

200-ZP

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200-ZP 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 operable unit (OU), where activities focus on groundwater remediation, monitoring, and reporting. Figure ZP.1 shows key facility areas and groundwater wells. Contaminants include: carbon tetrachloride, chromium (total and hexavalent), iodine-129, nitrate, technetium-99, trichloroethene (TCE), and tritium ([EPA et al., 2008](#)). Table ZP.1 lists some key facts about 200-ZP.

Carbon tetrachloride is the main contaminant of concern in groundwater, forming a plume greater than 13 square kilometers in area extending north, south, and east from the source areas. The primary source is associated with discharges of liquid waste from the Plutonium Finishing Plant's (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 ZP.2 illustrates the change in plume area from 2003 to 2013 for each of the contaminants of concern.

Within 200-ZP, groundwater occurs as an unconfined aquifer and as a confined aquifer 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. Depths from land surface to the water table range from 64 to 106 meters, with the largest depths occurring in the northeastern portion. The thickness of the unconfined aquifer within the interest area ranges from 8 to 68 meters 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 the confined aquifer (Figure ZP.3).

Groundwater in the 200 West Area generally flows east-northeast (Figure ZP.4), but is influenced by the 200 West Pump and Treat (P&T) and effluent discharges to the State-Approved Land Disposal Site (SALDS). Groundwater flow rates range from 0.0001 meter per day in fine-textured, lower permeability Ringold sediments, to 0.5 meters per day in coarse-textured, higher permeability Hanford sediments (SGW-38815, *Water-Level Monitoring Plan for the Hanford Site Soil and Groundwater Remediation Project*). The water table has continued to decline since discharge of wastewater was terminated to various cribs, ponds, and ditches from the 1980s and 1990s. 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 the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) to assess the performance of the final remedy as documented in the Record of Decision (ROD) ([EPA et al., 2008](#)); under Resource Conservation and Recovery Act of 1976 (RCRA) at Waste Management Area (WMA) T, WMA TX-TY, Low-Level Waste Management Area (LLWMA)-3 burial ground, and LLWMA-4 burial ground; and under Washington Administrative Code (WAC) at the SALDS. Radionuclide monitoring is performed in accordance with the [Atomic Energy Act of 1954](#) (AEA) and CERCLA. Figure ZP.1 shows wells sampled in 2013.

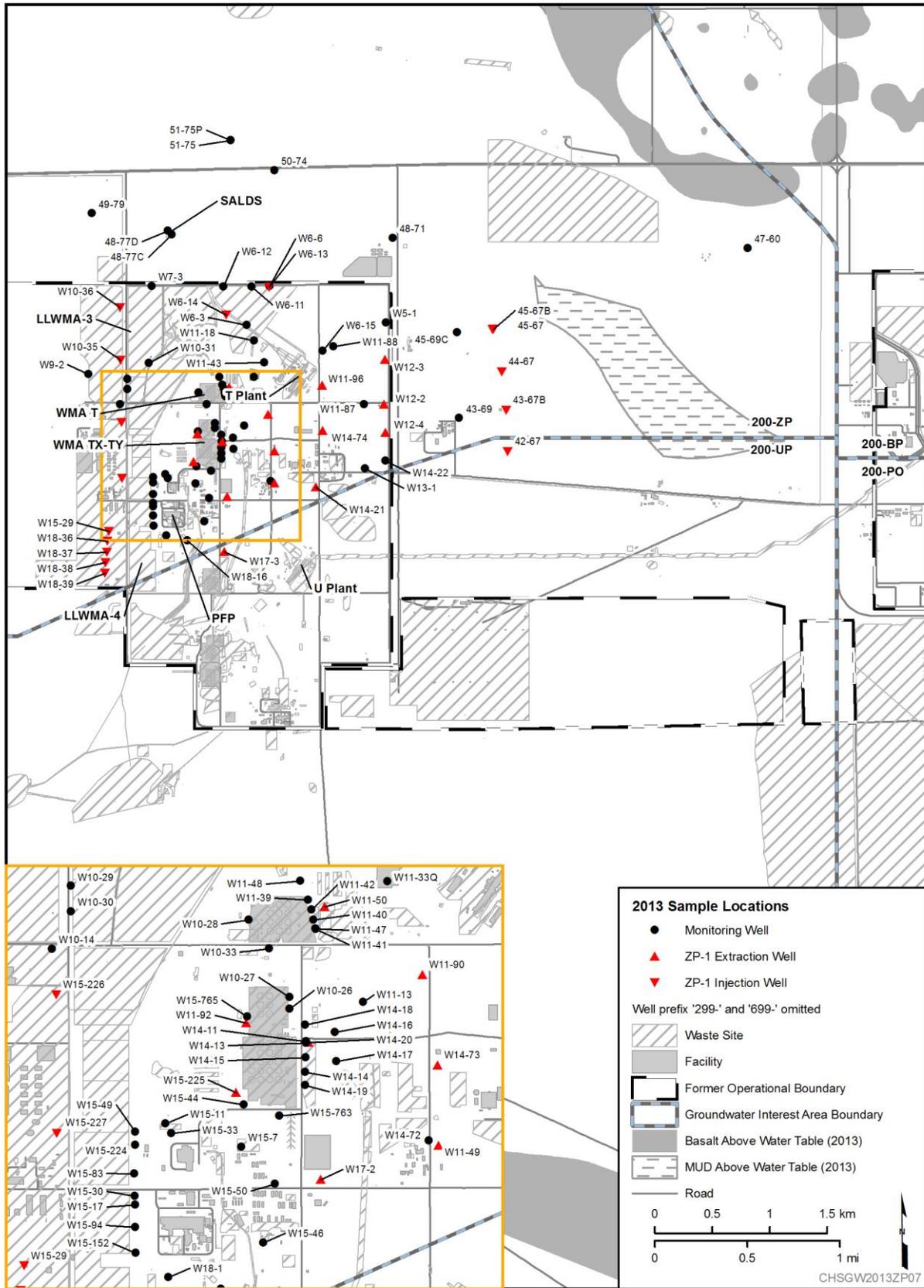


Figure ZP.1 200-ZP Wells and Key Facilities

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

T Plant Operations: 1944 to 1956 (Plutonium Separation)					
Plutonium Finishing Plant Operations: 1949 to 1989					
2013 Groundwater Monitoring				200 West Pump and Treat	Since Startup July 2012
Contaminant	Final Cleanup Level	Maximum Concentration	Plume Area ^a (km ²)	Mass Removed (2013)	Mass Removed (2012 to 2013)
Carbon Tetrachloride	3.4 µg/L	2,600 µg/L	13.30 ^b	3,049 kg	3,580 kg
Chromium (Cr ⁺³ and Cr ⁺⁶)	100/48 µg/L ^{c,d}	182/186 µg/L	0.22	72 kg	91 kg
Iodine-129	1 pCi/L	3.64 pCi/L	0.10	0.000158 µCi	0.000242 µCi
Nitrate	45 ^e mg/L	846 mg/L	9.77	195,051 kg	243,905 kg
Technetium-99	900 pCi/L	8,600 pCi/L	0.07	1.34 Ci (79 g)	1.67 Ci (98 g)
Trichloroethene	1 µg/L	19 µg/L	1.16	13 kg	15.5 kg
Tritium	20,000 pCi/L	24,000 pCi/L	0.08	NA	NA
Uranium ^f	30 µg/L			0.47 kg	1.08 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. Nitrate as nitrate; 10 mg/L nitrate as nitrogen.

f. Uranium is not a COC in 200-ZP-1; contaminant is extracted from wells in the 200-UP-1 OU.

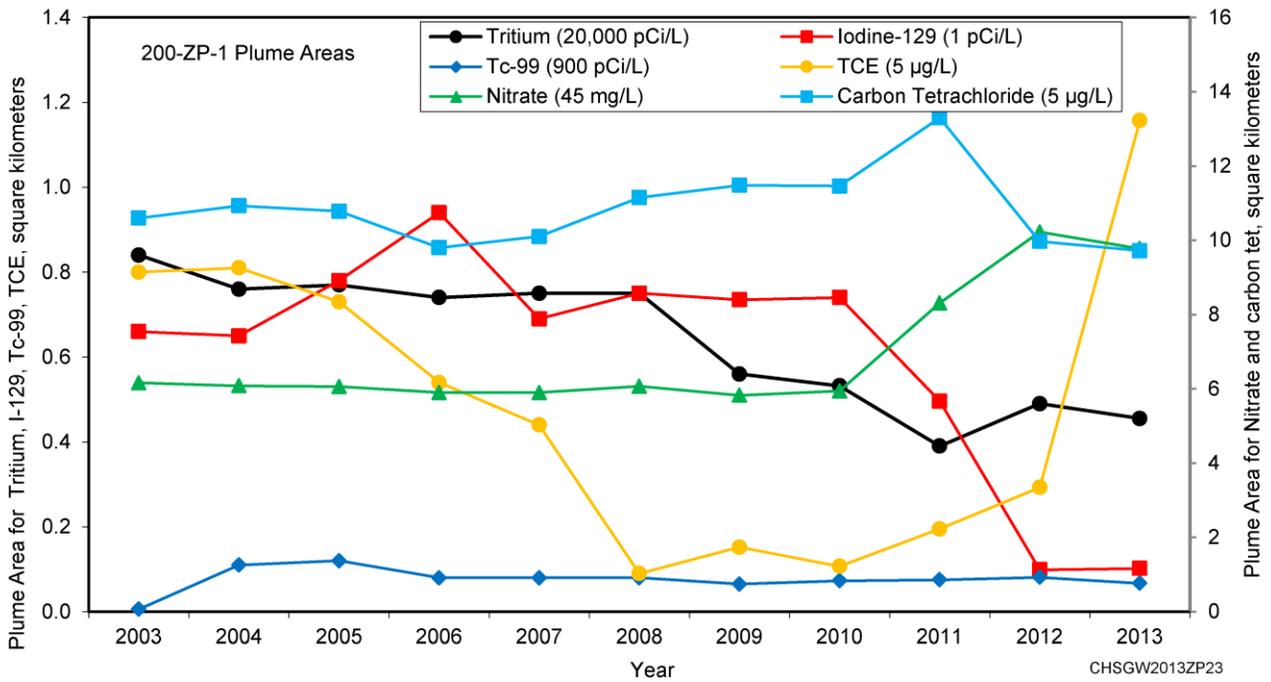


Figure ZP.2 200-ZP Plume Areas

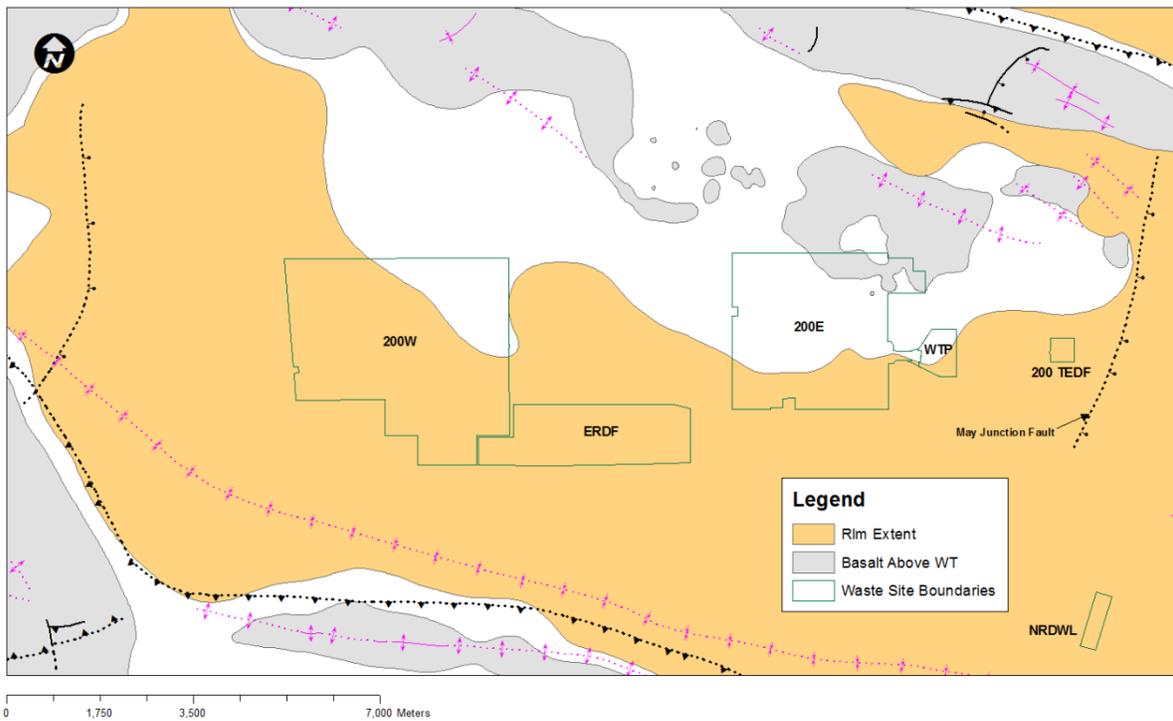


Figure ZP.3 Ringold Lower Mud Unit Extent

200-ZP 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: monitored natural attenuation (MNA), institutional controls (ICs), flow-path controls, and pump and treat (P&T) of the contamination. The 200 West P&T began operations in 2012 and operated continuously in 2013. Groundwater is monitored to assess the effectiveness of the remedy ([DOE/RL-2009-115](#)). Table A.14 of Appendix A lists the wells and constituents monitored under CERCLA.

