12 200-ZP

12.1 Overview

The 200-ZP groundwater interest area is located in the northern and central portions of the 200 West Area and nearby portions of the 600 Area. It includes the 200-ZP-1 Groundwater OU, where activities focus on groundwater remediation, monitoring, and reporting. Figure 12-1 shows key facility areas and groundwater wells. Groundwater COCs include carbon tetrachloride, chromium (total and hexavalent), iodine-129, nitrate, technetium-99, TCE, and tritium (EPA et al., 2008). Table 12-1 lists some key facts about 200-ZP. Section 1.3 of the Introduction provides plume mapping details, including descriptions of terms in figure legends (e.g., Type 1 Control Point).

Carbon tetrachloride is the main COC in groundwater, forming a plume greater than 13 km^2 (5 mi^2) in area extending north, south, and east from the source areas. The primary sources were associated with discharges of liquid waste from the PFP plutonium separation processes to the 216-Z-1A, 216-Z-9, and 216-Z-18 Cribs and Trenches. Except for nitrate, the remaining contaminant plumes within 200-ZP are located within the boundaries of the carbon tetrachloride plume. Figure 12-2 illustrates the change in plume area from 2003 to 2014 for each of the COCs.

Within 200-ZP, groundwater occurs in an unconfined aquifer and in confined aquifers beneath the Ringold lower mud unit and between the basalt flows. The unconfined aquifer is the aquifer directly impacted by past waste disposal operations. The unconfined aquifer occurs within Ringold unit E; its base is the fine-grained Ringold lower mud unit, where present, or the top of basalt, where the mud is absent in areas where the Ringold Formation sediments were eroded by Ice Age floods and subsequently filled with Hanford formation sediments (Figure 12-3). Depths from land surface to the water table range from 64 to 106 m (210 to 350 ft), with the largest depths occurring in the northeastern portion. The thickness of the unconfined aquifer within the interest area ranges from 8 to 68 m (26 to 220 ft) on the east and north sides, respectively (PNNL-13858). In those areas where the Ringold lower mud unit is missing in the stratigraphic sequence, carbon tetrachloride migrated below the mud unit and into Ringold Formation unit A. The contaminated groundwater then flows beneath the lower mud unit, contaminating the Ringold confined aquifer.

Groundwater in the 200 West Area generally flows east-northeast (Figure 12-4), but is influenced by the 200 West P&T and, to a lesser extent, effluent discharges to the State-Approved Land Disposal Site (SALDS). When 200 West facilities were active, disposal of liquid effluent raised the water table throughout the area and altered directions of groundwater flow. Cessation of effluent disposal in the 1990s caused the water table to drop. Since 2012, groundwater extraction wells for the 200 West P&T have created cones of depression that affect flow in a large part of the interest area. Injection of treated water west of the contaminant plumes has created groundwater mounds that create radial flow for a limited distance around the wells and steepen gradients toward the east. More injection wells located in the eastern part of the interest area help control migration of contaminant plumes in that direction. Section 12.11 discusses groundwater flow directions beneath the RCRA facilities in 200-ZP.

Groundwater flow rates range from 0.0001 m/d (0.0003 ft/d) in fine-textured, lower permeability Ringold sediments, to 0.6 m/d (2 ft/d) in coarse-textured, higher permeability Hanford sediments (SGW-38815). Detailed discussions of geology and hydrogeology within 200-ZP are provided in DOE/RL-2011-118, Rev. 0.

Groundwater in 200-ZP is monitored under CERCLA to assess the performance of the final remedy as documented in the ROD (EPA et al., 2008); under RCRA at WMA T, WMA TX-TY, Low-Level Waste Management Area (LLWMA)-3 Burial Ground, and LLWMA-4 Burial Ground; and under the

Washington Administrative Code at the SALDS. Radionuclide monitoring is performed in accordance with the AEA and CERCLA. Figure 12-1 shows wells sampled in 2014.

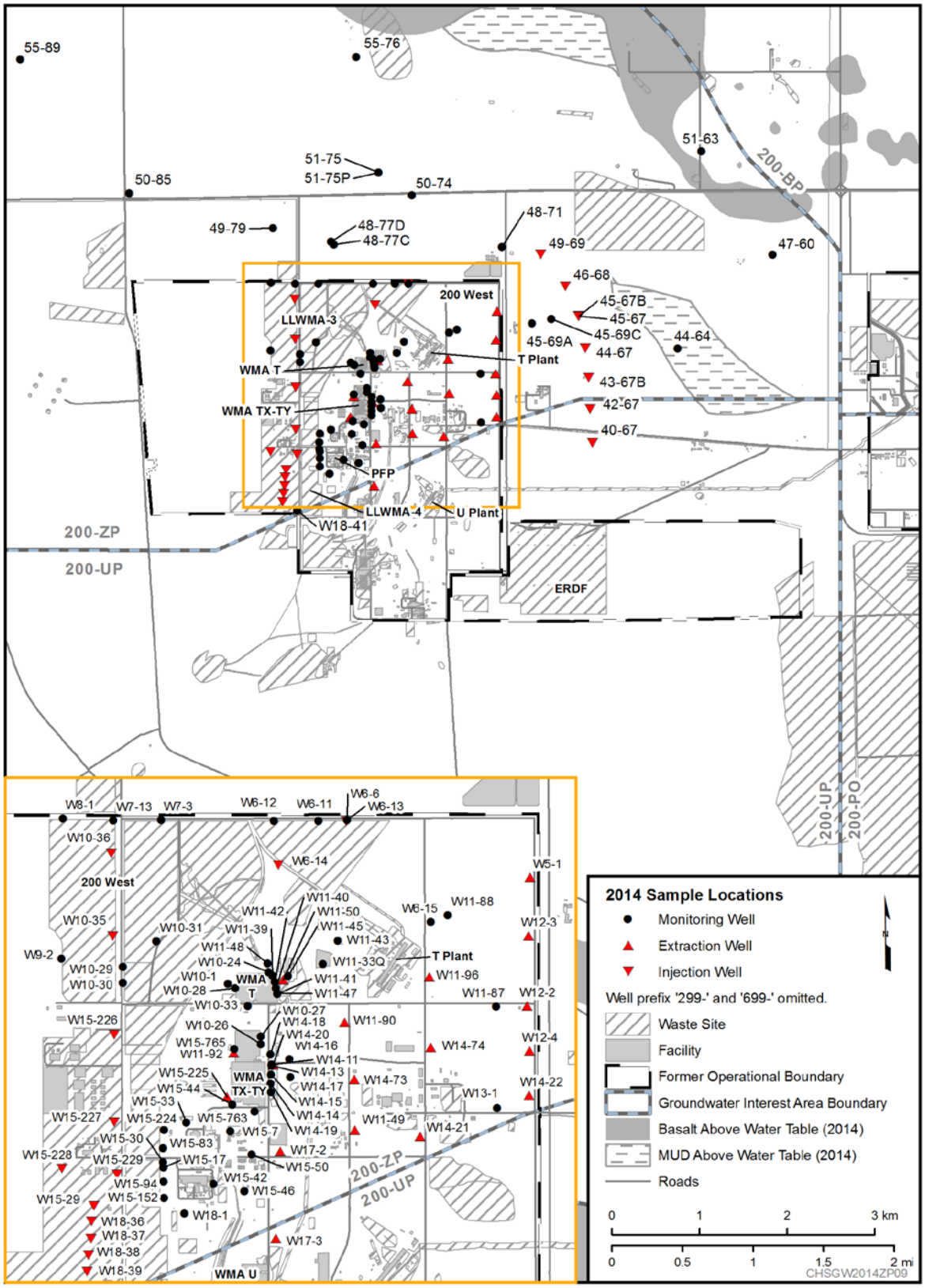


Figure 12-1. 200-ZP Wells and Key Facilities

Table 12-1. 200-ZP-1 at a Glance

T Plant operations: 1944 to 1956 (plutonium separation)
Plutonium Finishing Plant operations: 1949 to 1989

2014 Groundwater Monitoring				200 West Pump and Treat	
Contaminant	**Cleanup Level**	**Maximum Concentration**	**Plume Area[a] (km^2)**	**Mass or Activity Removed (2014)**	**Mass or Activity Removed (2012 to 2014)**
Carbon tetrachloride	3.4 µg/L	2,000 µg/L	17.9[b]	2,898 kg	6,478 kg
Chromium (Total and Hexavalent)	100/48 µg/L[c,d]	186/190 µg/L	0.33	75 kg	166 kg
Iodine-129	1 pCi/L	1.88 pCi/L	0.06	NA[e]	242,000,000 pCi
Nitrate	45[f] mg/L	536 mg/L	8.4	251,595 kg	495,682 kg
Technetium-99	900 pCi/L	21,500 pCi/L	0.03	1.31 Ci (77 g)	2.98 Ci (175 g)
Trichloroethene	1 µg/L	13 µg/L	3.25	10 kg	25.7 kg
Tritium	20,000 pCi/L	14,200 pCi/L	0.23	N/A	N/A
Uranium[g]	30 µg/L		N/A	0.77 kg	1.90 kg

a. Estimated area above listed cleanup level.
b. Area of full plume footprint (includes 200-UP-1 OU), all depths in unconfined aquifer.
c. 100 µg/L federal DWS for total chromium.
d. 48 µg/L groundwater cleanup standard for hexavalent chromium.
e. Iodine-129 concentrations were undetected in the influent and effluent in 2014.
f. Nitrate as nitrate; 10 mg/L nitrate as nitrogen.
g. Uranium is not a COC in 200-ZP-1; contaminant is extracted from wells in the 200-UP-1 OU.
COCs = contaminant of concern
DWS = drinking water standard

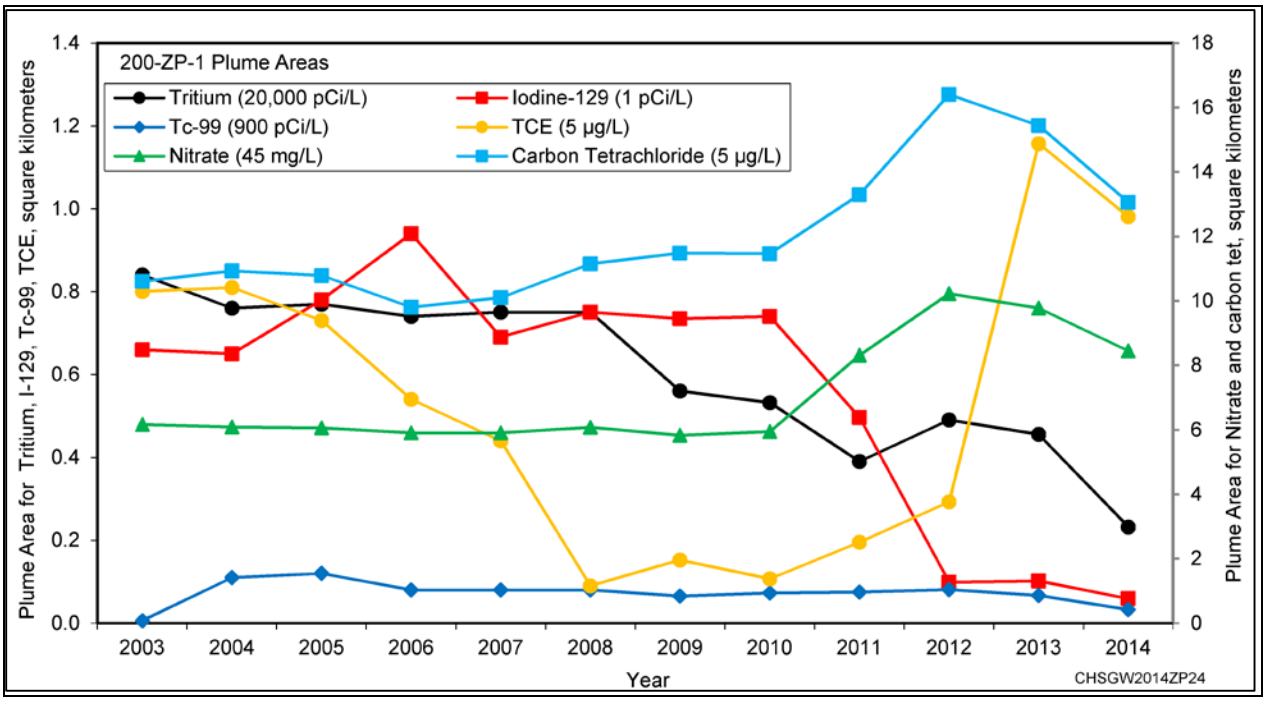


Figure 12-2. 200-ZP Plume Areas, 2014

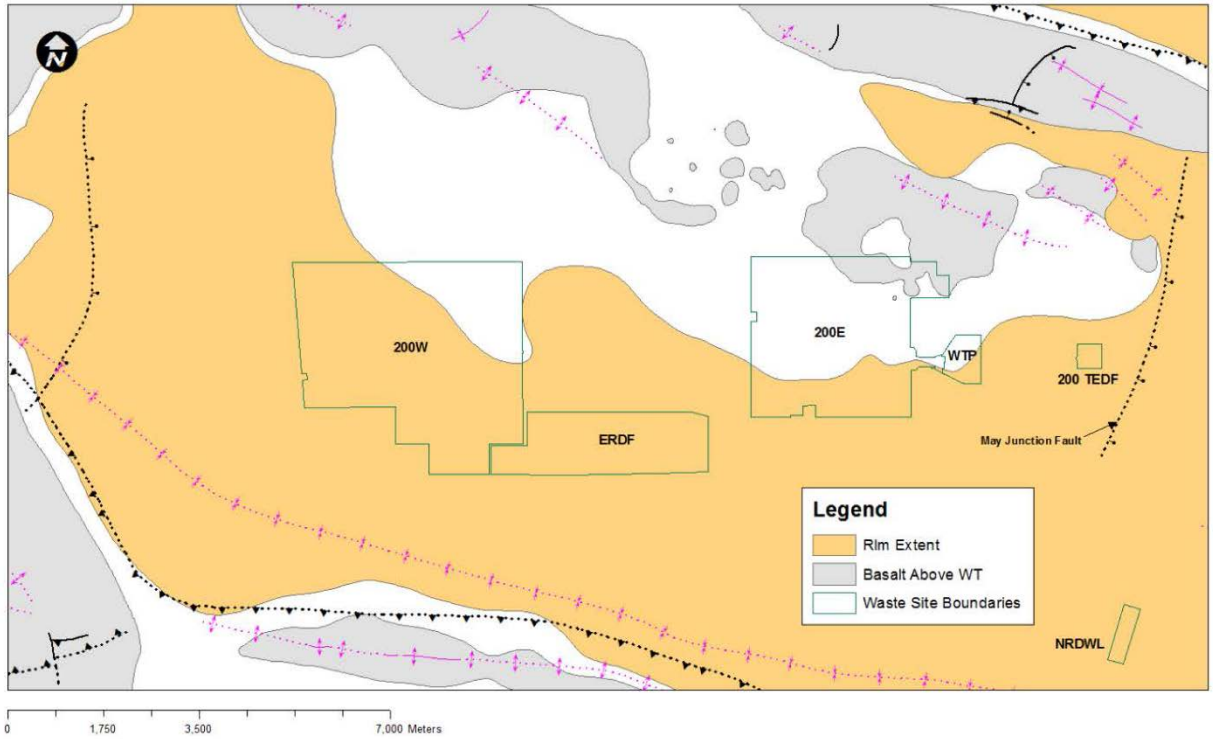


Figure 12-3. Ringold Lower Mud Unit Extent

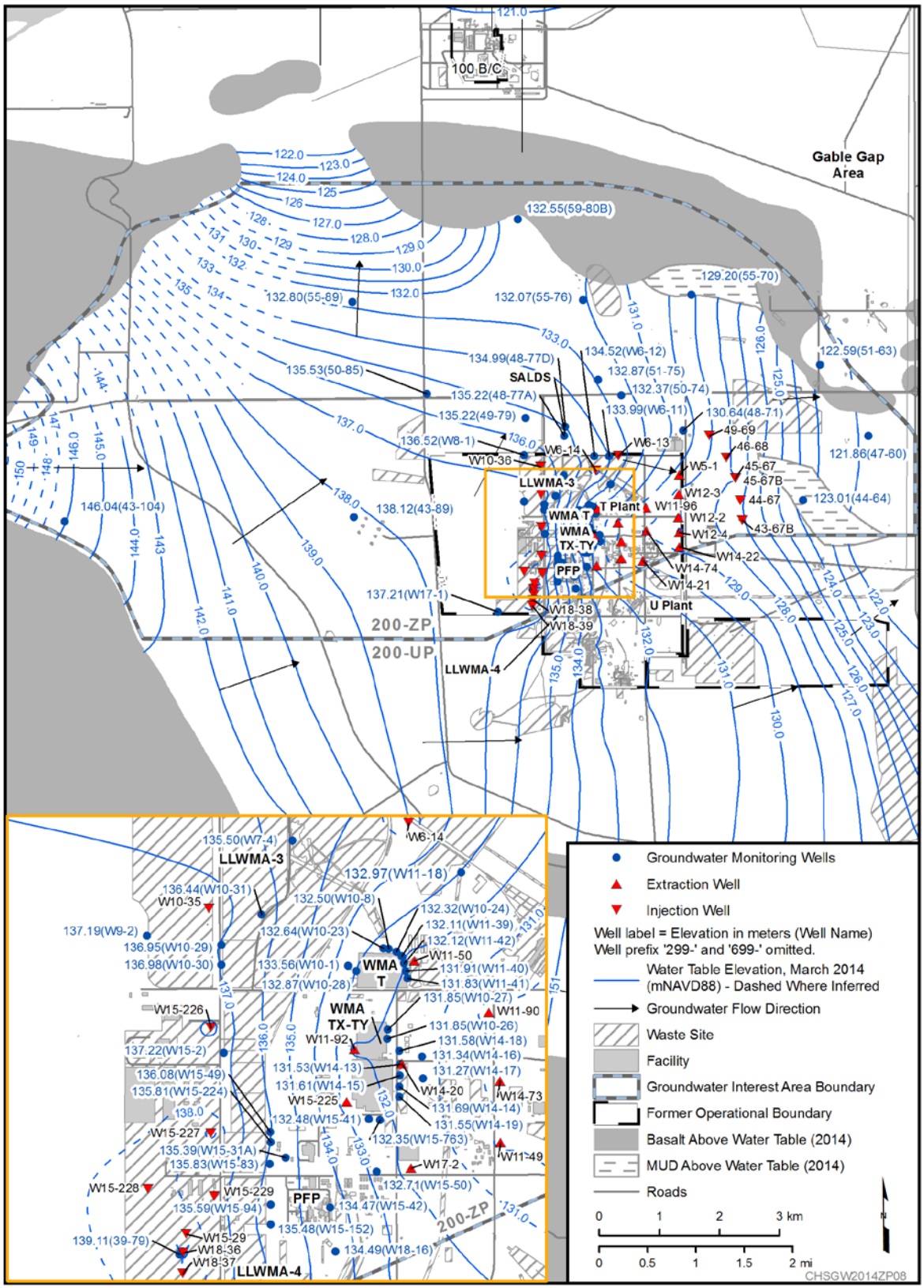


Figure 12-4. 200-ZP Overview with Groundwater Flow

12.2 CERCLA Activities

Groundwater contaminants in the 200-ZP-1 OU are being cleaned up under a CERCLA ROD (EPA et al., 2008).

