19-0130, *Groundwater Elevation Mapping for 200 East Area - Quarter 3 Calendar Year 2019*.

**Figure 5. WMA C Monitoring Well Network and July-September 2019 Water Table**

Previous releases from WMA C have contributed to groundwater contamination with the dangerous waste cyanide. The WMA is monitored under DOE/RL-2009-77, *Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area C*. Table 3 lists July through September 2019 sampling results for cyanide. A contaminant plume map is not provided because total cyanide concentrations are below levels used for contouring plumes in Chapter 9 of DOE/RL-2018-66, *Hanford Site Groundwater Monitoring Report for 2018*. The highest concentration was 40.4 µg/L in deep well 299-E27-155. It is likely the deep contamination originated at an upgradient source (Section 9.10 of DOE/RL-2018-66).

During July through September 2019, the average direction of groundwater flow beneath WMA C was south and the average velocity was 0.75 m/d (2.5 ft/d) (ECF-HANFORD-19-0132).

**Table 3. WMA C Sample Results for July-September 2019**

Well Name	Sample Date	Cyanide (Total) (µg/L)	Comment
299-E27-12*	9/20/2019	1.67 U	
299-E27-13	9/20/2019	1.67 U	
299-E27-14	9/17/2019	11.4	
299-E27-15*	9/17/2019	1.67 U	
299-E27-21	9/17/2019	1.67 U	
299-E27-22*	9/18/2019	1.77 B	
299-E27-23	9/18/2019	8.61	
		8.19	Duplicate sample
299-E27-24	9/17/2019	17.5	Deep well
299-E27-26*	9/18/2019	9.6	
299-E27-155	9/17/2019	40.4	Deep well

Note: Practical quantitation limit for cyanide by Methods 335.4, 9012, 9014, and 4500: 10.5 µg/L (ECF-HANFORD-18-0058, *Practical Quantitation Limits for Groundwater Environmental Samples*).

\*Upgradient well.

B = Detected at a value less than the required detection limit (e.g., practical quantitation limit) but greater than or equal to the method detection limit.

U = Undetected.

## 4 Waste Management Area S-SX

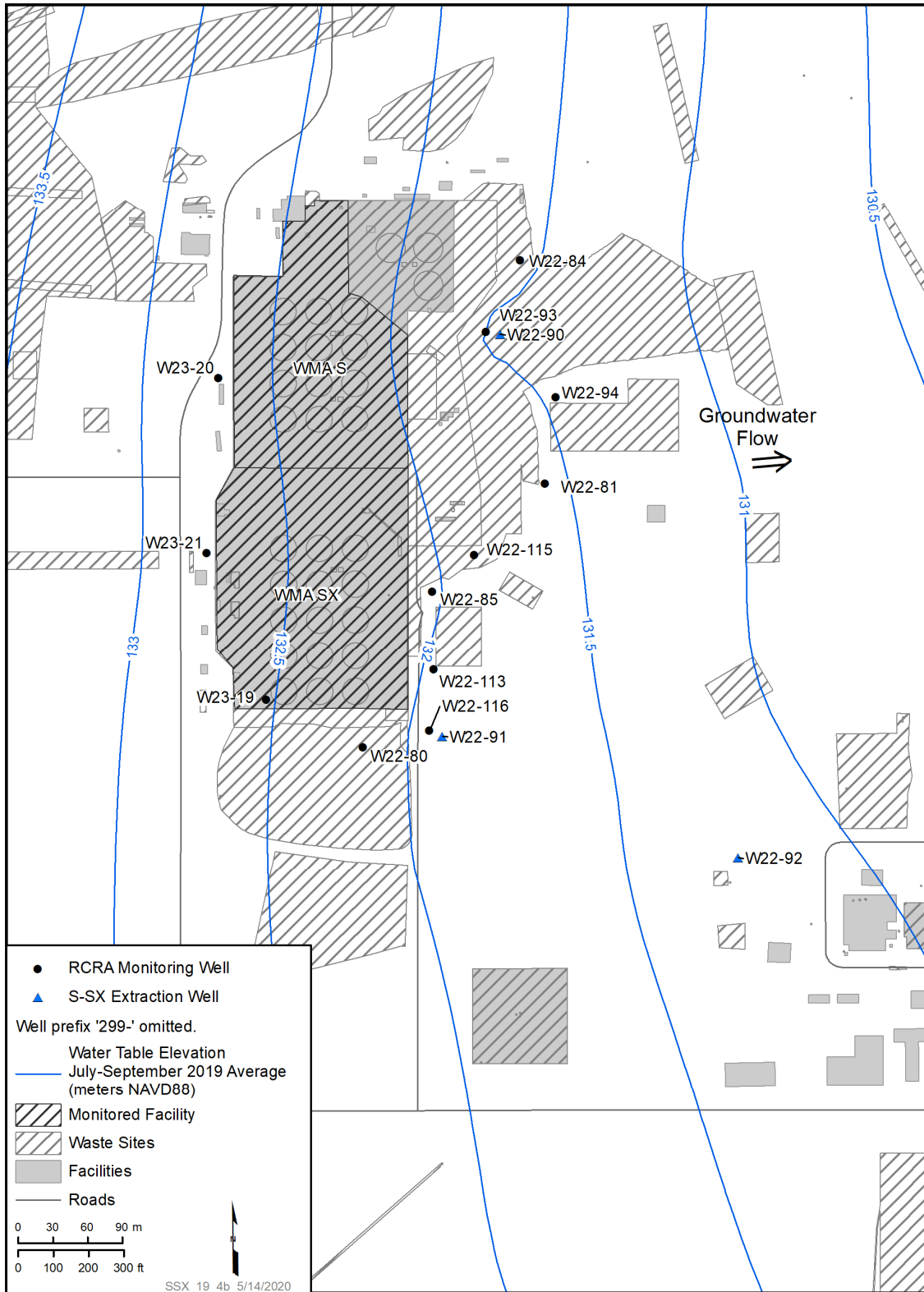
WMA S-SX, which includes the single-shell tanks and ancillary equipment of the 241-S and 241-SX Tank Farms, is located in the southern portion of the 200 West Area (Figure 2). Figure 6 illustrates the monitoring well network and water table contours for the reporting quarter.