The 200 West P&T is designed to capture and treat contaminated groundwater to reduce the mass of contaminants of concern throughout 200-ZP-1 by a minimum of 95 percent in 25 years. The 9,464 liters-per-minute P&T system 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 to achieve cleanup levels listed in the ROD ([EPA et al., 2008](#)) for all contaminants of concern in 125 years. Description of the 200 West P&T facility is included in [DOE/RL-2013-14](#).

With construction of the 200 West P&T complete, 2012 marked the transition from the interim to final remedy for 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](#). Additional information on the 200 West P&T, including 2013 activities, are found in the 200-ZP Remedies section.

200-ZP Carbon Tetrachloride

Carbon tetrachloride is found at concentrations greater than the final cleanup level (3.4 µg/L) and the drinking water standard (DWS) of 5 µg/L under most of the 200 West Area (Figure ZP.5). Initially carbon tetrachloride concentrations exceeding 2,000 µg/L were located beneath the PFP. After 16 years of interim P&T operations and one year of the final remedy, the areal extent of the 2,000 µg/L contour in the upper portion of the aquifer was reduced from 530,000 square meters in 1996 to several small, isolated areas of approximately 6,500 square meters in 2013.

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 meters. Figure ZP.6 provides a visual “slice” 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 ZP.5), carbon tetrachloride extends to the east and vertically downward 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 2013, sample results indicate no wells with carbon tetrachloride concentrations above 4,000 µg/L and only four wells with a concentration above 2,000 µg/L (monitoring well 299-W15-765 [with 2,100 µg/L] and extraction wells 299-W11-92 [located next to 299-W15-765 with 2,100 µg/L], 299-W11-90 [with 2,500 µg/L], and 299-W14-22 [with 2,600 µg/L]; Figure ZP.7). Monitoring wells 299-W11-87, 299-W14-11, and 299-W14-72 had the next highest concentrations at 1,700 µg/L, 1,500 µg/L, and 1,400 µg/L, 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 2,600 µg/L in 2013) and in the number of wells exceeding 2,000 µg/L (from forty wells to four) demonstrates the effectiveness of the remedial actions in reducing carbon tetrachloride contamination. Concentrations continued to decline in most wells between 2012 and 2013 (Figure ZP.7).

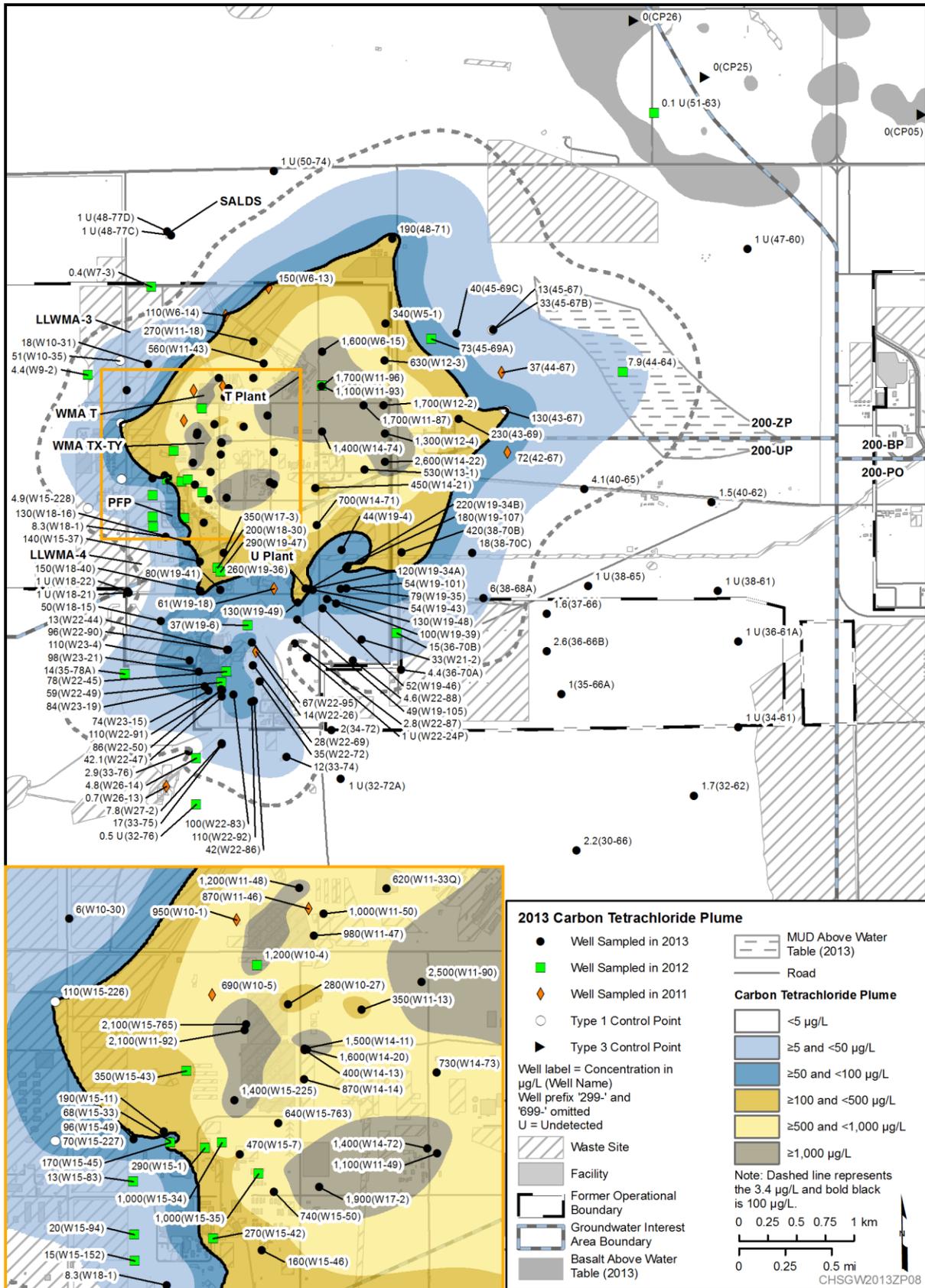


Figure ZP.5 200-ZP 2013 Carbon Tetrachloride Plume

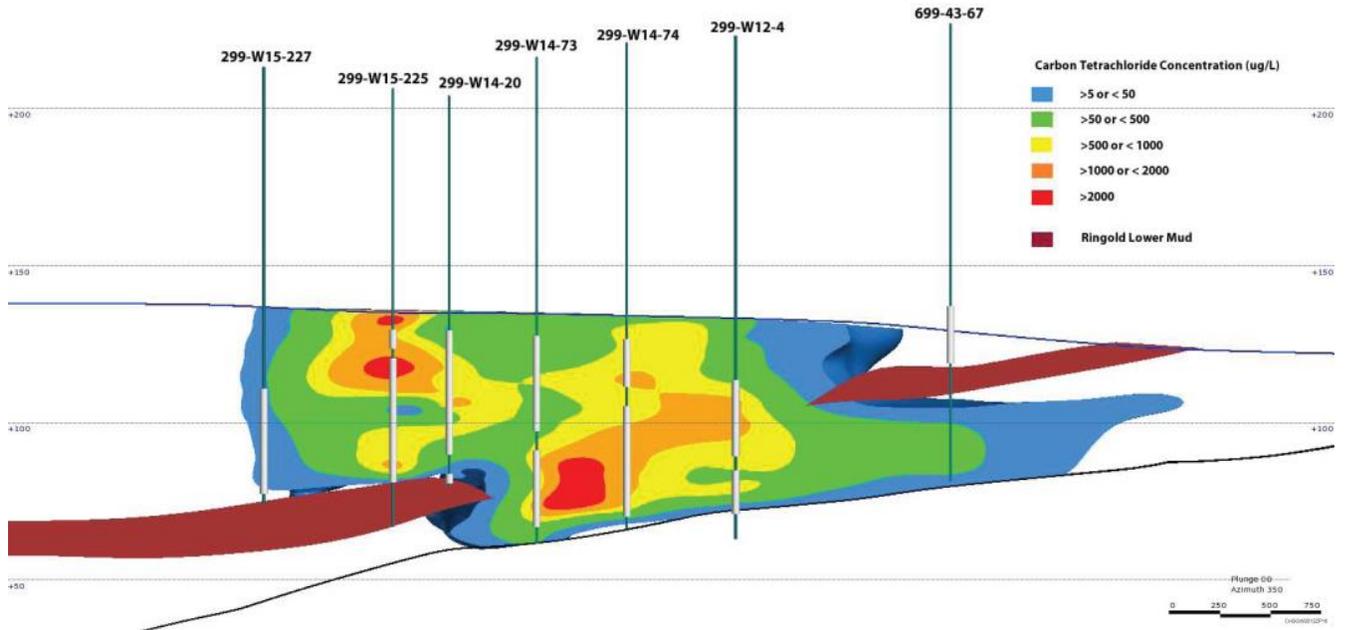


Figure ZP.6 200-ZP Carbon Tetrachloride Concentration Cross Section

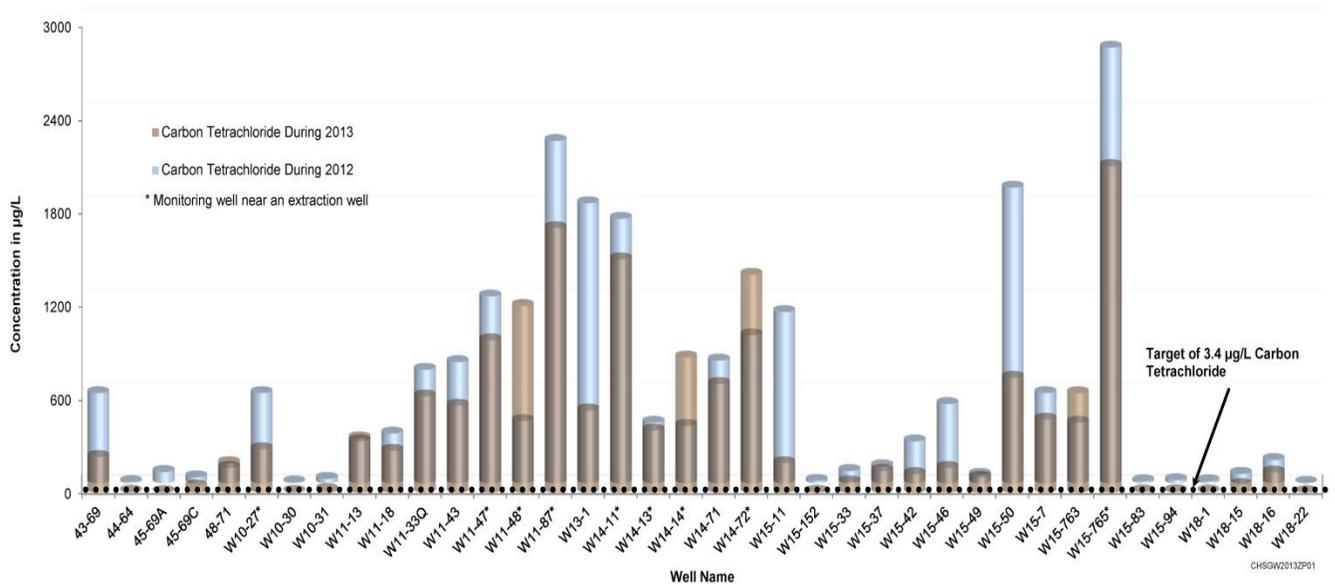


Figure ZP.7 Comparison of Carbon Tetrachloride Concentrations in Monitoring Wells During 2012 and 2013
(Note: Darker brown color represents overlap of 2012 and 2013 results).

200-ZP 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 ZP.8, ZP.9, and ZP.10; wells used for depiction of the 200-UP chromium plumes are shown in Figures UP.16 and UP.20). 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 Reduction-Oxidation (REDOX) and Plutonium-Uranium Extraction (PUREX) (located in the 200 East Area) plant operations ([DOE/RL-2009-66](#); [DOE/RL-2009-67](#)).

For groundwater analysis, total chromium is used to characterize concentrations and plume extent. In 2013, the maximum chromium concentration of 186 µg/L (hexavalent chromium) was found at 299-W11-43; 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.

