10 200-PO

10.1 Overview

This chapter summarizes groundwater sampling for the 200-PO groundwater interest area for calendar year 2014. Groundwater monitoring in 200-PO is performed to meet AEA, CERCLA, RCRA, and *Washington Administrative Code* requirements. The 200-PO interest area includes the CERCLA 200-PO-1 OU and adjacent region, seven RCRA units (216-A-29 Ditch, 216-A-36B Crib, 216-A-37-1 Crib, 216-B-3 Pond, Nonradioactive Dangerous Waste Landfill [NRDWL], Integrated Disposal Facility [IDF], and WMA A-AX (single-shell tanks), one state-regulated landfill (Solid Waste Landfill [SWL]), and the 400 Area. For purposes of CERCLA groundwater monitoring, the 200-PO-1 OU is informally divided into the near field area, which includes the former operational areas within and near the 200 East Area, and the far field area, which includes wells downgradient of the near field area, aquifer tubes along the Columbia River, and generally comprises areas where site operations did not occur (Figure 10-1). CERCLA sampling wells within the far field region have been grouped into several sub-areas including the BC Cribs, southeast transect, river transect, basalt confined aquifer, and the general far field (DOE/RL-2003-04, Rev. 1; TPA-CN-205). Table 10-1 summarizes some key facts about 200-PO. Section 1.3 provides plume mapping details, including descriptions of terms in figure legends (e.g., Type 1 Control Point).

Groundwater within the 200-PO interest area has been contaminated primarily by releases from cribs, ponds, single-shell tanks, and trenches associated with PUREX and B Plant operations. Groundwater sampling within the interest area is directed by the sampling and analysis plans, permits, Tri-Party Agreement (Ecology et al., 1989) change notices, and other documents that identify groundwater monitoring requirements. The CERCLA RI completed for the 200-PO-1 OU in 2008 identified tritium, iodine-129, nitrate, strontium-90, technetium-99, PCE, TCE, and uranium as final COPCs (DOE/RL-2009-85, Rev. 1). Active groundwater remediation is not currently being conducted within 200-PO.