The selected remedy in the ROD consists of a combination of the following remedy components: MNA, ICs, flow-path controls, and P&T of the contamination. The 200 West P&T began operations in 2012 and operated continuously in 2013 and 2014. Groundwater is monitored to assess the effectiveness of the remedy (DOE/RL-2009-115). Table A-13 of Appendix A lists the wells and constituents monitored under CERCLA.

Between 1996 and 2012, an interim remedial measure was active in 200-ZP-1. Both the 200-ZP-1 interim P&T system and WMA T P&T system were removed from service in 2012. Background information on the interim systems can be found in DOE/RL-2012-03. Description of the 200 West P&T facility is included in DOE/RL-2015-06. Additional information on the 200 West P&T, including 2014 activities, are found in the Section 12.10.

12.3 Carbon Tetrachloride

Carbon tetrachloride is found at concentrations greater than the final cleanup level (3.4 µg/L) and the DWS of 5 µg/L under most of the 200 West Area (Figure 12-5). Initially, carbon tetrachloride concentrations exceeding 2,000 µg/L were located beneath the PFP. After 16 years of interim P&T operations and 2.5 years of the final remedy, the areal extent of the 2,000 µg/L contour in the upper portion of the aquifer was reduced from 0.53 km^2 (0.20 mi^2) in 1996 to zero in 2014.

Continued investigations during drilling of groundwater monitoring, extraction, and injection wells revealed carbon tetrachloride concentrations greater than 1,000 µg/L throughout the entire thickness of the aquifer, not just the upper 15 m (50 ft). Figure 12-6 provides a visual cross-section through a three-dimensional conceptual model of the carbon tetrachloride plume. The data supporting this figure were derived from groundwater samples collected for all wells screened above the basalt within the unconfined aquifer.

As shown on the plume map (Figure 12-5), carbon tetrachloride extends to the east from the source areas. Prior to the start of 200-ZP-1 interim actions in 1996, concentrations of carbon tetrachloride in 17 extraction wells and 23 monitoring wells exceeded 2,000 µg/L, and 20 of those wells exceeded 4,000 µg/L. In 2014, sample results indicate no wells with carbon tetrachloride concentrations above 4,000 µg/L, and only two wells with maximum concentrations at 2,000 µg/L (monitoring Well 299-W11-87 and extraction Well 299-W11-90) (Figure 12-7). Extraction Wells 299-W17-2, 299-W11-50, and 299-W14-20 had the next highest concentrations at 1,800 µg/L, 1,600 µg/L, and 1,600 µg/L, respectively. The next highest concentrations in monitoring wells were 1,400 µg/L, 1,320 µg/L, and 1,200 µg/L in Well 299-W14-72, 299-W14-11, and 299-W10-1, respectively.

Concentrations of carbon tetrachloride are declining across 200-ZP as a result of capture by extraction wells and by natural attenuation processes (dispersion and degradation). The significant decline in both maximum carbon tetrachloride concentration (from 8,700 µg/L in 1990 to 2,000 µg/L in 2014) and in the number of wells exceeding 2,000 µg/L (from 40 wells to zero) demonstrates the effectiveness of the remedial actions in reducing carbon tetrachloride contamination. Concentrations continued to decline in most wells between 2012 and 2014 (Figure 12-7).

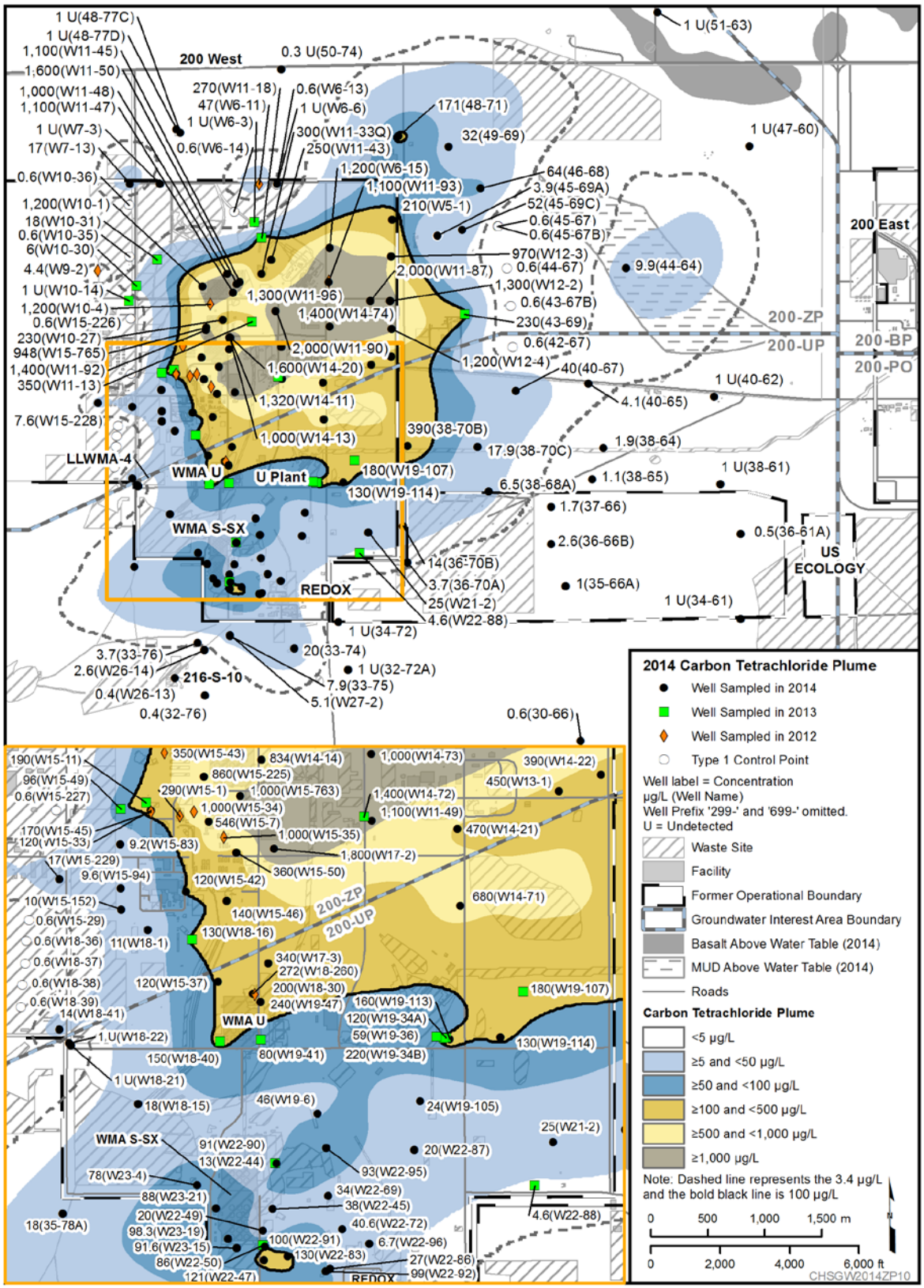


Figure 12-5. 200-ZP Carbon Tetrachloride Plume, 2014

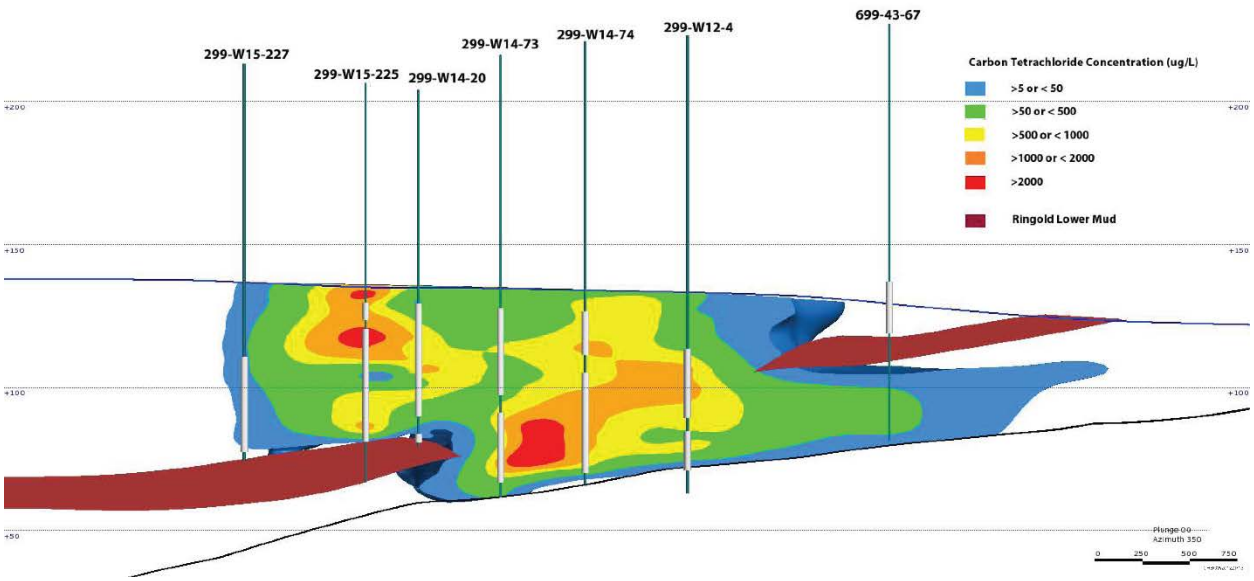


Figure 12-6. 200-ZP Carbon Tetrachloride Concentration Cross Section

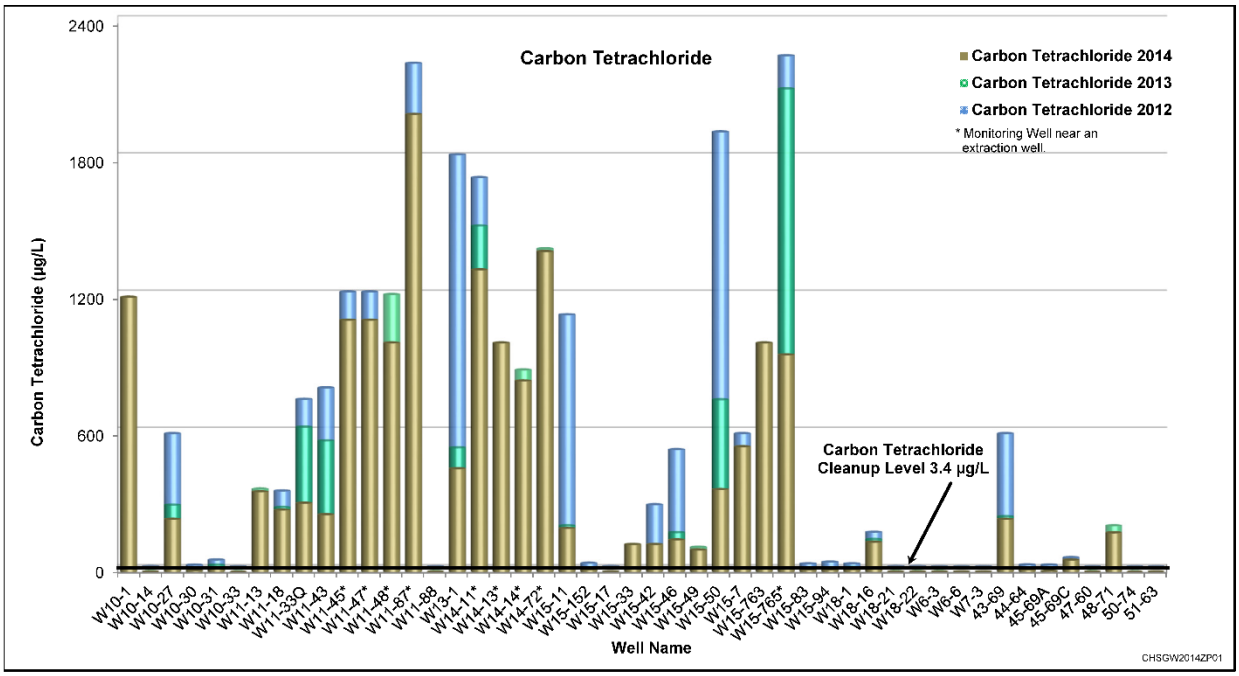


Figure 12-7. Comparison of Carbon Tetrachloride Concentrations in Monitoring Wells During 2012, 2013, and 2014

12.4 Chromium

Chromium contamination is found at concentrations above the final cleanup level (100 µg/L for total chromium and 48 µg/L for hexavalent chromium) beneath and downgradient of the single-shell tanks at WMA T and WMA TX-TY (Figures 12-8, 12-9, and 12-10; wells used for depiction of the 200-UP chromium plumes are shown in Figures 11-22). Sources of chromium contamination include past leaks from single-shell tanks containing metal and liquid waste from chemical processing of uranium-bearing, irradiated reactor fuel rods, the bismuth phosphate process, uranium-recovery process, and from REDOX and PUREX (located in the 200 East Area) plant operations (DOE/RL-2009-66; DOE/RL-2009-67).

In 2014, the maximum chromium concentration of 190 µg/L (hexavalent chromium) was found at Well 299-W11-43, located northeast of WMA T. This was an increase from 167 µg/L measured in this well in 2012. The increase in concentration is because the monitoring well is located near an extraction well, which is drawing groundwater from surrounding areas toward the extraction well. Monitoring Well 299-W15-763, south of WMA TX-TY, had an average chromium concentration of 285 µg/L in the unfiltered, total chromium samples, which is attributed to particulates and corrosion as the hexavalent chromium concentration averaged only 8.1 µg/L.

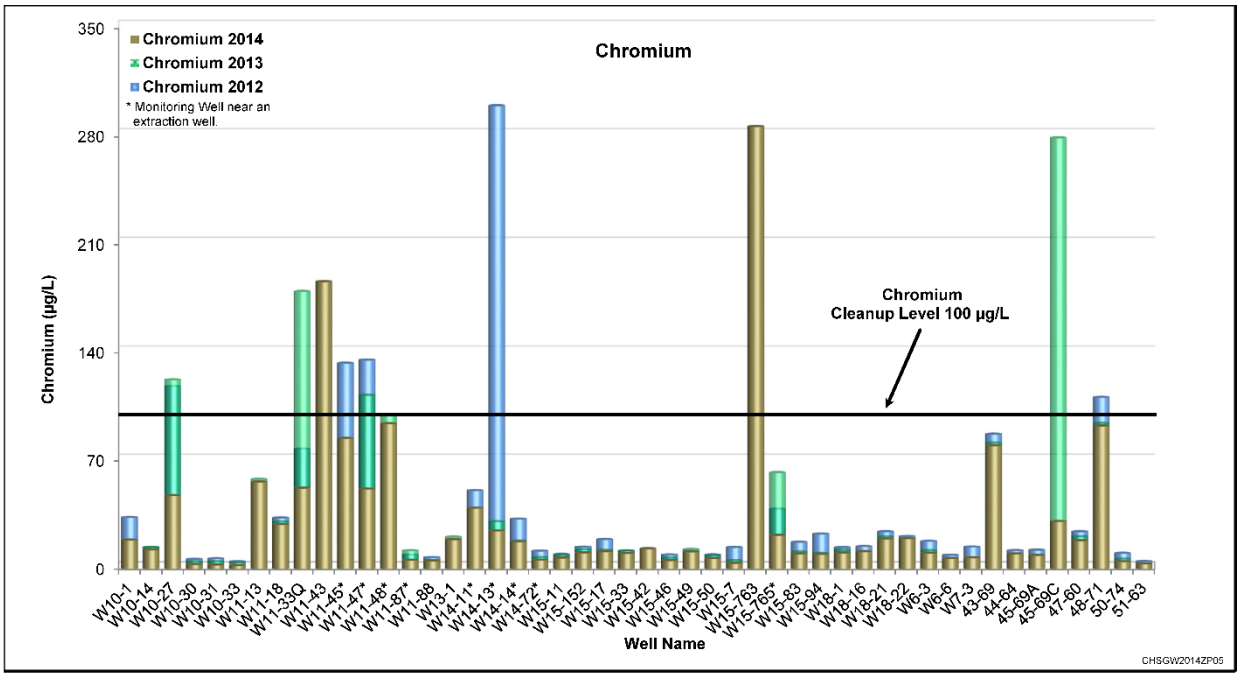


Figure 12-8. Comparison of Chromium Concentrations in Monitoring Wells During 2012, 2013, and 2014