The highest chromium concentration reported in 200 West extraction well 299-W11-50 (located downgradient of WMA T Tank Farm) during 2013 was 117 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 ZP.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 2013 was 46 µg/L; a 42 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. Although chromium concentrations are declining across 200-ZP, the aerial extent of the chromium plume exceeding 48 µg/L decreased from 521,025 square meters in 2012 to 224,600 square meters in 2013 as a result of the 200 West P&T operations.

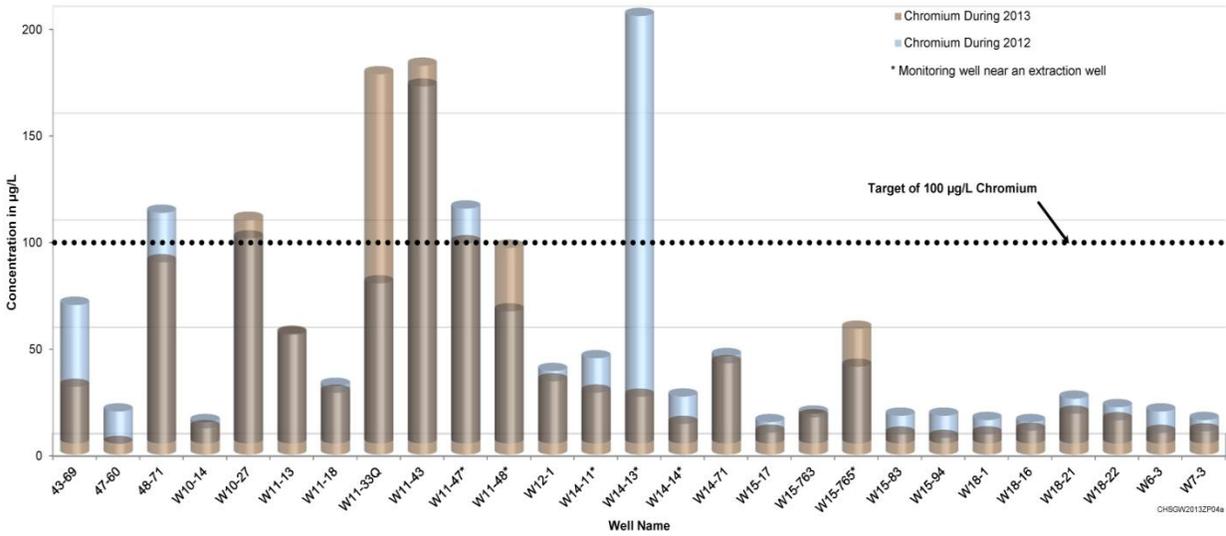


Figure ZP.8 Comparison of Chromium Concentrations in Monitoring Wells During 2012 and 2013
(Note: Darker brown color represents overlap of 2012 and 2013 results).

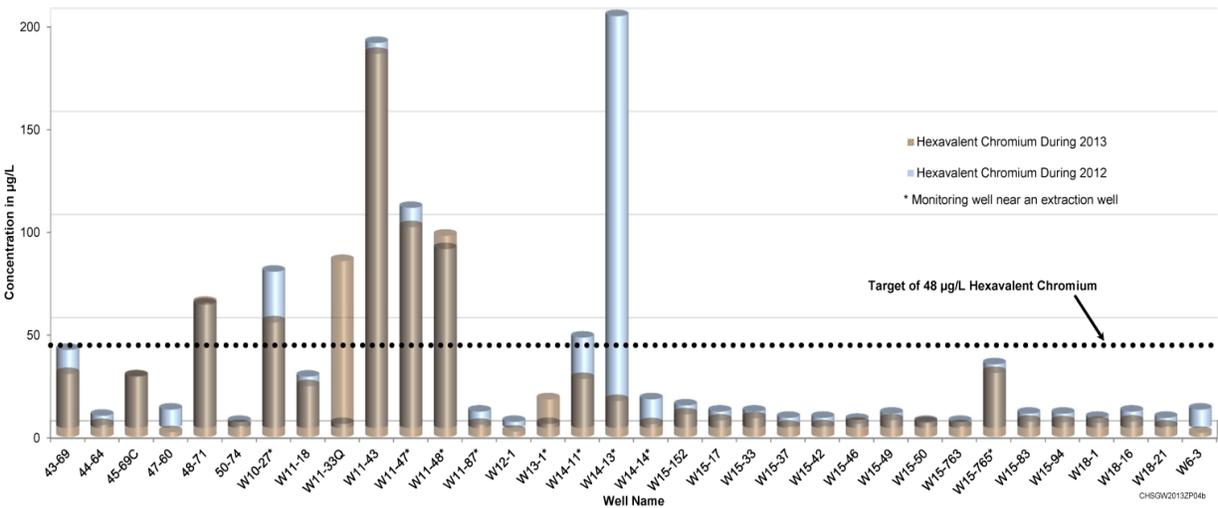


Figure ZP.9 Comparison of Hexavalent Chromium Concentrations in Monitoring Wells During 2012 and 2013
(Note: Darker brown color represents overlap of 2012 and 2013 results).

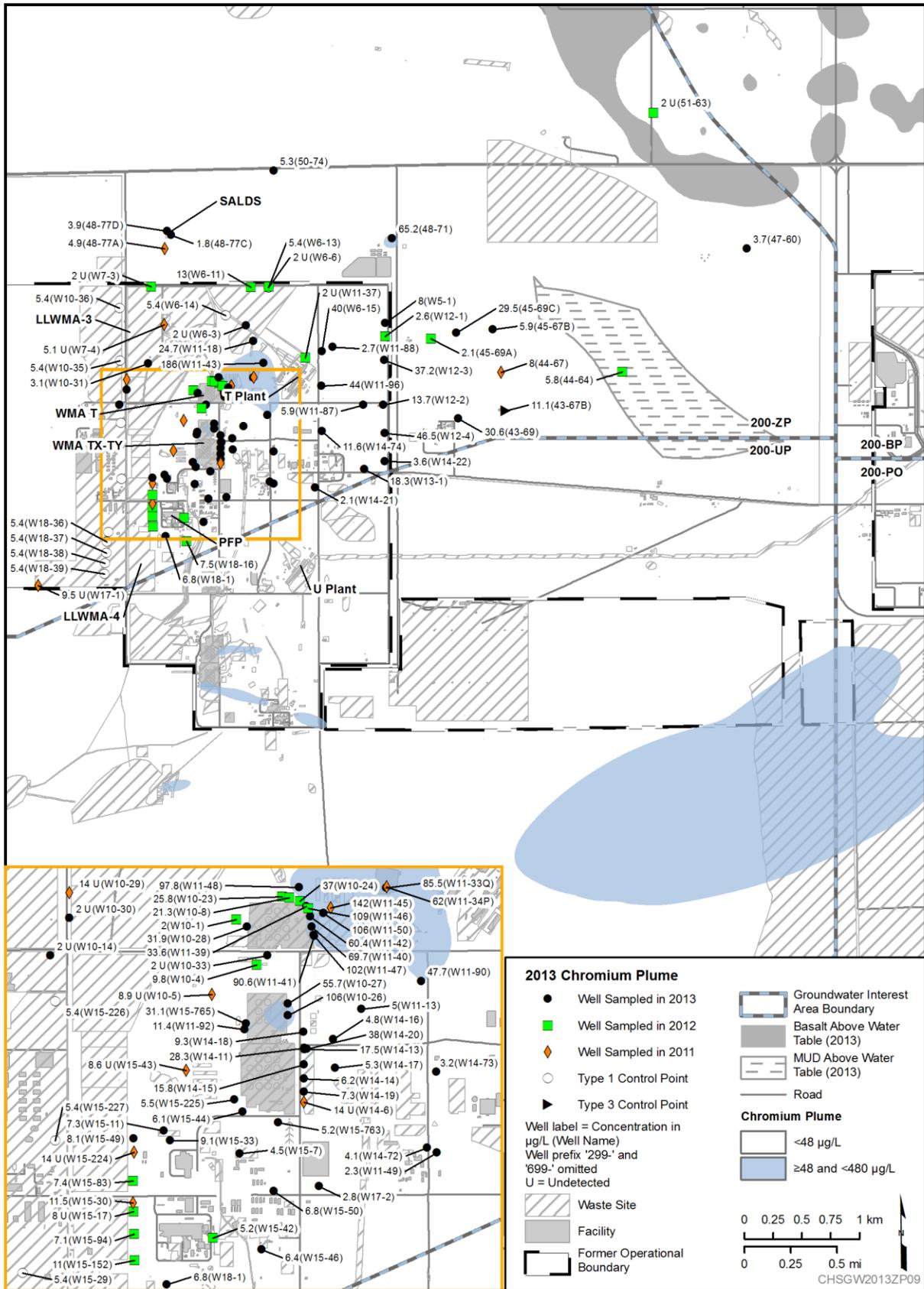


Figure ZP.10 200-ZP 2013 Chromium Plume

200-ZP Iodine-129

In wells sampled in 2013, iodine-129 concentrations exceed the 1 pCi/L final cleanup level in three wells east and south of WMA T (wells 299-W10-4, 299-W11-47, and 299-W11-33Q) (Figure ZP.11). Iodine-129 was detected above the 1 pCi/L final cleanup level in well 299-W11-34P located east of WMA T during the most recent sampling event in 2011, and in well 299-W14-15 located east of WMA TX-TY during the most recent sampling event in 2012. 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 0.5 pCi/L. In 2013, the maximum reported concentration of 3.64 pCi/L was at 299-W11-33Q (Figures ZP.11 and ZP.12), east of WMA T. Iodine-129 concentrations in 299-W11-47 also exceeded the final cleanup level during 2013 (with 1.11 pCi/L) and in newly-drilled extraction well 299-W6-15 (with 1.22 pCi/L). Sample results from 299-W11-37, east of WMA T and at 299-W10-4, south of WMA T exceeded the cleanup level in 2012, but these wells could not be sampled in 2013 because they were dry. 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 0.30 pCi/L and 0.85 pCi/L respectively. Iodine-129 concentrations in 2013 declined compared to 2012 data although the aerial extent of the iodine-129 plume in 2013 is similar to the 99,000 square meters in 2012. The greatest declines in iodine-129 concentrations occurred in monitoring wells located near extraction wells (Figure ZP.11). For example, 299-W14-13 declined from 16 pCi/L in 2012 to less than 0.2 pCi/L (undetected) in 2013 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 to less-than-detection concentrations. Iodine-129 was detected at 0.2 pCi/L.