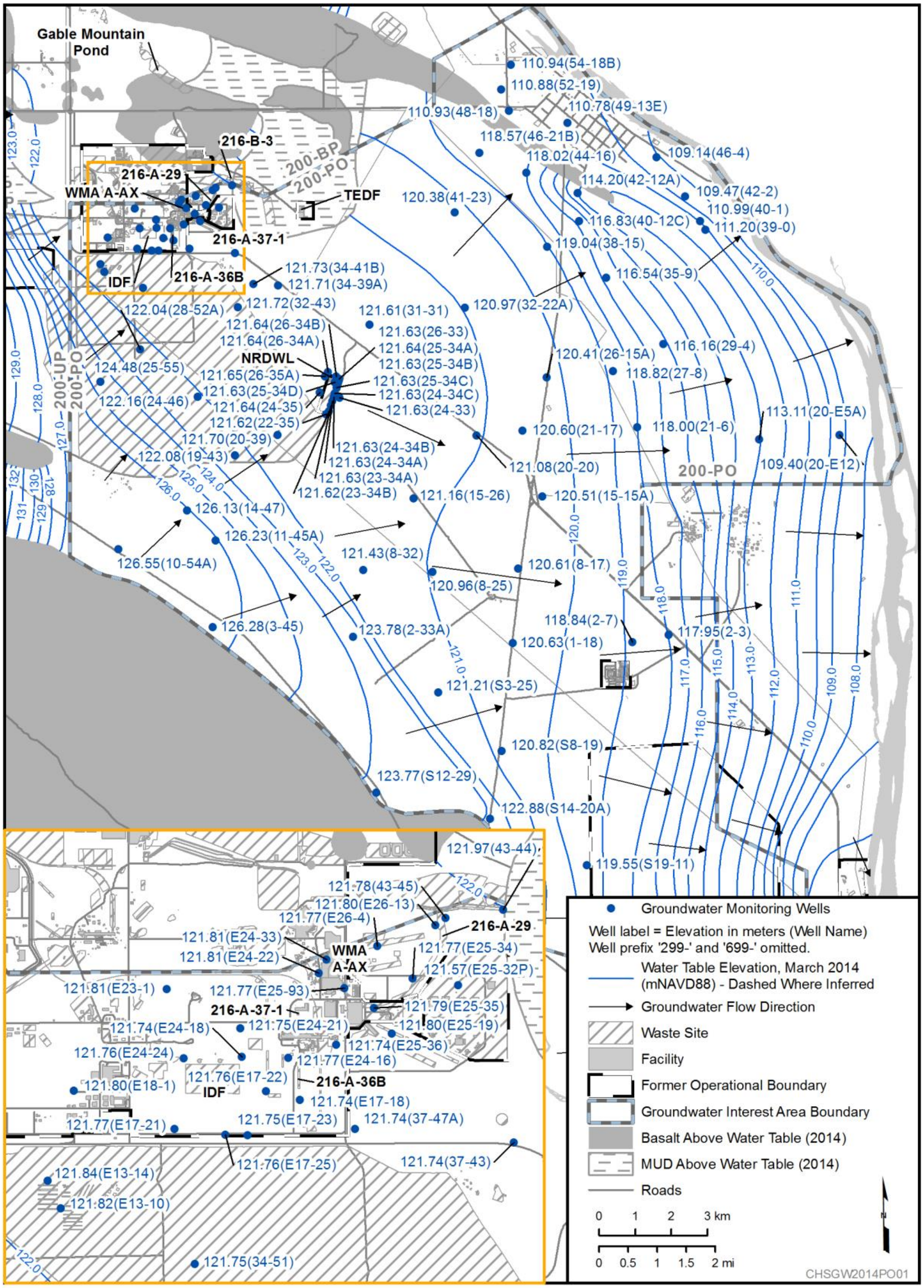

Figure 10-1. 200-PO Overview with Groundwater Flow

Table 10-1. 200-PO at a Glance

PUREX Plant operations:	1956 to 1972 (plutonium separation) 1983 to 1989 (plutonium separation)		
2014 Groundwater Monitoring			
Contaminant	**Drinking Water Standard**	**Maximum Concentration**	**Plume Area* (km^2)**
Tritium	20,000 pCi/L	510,000 µg/L (299-E17-19)	79.2
Iodine-129	1 pCi/L	6.49 pCi/L (699-43-45)	49.3
Nitrate	45 mg/L	156 mg/L (299-E17-19)	3.8
Strontium-90	8 pCi/L	15 pCi/L (299-E24-22)	0.01
Technetium-99	900 pCi/L	1,840 pCi/L (299-E25-93)	0.04
Uranium	30 µg/L	57.8 µg/L (299-E25-36)	0.05

* Estimated area at a concentration greater than the listed drinking water standard.

Groundwater beneath the interest area primarily occurs in an unconfined aquifer consisting of Hanford formation and Ringold Formation sands and gravels (Figure 10-2). However, due to the large extent and overall thickness of the aquifer (up to 215 m [705 ft]), it includes localized semiconfined and confined intervals within deeper portions of the aquifer system as well. The Ringold lower mud unit (hydrostratigraphic unit 8) confines the underlying unit 9. There are also finer-grained strata within unit 9 that confine underlying sediments. East of 200 East Area, there are no saturated sediments above unit 8 and the unconfined aquifer is absent. Detailed discussions of geology and hydrogeology within the 200-PO interest area are provided in DOE/RL-2009-85, DOE/RL-2011-118, and PNNL-12261.