Previous releases from WMA S-SX have contributed to groundwater contamination with chromium. The WMA is monitored under DOE/RL-2009-73, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area S-SX*. Table 4 lists July through September 2019 sampling results for total chromium and Cr(VI). Two narrow Cr(VI) plumes with concentrations above 48 µg/L were defined based on 2018 data (Figure 7).

Many of the Cr(VI) samples were analyzed outside the recommended 24-hour holding time (X and H flags in Table 4) but within 48 hours. The impact on data usability is insignificant. A limited study using Hanford Site groundwater samples in 2013 found that there was no discernible impact on Cr(VI) results analyzed up to 8 weeks after the sample date (Section 4.3.7.2 of DOE/RL-2010-96, *Remedial Investigation/Feasibility Study for the 100-BC-1, 100-BC-2, and 100-BC-5 Operable Units*).

Two of the filtered/unfiltered total chromium pairs were flagged “Q” because they were associated with quality control (QC) field blanks contaminated at levels that were at least 5% of the sample result. The impact on data quality is insignificant based on comparisons to previous total chromium data and Cr(VI) results.

Groundwater flow is influenced by extraction wells 299-W22-90 and 299-W22-91, located just east of WMA S-SX. Evaluation of June through September 2019 water levels indicated the average flow direction was to the east and the average velocity was 0.14 m/d (0.46 ft/d) (ECF-HANFORD-19-0132). Extraction wells 299-W22-90 and 299-W22-91 capture contaminated groundwater from these plumes (Figure 7), so the plumes did not expand during the reporting quarter.



Reference: ECF-200W-19-0131, *Groundwater Elevation Mapping for 200 West Area - Quarter 3 Calendar Year 2019.*

**Figure 6. WMA S-SX Monitoring Well Network and July-September Water Table**

**Table 4. WMA S-SX Sample Results for July-September 2019**

Well Name	Sample Date	Chromium ( $\mu\text{g/L}$ )		Hexavalent Chromium ( $\mu\text{g/L}$ ) <sup>a</sup>	Comment
		Unfiltered	Filtered		
299-W22-80	9/10/2019	32	5.4 B	2.0 U	
		32	5.2 B	2.0 U	Duplicate sample
299-W22-81	9/6/2019	69.8 D	4.0 UD	2.0 UZH	
299-W22-84	9/9/2019	5.0 Q	4.8 Q	4.54 XH	
299-W22-85	9/6/2019	4.9 BD	4.7 BD	2.0 UZH	
299-W22-93	9/9/2019	190	190	235 DXH	
299-W22-94	9/10/2019	28.6 D	9.3 BD	6.69	
299-W22-113	9/9/2019	4.0 UD	4.0 UD	3.4 BXH	
299-W22-115	9/9/2019	3.3 BQ	3.6 BQ	3.85 BXH	
299-W22-116	9/9/2019	106	111	119 DXH	
		110	112	119 DXH	Duplicate sample
299-W23-19	9/6/2019	438 D	433 D	318 ZD	
299-W23-20 <sup>b</sup>	9/6/2019	6.9	3.5	2.0 UZH	
299-W23-21 <sup>b</sup>	9/6/2019	4.0 UD	4.0 UD	2.0 UZH	

Note: Practical quantitation limits for chromium by Method 6010 or 6020: 10.5  $\mu\text{g/L}$ ; hexavalent chromium by Method 7196: 10.5  $\mu\text{g/L}$  (ECF-HANFORD-18-0058, *Practical Quantitation Limits for Groundwater Environmental Samples*).

a. Supporting constituent.

b. Upgradient well.