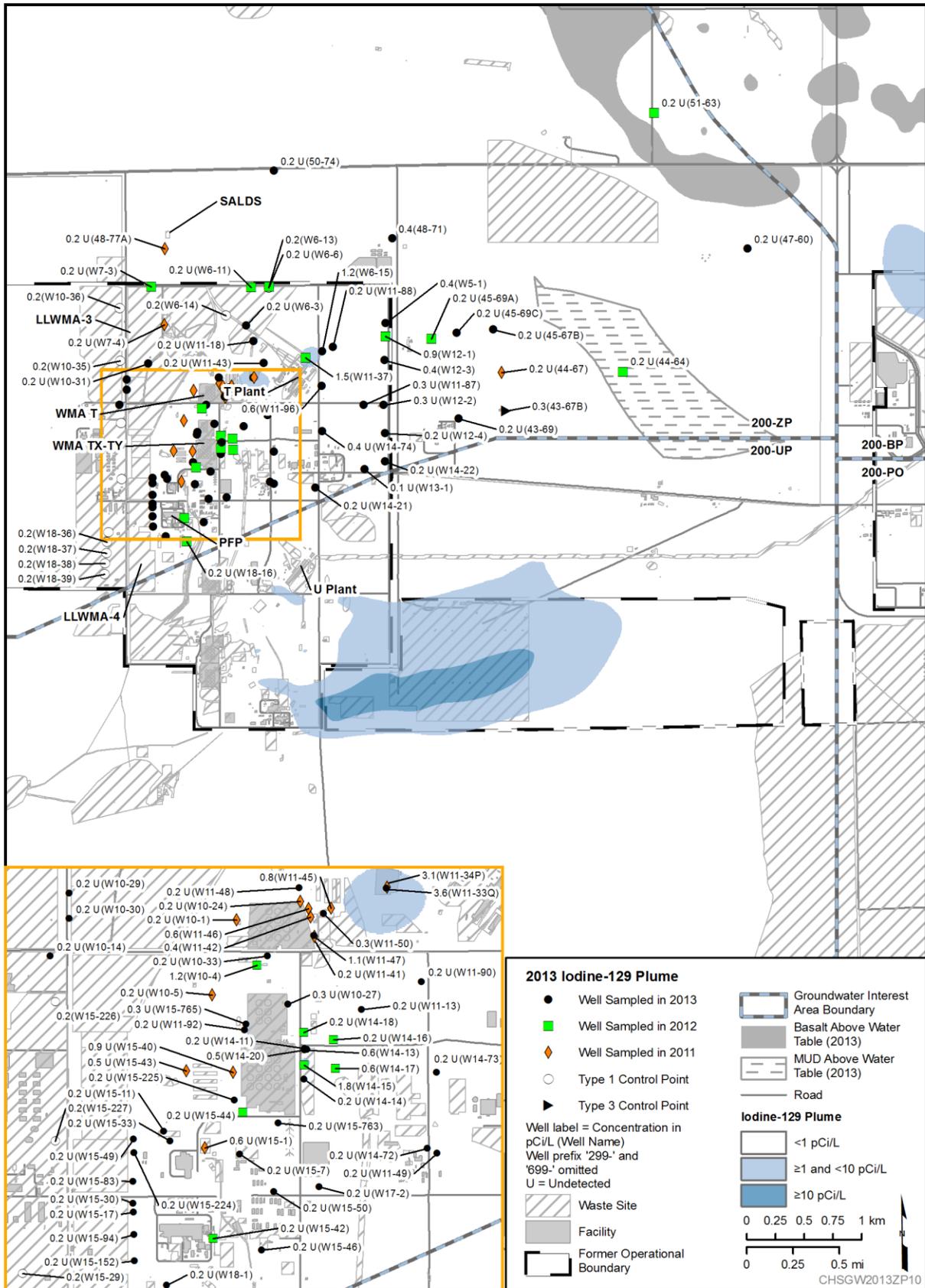


Figure ZP.11 200-ZP 2013 Iodine-129 Plume

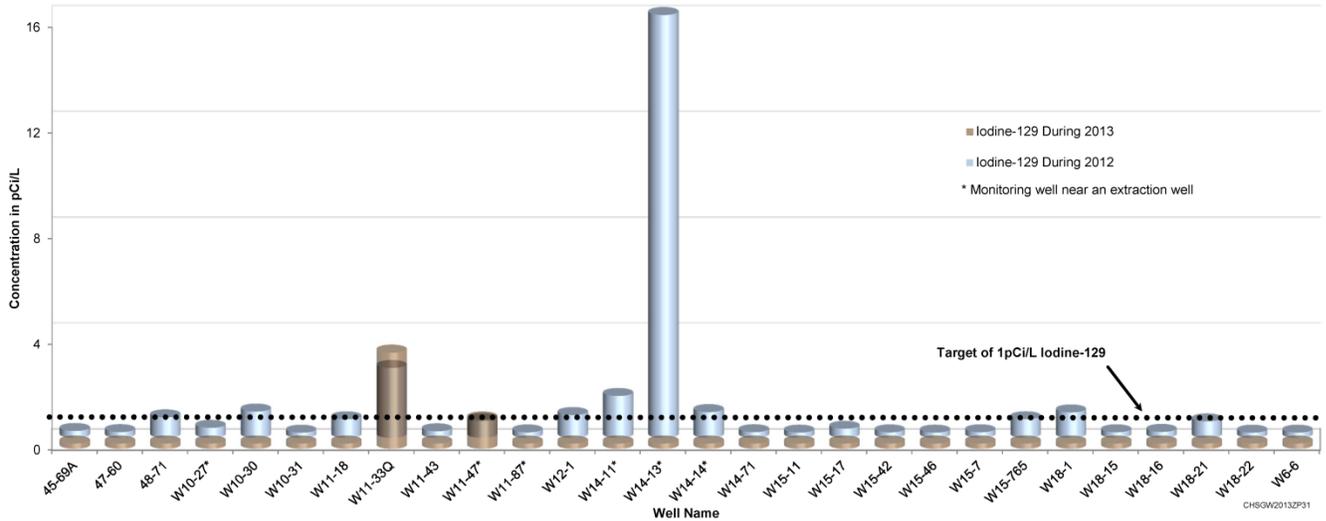


Figure ZP.12 Comparison of Iodine-129 Concentrations in Monitoring Wells During 2012 and 2013
(Note: Darker brown color represents overlap of 2012 and 2013 results).

200-ZP Nitrate

Nitrate concentrations greater than the final cleanup level (45 mg/L as nitrate) are present beneath much of 200-ZP (Figure ZP.13). The size and concentration of contours in 2013 were similar to those reported in 2012. Sources of nitrate include 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 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 area of the nitrate plume beneath WMA T is located within the capture zone of 200 West P&T extraction well 299-W11-50. The highest concentration at the 200-ZP wells for 2013 was 846 mg/L at 299-W10-27 and 299-W18-16 (Figure ZP.13). The increase in nitrate concentration in 299-W18-16 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 ZP.14).

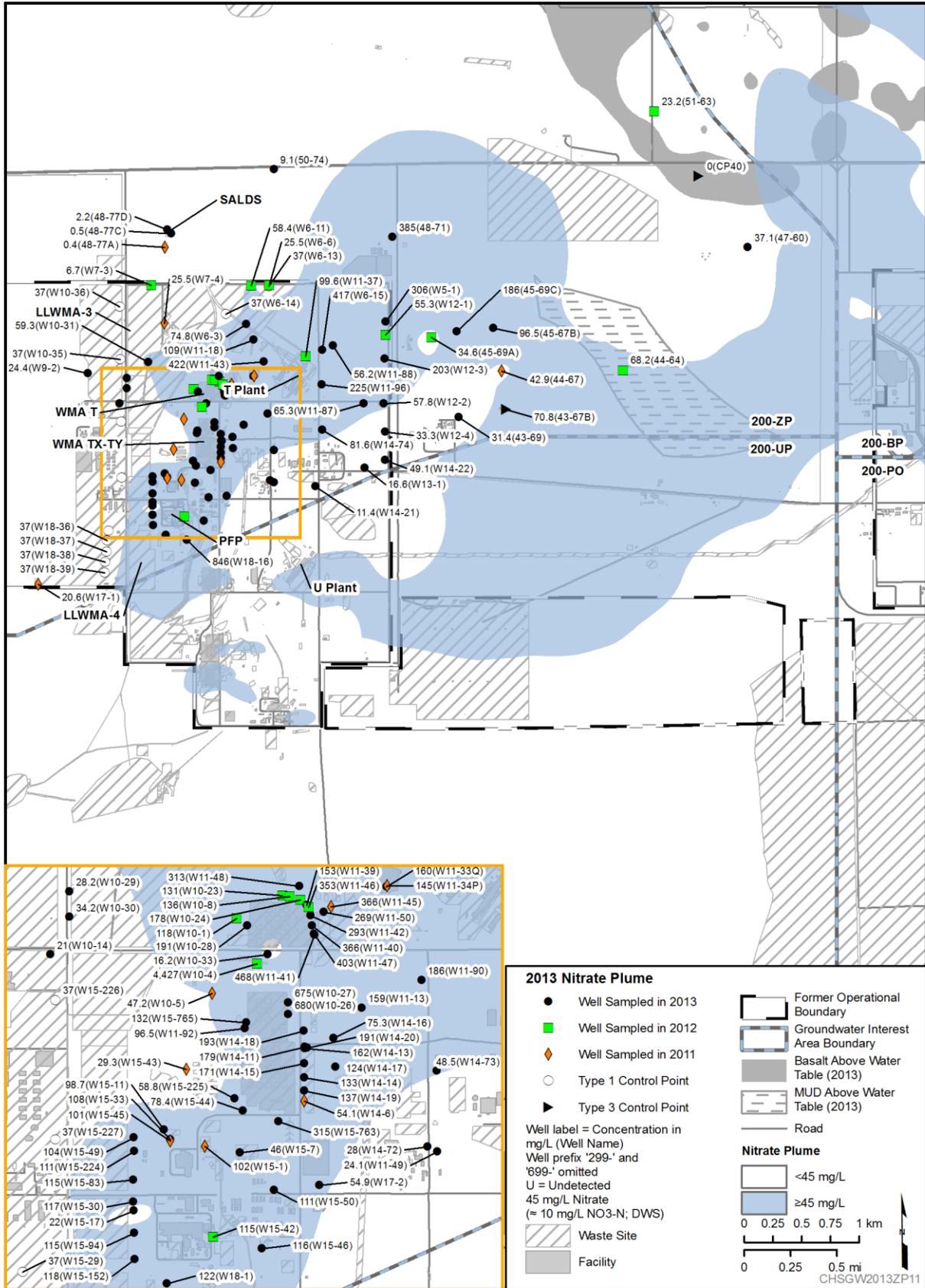


Figure ZP.13 200-ZP 2013 Nitrate Plume

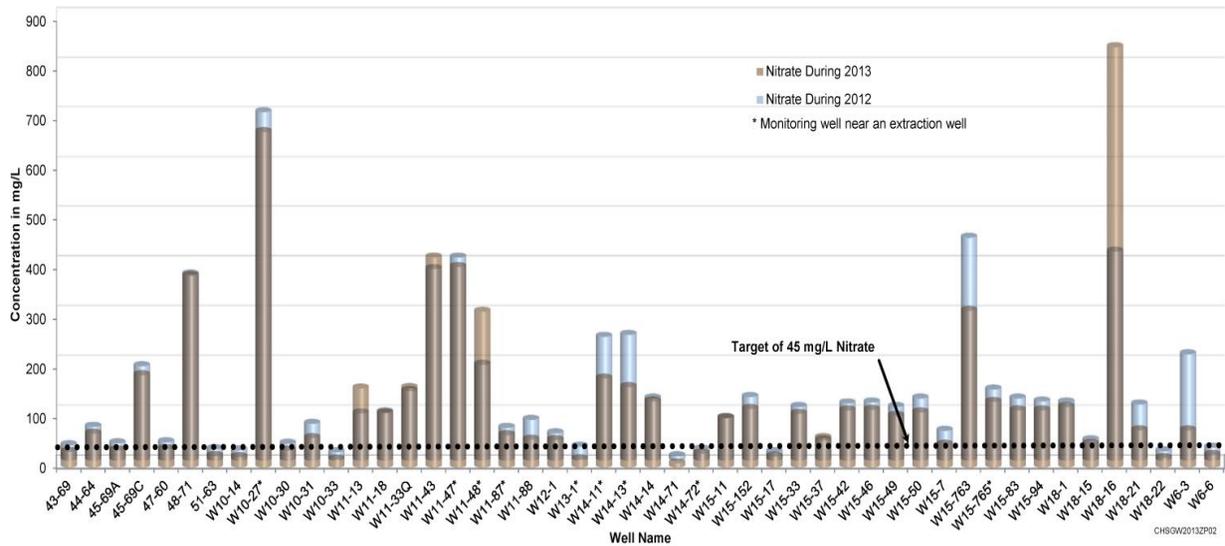


Figure ZP.14 Comparison of Nitrate Concentrations in Monitoring Wells During 2012 and 2013
(Note: Darker brown color represents overlap of 2012 and 2013 results).

200-ZP Technetium-99

Technetium-99 exceeded the 900 pCi/L final cleanup level at five wells in 2013 (Figure ZP.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 ZP.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 8,600 pCi/L in 299-W14-13 located east (downgradient) of WMA TX-TY. High technetium-99 concentrations also occurred in 299-W11-47 (8,200 pCi/L), 299-W14-11 (3,000 pCi/L), and in extraction wells 299-W14-20 (1,343 pCi/L) and 299-W11-50 (1,547 pCi). The plume beneath WMA T assumes the same eastward trend as other contaminant plumes in the OU. Technetium-99 contamination is found primarily in the upper 15 meters 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 2013, only five wells exceeded the DWS: three monitoring wells and two extraction wells (Figure ZP.16). Note 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 110,000 square meters in 2012 to 70,000 square meters in 2013 as a result of remediation activities.