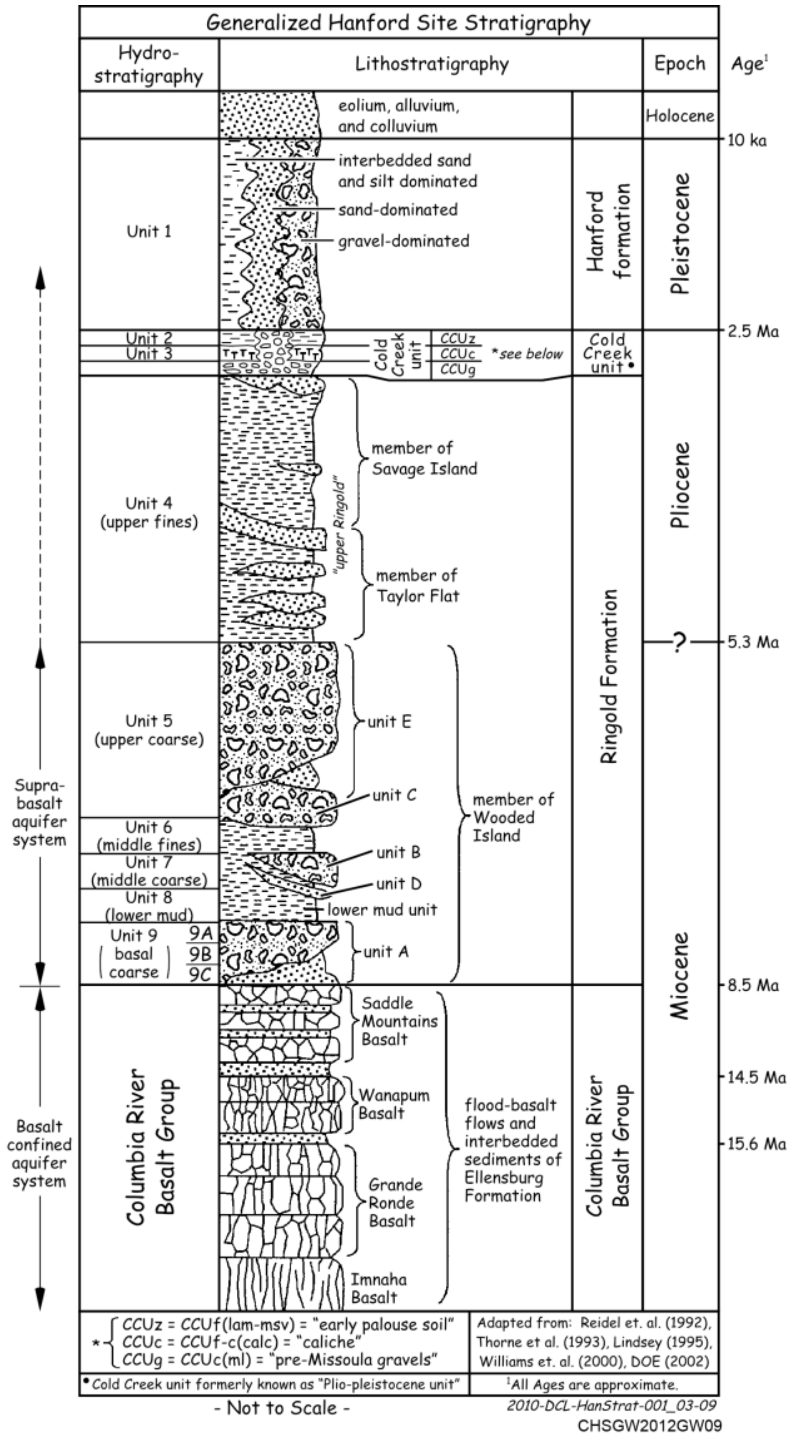

Figure 10-2. 200-PO Geology

10.2 200-PO and 200 East Area Hydraulic Gradient and Groundwater Flow Directions

The depth to the water table is more than 90 m (300 ft) near the southern boundary of the 200 East Area, and it varies in depth to near 0 m bgs at the Columbia River. The water table beneath 200 East Area and the region to the southeast is very flat (Figure 10-1), so special efforts are needed to determine the direction and magnitude of the hydraulic gradient. A network of wells used to evaluate the low-gradient region includes most of the 200 East Area. The network now consists of 56 wells extending from Well 699-50-56 north of LLWMA-1 to Well 699-37-47A just outside the southeast corner of the 200 East Area (SGW-54165). Geodetic casing elevation surveys and gyroscope surveys (for borehole verticality) have been performed in all wells. The collection of monthly water-level measurements from the expanded network began during May 2013. Contours representing the average water table across the low-gradient evaluation network, generated using the inverse distance gridding method, are shown in Figures 10-3 and 10-4 for 2013 and 2014, respectively. The maps generally show flow toward the southeast across the 200 East Area. The contours are more closely spaced in the northwest, indicating the magnitude of the hydraulic gradient is larger in the northwestern part of the 200 East Area compared to the southeast part. The aquifer thickness is smallest in the northwest causing the transmissivity to be lower, and lower transmissivity equates to higher hydraulic gradient magnitudes (when all other factors are equal).

The configuration of the 200 East Area water table at any given time results from the interaction of the river stage and stressors related to discharges to the Treated Effluent Disposal Facility (TEDF), located east of 200 East Area. Discharges to the TEDF are variable. The normal pattern of discharge is a low-volume background averaging 6.7 million L/month (1.8 million gal/month) (2011 through 2013), with occasional discharge volumes in excess of 100 million L/month (26 million gal/month) that occur when the 242-A Evaporator is operating. It is these larger discharges that affect the 200 East Area water table. The 242-A Evaporator began operating again during 2014, and high-volume discharges to the TEDF occurred during February, March, July, September, and October. The largest monthly discharge volume during 2014 was 40 million L (110 million gal) during September. The water table in 200 East Area also responds to Columbia River stage changes via the high-transmissivity paleochannel that originates to the north, near 100-BC Area (Figure 2-4 of SGW-54165). During the summers of 2013 and 2014 river stage was near its long-term average for the summer months, so this stressor was not as substantial as in 2011 and 2012. The combination of higher TEDF discharges to the east and lower river stages to the northwest resulted in a lower hydraulic gradient magnitude in the 200 East Area during 2014, as shown by the contours in Figure 10-4 being farther apart than in Figure 10-3. However, discharges to the TEDF were not substantial enough to cause the groundwater flow direction to change, and flow continued toward the southeast during most of 2014. The main effect of the TEDF discharges was to reduce the gradient toward the southeast. Section 10.13 describes groundwater flow directions beneath specific RCRA sites in 200-PO.