B = Detected at a value less than the required detection limit (e.g., practical quantitation limit) but greater than or equal to the method detection limit.

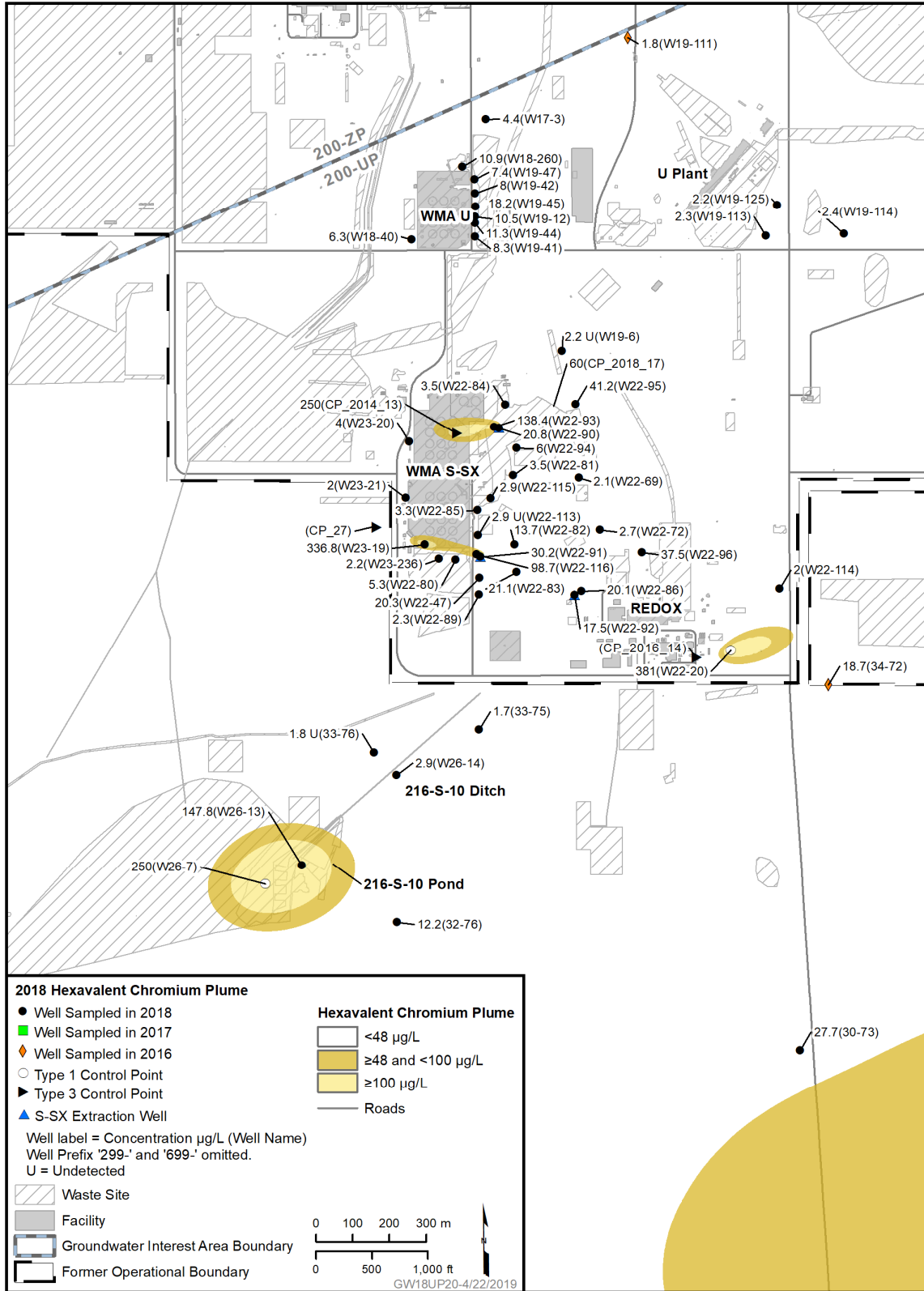
D = Reported at a secondary dilution factor.

H = Laboratory holding time exceeded (see Chapter 4).

Q = Associated quality control field blank was out of limits (see Chapter 4).

U = Undetected.

X, Z = Laboratory report noted the samples were analyzed beyond recommended holding time (see Chapter 4).