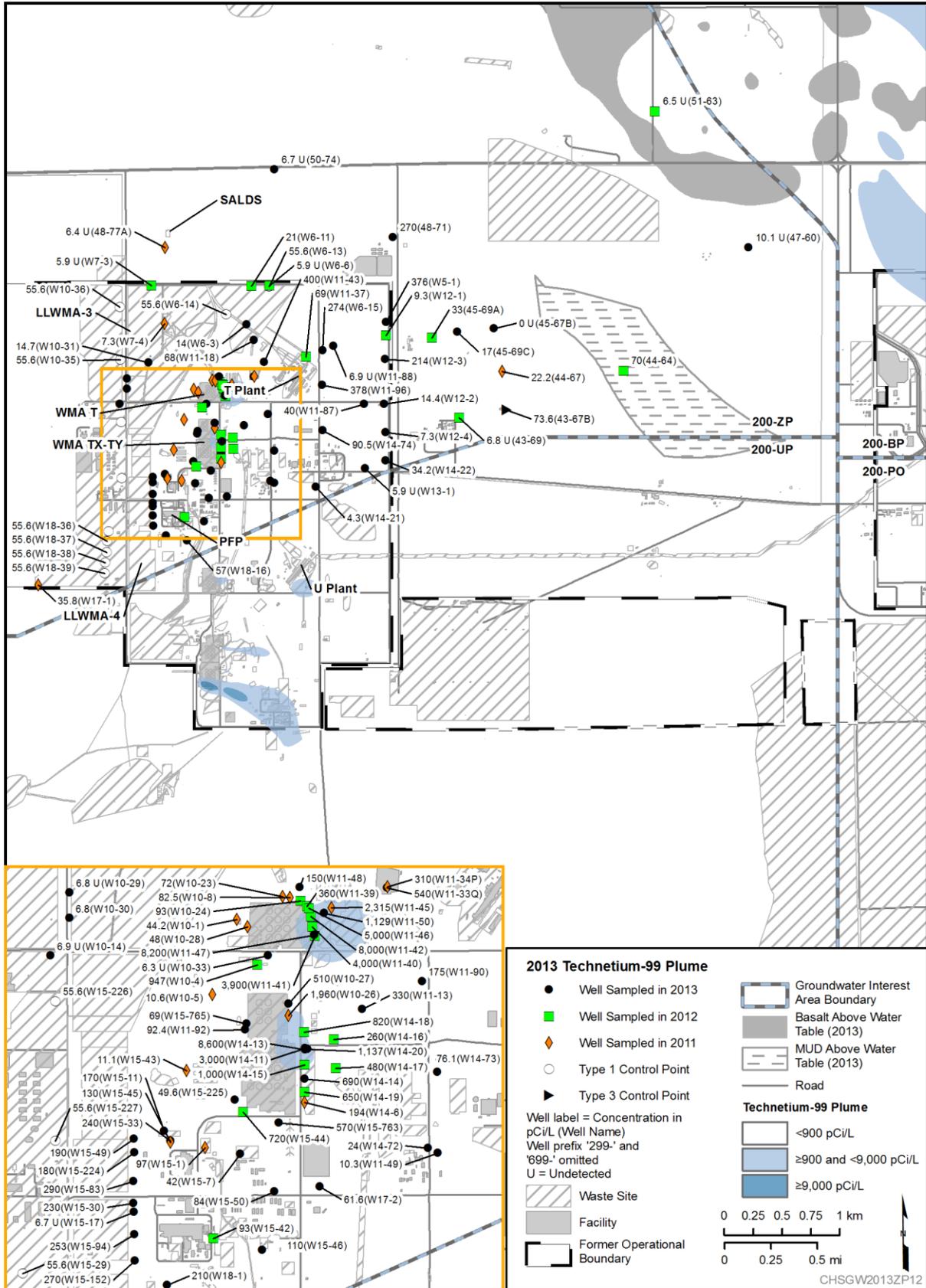


Figure ZP.15 200-ZP 2013 Technetium-99 Plume

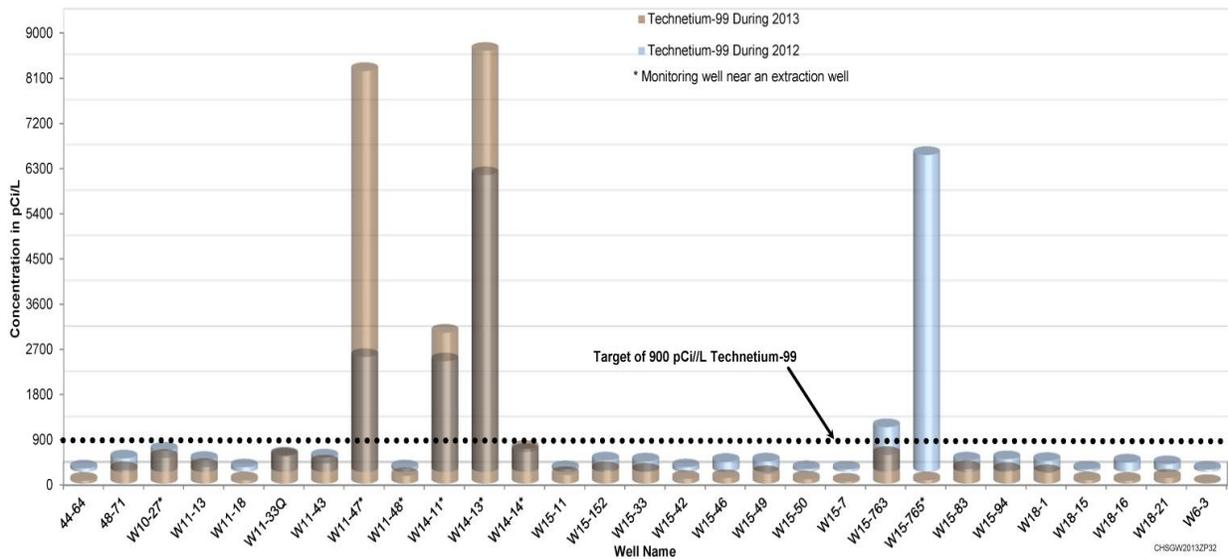


Figure ZP.16 Comparison of Technetium-99 Concentrations in Monitoring Wells During 2012 and 2013
(Note: Darker brown color represents overlap of 2012 and 2013 results).

200-ZP Trichloroethene (TCE)

TCE is detected at levels above the final cleanup standard (1 µg/L) throughout much of 200-ZP (Figure ZP.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. Plume size increased between 2012 and 2013 because analytical sample data collected from varying depth intervals during drilling was 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 2013 was 19 µg/L in extraction well 299-W17-2. Concentrations declined in most wells with the exception of monitoring wells located near extraction wells (Figure ZP.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.

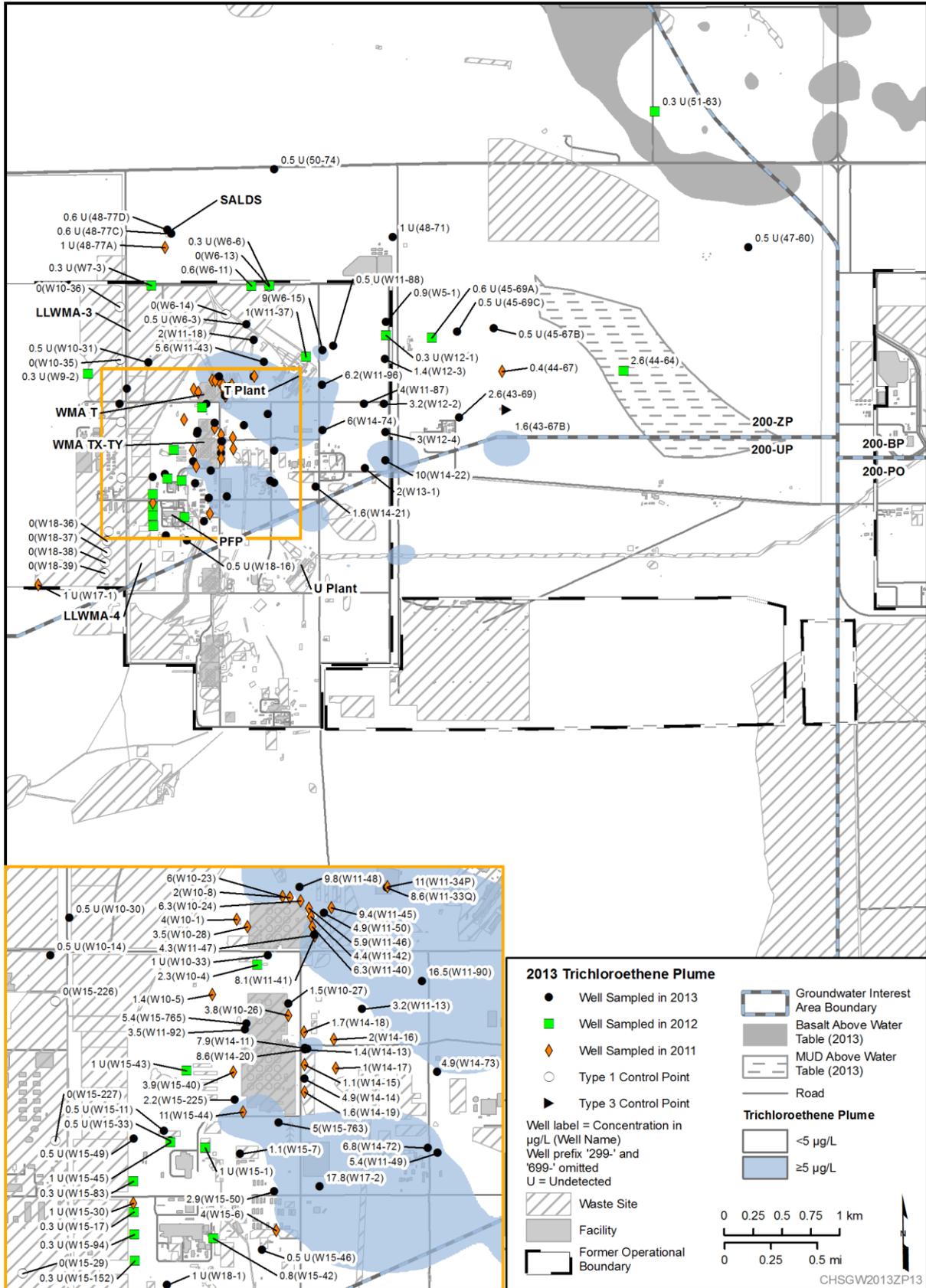


Figure ZP.17 200-ZP 2013 Trichloroethene (TCE) Plume

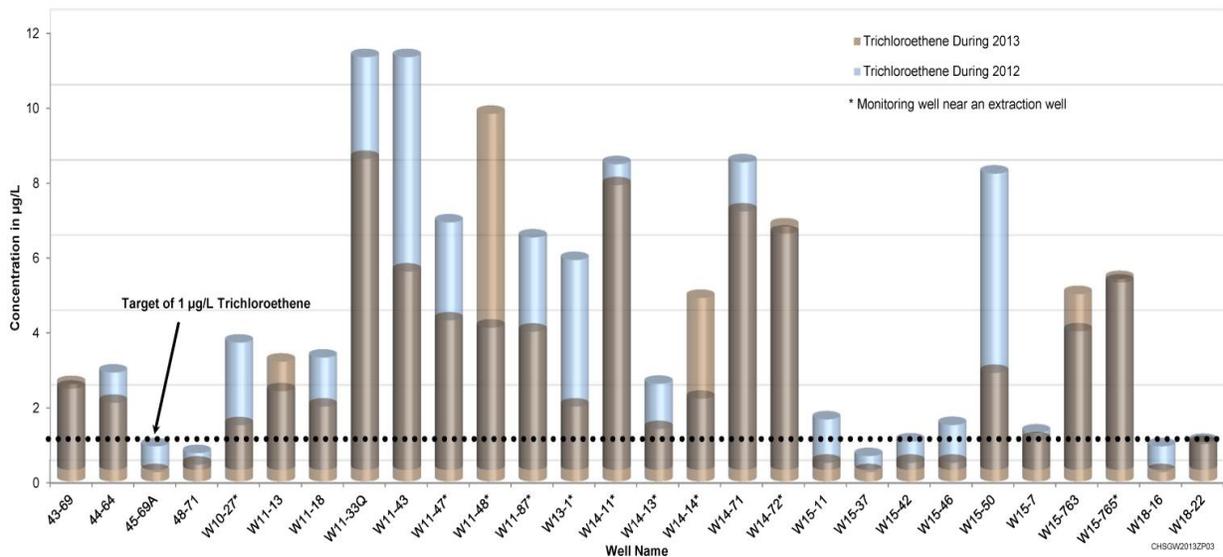


Figure ZP.18 Comparison of Trichloroethene (TCE) Concentrations in Monitoring Wells During 2012 and 2013
(Note: Darker brown color represents overlap of 2012 and 2013 results).

200-ZP Tritium

Tritium concentrations exceeded the final cleanup level of 20,000 pCi/L at two locations: within the 200-ZP adjacent to WMA T (well 299-W11-33Q) and adjacent to the SALDS (wells 699-48-77C and 699-48-77D) during 2013. Active permitted discharges at the SALDS are an ongoing source of tritium to groundwater in 200-ZP. Other sources of contamination are the liquid waste from plutonium processing to disposal facilities, including 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 meters of the unconfined aquifer.

Figure ZP.19 shows the geometry and extent of the tritium plumes, with contaminant levels ranging from 2,600 to 24,000 pCi/L in wells east of WMA T. In 2013, the highest tritium concentration found in the 200-ZP OU measured 24,000 pCi/L at 299-W11-33Q, located east of WMA T. Tritium concentrations at wells near the waste management areas are declining (from a maximum tritium concentration of 2,940,000 pCi/L in 2000 to 24,000 pCi/L in 2013—a 99 percent decrease), suggesting that less contamination is moving from the vadose zone to groundwater.