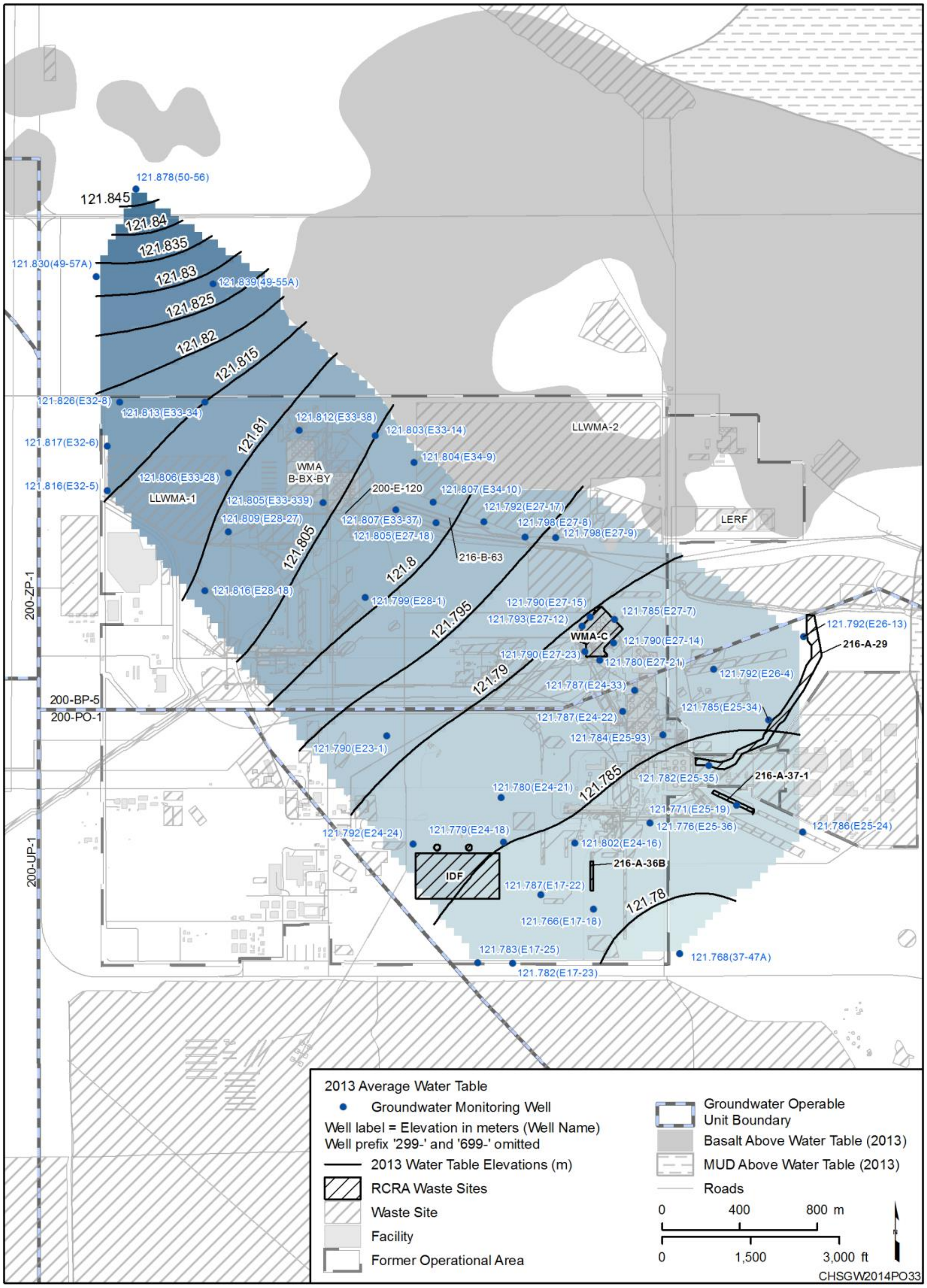

Figure 10-3. Average 2013 Water Table, 200 East Area

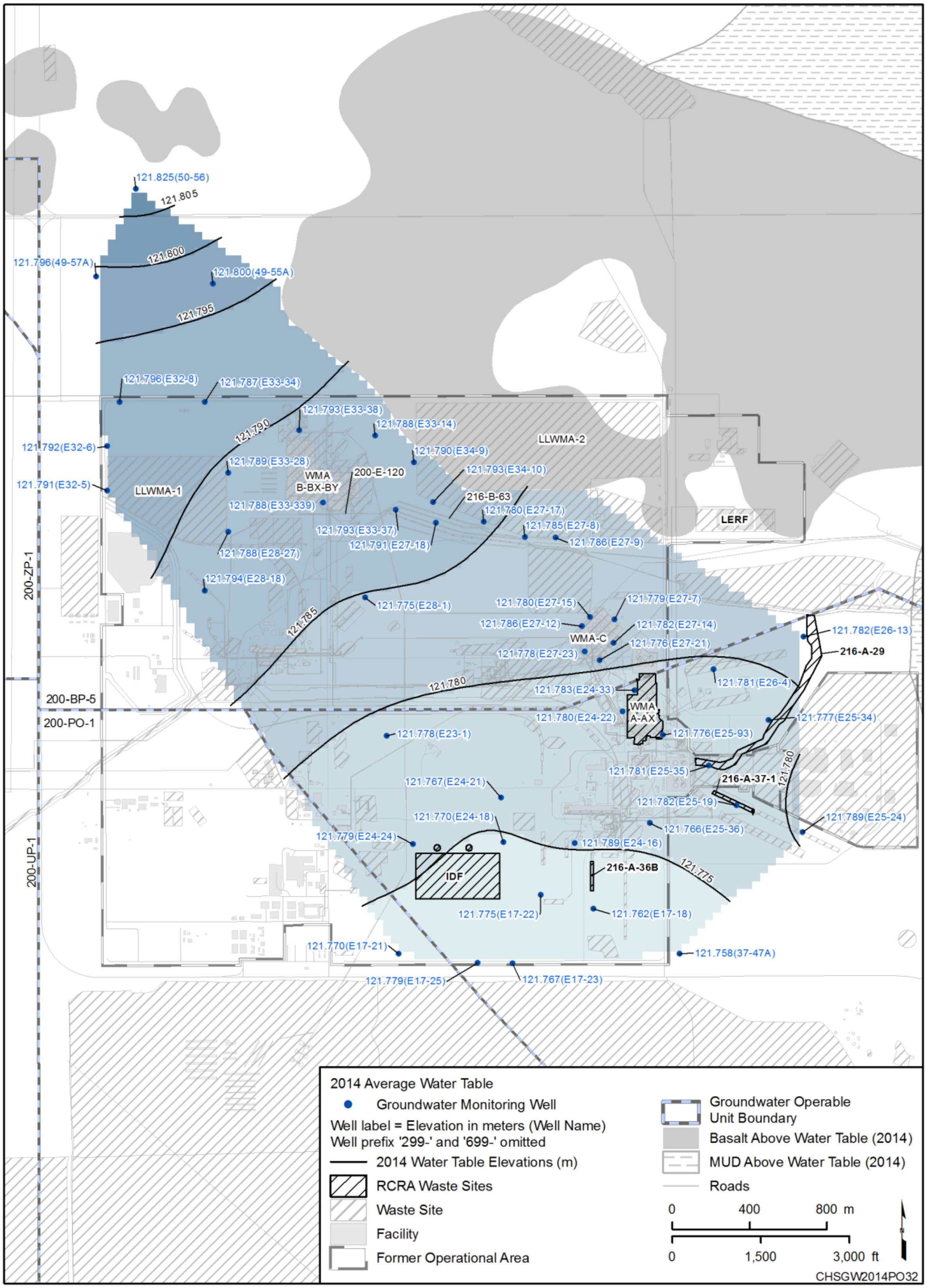

Figure 10-4. Average 2014 Water Table, 200 East Area

10.3 CERCLA Activities

Groundwater monitoring under CERCLA is described in the SAP (DOE/RL-2003-04, Rev. 1), as amended by TPA-CN-205; and DOE/RL-2007-31, Rev. 0, as amended by TPA-CN-2-253. Groundwater is monitored within the unconfined aquifer, Ringold confined aquifers, and the basalt-confined aquifer. Wells and aquifer tubes (Figure 10-5) are generally sampled annually or triennially (every 3 years). Additional aquifer tube sampling within 200-PO is also conducted as defined within the SAP for aquifer sampling tubes (DOE/RL-2000-59). Table A-17 of Appendix A lists monitoring wells, constituents, and sampling status for 2014. Table C-2 of Appendix C lists aquifer tubes sampled in 2014 and January 2015.

The results of the RI are provided in DOE/RL-2009-85, Rev. 1. The report recommended that the OU should advance to the next step in the CERCLA process, which is a FS to develop alternatives to remediate the groundwater contamination. The RI identified tritium, iodine-129, nitrate, strontium-90, technetium-99, PCE, TCE, and uranium as final COPCs. PCE and TCE were only detected at very low (laboratory estimated) concentrations (below the DWS) in far field region wells near the NRDWL and the SWL. Details regarding 2014 groundwater for each of these COPCs are described in the following sections of the report. An RI addendum is currently underway to update the risk assessment for the 200-PO-1 OU based on additional groundwater data collected since the RI was completed.