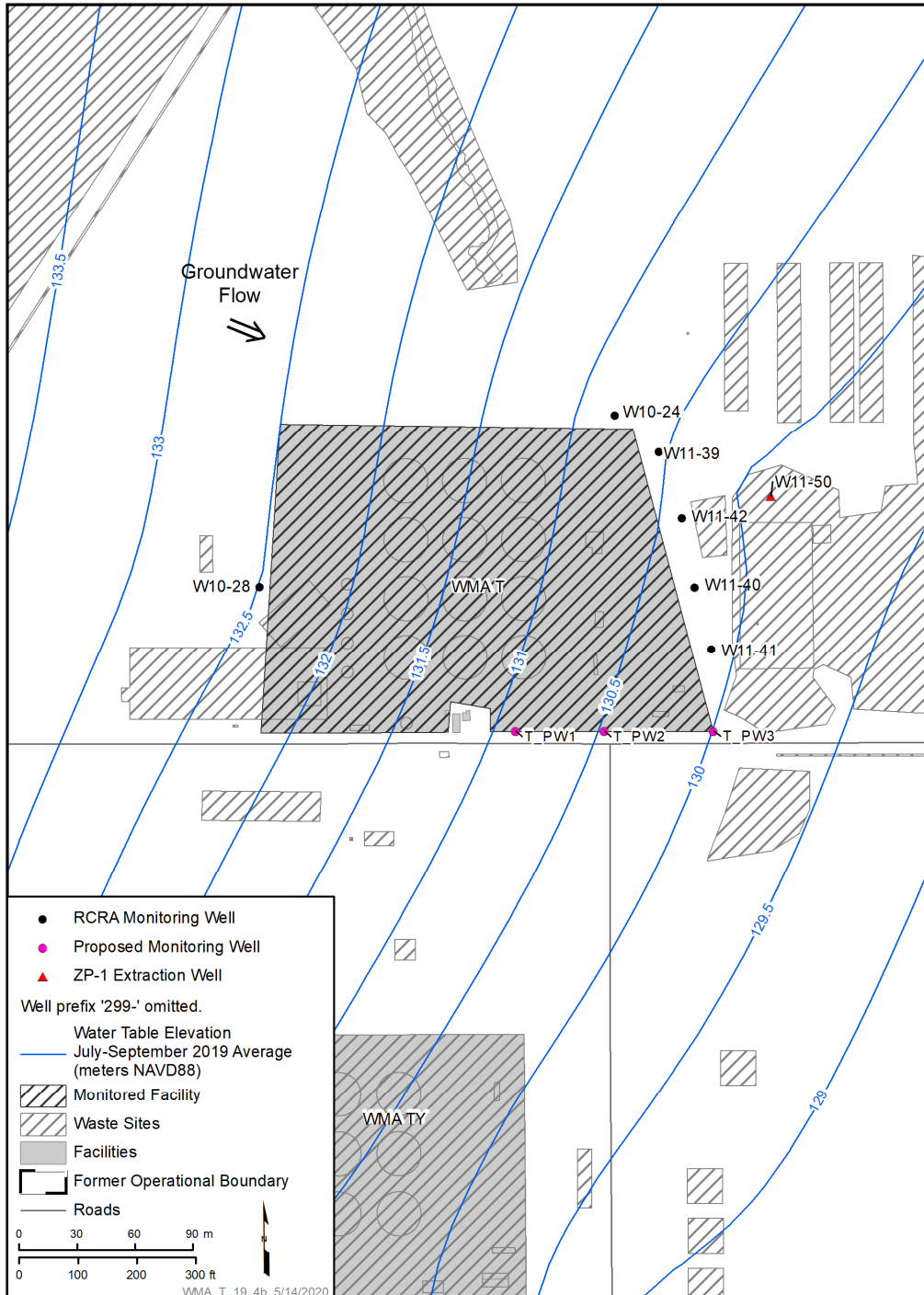


Source: DOE/RL-2018-66, Hanford Site Groundwater Monitoring Report for 2018.

Figure 7. Chromium Plumes Near WMA S-SX, 2018

## 5 Waste Management Area T

WMA T, which includes the single-shell tanks and ancillary equipment of the 241-T Tank Farm, is located in the northern portion of the 200 West Area (Figure 2). Figure 8 illustrates the monitoring well network and water-table contours for the reporting quarter.



Reference: ECF-200W-19-0131, *Groundwater Elevation Mapping for 200 West Area - Quarter 3 Calendar Year 2019*.

**Figure 8. WMA T Monitoring Well Network and July-September 2019 Water Table**

Previous releases from WMA T have contributed to groundwater contamination with chromium. The WMA is monitored under DOE/RL-2009-66, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area T*. Table 5 lists July through September 2019 quarterly sampling results for total chromium and Cr(VI).