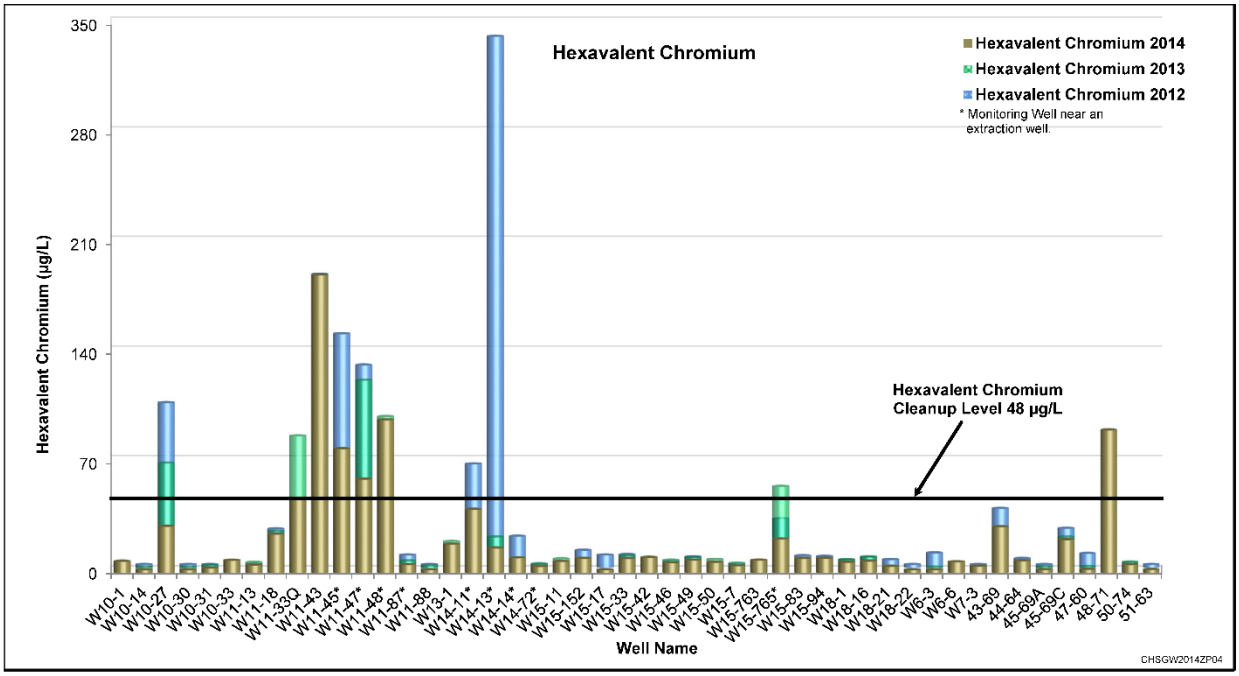


Figure 12-9. Comparison of Hexavalent Chromium Concentrations in Monitoring Wells During 2012, 2013, and 2014

Chromium concentrations in 699-48-71, located northeast of 200 West Area, have increased from 10 µg/L in 2000 (filtered, total chromium) to 93 µg ug/L (hexavalent chromium). The reason for the increase in unknown. This well will continue to be sampled under the 200-ZP-1 Performance Monitoring Plan (DOE/RL-2009-115).

The highest chromium concentration reported in 200 West extraction Well 299-W11-50 (located downgradient of WMA T Tank Farm) during 2014 was 89 µg/L. Chromium contamination in groundwater beneath WMA T is within the capture zone of the extraction well. Maximum chromium concentrations decreased in 200-ZP wells (Figure 12-8) as a result of the 200 West P&T remedial actions. The highest concentration reported in WMA TX-TY extraction Well 299-W14-20 during 2014 was 37 µg/L, a 53 percent reduction from the maximum chromium concentration of 79 µg/L in 2012. Chromium contamination in groundwater beneath WMA TX-TY is within the capture zone of the extraction well. Chromium concentrations are declining across 200-ZP; the areal extent of the chromium plume exceeding 48 µg/L decreased from 0.52 km^2 (0.20 mi^2) in 2012 to 0.33 km^2 (0.13 mi^2) in 2014 as a result of the 200 West P&T operations.

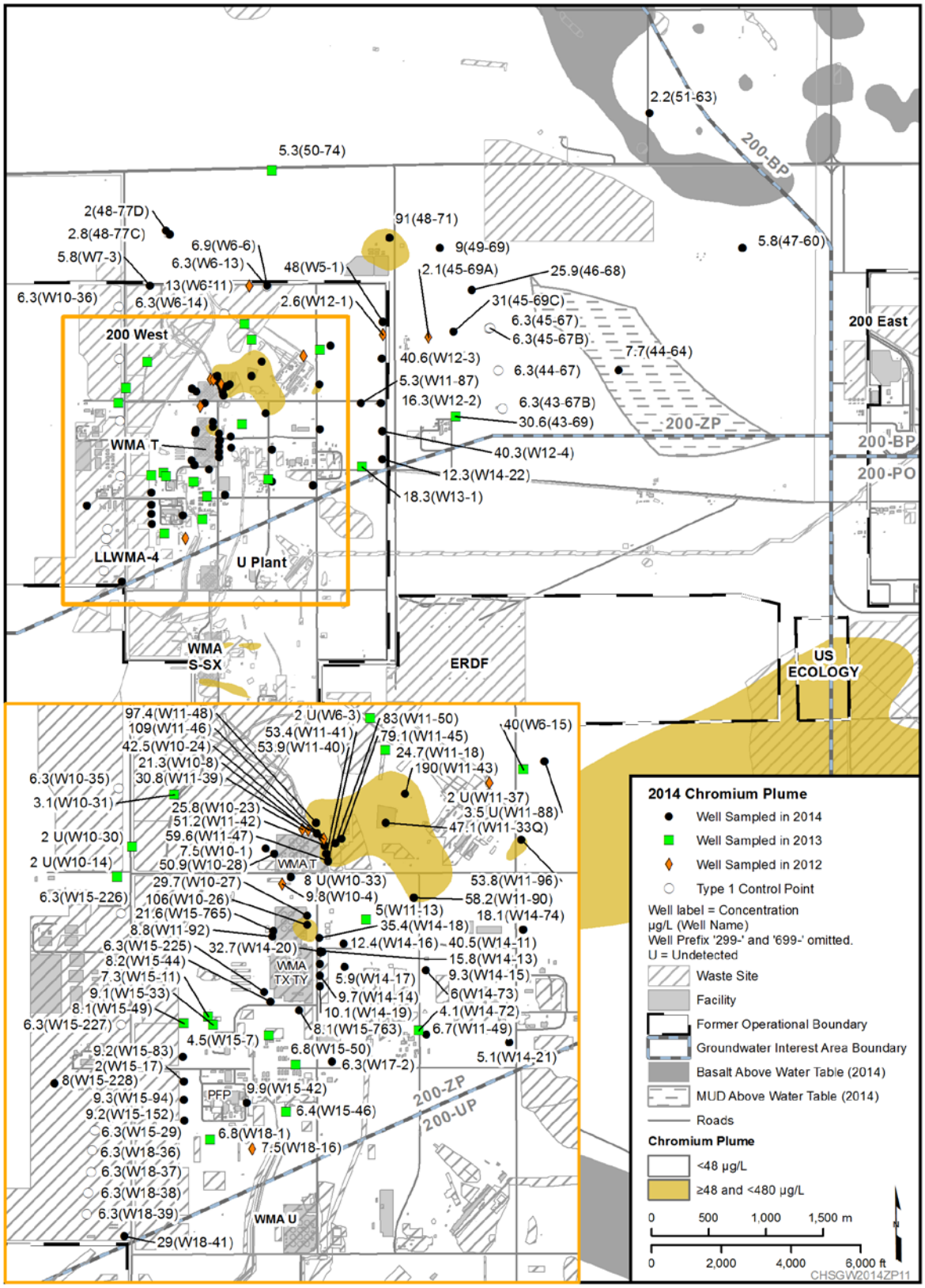


Figure 12-10. 200-ZP Chromium Plume, 2014

12.5 Iodine-129

In wells sampled in 2014, iodine-129 concentrations exceed the 1 pCi/L final cleanup level in only two wells east of WMA T: monitoring Well 299-W11-33Q at 1.88 pCi/L, and extraction Well 299-W6-15 at 1.22 pCi/L (Figure 12-11). Iodine-129 was detected above the 1 pCi/L final cleanup level in Well 299-W11-37 (1.50 pCi/L) located east of WMA T during the most recent sampling event in 2012, and in Well 299-W10-4 (1.35 pCi/L) located south of WMA T during the most recent sampling event in 2012. These wells could not be sampled in 2013 or 2014 because they were dry. Sources of iodine-129 include past leaks from single-shell tanks containing metal and liquid waste, and from chemical processing at T Plant. The plume map shows the extent and geometry of the iodine-129 plume at the 1 pCi/L final cleanup level. The detection limit for iodine-129 is approximately 0.2 pCi/L. Iodine-129 also exceeded the final cleanup level in Well 299-W14-15 (a RCRA monitoring well with 1.84 pCi/L), during the most recent sampling event in 2012.

The highest iodine-129 concentrations found in WMA T extraction Well 299-W11-50 and WMA TX-TY extraction Well 299-W14-20 measured 0.35 pCi/L and 0.26 pCi/L, respectively. Iodine-129 concentrations in 2014 declined compared to 2012 data, as did the areal extent of the iodine-129 plume, from 0.99 km^2 (0.038 mi^2) in 2012 to 0.059 km^2 (0.022 mi^2) in 2014. The greatest declines in iodine-129 concentrations occurred in monitoring wells located near extraction wells (Figure 12-12). For example, Well 299-W14-13 declined from 16 pCi/L in 2012 to less than 0.4 pCi/L in 2014 because the well is close to extraction Well 299-W14-20. Iodine-129 was detected in the influent to the radiological treatment system at low levels (less than 1 pCi/L) and was removed by the Purolite resin.

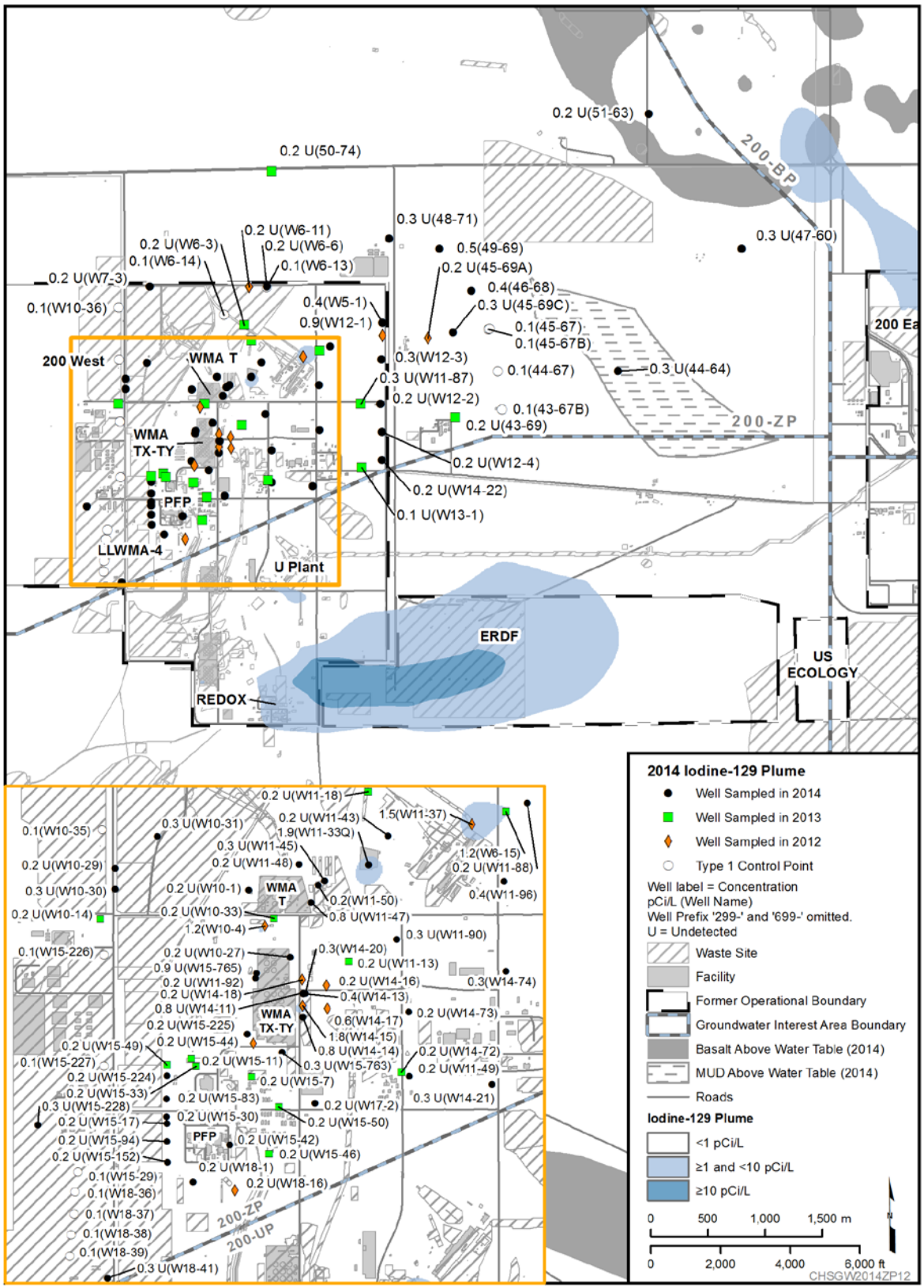


Figure 12-11. 200-ZP Iodine-129 Plume, 2014

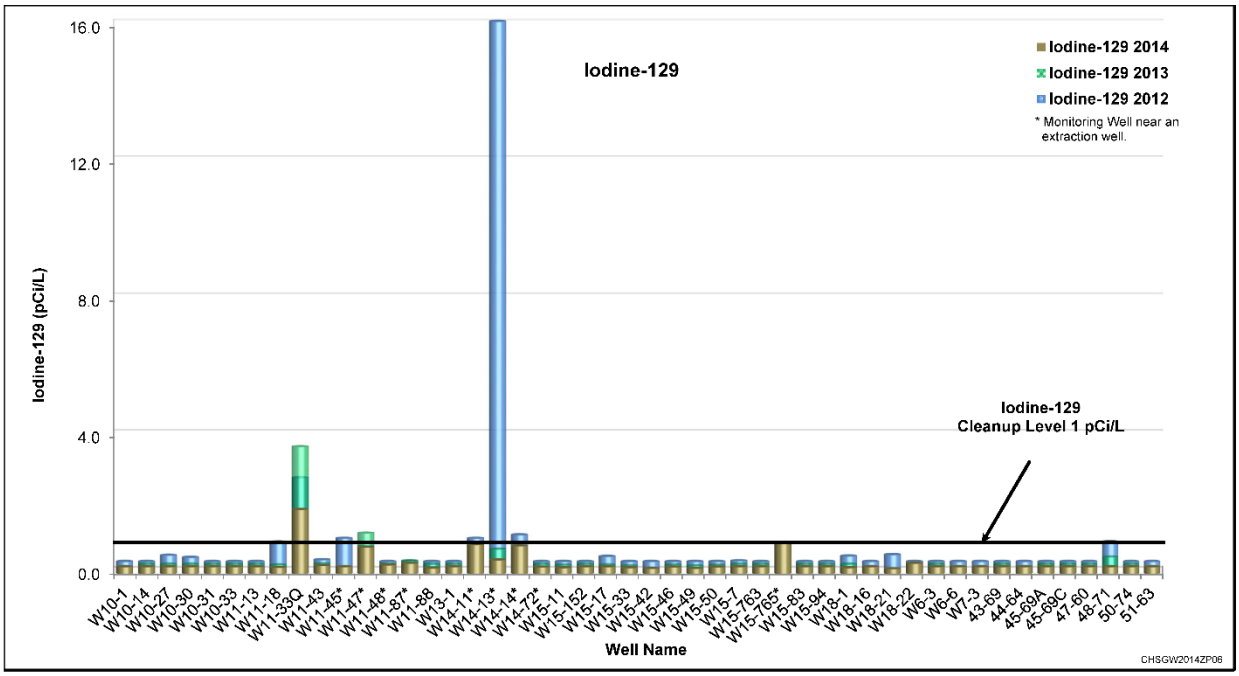


Figure 12-12. Comparison of Iodine-129 Concentrations in Monitoring Wells During 2012, 2013, and 2014

12.6 Nitrate

Nitrate concentrations greater than the final cleanup level (45 mg/L as nitrate) are present beneath much of 200-ZP (Figure 12-13). The size and concentration of contours in 2014 are less than those reported in 2013, from 11.1 km^2 (4.3 mi^2) in 2013 to 8.4 km^2 (3.2 mi^2) in 2014. Sources of nitrate included liquid waste disposal from PFP processes to the cribs near WMA T and the 216-Z Cribs and Trenches. Two discrete, high-concentration plumes are discernible: a plume located beneath WMA T and WMA TX-TY, and a plume observed at Well 299-W18-16 (near the 216-Z Cribs and Trenches). These plumes merge above the 45 mg/L contour extending from the 216-Z Cribs and Trenches to beyond the 200 West Area boundary to the northeast and the combined plume is distributed throughout the entire aquifer.

The high-concentration areas of the nitrate plume beneath WMA T and WMA TX-TY are located within the capture zones of 200 West P&T extraction Wells 299-W11-50 and 299-W14-20. The highest concentration at the 200-ZP wells for 2014 was 536 mg/L at Well 299-W14-13, an increase from previous years (Figure 12-13). The increase in nitrate concentration is likely because of the shifting of the regional nitrate plume and changes in groundwater flow in the area. Nitrate concentrations across 200-ZP are declining in most wells as a result of remedial efforts (Figure 12-14).