Plume areas measured from 2003 through 2014 for tritium, iodine-129, nitrate, uranium, and technetium-99 are presented on Figure 10-6. A change in calculated plume area occurred for some contaminants (e.g., nitrate) between 2011 and 2012 due to calculation of areas by interest area boundary starting in 2012, instead of calculation by source area prior to 2012. These COPCs, except technetium-99, are primarily associated with PUREX operations that discharged liquid effluents to the cribs and ditches in the southern part of the 200 East Area from 1956 to 1972, and 1983 to 1988. Technetium-99 within 200-PO has been detected above the DWS near WMA A-AX.

In 2013, one well was decommissioned (299-E25-236) due to casing corrosion issues and one well (699-S12-3) became sample dry. Drilling of a replacement well (299-E25-237) for Well 299-E25-236 was initiated in late 2014, with an early 2015 completion date. Well 699-S12-3 is now a candidate for decommissioning. In 2014, Well 699-25-34E was installed at the SWL as a replacement for Wells 699-25-34C and 699-24-34C, which had previously gone dry. New upgradient monitoring Wells 699-26-38 and 699-24-36 were installed for the NRDWL and the SWL, respectively (Table E-2, Appendix E).

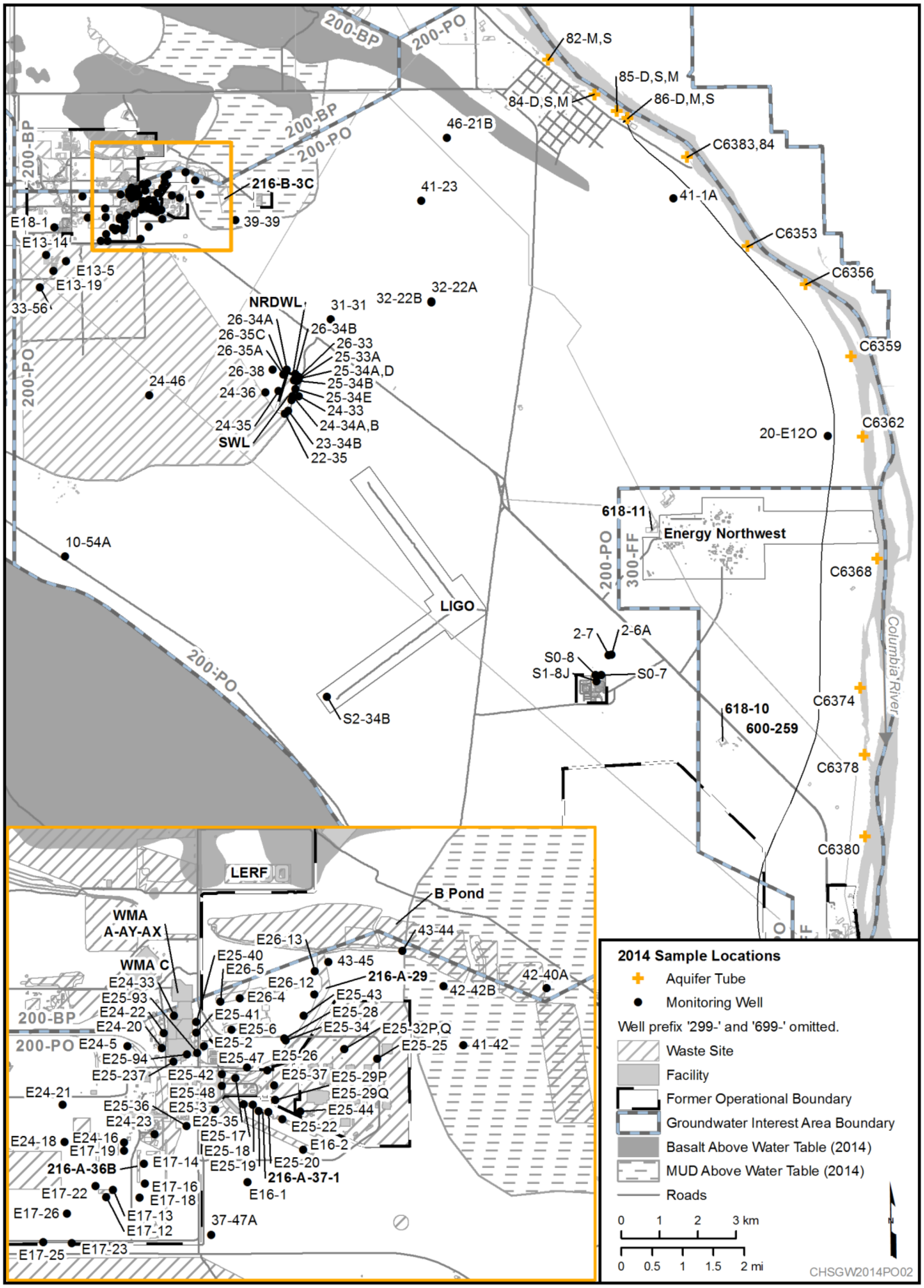

Figure 10-5. 200-PO Sampling Locations, 2014

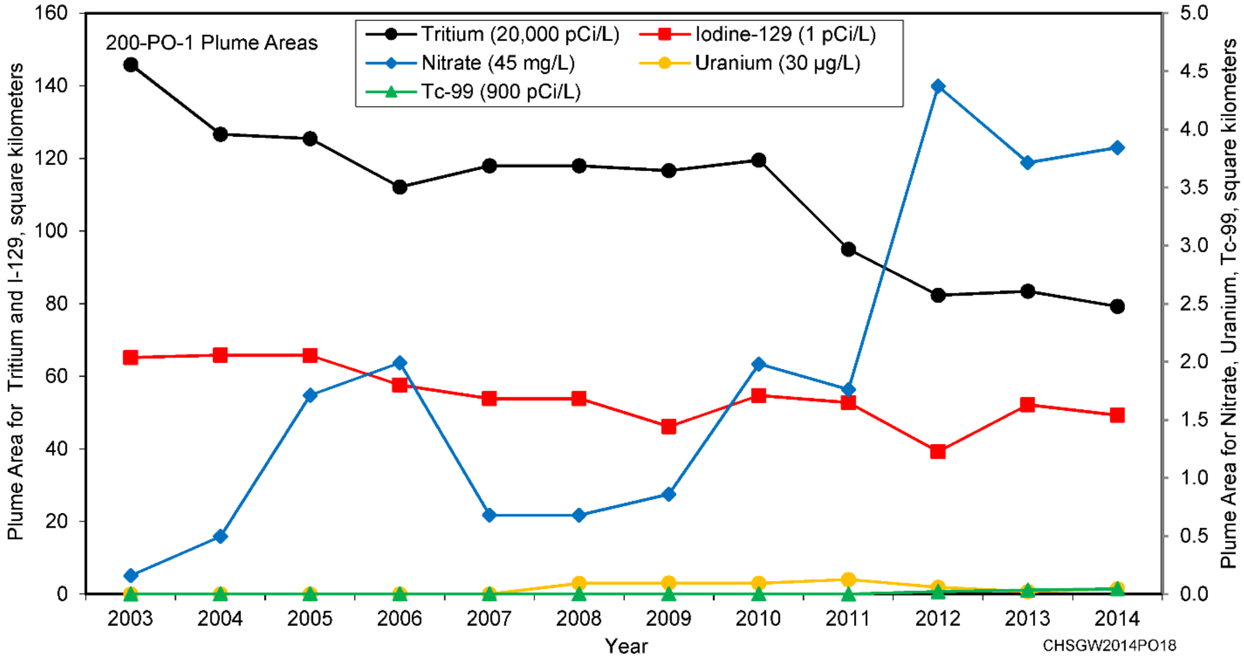

Figure 10-6. 200-PO Plume Areas, 2014

10.4 Tritium