**Table 5. WMA T Sample Results for July-September 2019**

Well Name	Sample Date	Chromium (µg/L)		Hexavalent Chromium (µg/L) <sup>a</sup>	Comment
		Unfiltered	Filtered		
299-W10-24	8/15/2019	10	8.96 B	14.4 C	
299-W10-28 <sup>b</sup>	8/15/2019	58	51	59.6	
299-W11-39	8/13/2019	90	36	42.5	
299-W11-40	8/12/2019	38.8	38.2	40.5	
299-W11-41	8/12/2019	54	51.4	52.7	
299-W11-42	8/13/2019	31.5 D	32.8 D	35.8	

Note: Practical quantitation limits for chromium by Method 6010 or 6020: 10.5 µg/L; hexavalent chromium by Method 7196: 10.5 µg/L (ECF-HANFORD-18-0058, *Practical Quantitation Limits for Groundwater Environmental Samples*).

a. Supporting constituent.

b. Upgradient well.

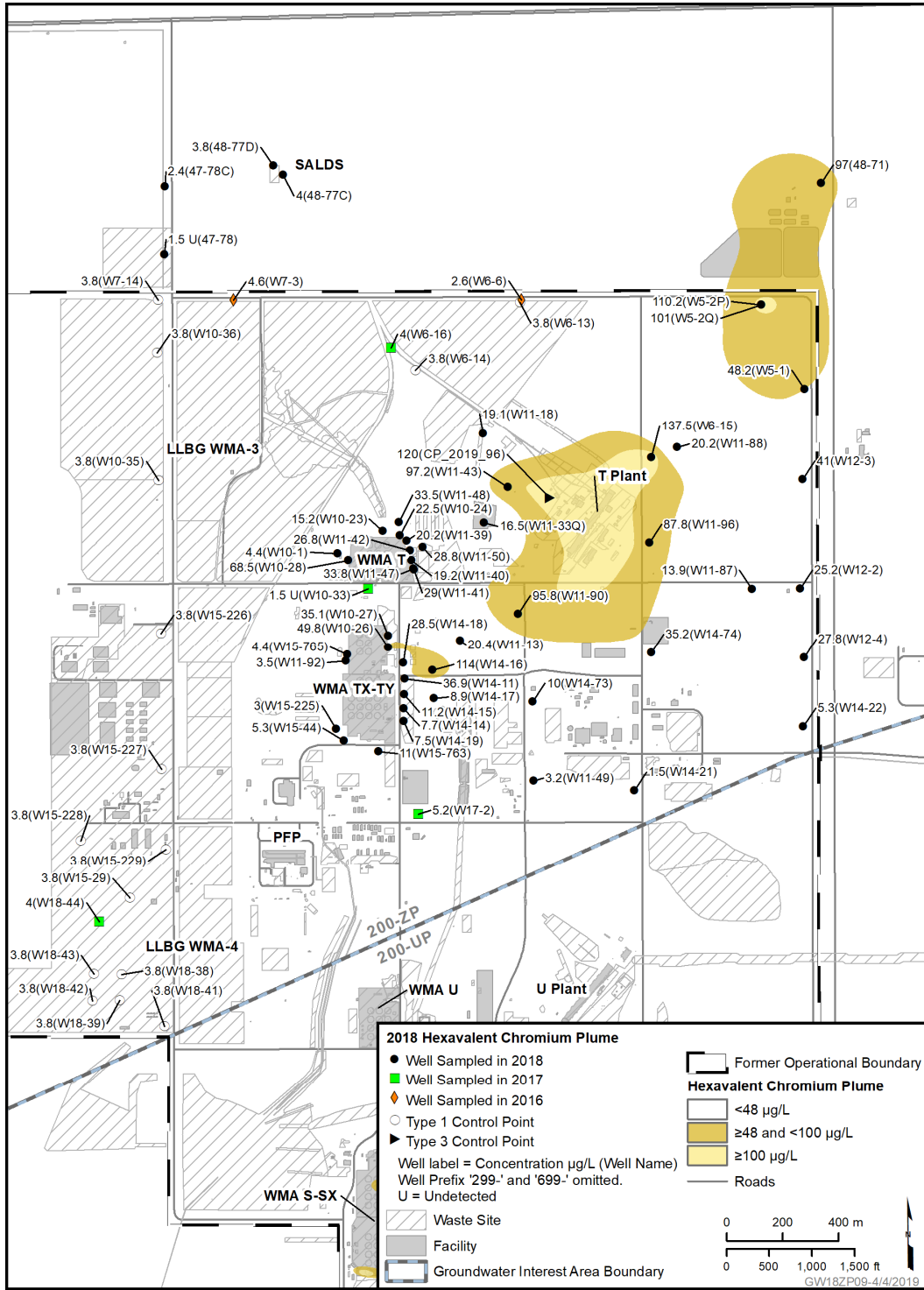
B = Detected at a value less than the required detection limit (e.g., practical quantitation limit) but greater than or equal to the method detection limit.

C = The analyte was detected in both the sample and the associated quality control blank, and the sample concentration was <= 5 times the blank concentration.