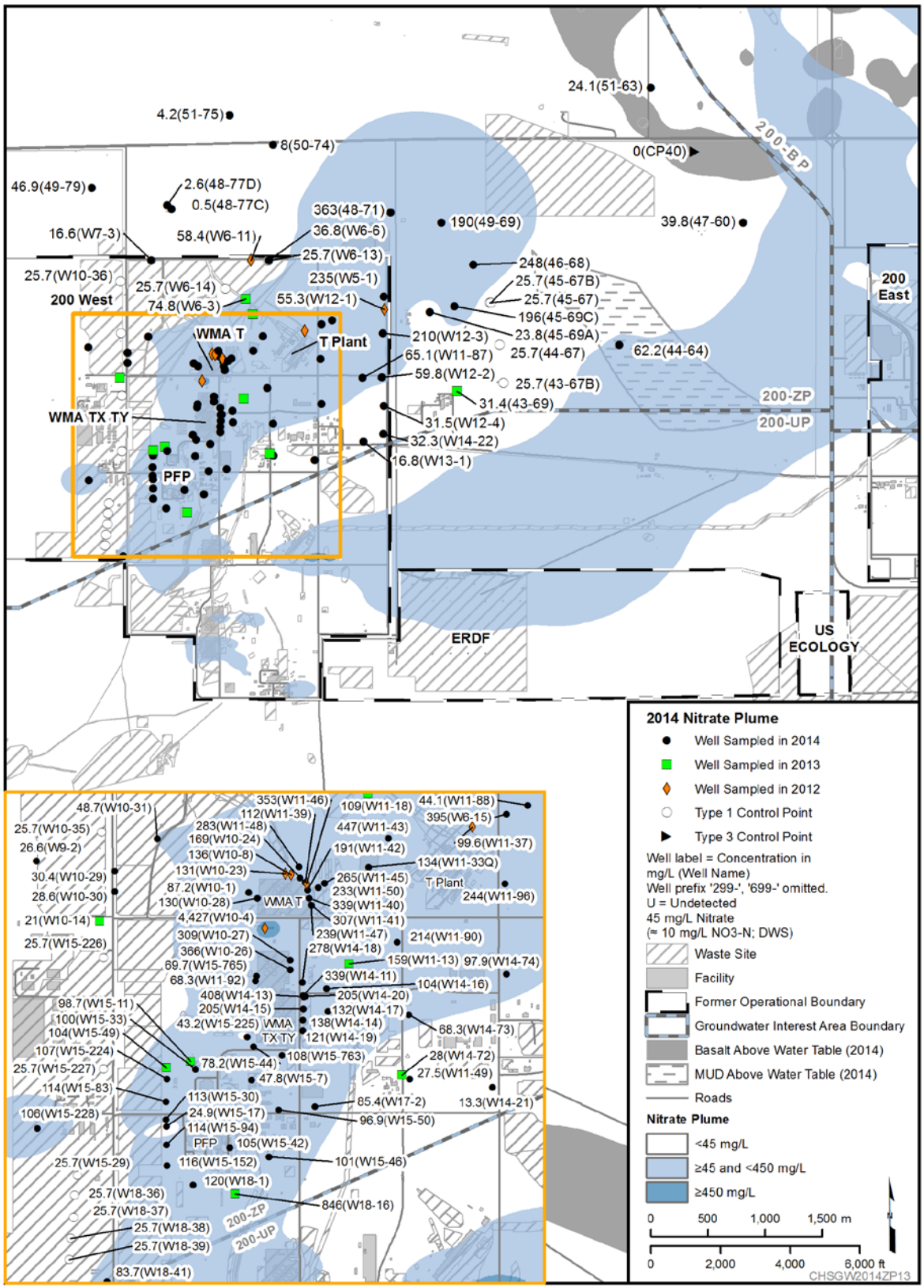


Figure 12-13. 200-ZP Nitrate Plume, 2014

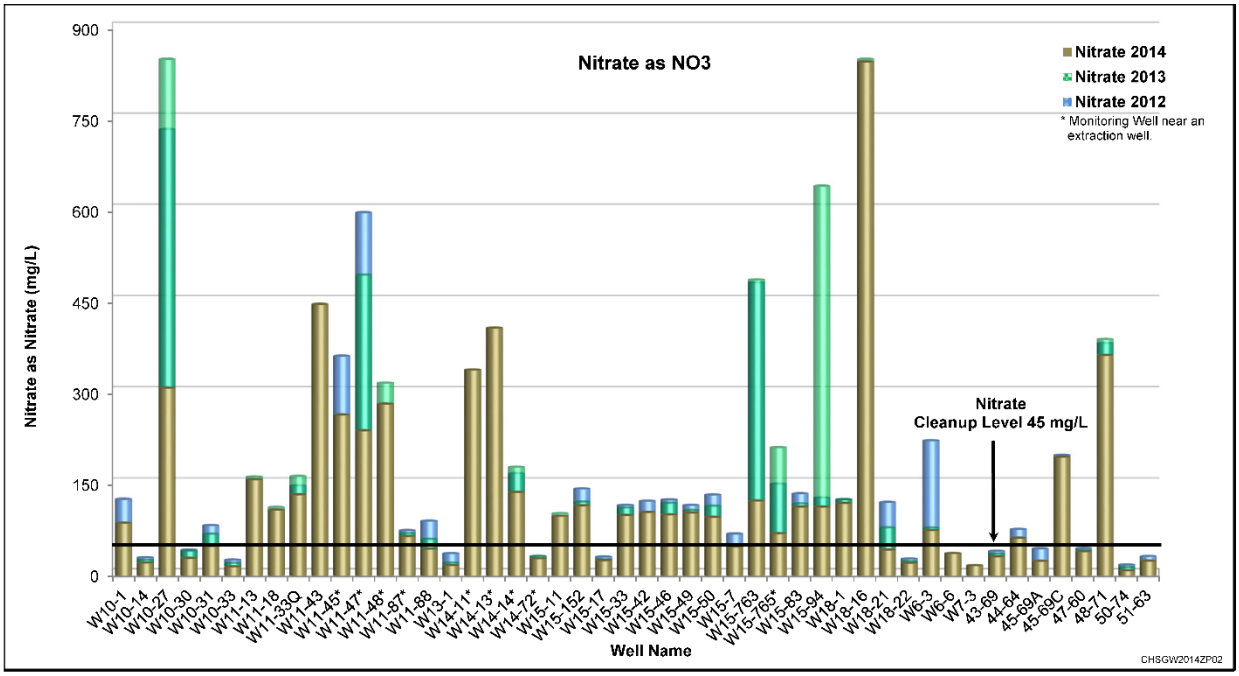


Figure 12-14. Comparison of Nitrate Concentrations in Monitoring Wells During 2012, 2013, and 2014

12.7 Technetium-99

Technetium-99 exceeded the 900 pCi/L final cleanup level at three monitoring wells in 2014 (Figure 12-15). Sources of technetium-99 contamination in 200-ZP were releases from past leaks in single-shell tanks and pipelines in WMA T and WMA TX-TY, and liquid waste disposal from plutonium-processing operations to cribs and trenches adjacent to the WMAs. Figure 12-15 shows two distinct technetium-99 plumes above the 900 pCi/L final cleanup level, centered at the north end of WMA TX-TY and beneath and east of WMA T. The highest concentration was 21,500 pCi/L in Well 299-W14-13, located east (downgradient) of WMA TX-TY. High technetium-99 concentrations also occurred in Well 299-W11-47 (11,800 pCi/L), 299-W14-11 (15,500 pCi/L), and in extraction Wells 299-W14-20 (2,110 pCi/L) and 299-W11-50 (1,510 pCi). The plumes assume the same eastward trend as other contaminant plumes in the OU. Technetium-99 contamination is found primarily in the upper 15 m (50 ft) of the unconfined aquifer.

Concentrations within the plume are declining. Before remediation activities began in 2007 at WMA T, 19 wells exceeded the DWS. During 2014, only five wells exceeded the cleanup level: three monitoring wells and two extraction wells (Figure 12-15 and 12-16). The three monitoring wells with increasing concentrations are located near extraction wells. Concentrations in these wells are increasing because the extraction wells are drawing groundwater in from surrounding areas. Plume size decreased from 0.11 km^2 (0.042 mi^2) in 2012 to 0.033 km^2 (0.013 mi^2) in 2014 as a result of remediation activities.

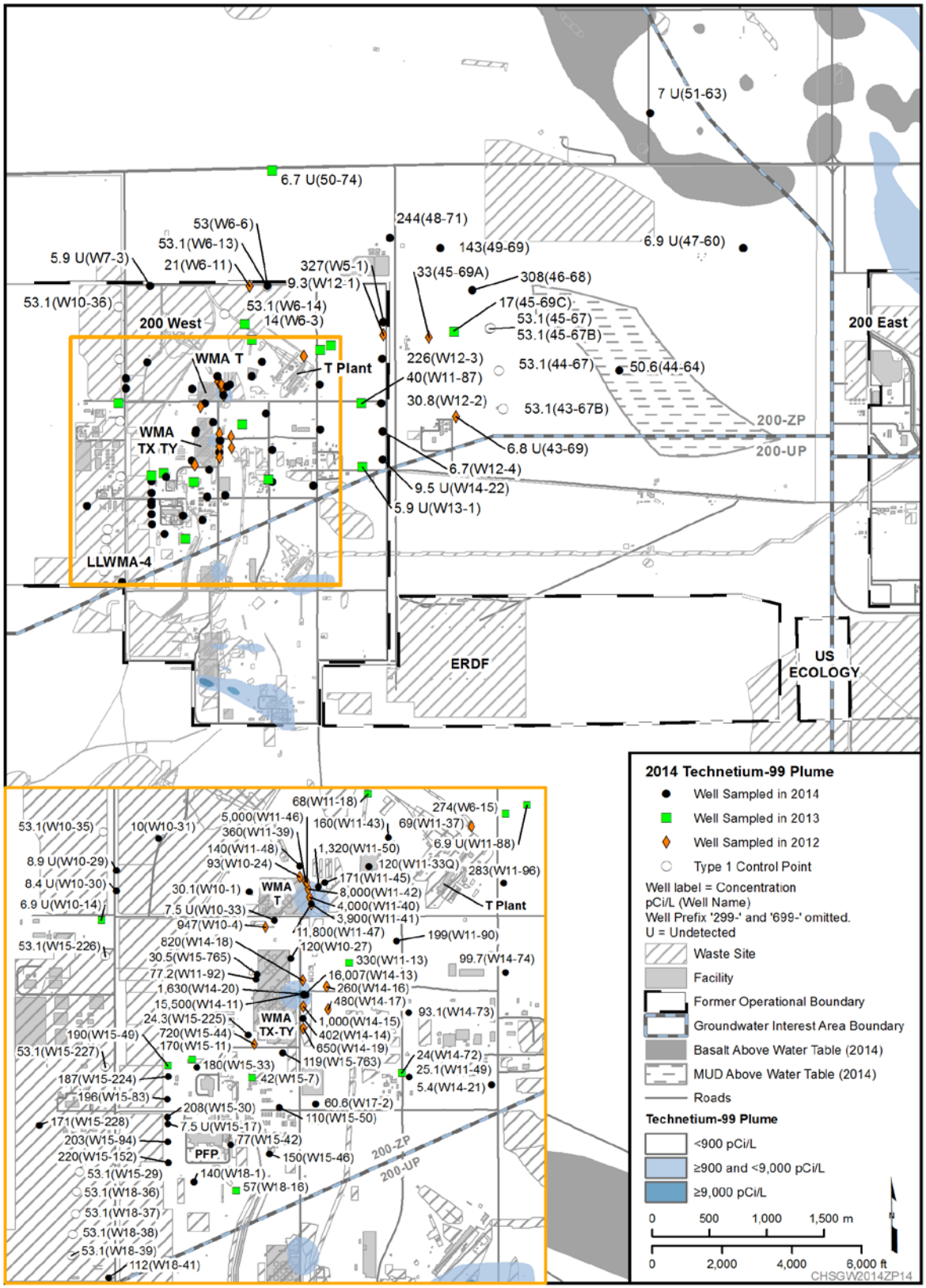


Figure 12-15. 200-ZP Technetium-99 Plume, 2014

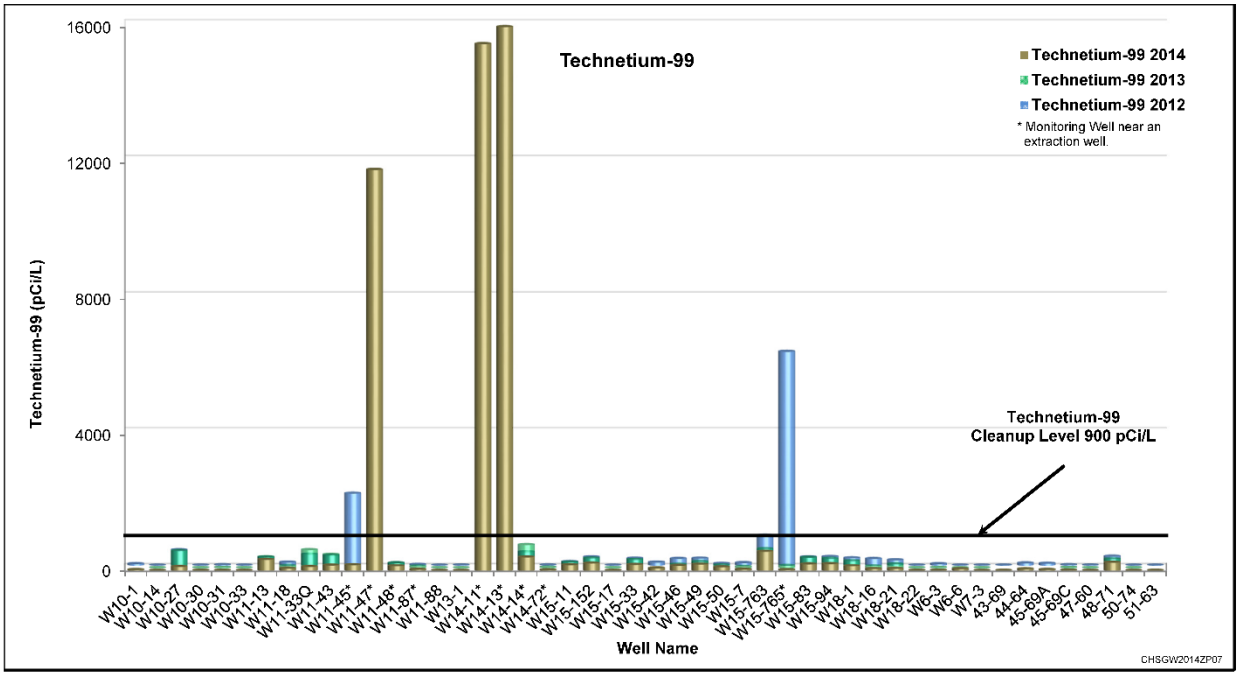


Figure 12-16. Comparison of Technetium-99 Concentrations in Monitoring Wells During 2012, 2013, and 2014

12.8 Trichloroethene

TCE is detected at levels above the final cleanup standard (1 µg/L) throughout much of 200-ZP (Figure 12-17). The TCE plume is co-located with the carbon tetrachloride plume and is found above the cleanup level from the water table to the bottom of the aquifer. The interpreted plume size increased between 2012 and 2014 because analytical sample data collected from varying depth intervals during drilling were used to better define the extent of the TCE plume. The detection limit for TCE is 0.5 µg/L.

The maximum TCE concentration reported during 2014 was 13 µg/L in extraction Well 299-W17-2. Concentrations declined in most wells with the exception of monitoring wells located near extraction wells (Figure 12-18). The increase in TCE concentration is caused by the influence on groundwater flow by nearby extraction wells. The high flow rate in extraction wells directs groundwater flow toward the extraction wells, effectively capturing contamination.