For the 200-PO-1 OU, sampling for tritium in the near field is performed annually (Appendix A, Table A-16). For far field general wells, sampling is conducted primarily on a triennial frequency (Appendix A). Triennial sampling events were conducted in 2010 and 2013. Far field wells comprising the southeast transect and river transect are sampled annually (Appendix A, Table A-17).

Tritium contamination in groundwater is found at a concentration greater than the 20,000 pCi/L DWS in a large plume within 200-PO from the 200 East Area to the Columbia River (Figure 10-7). The highest current and historical concentrations have been detected near the PUREX Cribs and Trenches, which were the major sources of this contaminant. The tritium plume continues to be present the far field area with a portion of the plume discharging into the Columbia River to the east (Figure 10-7). Decreasing concentrations and attenuation of the plume in the far field region is due to dispersion and radioactive decay of tritium, but concentrations near the PUREX Cribs and Trenches remain up to 25 times the DWS of 20,000 pCi/L and have been relatively stable since 2000 indicating potential vadose zone sources. The interpolated portion of the tritium plume at a concentration above 20,000 pCi/L that discharges to the river has been reduced in 2014 in comparison to 2013 based on declines in levels observed in aquifer tubes and near-river wells. The highest tritium concentration detected at an aquifer tube sample location was 9,560 pCi/L at C6384 (Figure 10-7).