D = Reported at a secondary dilution factor.

Evaluation of July through September 2019 water levels indicates that groundwater beneath WMA T flowed to the east-southeast at 0.30 m/d (0.98 ft/d) (ECF-HANFORD-19-0132). Flow is influenced by extraction well 299-W11-50 on the east side of WMA T. Figure 9 presents the 2018 Cr(VI) plume in the vicinity of WMA T. Concentrations have declined in WMA T network wells in response to groundwater remediation, and most were below the 48 µg/L contour level in network wells in 2018.

One of the Cr(VI) results had a laboratory qualifier “C” because it was associated with QC blank contamination. The reported Cr(VI) result (14.4 µg/L) was higher than the filtered total chromium result (8.96 µg/L), possibly as a result of laboratory contamination.

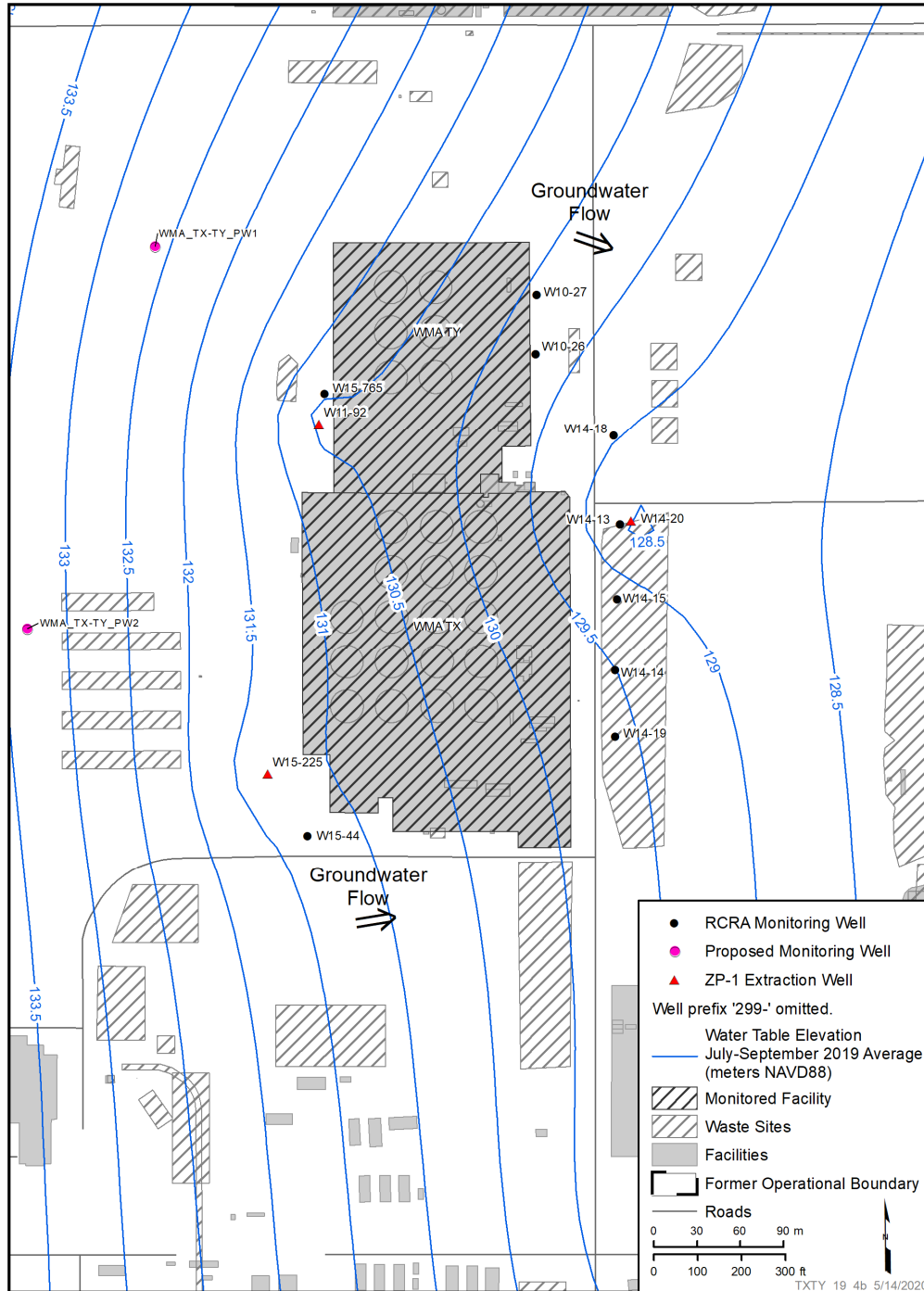


Source: DOE/RL-2018-66, Hanford Site Groundwater Monitoring Report for 2018.