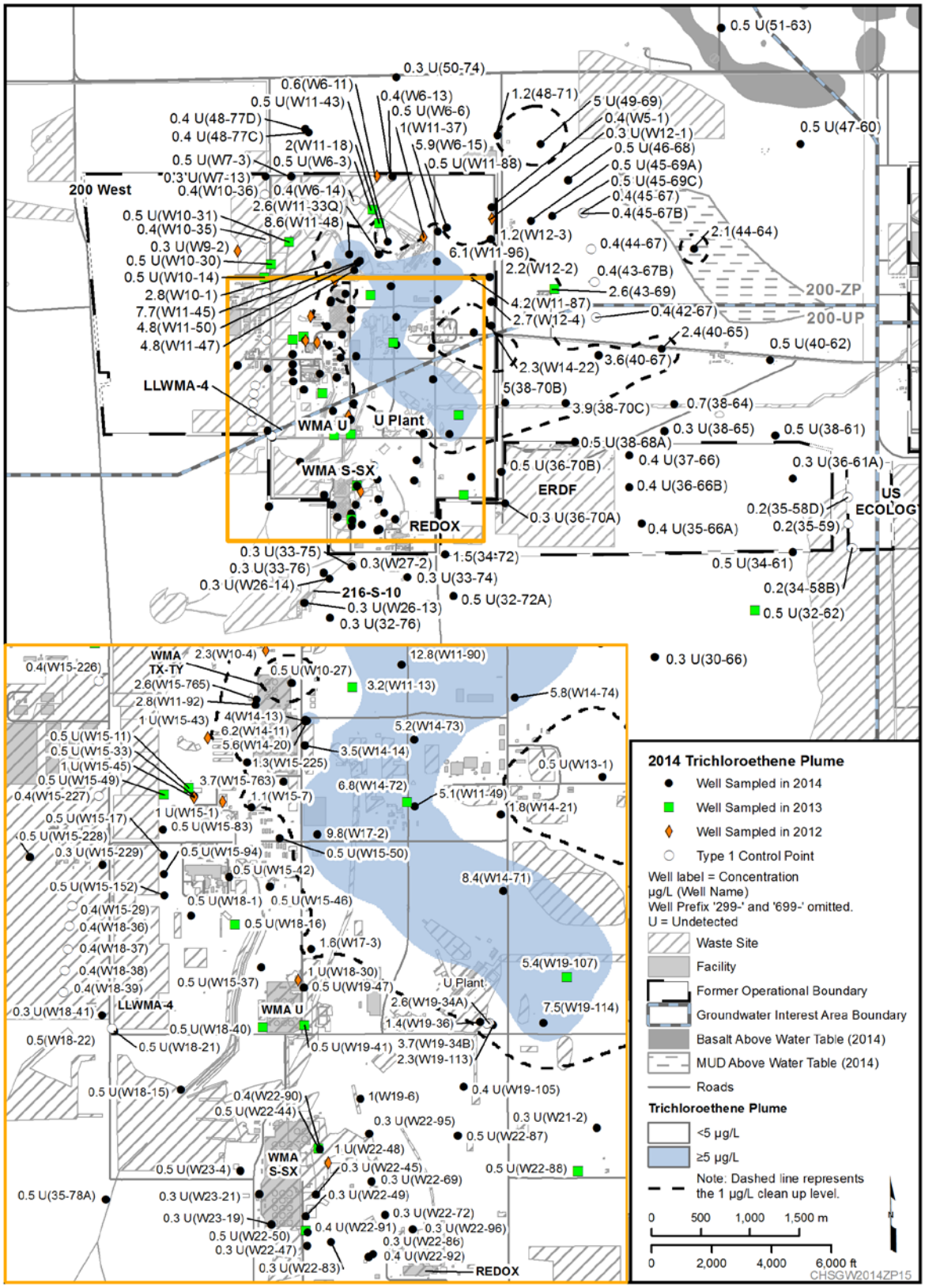


Figure 12-17. 200-ZP TCE Plume, 2014

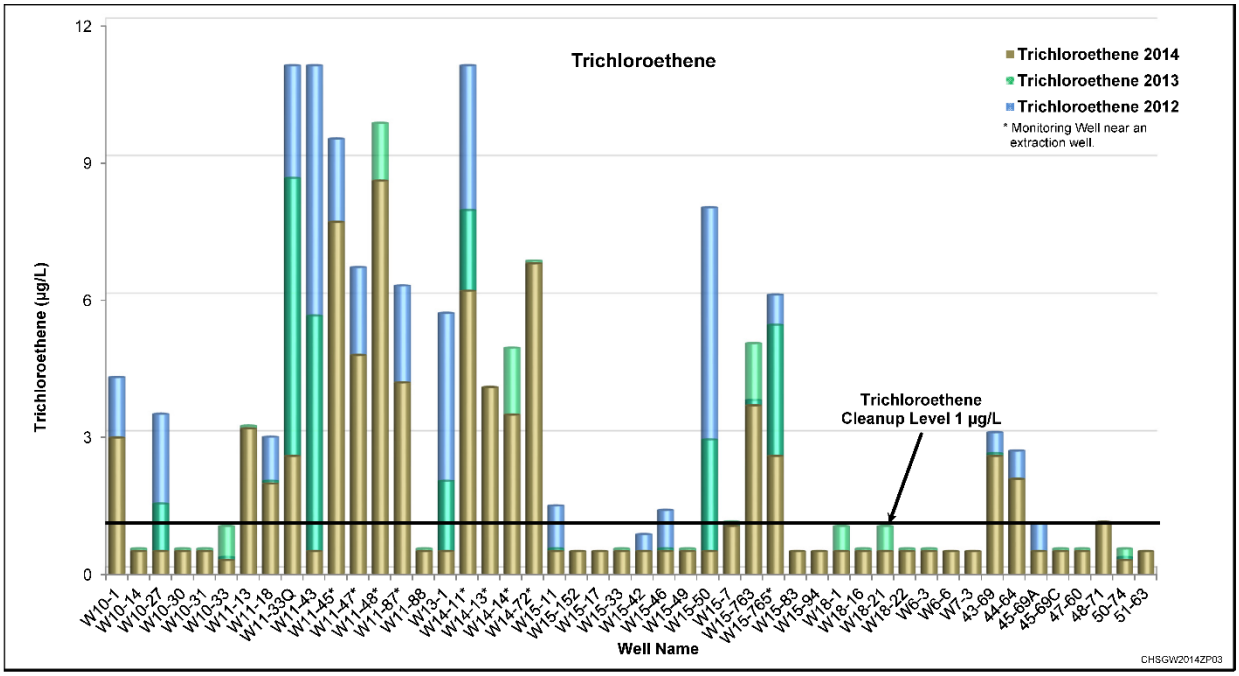


Figure 12-18. Comparison of TCE Concentrations in Monitoring Wells During 2012, 2013, and 2014

12.9 Tritium

Figure 12-19 shows the distribution of tritium in 200-ZP. Tritium concentrations did not exceed the final cleanup level of 20,000 pCi/L except in wells adjacent to the SALDS (699-48-77C and 699-48-77D) during 2014. Active permitted discharges at the SALDS are an ongoing source of tritium to groundwater in 200-ZP. Inactive sources of contamination are the liquid waste from plutonium processing to disposal facilities, including the 216-T-25 Trench, and past leaks from tanks and pipelines adjacent to WMA TX-TY. Tritium contamination is found primarily in the upper 15 m (50 ft) of the unconfined aquifer.

Outside the SALDS plume, tritium contaminant levels ranged from less than detection (<300 pCi/L) to 14,200 pCi/L in 200-ZP wells, with the highest concentration at extraction Well 299-W11-90 located east of WMA T. Tritium concentrations at wells near WMA T are declining (from a maximum tritium concentration of 2,940,000 pCi/L in 2000 to 14,200 pCi/L in 2014, which is a 99.5 percent decrease), suggesting that less contamination is moving from the vadose zone to groundwater.

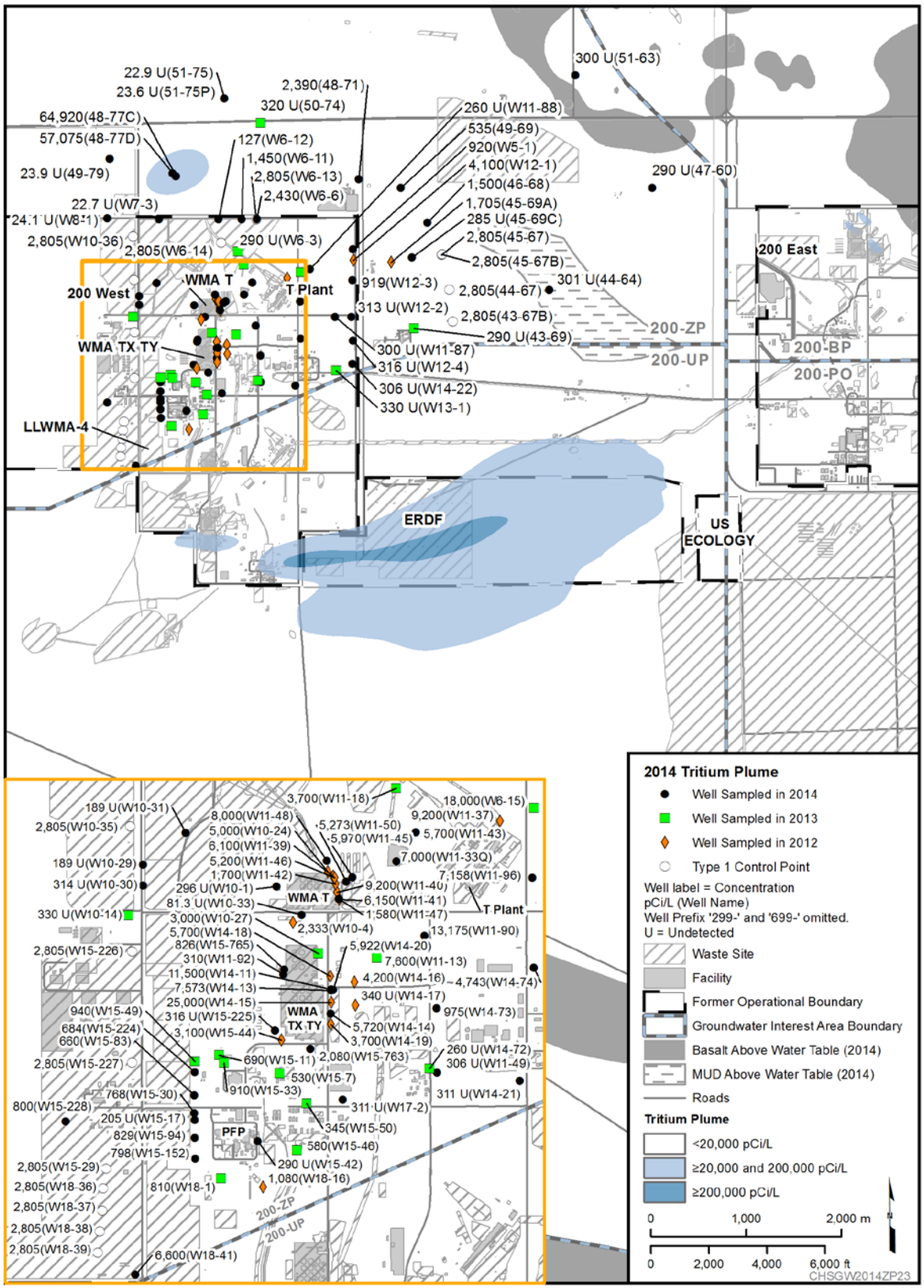


Figure 12-19. 200-ZP Tritium Plume, 2014

12.10 200-ZP-1 Remedies

Disposal of liquid wastes in the 200 West Area introduced an estimated 570,000 to 920,000 kg of carbon tetrachloride to the ground (DOE/RL-2006-58). As of December 2014, a final remedy P&T, a former interim remedy P&T, and vapor extraction systems have removed a total of 100,496 kg of carbon tetrachloride from the subsurface. Remediation also removes other contaminants including nitrate, chromium, and technetium-99.

12.10.1 Pump and Treat

CERCLA final remedial measures in operation at 200-ZP include groundwater P&T, soil vapor extraction, and MNA (Figure 12-20).

The 200 West P&T as a final remedy was implemented for the 200-ZP-1 OU beginning in 2012. The new system has a capacity of 9,500 L/min (2,500 gpm) and is designed to capture and treat contaminated groundwater and reduce the mass of COCs throughout the 200-ZP-1 OU by a minimum of 95 percent in 25 years. The 200 West P&T removes contaminants of concern (COCs) from groundwater using ion exchange, anoxic and aerobic bioreactors, and air stripping. Since there is no cost effective method of groundwater treatment for tritium, and because of its short half-life, natural radioactive decay will reduce tritium concentrations to below the cleanup level of 20,000 pCi/L within 125 years by 2137. The 200 West P&T has been implemented in combination with MNA (after completion of the P&T component) to achieve cleanup levels for all COCs in 125 years. At the end of 2014, 20 extraction wells and 21 injection wells were in use, and the treatment plant was operating at a flow rate of 5,913 L/min (1,562 gpm) (71 percent of its design capacity). Because the new 200 West P&T addresses all of the groundwater contamination in the northern 200 West Area, the two interim action P&T systems that had addressed carbon tetrachloride near the PFP and technetium-99 at the T Tank Farm were shut down during May 2012.

The 200 West P&T extraction and injection well network (Figure 12-20) is designed to capture and contain contamination within 200-ZP-1. The new extraction wells are 20 cm (8 in.) in diameter with long screens (greater than 30 m) placed to within 3 m (10 ft) of the bottom of each well. Aquifer testing was used to ensure that spacing of extraction wells would be sufficient to capture contamination throughout the aquifer (DOE/RL-2010-13). The estimate of hydraulic capture (Figure 12-21) is based on particle tracking using the water level surfaces and the techniques are detailed in SGW-42305.

In 2014, tasks performed to execute the final 200-ZP-1 ROD (EPA et al., 2008) RAOs included the completion of 4 injection wells to supplement the 33 wells completed between 2009 and 2013. In 2014, continuous operation of the 200 West P&T resulted in 3.12 billion L (8.24 million gal) of contaminated groundwater treated from 21 extraction wells. Table 12-2 lists the mass of contamination removed from groundwater in 2014. Initial mass estimates for each COC are provided in Table 7-1 of ECF-Hanford-14-0037, *Description of Groundwater Calculations and Assessments for the Calendar Year 2013 (CY2013) 200 Areas Pump-and-Treat Report*. Concentrations of COCs in the treated water sent to the 21 operational injection wells were at or below cleanup levels. More details on the 200 West P&T performance can be found in DOE/RL-2015-06. A photograph of the 200 West P&T process facility is shown in Figure 12-22.

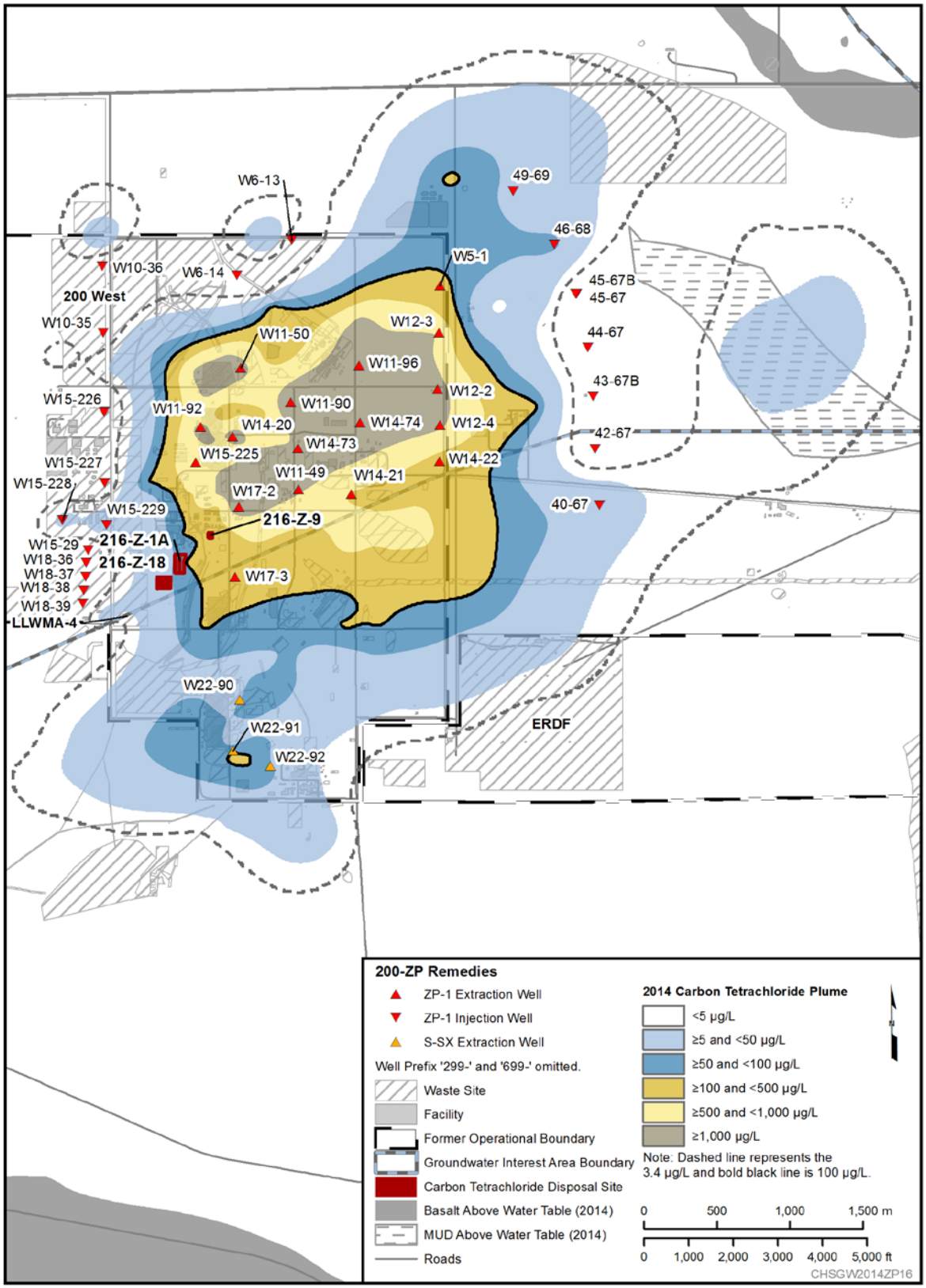


Figure 12-20. 200-ZP Remedy Overview

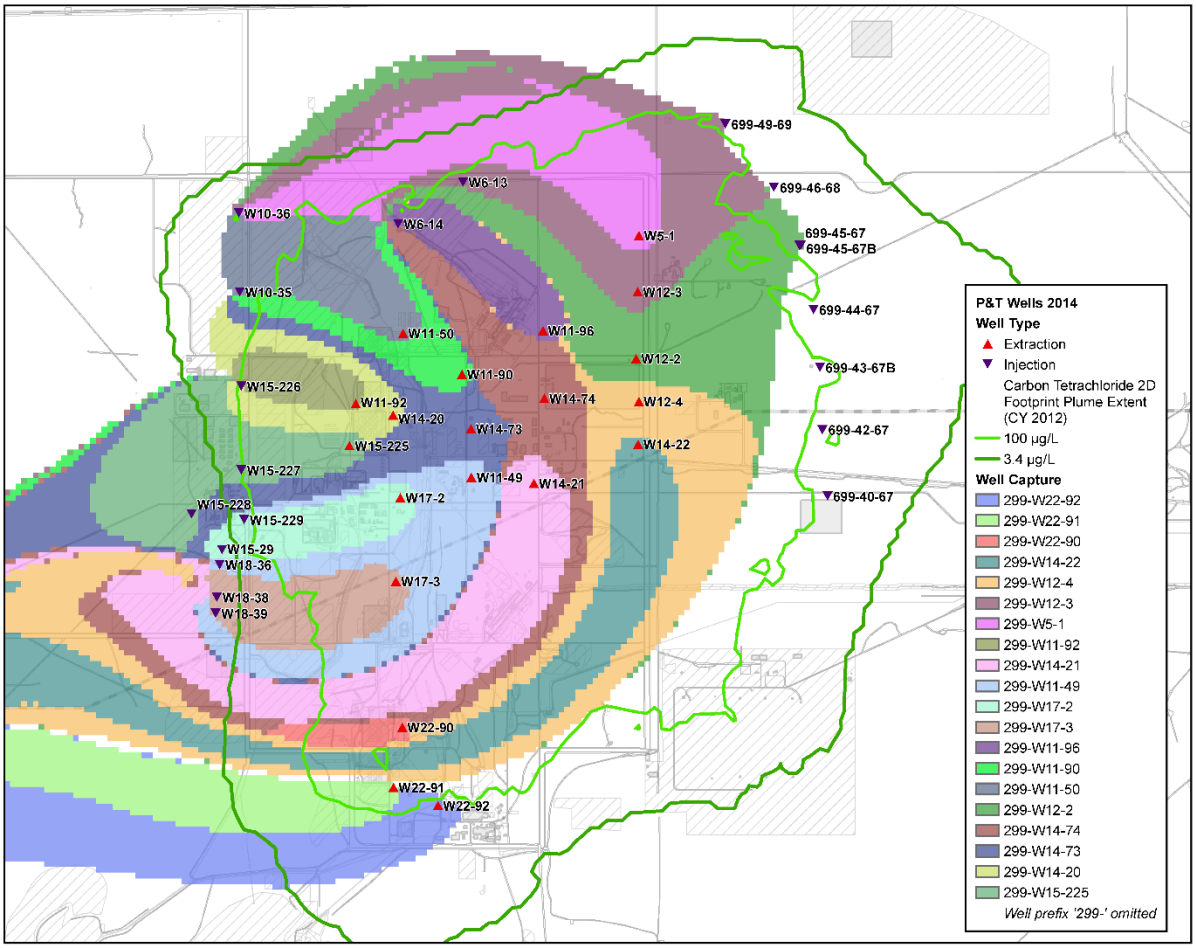


Figure 12-21. 200-ZP-1 P&T System Hydraulic Capture Zone

Table 12-2. 200 West P&T Performance for 2014

Performance	2014	Total Since Start of Final Remedy (2012)	Total Since Start of Interim Remedy (1996)
Total groundwater processed (L)	3,118,412,520	6,513,185,738	12,525,485,738
COCs	**Mass Removed**	**Total Since Start of Final Remedy (2012)**	**Total Since Start of Interim Remedy (1994)**
Carbon tetrachloride (kg)	2,898	6,478	20,389
Chromium (total and hexavalent) (kg)	75.17	166.37	181.54
Iodine-129 (p/Ci)	0[b]	242	242
Nitrate as nitrate (kg)	251,595	495,682	580,375
Technetium-99 (g)	76.96	174.99	256.99
Trichloroethene (kg)	10.24	25.73	26.73
Uranium[a] (kg)	0.77	1.85	1.85

a. Uranium is included to track 200-UP-1 groundwater treated.

b. Iodine-129 concentrations in the influent and effluent of the 200 West P&T in 2014 were less than the detection limit (0.2 pCi/L).