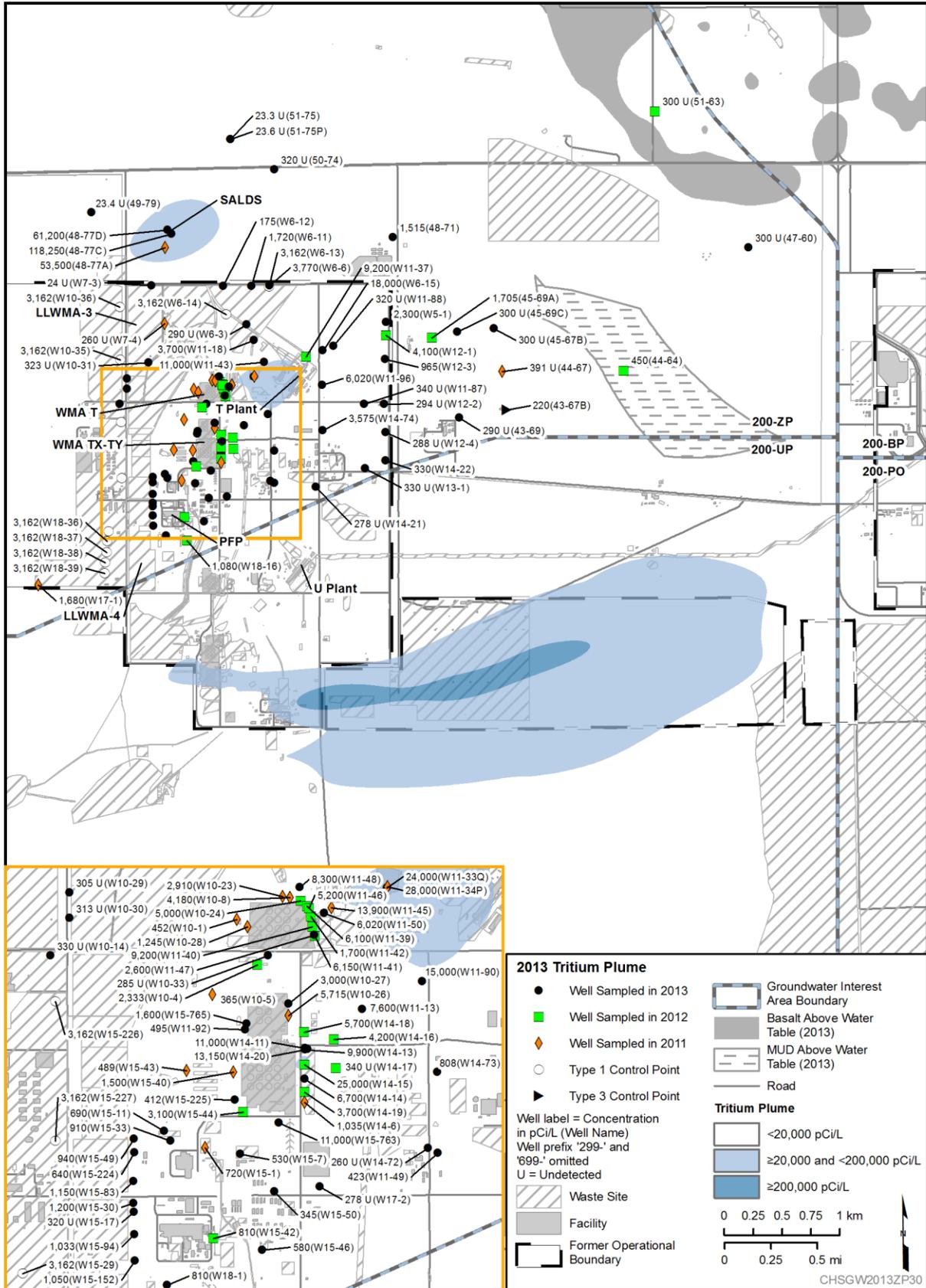


Figure ZP.19 200-ZP Tritium Plume

200-ZP Remedies – Pump and Treat (P&T)

CERCLA final remedial measures and groundwater performance monitoring program, including groundwater P&T, soil vapor extraction, and MNA are in operation at 200-ZP (Figure ZP.20).

Groundwater P&T as a final remedy was implemented for the 200-ZP-1 groundwater OU beginning in 2012. Based on groundwater characterization activities and interim P&T operations (from 1994 to 2012), the final remedy for 200-ZP-1 was developed and formalized with a list of eight COCs which exceed the final cleanup levels ([EPA et al., 2008](#)). The remedial action objectives will be achieved through four remedy components: MNA, ICs, flow-path controls, and P&T of the contamination. The 200 West P&T began operations in 2012. The new system has a capacity of 9,464 liters per minute 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 has been implemented in combination with MNA to achieve cleanup levels for all COCs in 125 years. At the end of 2013, 18 extraction wells and 16 injection wells were in use, and the treatment plant was operating at a flow rate of 5,300 liters per minute (60 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 ZP.20) is designed to capture and contain contamination within 200-ZP-1. The new extraction wells are large in diameter (20 centimeters) with long screens (> 30 m) placed to within 3 meters 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 underlying 200-ZP-1 ([DOE/RL-2010-13](#)). The estimate of hydraulic capture (Figure ZP.21) is based on particle tracking using the water-level surfaces and the techniques are detailed in [SGW-42305](#).

In 2013, tasks performed to execute the final 200-ZP-1 ROD ([EPA et al., 2008](#)) remedial action objectives included the completion of three extraction wells and one injection well to supplement the 29 wells completed between 2009 and 2012. In 2013, continuous operation of the 200 West P&T resulted in 2.83 billion liters of contaminated groundwater treated from eighteen extraction wells. Table ZP.2 Table ZP.2 200 West Pump and Treat Performance for 2013, lists the mass of contamination removed from groundwater in 2013. 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 sixteen operational injection wells were at or below cleanup levels. More details on the 200 West P&T performance can be found in DOE/RL-2014-26. A photograph of the 200 West P&T process facility is shown in Figure ZP.22.

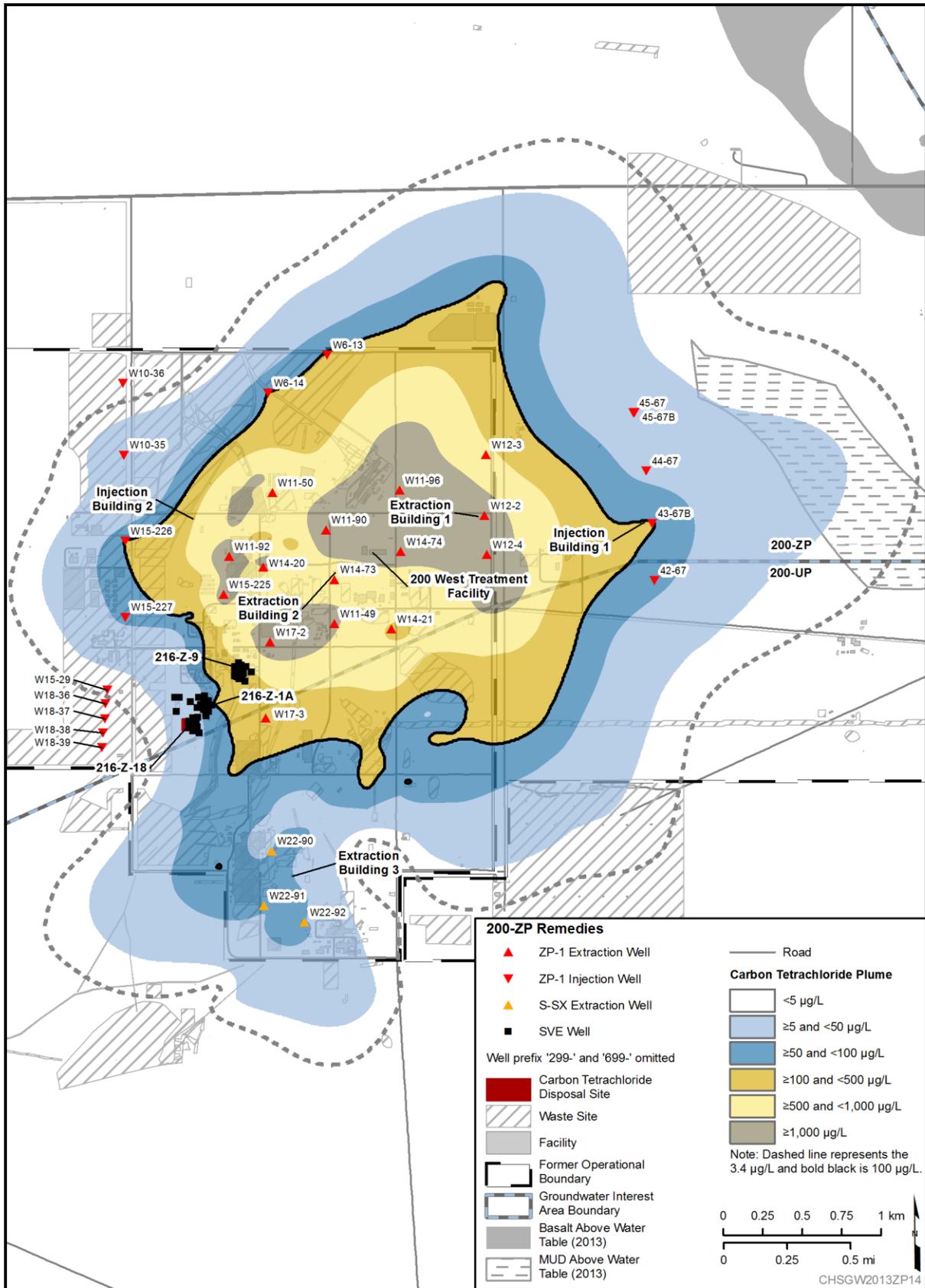


Figure ZP.20 200-ZP Remedy Overview

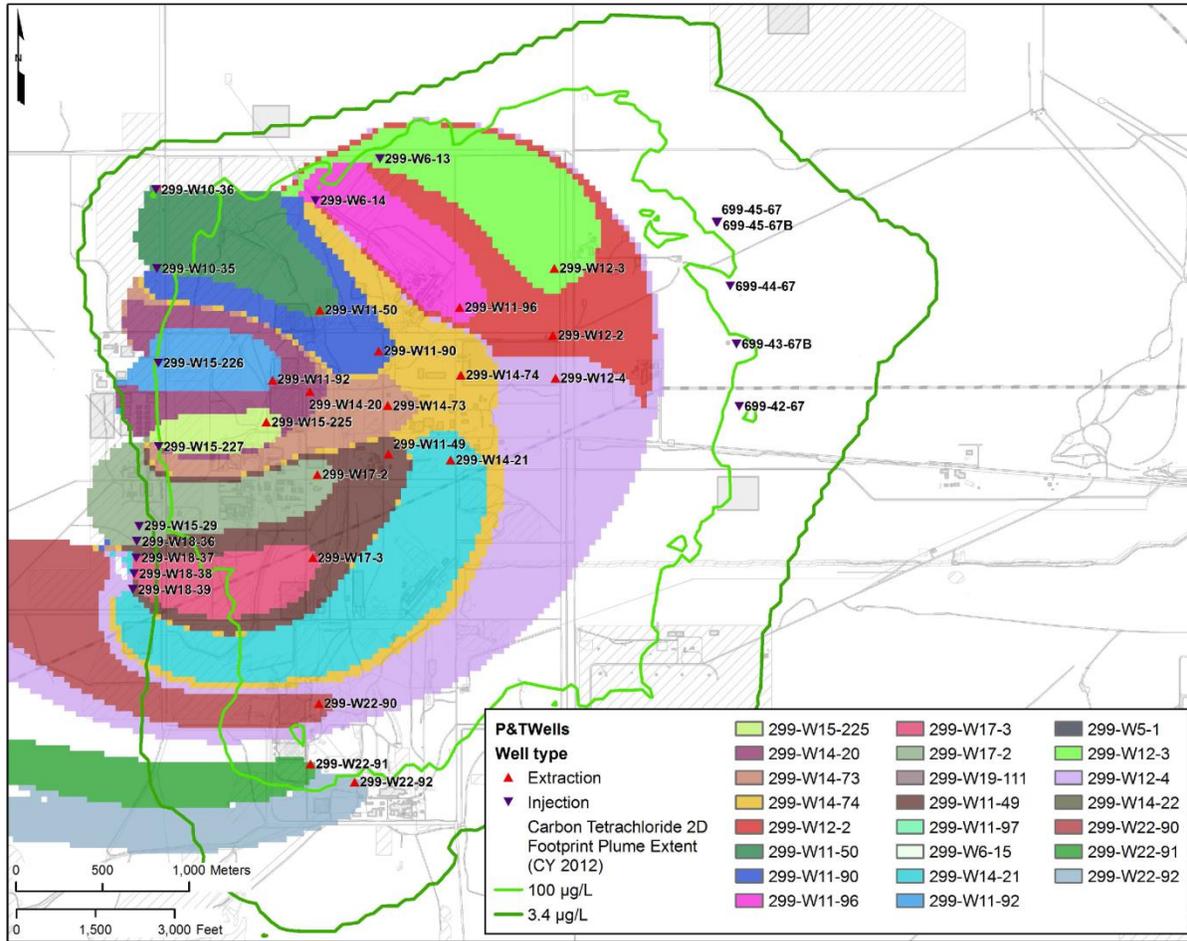


Figure ZP.21 200-ZP-1 Pump and Treat System

Table ZP.2 200 West Pump and Treat Performance for 2013

Performance	2013	Total Since Start of Final Remedy (2012)	Total Since Start of Interim Remedy (1994)
Total Groundwater Processed (Liters)	2,825,979,014	3,332,086,994	9,344,386,994
Contaminant of Concern	Mass Removed		
Carbon Tetrachloride (kilograms)	3,049	3,580	17,491
Chromium [Total and Hexavalent] (kilograms)	71.92	91.24	105.74
Iodine-129 (microcuries)	0.00016	0.000242	0.000242
Nitrate as Nitrate (kilograms)	195,051	243,905	328,598
Technetium-99 (grams)	78.66	98.03	179.73
Trichloroethene (kilograms)	13.07	15.49	16.22
Uranium ^a (kilograms)	0.471	1.08	1.08

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



Figure ZP.22 200 West Pump and Treat Facility

200-ZP Remedies – 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 ZP.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 14.2 to 42.5 cubic meters per minute were implemented with the interim systems. Between 2009 and 2012, two soil vapor extraction systems, each with a design capacity of 14.2 cubic meters per minute, 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 2014 to allow time for carbon tetrachloride vapor concentrations to rebound. In 2012 (the last year of operation), the two systems removed 162 kilograms of carbon tetrachloride from the vadose zone and treated 3.04 million cubic meters of vapor (Table ZP.3). Since startup of soil vapor extraction operations in 1992, 80,107 kilograms of carbon tetrachloride have been removed from the vadose zone in 118 million cubic meters of soil vapor (Figure ZP.24; Table ZP.3 Table ZP.3 Soil Vapor Extraction Performance in 2012 and Since Startup). Each soil vapor extraction system extracts simultaneously from multiple wells; in 2012, vapor was extracted through 24 well intervals using 20 wells (four of the wells have two isolated open intervals).