**Figure 9. Chromium Plumes Near WMA T and TX-TY, 2018**

## 6 Waste Management Area TX-TY

WMA TX-TY, which includes the single-shell tanks and ancillary equipment of the 241-TX and 241-TY Tank Farms, is located in the northern portion of the 200 West Area (Figure 2). Figure 10 illustrates the monitoring well network and water-table contours for the reporting period.



Reference: ECF-200W-19-0131, *Groundwater Elevation Mapping for 200 West Area - Quarter 3 Calendar Year 2019*.

**Figure 10. WMA TX-TY Monitoring Well Network and July-September 2019 Water Table**

Previous releases from WMA TX-TY have contributed to groundwater contamination with chromium. The WMA is monitored under DOE/RL-2009-67, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area TX-TY*. Table 6 lists July through September 2019 sampling results for total chromium and Cr(VI).

**Table 6. WMA TX-TY Sample Results for July-September 2019**

Well Name	Sample Date	Chromium (µg/L)		Hexavalent Chromium (µg/L) <sup>a</sup>	Comment
		Unfiltered	Filtered		
299-W10-26	8/23/2019	72.1	57.8	62.5	
299-W10-27	8/23/2019	31.7 D	28 D	24.8 Q	
299-W14-13	8/26/2019	14	7.8 B	8.5 XH	
299-W14-14	8/27/2019	12.3	9.6 B	7.12	
299-W14-15	8/27/2019	11.9	10.8	10.7 XH	
299-W14-18	8/26/2019	42.5	43.3	35.1XH	
299-W14-19	8/27/2019	8.35 B	7.83 B	7.51	
299-W15-44 <sup>b</sup>	8/26/2019	36	12.9	12.1 XH	
299-W15-765 <sup>b</sup>	8/26/2019	5.29 B	3.98 B	3.88 BXH	

Note: Practical quantitation limits for chromium by Method 6010 or 6020: 10.5 µg/L; hexavalent chromium by Method 7196: 10.5 µg/L (ECF-HANFORD-18-0058, *Practical Quantitation Limits for Groundwater Environmental Samples*).

a. Supporting constituent.

b. Upgradient well.

B = Detected at a value less than the required detection limit (e.g., practical quantitation limit) but greater than or equal to the method detection limit.

D = Reported at a secondary dilution factor.

H = Laboratory holding time exceeded (see Chapter 4).

Q = Associated quality control field blank was out of limits (see Chapter 6).

X = Laboratory report noted the samples were analyzed beyond recommended holding time (see Chapter 4).

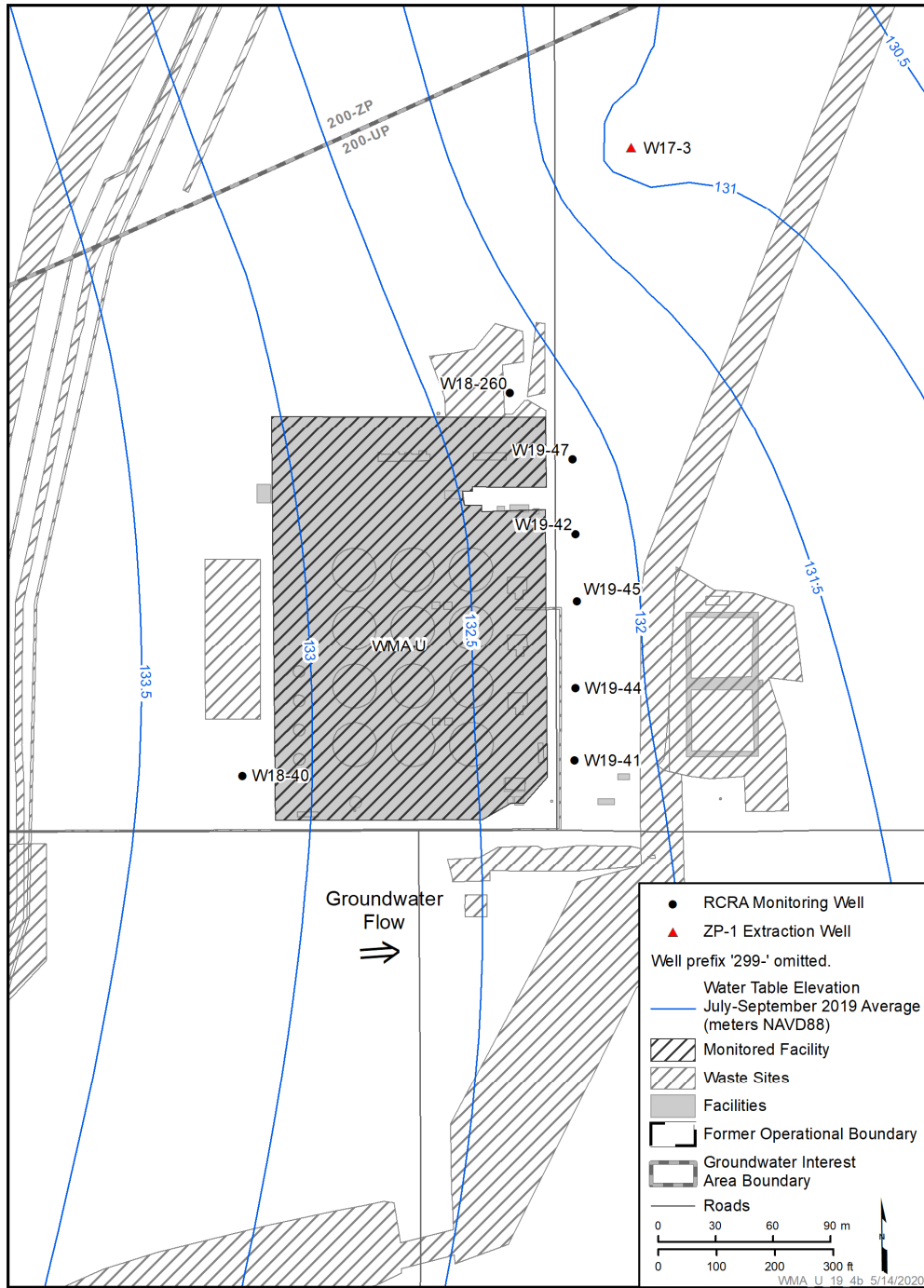
Directions of groundwater flow beneath WMA TX-TY reflect the influence of extraction wells. During the reporting quarter, the direction of flow beneath the northern portion of WMA TX-TY was toward the southeast. Groundwater flow beneath the southern part of the WMA was to the east. The average flow rate was 0.31 m/d (1.0 ft/d) (ECF-HANFORD-19-0132).