COCs = contaminant of concern

P&T = pump and treat

Figure 12-22. 200 West P&T Facility

12.10.2 Soil Vapor Extraction

Soil vapor extraction is being used to remove carbon tetrachloride from the vadose zone at the carbon tetrachloride site in 200-PW-1 overlying the 200-ZP-1 groundwater (Figure 12-23). Soil vapor extraction was implemented as an interim action in 1992. The purpose of the remediation using soil vapor extraction is to mitigate the threat to the environment caused by the migration of carbon tetrachloride vapors through the soil column and into the groundwater. The carbon tetrachloride site includes the three waste sites (216-Z-9 Trench, 216-Z-1A Tile Field, and 216-Z-18 Crib) used from 1955 through 1973 for disposal of waste liquids containing carbon tetrachloride. The purpose of the remediation using soil vapor extraction is to mitigate the threat to the environment caused by the migration of carbon tetrachloride vapors through the soil column and into the groundwater. Soil vapor extraction was implemented as an interim action in 1992 (Smith and Stanley, 1992). The CERCLA ROD for the 200-PW-1 OU was finalized in September 2011 (EPA et al., 2011). The ROD selected soil vapor extraction as the final remedial action for vadose zone carbon tetrachloride contamination at these OUs.

During soil vapor extraction operations, vapor-phase carbon tetrachloride is extracted through vadose zone wells and adsorbed onto granular activated carbon before the treated, clean vapor is released to the atmosphere. Design capacities ranging from 14 to 43 m^3/min (500 to 1,500 ft^3/min) were implemented with the interim systems. Between 2009 and 2012, two soil vapor extraction systems, each with a design capacity of 14 m^3/min (500 ft^3/min), were used from April through September of each year to remove carbon tetrachloride from the vadose zone. The systems were maintained in standby mode from October 2012 through April 2015 to allow time for carbon tetrachloride vapor concentrations to rebound. Since startup of soil vapor extraction operations in 1992, 80,107 kg of carbon tetrachloride have been removed from the vadose zone in 118 million m^3 (4.2 billion ft^3) of soil vapor (Figure 12-24; Table 12-3). Each soil vapor extraction system extracts simultaneously from multiple wells.

Passive soil vapor extraction systems formerly operated near the disposal sites associated with the PFP. Passive soil vapor extraction is a naturally occurring process driven by barometric pressure fluctuations. During its lifetime, the passive systems have removed approximately 110 kg of carbon tetrachloride. The passive soil vapor extraction wells were taken out of service permanently in March 2013.

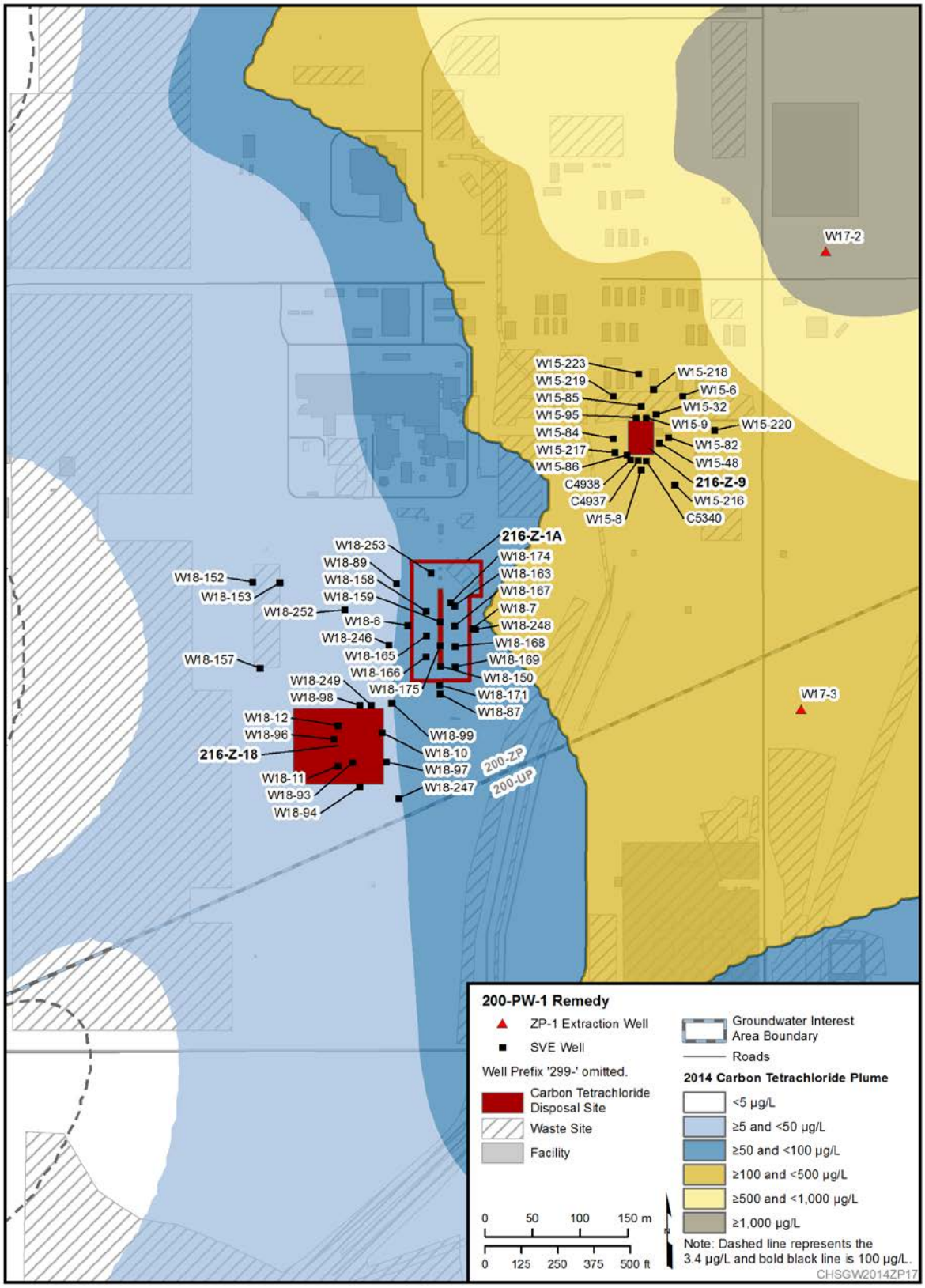


Figure 12-23. 200-PW-1 Soil Vapor Extraction Overview

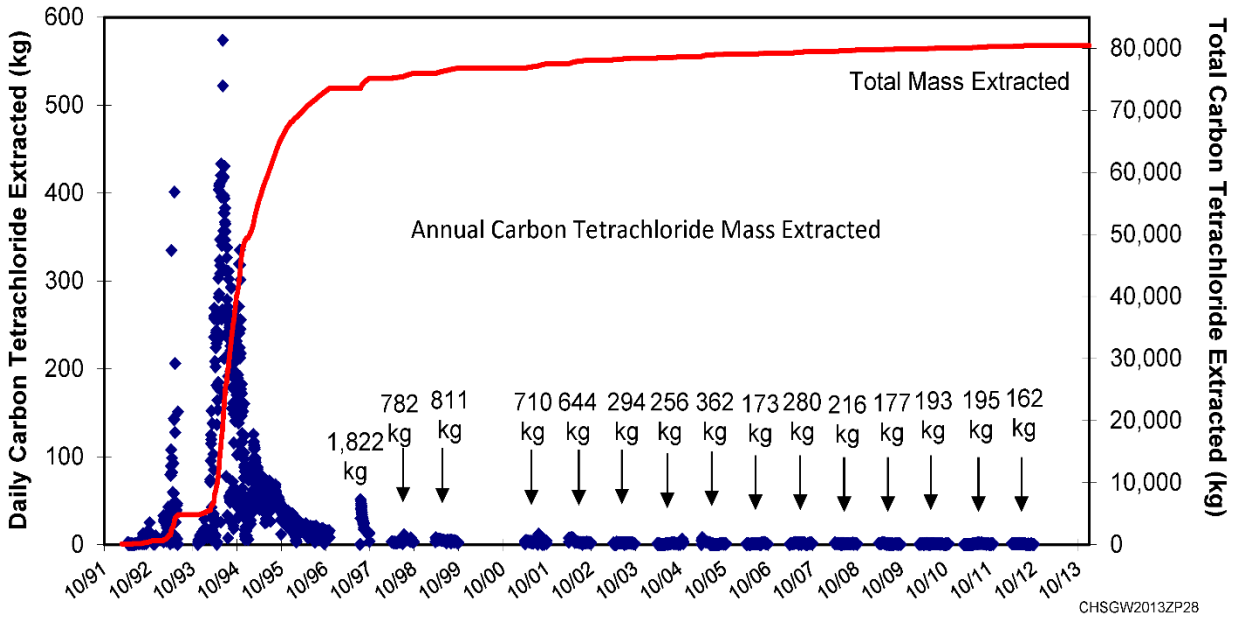


Figure 12-24. 200-ZP Mass of Carbon Tetrachloride Removed from 200-PW-1 Vadose Zone

Table 12-3. Soil Vapor Extraction Performance Since Startup

Performance	Since Startup (February 1992 to 2012[a, b])
Total soil vapor processed (m^3)	118,290,000
Total mass of carbon tetrachloride removed (kg)[c]	80,107

a. System did not operate in 2013 or 2014.

b. Includes the pilot test operations in April 1991.

c. Does not include the mass removed by the passive soil vapor extraction systems.

12.11 RCRA Monitoring

This section describes the results of monitoring at individual RCRA treatment, storage, and disposal units, including single-shell tank farms. Some of these units are monitored under RCRA requirements for dangerous waste constituents and under AEA for source, special nuclear, and byproduct materials.

The 200-ZP interest area contains four RCRA sites with groundwater monitoring requirements: WMA T, WMA TX-TY, LLWMA-3, and LLWMA-4 (Figures 12-25, 12-26, 12-27, and 12-28). Interim status groundwater quality assessment monitoring was conducted at WMA T and WMA TX-TY (40 CFR 265.93[d], as referenced by WAC 173-303-400). Interim status indicator parameter evaluation monitoring was conducted at LLWMA-3 and LLWMA-4 (40 CFR 265.92 and 40 CFR 265.93[b], as referenced by WAC 173-303-400). The following discussion summarizes the results of statistical comparisons, assessment studies, and other developments for the reporting period. LLWMA-3 and LLWMA-4 also have AEA monitoring conducted under a performance assessment monitoring plan (DOE/RL-2000-72).

Groundwater data are available in the HEIS database and in the appendices accompanying this report. The database is available at http://environet.hanford.gov/eda/. Appendix B includes additional information (including well and constituent lists, flow rates, and statistical tables).

12.11.1 Waste Management Area T

WMA T (Figure 12-25), which includes the T Tank Farm, is located in the northern portion of the 200 West Area and was used for interim storage of radioactive waste from chemical processing of reactor fuel for plutonium production. The WMA T contains 16 underground single-shell tanks that were constructed in 1943 and 1944. Tanks T-101 through T-112 have capacities of 2,000,000 L (528,344 gal), and Tanks T-201 through T-204 have capacities of 208,000 L (55,000 gal). In addition to the tanks, six diversion boxes and ancillary pumps, valves, and pipes are included in the Dangerous Waste Permit Application Part A Form (WA7890008967) for the T Tank Farm single-shell tank system.

The tanks in WMA T began receiving waste in 1944 and were mostly in continual use until 1980, at which time all tanks in the WMA were removed from service. The single-shell tanks received predominantly high-level metal and first-cycle waste from chemical processing of uranium-bearing, irradiated reactor fuel rods. Lesser amounts of other waste also were stored in the tanks at WMA T. More detailed information on the WMA T can be found in DOE/RL-2009-66. All drainable liquid in each tank has been removed and the tanks have been interim stabilized.

In 2008, an interim corrective measure, consisting of surface barrier emplacement over a portion of the WMA, was designed and constructed to reduce infiltration and the subsequent migration of contaminants through the vadose zone to groundwater. Sections 12.5 and 12.7 discuss the distribution of these non-RCRA constituents near WMA T.

WMA T is monitored under an interim status assessment program because concentrations of the dangerous constituent chromium exceed the DWS (100 µg/L) in downgradient wells (Section 12.4). The well network was sampled quarterly in some wells and semiannually and annually in others for waste constituents and indicator parameters in the groundwater (DOE/RL-2009-66). Figure 12-25 shows well locations and Table B-80 of Appendix B includes a list of wells and constituents monitored.

The water table continues to decline beneath WMA T in response to extraction by the 200 West P&T. Extraction wells east of the WMA affect groundwater flow in this location. Groundwater flows to the east-southeast and estimates of groundwater/contaminant flow rates beneath WMA T (using the Darcy relationship) range from 0.34 to 0.54 m/d (1.1 to 1.8 ft/d). Table B-1 of Appendix B contains calculations of groundwater flow rates and gradients.

The WMA T monitoring well network consists of two upgradient, one assessment, one far-field, and six downgradient monitoring wells. The assessment well is not directly upgradient or downgradient and is used to help distinguish other contaminant plumes impinging on WMA T. The well network complies with RCRA groundwater monitoring requirements. Sampling of WMA T wells occurred as scheduled except for Well 299-W11-45, which required conversion to a monitoring well following the shutdown of the interim P&T system. Conversion to a monitoring well occurred in October 2014 and the well was sampled only once in 2014. The direction of groundwater flow is not expected to change with operation of the 200 West P&T. However, the magnitude and direction of groundwater flow will not be known until after a performance monitoring and assessment of the system, as defined in DOE/RL-2009-115, is completed.

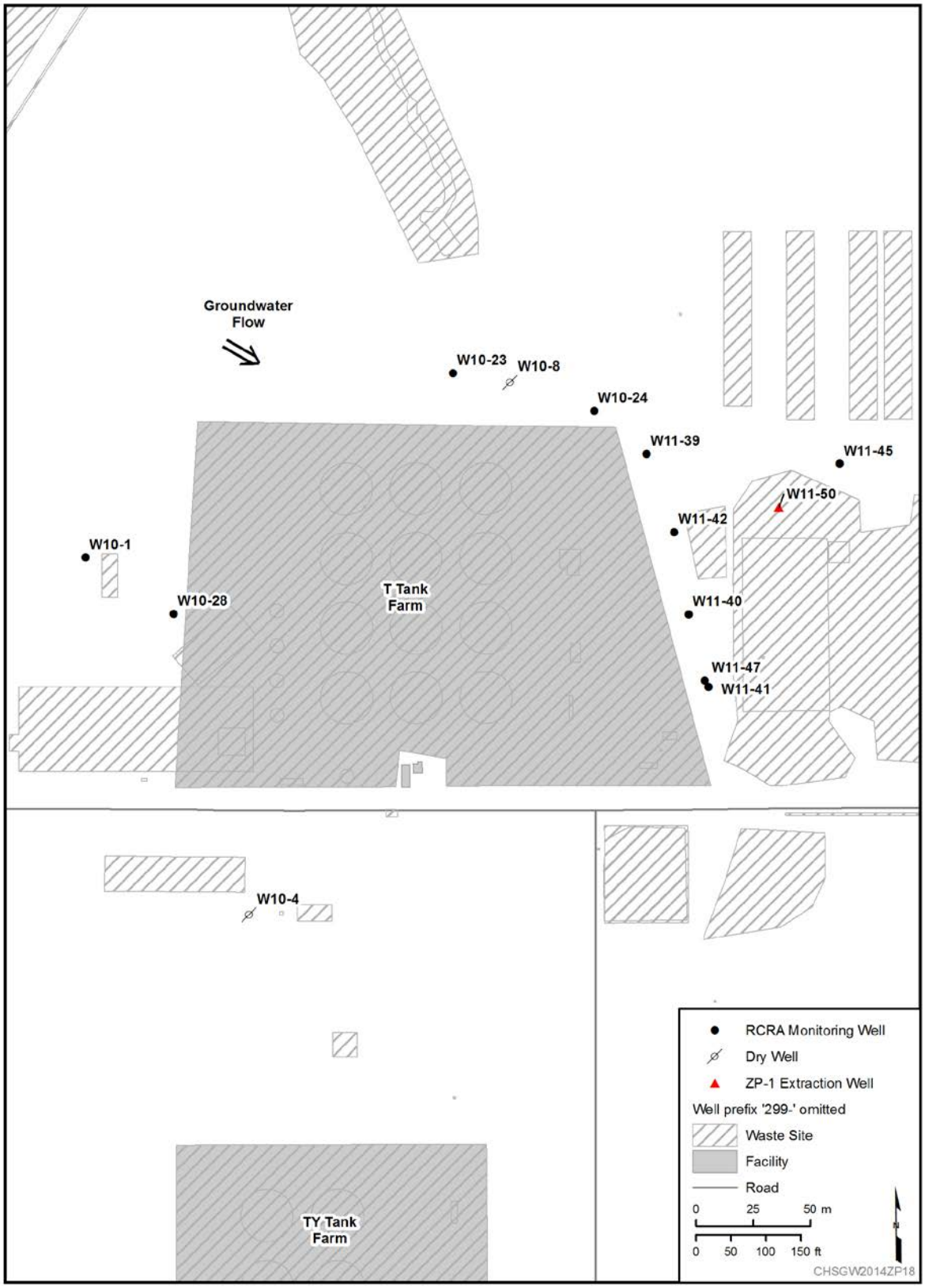


Figure 12-25. 200-ZP RCRA Facility WMA T Monitoring Well Locations

The primary dangerous waste constituents found beneath WMA T during the reporting period were chromium, carbon tetrachloride, and TCE. Carbon tetrachloride and TCE contamination is not related to WMA T but is associated with liquid disposal processes at the PFP (Section 12.3). These constituents are monitored as part of the 200-ZP-1 OU. Chromium is a dangerous constituent monitored under the RCRA assessment program. From 1944 to 1980, the WMA received metal and first-cycle waste from chemical processing, including the bismuth phosphate process, tributyl phosphate process, and REDOX process. Past leaks from single-shell tanks and waste pipelines within the WMA are the sources of the chromium contamination.