Passive soil vapor extraction systems operated during January through March 2013 at eight wells near the disposal sites associated with the PFP. Passive soil vapor extraction is a naturally occurring process driven by barometric pressure fluctuations. During 2013, the systems removed approximately 0.3 kilograms of carbon tetrachloride from the vadose zone. Since operations began in 2001, the passive systems have removed approximately 110 kilograms of carbon tetrachloride. The passive soil vapor extraction wells were taken out of service permanently in March 2013.

Table ZP.3 Soil Vapor Extraction Performance in 2012 and Since Startup

Performance	2012^a	Since Startup (February 1992^b)
Total soil vapor processed (cubic meters)	3,044,000	118,290,000
Total mass of carbon tetrachloride removed (kilograms) ^c	162	80,107
System availability	79% ^d	^e

a. System did not operate in 2013

b. Includes the pilot test operations in April 1991.

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

d. Average of the availability of two soil vapor extraction systems operating from April through September.

e. Not calculated.

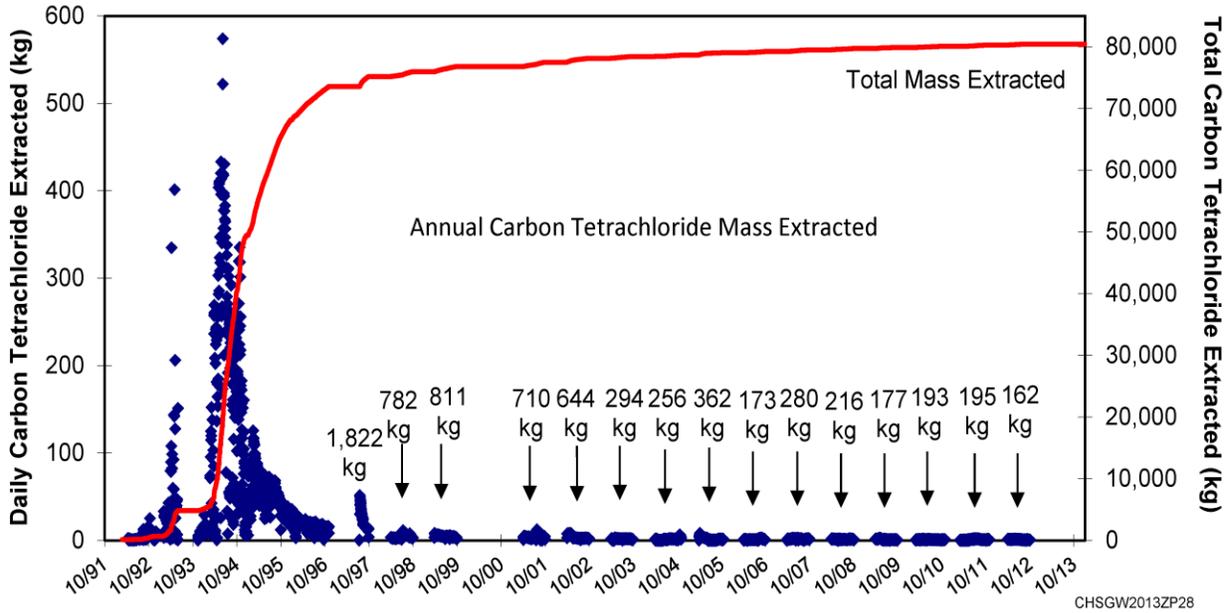


Figure ZP.24 200-ZP Mass of Carbon Tetrachloride Removed from 200-PW-1 Vadose Zone

200-ZP RCRA – Introduction

This section describes the results of monitoring at individual RCRA treatment, storage, and disposal units or 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 ZP.25, ZP.26, ZP.27, and ZP.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 Hanford Environmental Information System (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).

200-ZP RCRA – WMA-T

The WMA T (Figure ZP.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 liters, and tanks T-201 through T-204 have capacities of 208,000 liters. 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. The 200-ZP Iodine-129 and Technetium-99 sections 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 (200-ZP Chromium section). 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 ZP. 25 shows well locations and Table B.78 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-northeast and estimates of groundwater/contaminant flow beneath WMA T (using the Darcy relationship) range from 0.24 to 0.38 meters per day. 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 seven downgradient monitoring wells (299-W10-4 and 299-W10-8 went dry in 2012). 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 299-W11-45, which requires conversion to a monitoring well (scheduled in 2014) following the shutdown of the interim P&T system, and for 299-W10-4 and 299-W10-8 which could not be sampled because they are dry. 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.

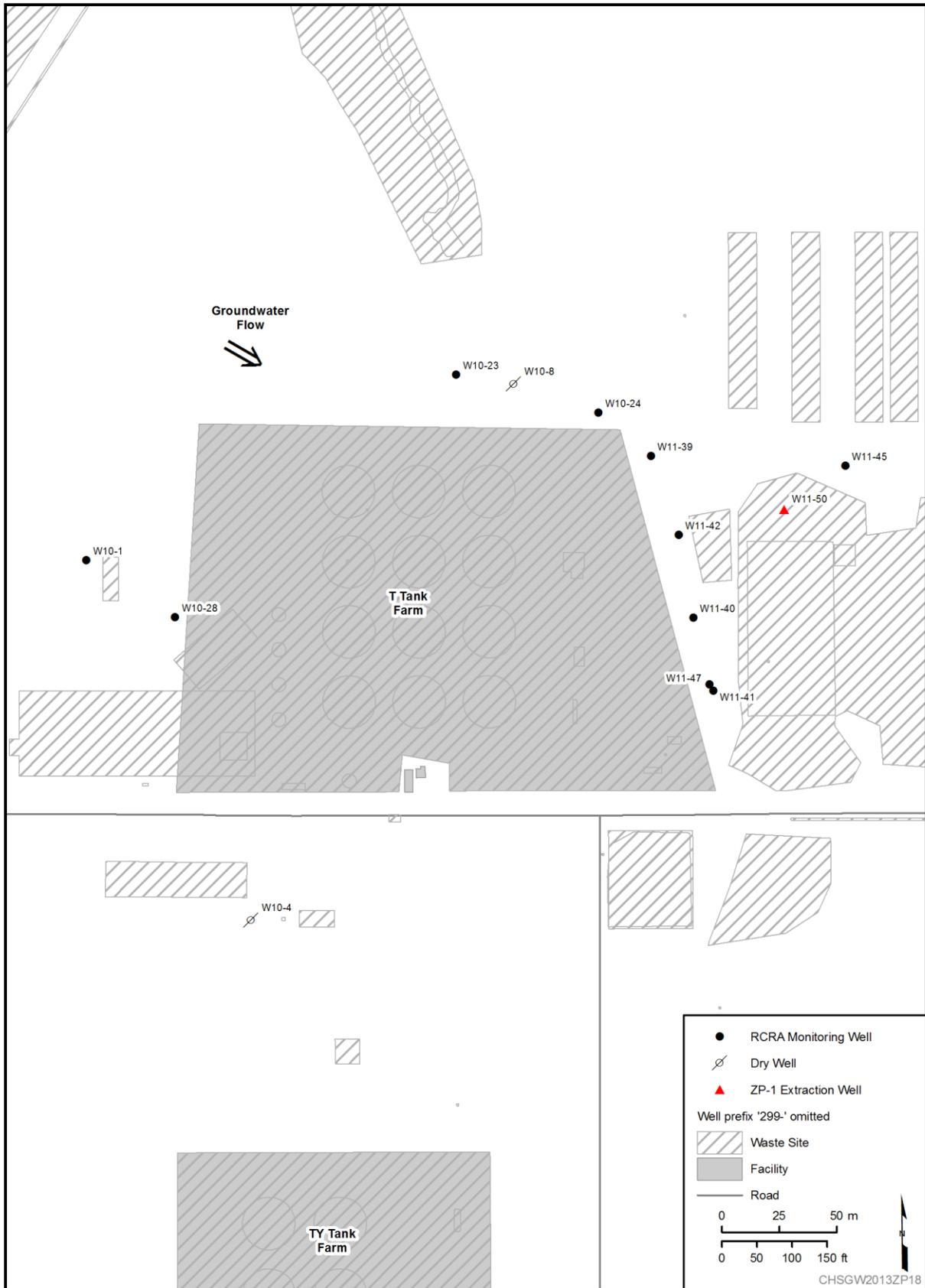


Figure ZP.25 200-ZP RCRA Facility WMA T Monitoring Well Locations

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 are associated with liquid disposal processes at the PFP (200-ZP Carbon Tetrachloride section). 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 2013, the highest chromium concentration in the upper portion of the aquifer was in 299-W11-41 (121 µg/L), located near the southeast corner 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 111 µg/L in downgradient well 299-W11-47 (screened between 7.5 and 17 meters below the water table). The highest chromium concentration in adjacent downgradient well 299-W11-39 (screened at the water table) was 33 µg/L. The higher concentrations in the deeper screened wells show that the chromium plume at WMA T extends relatively deep in the aquifer downgradient of WMA T and is present laterally at least 80 meters downgradient (eastward) at concentrations above the DWS of 100 µg/L (Figure ZP.10). Because of 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 ZP.13) and is consistent with the configuration in 2012. During the reporting period, the highest nitrate concentrations (as nitrate) were in 299-W11-41 (567 mg/L) and 299-W11-47 (491 mg/L). The nitrate concentrations above the DWS in the remaining WMA T wells were between 118 and 387 mg/L. While WMA T is a source of nitrate, other upgradient sources are larger contributors.

200-ZP RCRA – WMA TX-TY

The WMA TX-TY (Figure ZP.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](#). The 200-ZP Iodine-129 and Technetium-99 sections discuss the distribution of these non-RCRA constituents 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 liters. 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.

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 2013. 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, two far-field, and eight downgradient monitoring wells (Figure ZP.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.81 of Appendix B includes a list of wells and constituents monitored in 2013.

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 2013, chromium was detected above the 100 µg/L DWS in two wells monitoring WMA TX-TY (Figure ZP.10): 299-W10-26 and 299-W10-27. The highest chromium concentration in 299-W10-26 was 144 µg/L, an increase from 109 µg/L recorded in 2012. The highest chromium concentration in 299-W10-27 was 121 µg/L, an increase from 115 µg/L recorded in 2012. The increase in concentrations is attributed to the influence of 200 West P&T extraction well 299-W14-20. The source for the chromium was past leaks from tanks and pipelines at WMA TX-TY. The chromium plume is smaller in extent than depicted in 2012 as a result of remediation activities.

During 2013, nitrate concentrations exceeded the DWS in all wells in the monitoring network (Figure ZP.14). 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 2013 at 299-W10-27 (846 mg/L). Nitrate concentrations in other WMA TX-TY wells ranged between 80.6 mg/L (299-W15-44) and 699 mg/L (299-W10-26). Most of the nitrate contamination is attributed to PFP operations, as well as past-practice disposal to cribs and trenches in the area.