One of Cr(VI) results was flagged “Q” because it was associated with a QC field blank contaminated at a level that was at least 5% of the sample result. The impact on data quality is insignificant based on comparisons to previous Cr(VI) data and the filtered, total chromium result.

Figure 9 shows the 2018 Cr(VI) plume in the vicinity of WMA TX-TY. Groundwater extraction well 299-W14-20, located east of the plume, captures contaminated groundwater.

## 7 Waste Management Area U

WMA U, which includes the single-shell tanks and ancillary equipment of the U Tank Farm, is located in the south-central portion of the 200 West Area (Figure 2). Figure 11 illustrates the monitoring well network and water-table contours for the reporting quarter.



Reference: ECF-200W-19-0131, *Groundwater Elevation Mapping for 200 West Area - Quarter 3 Calendar Year 2019.*

**Figure 11. WMA U Monitoring Well Network and July-September 2019 Water Table**

Previous releases from WMA U have contributed to groundwater contamination with chromium. The WMA is monitored under DOE/RL-2009-74, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area U*. Table 7 lists July through September 2019 sampling results for chromium and Cr(VI).

Evaluation of July through September 2019 water levels indicates that groundwater beneath WMA U generally flowed to the east at 0.21 m/d (0.69 ft/d) (ECF-HANFORD-19-0132).

A contaminant plume map is not provided because chromium concentrations are below levels used for contouring plumes in Chapter 11 of DOE/RL-2018-66.

**Table 7. WMA U Sample Results for July-September 2019**

Well Name	Sample Date	Chromium (µg/L)		Hexavalent Chromium (µg/L) <sup>a</sup>	Comment
		Unfiltered	Filtered		
299-W18-40 <sup>b</sup>	7/19/2019	7.4 B	6.4 B	8.48 Q	
299-W18-260	7/19/2019	13.2 D	12.2 D	13.4 XHQ	
299-W19-41	7/18/2019	13.8	10.2	11.1	
299-W19-42	7/18/2019	13.6	9.74 B	11.0	
299-W19-44	7/19/2019	30.0	9.6 B	11.4 XHQ	
299-W19-45	7/19/2019	15.6	15.2	18.5 XHQ	
299-W19-47	7/19/2019	12.2	11.0	14.5 XHQ	

Note: Practical quantitation limits for chromium by Method 6010 or 6020: 10.5 µg/L; hexavalent chromium by Method 7196: 10.5 µg/L (ECF-HANFORD-18-0058, *Practical Quantitation Limits for Groundwater Environmental Samples*).

a. Supporting constituent.

b. Upgradient well.

B = Detected at a value less than the required detection limit (e.g., practical quantitation limit) but greater than or equal to the method detection limit.

D = Reported at a secondary dilution factor.

H = Laboratory holding time exceeded (see Chapter 4).

Q = Associated quality control field blank was out of limits.

X = Laboratory report noted the samples were analyzed beyond recommended holding time (see Chapter 4).

## 8 References

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