In 2014, the highest chromium concentration in the upper portion of the aquifer was in Well 299-W11-40 (109 µg/L), located east of the WMA. The highest chromium concentration found in wells screened deeper in the aquifer (above the Ringold lower mud unit) in WMA T was 67 µg/L in downgradient Well 299-W11-47 (screened between 7.5 and 17 m [25 to 56 ft] below the water table). The highest chromium concentration in adjacent downgradient Well 299-W11-39 (screened at the water table) was 31 µg/L. The high concentrations in the deeper screened wells show that the chromium plume extends relatively deep in the aquifer downgradient of WMA T and is present laterally at least 80 m (260 ft) downgradient (Figure 12-10). Because of groundwater remediation activities at WMA T, however, chromium concentrations are declining and the plume extent is shrinking. The groundwater beneath WMA T is within the capture zone of 200 West P&T extraction Well 299-W11-50.

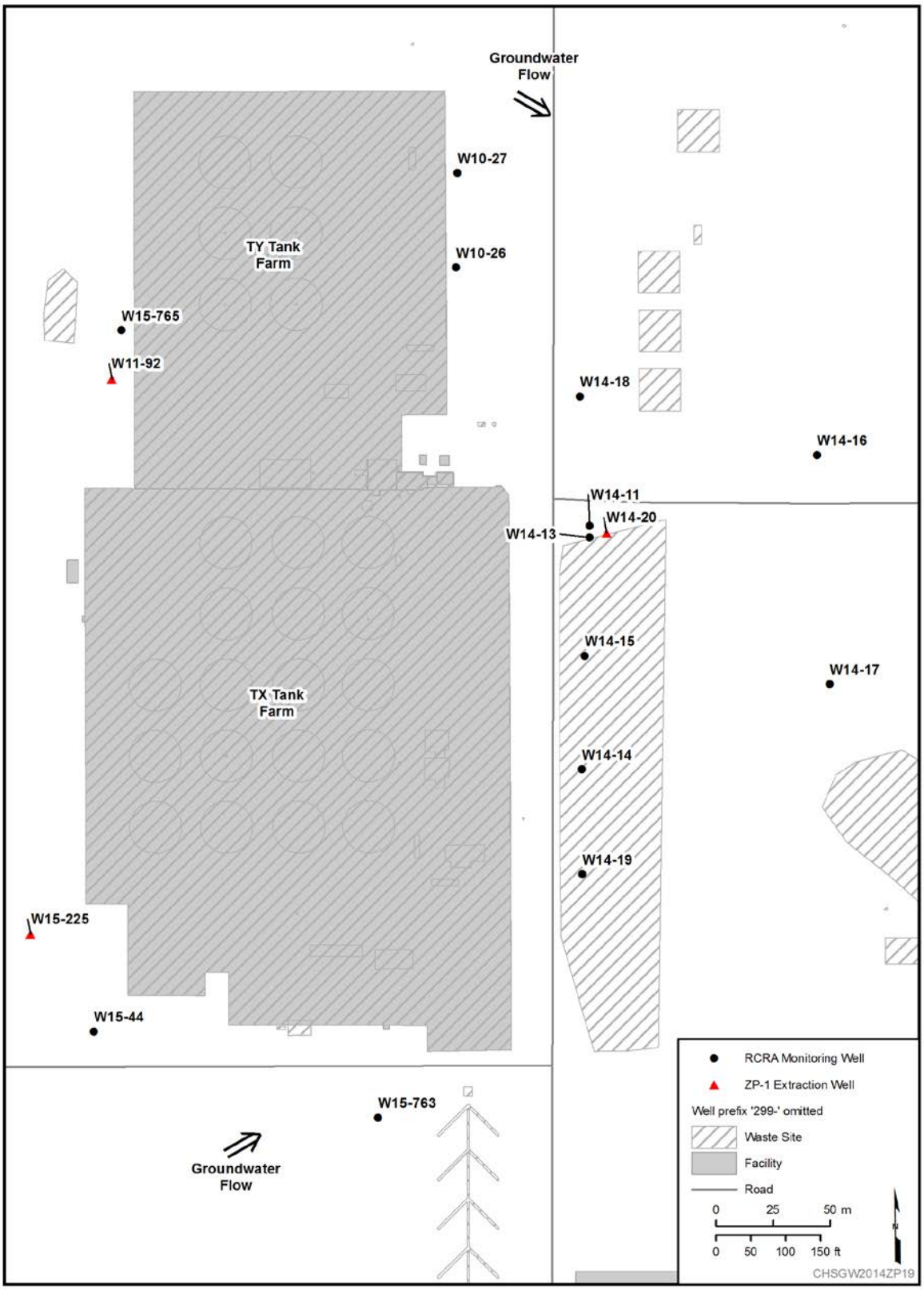
Nitrate is also found in the groundwater beneath the WMA from the same source as chromium. A nitrate plume beneath WMA T is located within the regional nitrate plume (Figure 12-13) and the plume configuration in 2014 was consistent with the configuration in 2013. During the reporting period, the highest nitrate concentrations (as nitrate) were in Well 299-W11-40 (456 mg/L) and 299-W11-41 (332 mg/L). The nitrate concentrations above the DWS in the remaining WMA T wells were between 77 and 26 mg/L. While WMA T is a source of nitrate, other upgradient sources are larger contributors.

12.11.2 Waste Management Area TX-TY

WMA TX-TY (Figure 12-26), which includes the TX and TY Tank Farms, is located in the northern portion of the 200 West Area and was used for interim storage of radioactive waste from chemical processing of reactor fuel for plutonium production. The WMA is regulated under RCRA and its implementing requirements in WAC 173-303-400. Sections 12.5 and 12.7 discuss the distribution of non-RCRA constituents iodine-129 and technetium-99 near WMA TX-TY.

The WMA contains 24 underground single-shell tanks, constructed in 1947 and 1948 for the TX Tank Farm and in 1951 and 1952 for the TY Tank Farm. Each tank has a capacity of 2.84 million L (750,000 gal). In addition to the tanks, six diversion boxes and ancillary pumps, valves, and pipes are included in the Dangerous Waste Permit Application Part A Form (WA7890008967) for the single-shell tanks in the TX-TY Tank Farms system.

The tanks in WMA TX-TY began receiving waste in 1949. The tanks in both the TX and TY Tank Farms were used to support the bismuth phosphate process and the uranium-recovery program. Some of the tanks in WMA TX-TY also received waste from REDOX Plant and PUREX Plant operations. Detailed information on the WMA TX-TY can be found in DOE/RL-2009-67. All drainable liquid in each tank has been removed and all tanks have been interim stabilized.



Note: Two flow direction arrows shown based on influence of P&T extraction wells.

Figure 12-26. 200-ZP RCRA Facility WMA TX-TY Monitoring Well Locations

The 200 West P&T extraction wells on the east, west, and south sides of the WMA alter the flow direction and hydraulic gradients. The water table continued to decline in 2014. Groundwater tends to flow to the east, although the extraction wells on the west side of the WMA disrupt the flow locally. Estimates of groundwater/contaminant flow rates beneath WMA TX-TY (using the Darcy relationship) range from 0.001 to 0.34 m/d (0.003 to 1.1 ft/d). Table B-1 of Appendix B contains calculations of groundwater flow rates and gradients. The magnitude and direction of changes in groundwater flow direction and rate will not be known until after the performance monitoring and assessment of the system is completed as defined in the Performance Monitoring Plan (DOE/RL-2009-115).

WMA TX-TY is monitored under an interim status assessment program because of elevated specific conductance in two downgradient wells in 1993. The well network currently consists of one upgradient, 2 far-field, and 10 downgradient monitoring wells (Figure 12-26). The well network complies with RCRA groundwater monitoring requirements. The WMA TX-TY well network was sampled quarterly, semiannually, and annually for contamination indicator parameters and supporting constituents (DOE/RL-2009-67). Table B-83 of Appendix B includes a list of wells and constituents monitored in 2014.

The dangerous waste constituent chromium was monitored under the RCRA assessment program in WMA TX-TY during the reporting period. Other dangerous waste constituents found at the WMA included carbon tetrachloride and TCE, which come from other sources associated with PFP operations. Nitrate is also found in the groundwater beneath the WMA.

In 2014, chromium was detected above the 100 µg/L DWS in two wells monitoring WMA TX-TY (Figure 12-10): Well 299-W10-26 and 299-W15-763. The highest chromium concentration in Well 299-W10-26 was 108 µg/L; a result of 144 µg/L was recorded in this well in 2013. The highest chromium concentration in Well 299-W15-763 was 447 µg/L in an unfiltered sample, but this is attributed to particulates and corrosion of the well; the highest hexavalent chromium concentration in this well was 10 µg ug/L. The source for the dissolved chromium was past leaks from tanks and pipelines at WMA TX-TY. The chromium plume is slightly larger in extent than depicted in 2013, from 0.25 km^2 (0.098 mi^2) to 0.33 km^2 (0.13 mi^2) in 2014 .

During 2014, nitrate concentrations exceeded the DWS in all wells in the monitoring network (Figure 12-13). Nitrate concentrations decreased in WMA TX-TY monitoring wells from the highest concentration found at 299-W14-11 during drilling in 2005 (3,600 mg/L) to the highest concentration found in 2014 at 299-W14-13 (536 mg/L). Nitrate concentrations in other WMA TX-TY wells ranged between 49.1 mg/L (299-W15-765) and 487 mg/L (299-W14-11). Most of the nitrate contamination is attributed to PFP operations, as well as past-practice disposal to cribs and trenches in the area.

12.11.3 Low-Level Waste Management Area 3

LLWMA-3 (Figure 12-27), located in the northwest corner of the 200 West Area, consists of the 218-W-3A Burial Ground, 218-W-3AE Burial Ground, and 218-W-5 Burial Ground. The 218-W-3A Burial Ground (0.204 km^2 [0.079 mi^2]) contains 57 unlined trenches operated between 1970 and 1998. The 218-W-3AE Burial Ground (0.200 km^2 [0.077 mi^2]) contains eight unlined trenches operated between 1981 and July 2004. The 218-W-5 Burial Ground (0.372 km^2 [0.144 mi^2]) contains 10 unlined trenches and 2 lined trenches. This burial ground began operating in 1986, and the two double-lined mixed waste trenches are the only trenches continuing to receive waste.

The LLWMA-3 is monitored under an interim status contamination indication (detection) program. Wells are sampled semiannually and annually from a network of four wells and samples are analyzed for

indicator parameters and supporting constituents (DOE/RL-2009-68). All the wells were sampled in 2014 (Table B-56 of Appendix B).

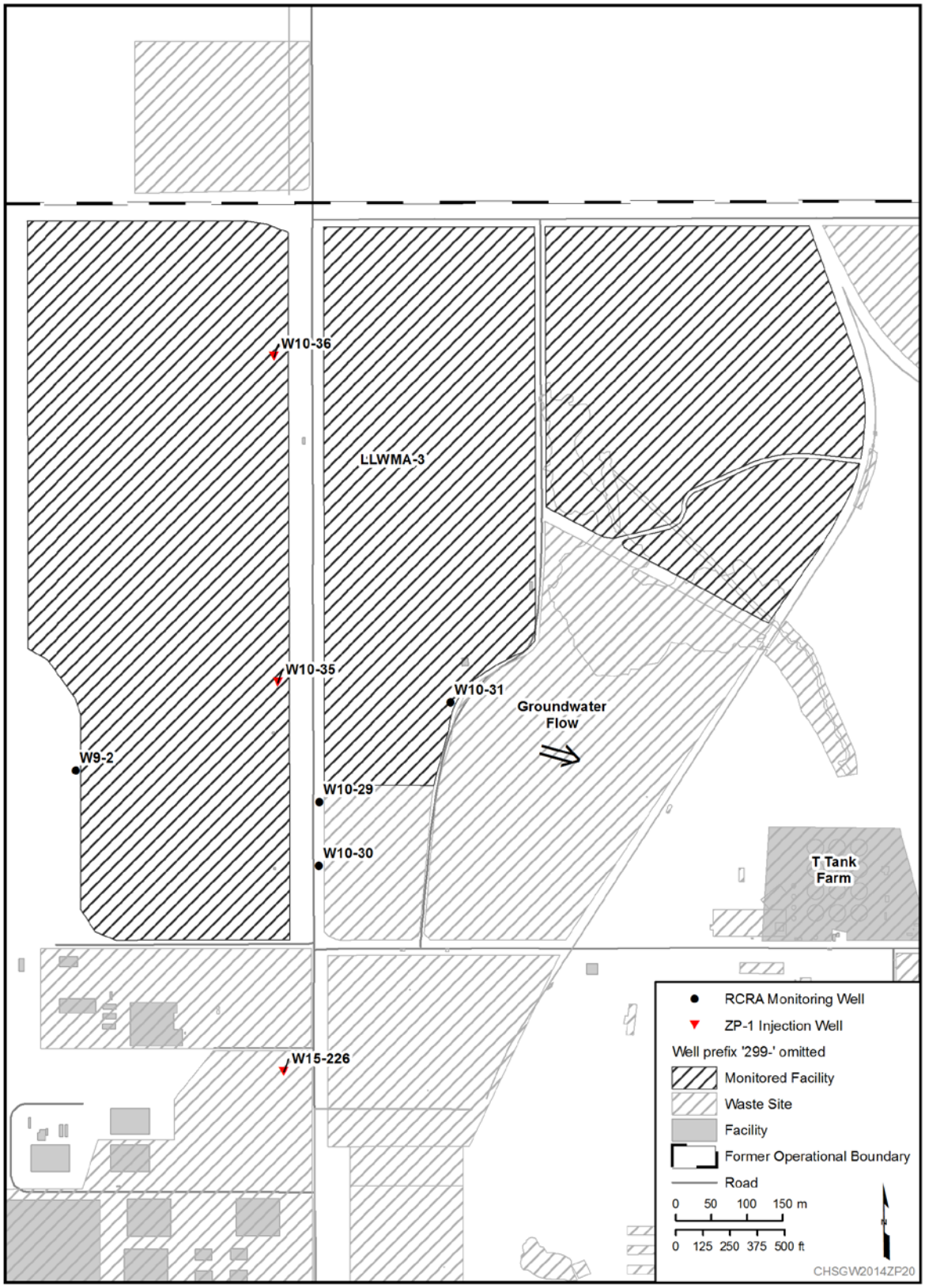


Figure 12-27. 200-ZP RCRA Facility LLWMA-3 Monitoring Well Locations

Water-level measurements are taken each time a groundwater sample is collected, and sitewide water-level measurements are collected annually, usually during March. The water table has risen in this region in 2012, 2013, and 2014 in response to groundwater injection. Two 200 West injection wells are within the boundaries of LLWMA-3. Another injection well is located east of the LLWMA. The groundwater flow direction across LLWMA-3 (east of injection Wells 299-W10-35 and 299-W10-36) is east to east-southeast at a calculated rate (using the Darcy relationship) of 0.16 to 0.63 m/d (0.52 to 2.1 ft/d). Groundwater may flow radially from the injection wells for some distance, but the head in upgradient Well 299-W9-2 remains higher than in the downgradient wells.

During the reporting period, all wells were sampled as scheduled for indicator parameters pH, specific conductance, total organic carbon (TOC), and total organic halides (TOX) (Table B-56, Appendix B). Concentrations of indicator parameters did not exceed their critical mean values except for specific conductance in Well 299-W10-31. Specific conductance measurements from 299-W10-31 exceeded the critical mean value of 448 µS/cm, with average values of 503 µS/cm and 473 µS/cm for the March 4, 2014, and September 5, 2014 samples. As reported in previous years' Hanford Site groundwater monitoring reports, the specific conductance trend at 299-W10-31 is presumed to be related to the increasing nitrate concentrations at this well, likely caused by movement of the regional nitrate plume. Indicator parameter averages in 2014 (Table B-58, Appendix B) were slightly higher than those in 2013.