Figure ZP.26 200-ZP RCRA Facility WMA TX-TY Monitoring Well Locations
(Note: Two flow direction arrows shown based on influence of pump-and-treat extraction wells)

200-ZP RCRA – LLWMA-3

The LLWMA-3 (Figure ZP.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 square kilometers [0.079 square miles]) contains 57 unlined trenches operated between 1970 and 1998. The 218-W-3AE Burial Ground (0.200 square kilometers [0.077 square miles]) contains eight unlined trenches operated between 1981 and July 2004. The 218-W-5 Burial Ground (0.372 square kilometers [0.144 square miles]) contains ten unlined trenches and two 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 2013 (Table B.53 of Appendix B).

Water-level measurements are taken each time a groundwater sample is collected, and site-wide water-level measurements are collected annually, usually during March. The water table has risen in this region in 2012 and 2013 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 0.12 to 0.48 meters per day. 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.53, Appendix B). Concentrations of indicator parameters did not exceed their critical mean values except for specific conductance in 299-W10-31. Specific conductance measurements from 299-W10-31 exceeded the critical mean value of 457 μ S/cm, starting in March 2010 with a reported value of 497 μ S/cm. Specific conductance sample results for the October 1, 2013 and October 9, 2013 samples were 676 and 534 μ S/cm, respectively. 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 2013 (Table B.57, Appendix B) were slightly higher than those in 2012. TOC decreased in 299-W9-2 from a maximum of 12,200 μ g/L in 2012 to an average of 803 μ g/L in 2013. The 2012 elevated TOC in 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 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 un-protective 2013 critical mean for downstream wells. For this reason, intrawell TOC critical means (Appendix B, Table B.56) were calculated for downgradient wells 299-W10-30, 299-W10-29 and 299-W10-31 (ECF-Hanford-13-0013, *Calculation of Critical Means for Calendar Year 2013 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 1.59 µg/L (background) in 299-W10-31. These results indicate the LLWMA-3 is not releasing radionuclides to groundwater.

200-ZP RCRA – LLWMA-4

The LLWMA-4 (Figure ZP.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 twelve 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. Burial Ground 218-W-4B 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](#)).

The LLWMA-4 well network was sampled semiannually for contamination indicator parameters and supporting constituents ([DOE/RL-2009-69](#)). Table B.59 of Appendix B includes a list of wells and the indicator parameter comparison values to be used in 2013.

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 0.15 to 0.60 meters per day 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 ZP.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) available for sampling. The well network was successfully sampled twice in 2013 for indicator and site-specific parameters including pH, specific conductance, TOC, and TOX.

Table B.60 of Appendix B includes a table with indicator parameter ranges for LLWMA-4 wells in 2012 and 2013. Specific conductance, pH, TOC, and TOX in downgradient wells remained below their critical mean values. TOX and TOC results declined in 2013 compared to 2012 results. Indicator parameter averages for pH and specific conductance are similar to 2012.



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



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

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 290 pCi/L in 299-W15-152), and uranium was detected in all wells with a maximum of 1.84 µg/L in 299-W15-152. Detection of technetium-99 is consistent with observed levels in the aquifer and does not indicate contamination from LLWMA-4.

200-ZP WAC Facility – SALDS

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 ZP.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 meters outside the northern boundary of the 200 West Area and consists of a 35 meters by 61 meters drain field.

During 2013, 30.4 million liters of water were discharged to the SALDS, a decrease from the 35.8 million liters discharged during 2012. Discharge volumes have been lower than in previous years (e.g., 75.2 million liters during 2011) because two interim-action P&T systems in the 200 West Area (at WMA T and the U Plant area), for which the extracted water had been treated at the ETF, are no longer operating.

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 2013 releases contained 10.98 curies of tritium, an increase from the 3.52 curies released during 2012. Monthly average concentrations in the effluent ranged from <1,000 to 500,000 pCi/L. Releases of tritium from the SALDS have caused a tritium plume in groundwater beneath the facility.

DOE monitors groundwater in the SALDS vicinity to track the migration of the tritium plume (Figure ZP.19) and to compare concentrations of other constituents to permit limits. 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.89 of Appendix B includes a list of wells and constituents sampled for the SALDS. All required sampling was completed during 2013, although some wells were sampled later than originally scheduled because of maintenance 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 2013* (SGW-56060). 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-53569](#).

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. Water table mapping indicates that the regional groundwater flow direction in the SALDS vicinity is currently towards the east-northeast.

Between April 2012 and March 2013, the water table in the SALDS vicinity increased by an average of 0.22 meters (SGW-56060). The water table responds to SALDS discharges, but a slight increase in the water table due to operation of nearby P&T system injection wells for the 200-ZP-1 OU was predicted by groundwater modeling (SGW-56060 and SGW-50907, *Predicted Impact of Future Water-Level Declines on Groundwater Well Longevity within the 200 West Area, Hanford Site*). Beginning in 2014, model predictions indicate that the long-term water table decline will resume. This long-term decline has caused eleven of the nineteen 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, *Predicted Impact of Future Water-Level Declines on Groundwater Well Longevity within the 200 West Area, Hanford Site*). The third proximal well, 699-48-77C, is completed deeper in the unconfined aquifer and is not in danger of becoming dry. The permit is due to be renewed, and the issue of the proximal wells becoming dry will be addressed during the renewal process.

The proximal wells are sampled for seventeen 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. Sampling of gross alpha, gross beta, strontium-90, and tritium is also required by the permit, but these constituents are not assigned permit limits. All groundwater sampling results from the SALDS proximal wells were within permit compliance limits during 2013.

Tritium concentrations in the proximal wells are affected by releases from the SALDS. Concentrations exhibit a correlation 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 ZP.30). Peak tritium concentrations during 2013 were 140,000 pCi/L in 699-48-77C and 74,000 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-53569](#)). The low levels of tritium observed in wells 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 ZP.19). Tritium was detected in tritium-tracking well 299-W6-6 during 2013 at 3,770 pCi/L, but the source is a 200-ZP-1 injection well, 299-W6-13, located just 10 meters 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 299-W6-6.

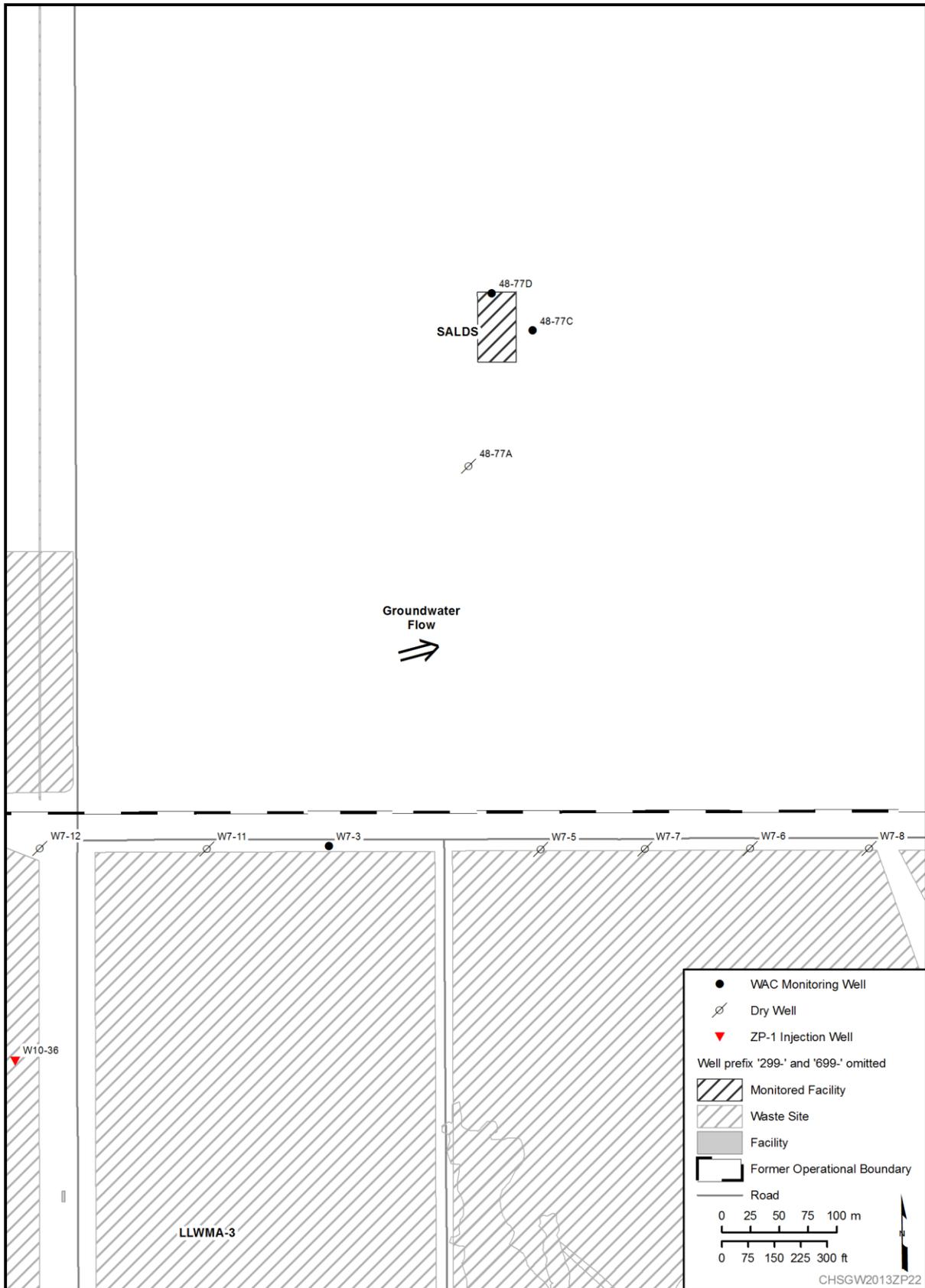


Figure ZP.29 200-ZP WAC Facility SALDS Monitoring Well Locations

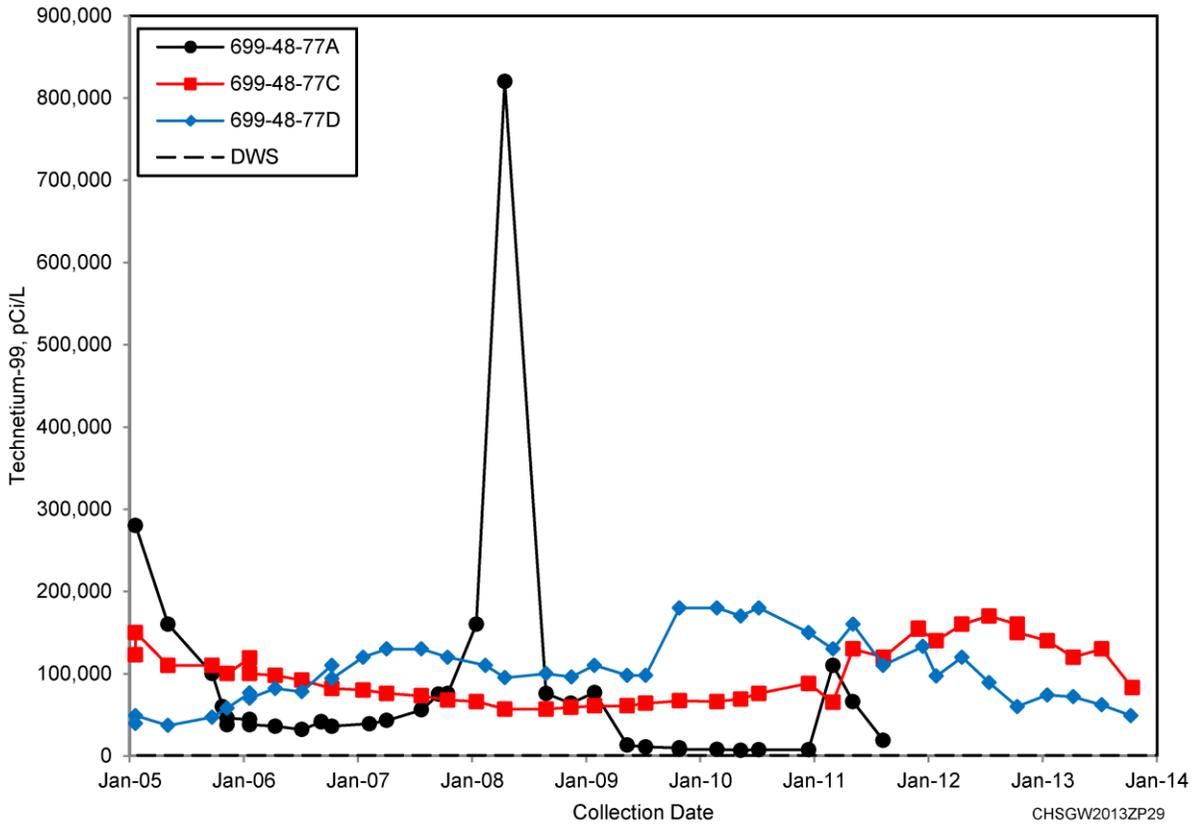


Figure ZP.30 200-ZP Tritium Data for Wells Monitoring SALDS