In upgradient Well 299-W9-2, TOC decreased from a maximum of 12,200 µg/L in 2012 to an average of 304 µg/L in 2014. The 2012 elevated TOC in Well 299-W9-2 was attributed to the significant amount of vegetable grease used during well construction to lubricate casing connections. Because the vegetable grease was suspected to be the source of the elevated TOC, concentrations were expected to decrease with each sampling event to background levels. The decline in 2013 and 2014 sample results suggests vegetable grease was the source of the elevated TOC.

The high TOC values in 2012 resulted in an extremely high and potentially unprotective 2013 critical mean for downstream wells. For this reason, intrawell TOC critical means (Appendix B, Table B-58) were calculated for downgradient Wells 299-W10-30, 299-W10-29, and 299-W10-31 (ECF-Hanford-14-0043, *Calculation of Critical Means for Calendar Year 2014 RCRA Groundwater Monitoring*). These limits were calculated following procedures outlined in the Unified Guidance (EPA/530/R-09/007).

DOE monitors the LLWMAs for AEA radionuclides, as described in DOE/RL-2000-72. Iodine-129, technetium-99, and uranium are monitored semiannually in the three downgradient wells. Iodine-129 was undetected, and technetium-99 was at detection level in all three wells. Uranium was detected in all wells with a maximum concentration of 1.40 µg/L (background) in Well 299-W10-31. These results indicate the LLWMA-3 is not releasing radionuclides to groundwater.

12.11.4 Low-Level Waste Management Area 4

LLWMA-4 (Figure 12-28) consists of the 218-W-4B and 218-W-4C Burial Grounds, and contains 28 unlined trenches used for disposal of low-level radioactive wastes and low-level mixed wastes beginning in 1967. The 218-W-4B Burial Ground also contains 12 below-grade caissons at the southern end of the facility. The caissons in the 218-W-4B Burial Ground contain remote-handled, low-level waste and retrievable transuranic waste. The 218-W-4B Burial Ground was closed in 1990, and 218-W-4C was closed in 2004. The dangerous chemicals in the low-level mixed waste portions of LLWMA-4 are regulated under RCRA and its implementing requirements (WAC 173-303-400).

Figure 12-28. 200-ZP RCRA Facility LLWMA-4 Monitoring Well Locations

The LLWMA-4 well network was sampled semiannually for contamination indicator parameters and supporting constituents (DOE/RL-2009-69). Table B-62 of Appendix B includes a list of wells and the indicator parameters sampled in 2014.

Five 200 West injection wells located west (upgradient) of LLWMA-4 have caused the water table to rise and steepened the hydraulic gradient. The general direction of groundwater flow is east-northeast and the rate of flow (using the Darcy relationship) is estimated to be 0.16 to 0.64 m/d (0.52 to 2.1 ft/d) beneath this WMA (Table B-1 of Appendix B).

The monitoring network at LLWMA-4 includes six downgradient wells and one upgradient Well 299-W18-22 (Figure 12-28). Upgradient Well 299-W18-22 (screened at the bottom of the unconfined aquifer) is located at the southwestern corner of LLWMA-4. The well network complies with RCRA groundwater monitoring requirements. No new wells are expected at LLWMA-4 until the effects of the 200 West P&T are known.

Except for the upgradient well and downgradient, deep-screened Well 299-W15-17, all wells in the network are screened across the water table. These water table wells have adequate water columns in the screened interval (from 4 to 8 m [13 to 26 ft]) available for sampling. The well network was successfully sampled twice in 2014 for indicator and site-specific parameters including pH, specific conductance, TOC, and TOX.

Table B-63 of Appendix B includes a table with indicator parameter ranges for LLWMA-4 wells in 2014. Specific conductance, pH, TOC, and TOX in downgradient wells remained below their critical mean values for all wells except for TOX in Well 299-W15-224. The elevated TOX concentrations are consistent with observed levels of carbon tetrachloride from PFP operations. In 2014, TOX and TOC results increased compared to 2013 results. Indicator parameter averages for pH and specific conductance are similar to 2013.

DOE monitors the LLWMAs for AEA radionuclides, as described in DOE/RL-2000-72. Iodine-129, technetium-99, and uranium are monitored semiannually. Iodine-129 was undetected in all wells, technetium-99 was undetected in Wells 299-W15-17 and 299-W18-22 and detected at very low levels in the remaining five wells (maximum detected was 240 pCi/L in Well 299-W15-152), and uranium was detected in all wells, with a maximum of 2.13 µg/L in Well 299-W15-152. Detection of technetium-99 is consistent with observed levels in the aquifer and does not indicate contamination from LLWMA-4.

12.12 State-Approved Land Disposal Site — *Washington Administrative Code* Facility

The Effluent Treatment Facility (ETF) is regulated under WAC 173-216. The ETF processes aqueous wastes from various Hanford Site facilities. Treated water from the ETF is discharged to the SALDS (Figure 12-29), which is authorized to receive the effluent by State Waste Discharge Permit Number ST 4500 (Ecology, 2000; hereinafter referred to as the "Permit"). The Permit was issued in June 1995, and the site began operating in December 1995. The SALDS is located 400 m (1,300 ft) outside the northern boundary of the 200 West Area and consists of a 35 m by 61 m (115 ft by 200 ft) drain field. DOE has taken the position that its groundwater monitoring and provision of data to Ecology is a matter of intergovernmental comity and cooperation, and that the Permit has no jurisdiction over radionuclides, which are regulated by DOE under AEA authority, in the same way that permits for wastewater discharge to surface waters issued by the EPA under Section 402 of the *Clean Water Act* are preempted by the AEA from regulating radionuclides (40 CFR 122.2, Train v. Colorado Public Interest Research Group Inc.). A revised Permit was issued in December 2014 and is discussed at the end of this section.

During 2014, discharges to the SALDS occurred only during January. The volume released was 4.8 million L (1.3 million gal). The ETF has been shut down since February 2014 due to a major failure of the evaporator heat exchanger (reboiler). Replacement of the heat exchanger is expected to keep the facility shut down until late 2015. All of the water discharged in January was treated process condensate from the 242-A Evaporator.

Much of the effluent disposed of to the SALDS contains tritium because no cost-effective treatment technology is available to remove tritium from wastewater. The January 2014 release contained 2.26 Ci of tritium, a decrease from the 10.98 Ci released during 2013. Releases of tritium from the SALDS have resulted in a tritium plume in groundwater beneath the facility (Figure 12-19).

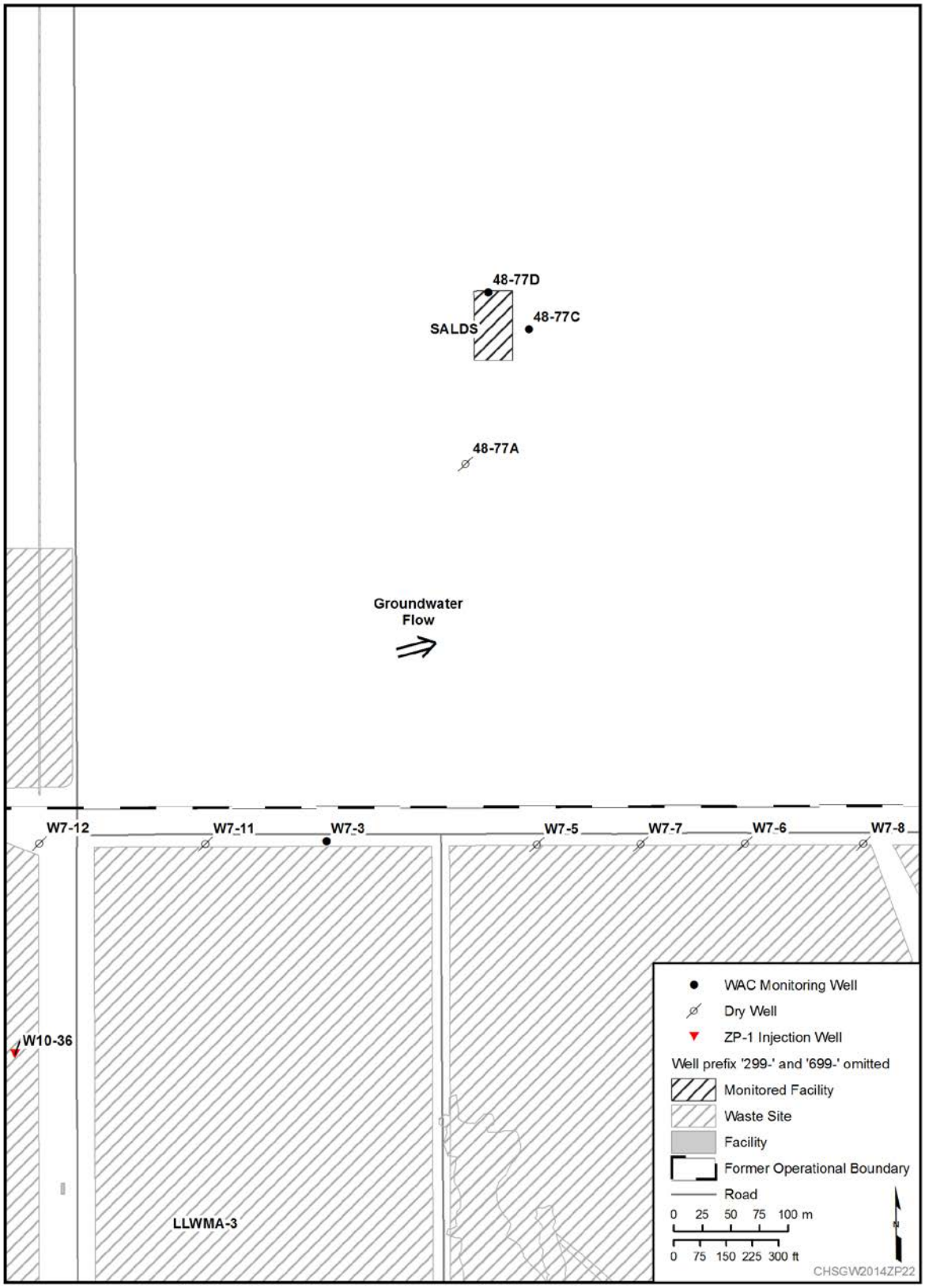


Figure 12-29. SALDS Facility Monitoring Well Network

DOE monitors groundwater in the SALDS vicinity to track the migration of the tritium plume and to compare concentrations of other constituents to Permit limits (prior to the revision of the Permit). Groundwater monitoring requirements are described in PNNL-13121. Quarterly sampling is required for two wells proximal to the SALDS facility, and both annual and semiannual sampling is required for a set of tritium-tracking wells located farther afield. Several wells are no longer sampled because they are dry. Table B-91 of Appendix B includes a list of wells and constituents sampled for the SALDS. All required sampling was completed during 2014, although some wells were sampled later than originally scheduled because of maintenance or access issues. Monitoring results for the SALDS are reported in annual reports (on a fiscal-year basis), most recently in *Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State Approved Land Disposal Site, Fiscal Year 2014* (SGW-58210). The Permit also specifies that periodic numerical modeling of the tritium plume be performed to predict future plume migration. The model was last updated during 2011; the results are summarized in SGW-58210.

Discharges from the SALDS form a small groundwater mound causing a localized area of radial flow beneath the facility. The center of the mound is offset from the facility to the south because the southward dip of the Cold Creek unit diverts the effluent while it infiltrates through the vadose zone. This mound was greatly diminished during 2014 because no discharges to the SALDS occurred after January (Figure 12-4). Water table mapping indicates that the regional groundwater flow direction in the SALDS vicinity is currently towards the east-northeast.

The water table beneath the SALDS responds to discharges from the facility, but it also responds to operation of the nearby 200-ZP-1 P&T system. Despite the low volume of discharges to the SALDS in 2014, the water table in the vicinity increased by an average of 0.26 m (0.85 ft) between March 2013 and March 2014 (SGW-58210). This was due to operation of nearby P&T system injection wells for the 200-ZP-1 OU and was predicted by groundwater modeling (SGW-56060, *Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State Approved Land Disposal Site, Fiscal Year 2013*; SGW-50907, *Predicted Impact of Future Water-Level Declines on Groundwater Well Longevity within the 200 West Area, Hanford Site*). Prior to startup of the P&T system in 2012, water table elevations exhibited a long-term declining trend due to the curtailment of wastewater discharges to the soil column between the mid-1980s and mid-1990s. This long-term decline has caused 11 of the 19 tritium-tracking wells listed in the monitoring plan (PNNL-13121) to become dry. One of the proximal wells, 699-48-77A, became dry during 2011. This issue is also affecting proximal Well 699-48-77D, which is expected to become dry within the next few years (Table 1 of SGW-50907). The third proximal well, 699-48-77C, is completed deeper in the unconfined aquifer and is not in danger of becoming dry.

During 2014, proximal Wells 699-48-77C and 699-48-77D were sampled for 17 constituents/parameters listed in the Permit. The Permit sets concentration limits for acetone, benzene, cadmium (total), chloroform, copper (total), lead (total), mercury (total), field pH, sulfate, tetrahydrofuran, and total dissolved solids. Gross alpha, gross beta, strontium-90, and tritium are also listed in the Permit, but these constituents are not assigned concentration limits. All groundwater sampling results from the SALDS proximal wells were within concentration limits during 2014.

Tritium concentrations in the proximal wells are affected by releases from the SALDS. Concentrations correlate with the activity of tritium released, although the concentration response in the deeper well, 699-48-77C, exhibits a time lag of several years. Recent trends in the proximal wells indicate declining tritium concentrations (Figure 12-30). Peak tritium concentrations during 2014 were 68,000 pCi/L in 699-48-77C and 60,500 pCi/L in 699-48-77D.

To date, tritium from the SALDS has not been detected in any of the tritium-tracking wells; this observation is consistent with numerical model predictions (SGW-58210). The low levels of tritium

observed in Well 299-W6-11, 699-W6-12, and 699-48-71 are interpreted to have originated from past wastewater releases from other 200 West Area sources to the south (Figure 12-19). Tritium was detected in tritium-tracking Well 299-W6-6 during 2014 at 2,430 pCi/L, but the source is a 200-ZP-1 injection well, 299-W6-13, located just 10 m (32.8 ft) away. Water extracted in the 200-ZP-1 OU contains tritium, but just like for the ETF, the 200 West P&T does not remove tritium from the water. Thus, the water injected into the aquifer at 299-W6-13 contains tritium, which is being detected in Well 299-W6-6.

The Permit was renewed effective January 1, 2015, for a 5-year period. The major change pertaining to groundwater monitoring is that sampling for comparison to the groundwater concentration limits will be performed at the ETF verification tank prior to discharge of effluent to the SALDS. If the discharged water has concentrations below Permit limits, then concentrations in the groundwater would also be below Permit limits. The only analyte listed for groundwater sampling in the new Permit is tritium.

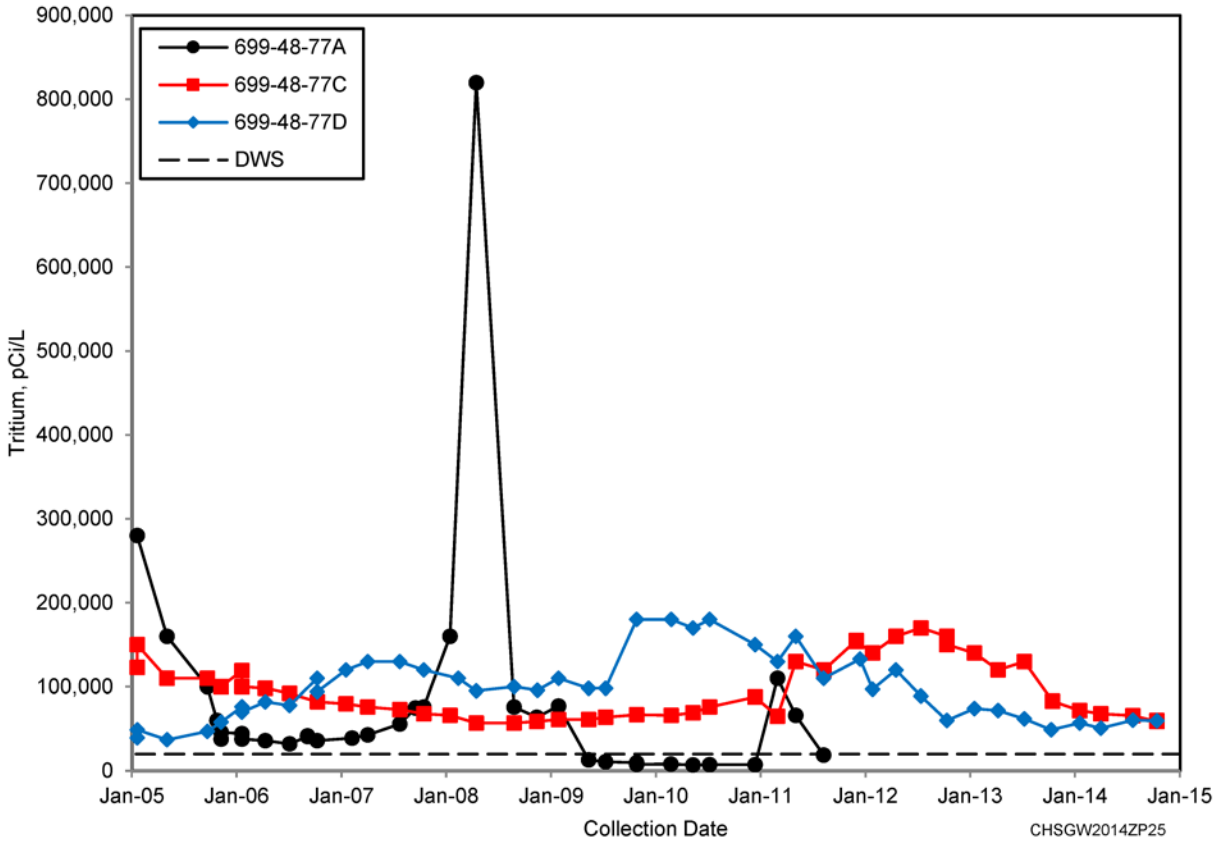


Figure 12-30. 200-ZP Tritium Data for Wells Monitoring SALDS

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