In 2014, the 20,000 pCi/L and 200,000 pCi/L interpolated plume intervals are generally consistent with the 2013 plume, with some localized reduction in extent (presented in DOE/RL-2014-32). The tritium plume has decreased in size by approximately 59 percent since 1996. For 2014, the highest concentrations of tritium in the near field area were 510,000 pCi/L in Well 299-E17-19 (near the 216-A-10 Crib), 400,000 pCi/L in Well 299-E17-14 (near the 216-A-36B Crib), and 172,000 pCi/L in Well 299-E24-16 (near the 216-A-10 Crib) (Figure 10-8). The highest concentration of tritium detected during 2014 from the far field was 739,000 pCi/L for a sample collected in October at Well 699-13-3A. The tritium in Well 699-13-3A originated at the 618-11 Burial Ground and is discussed in more detail in the 300-FF discussion (Chapter 7).

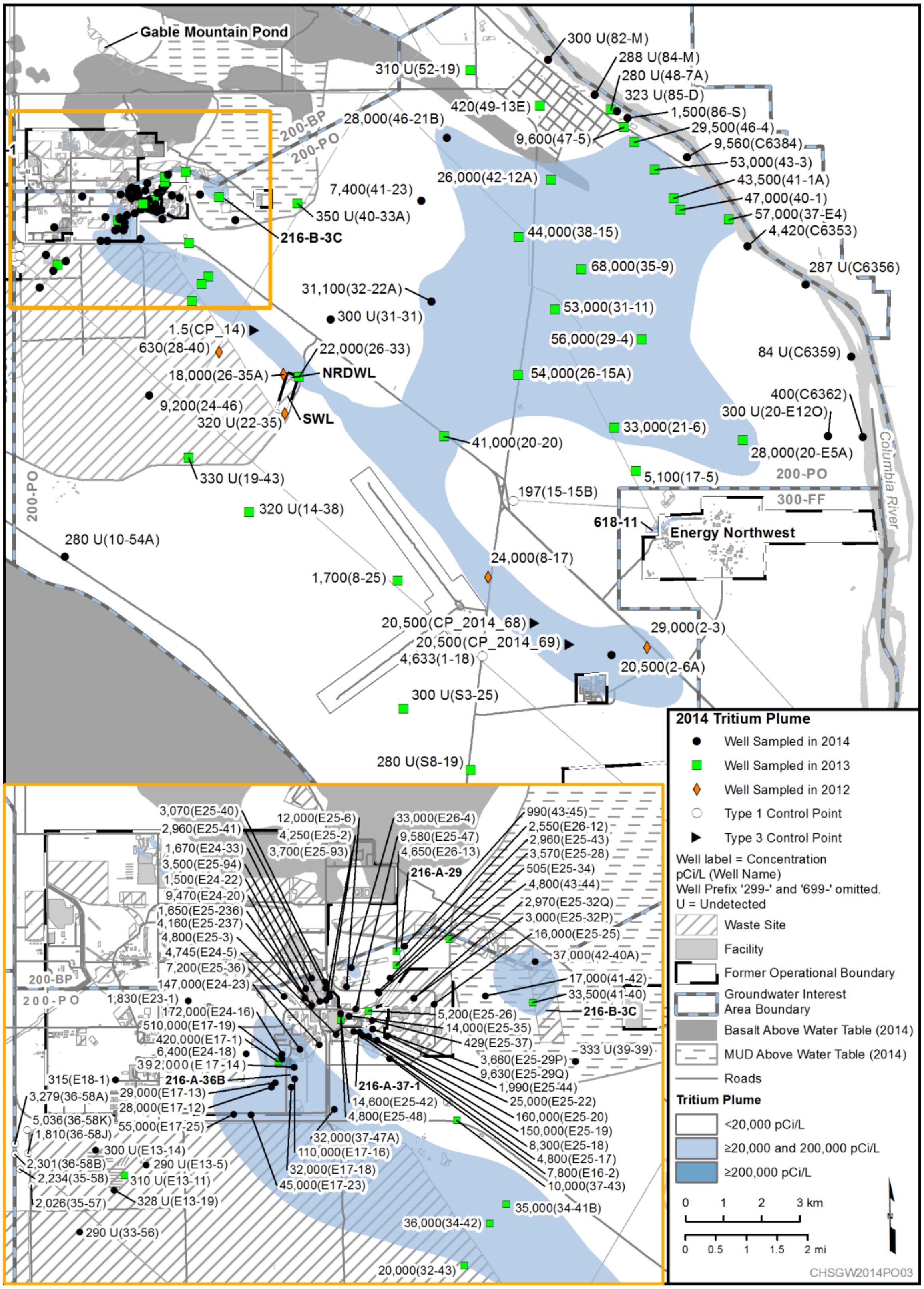

Figure 10-7. 200-PO Tritium Plume, 2014

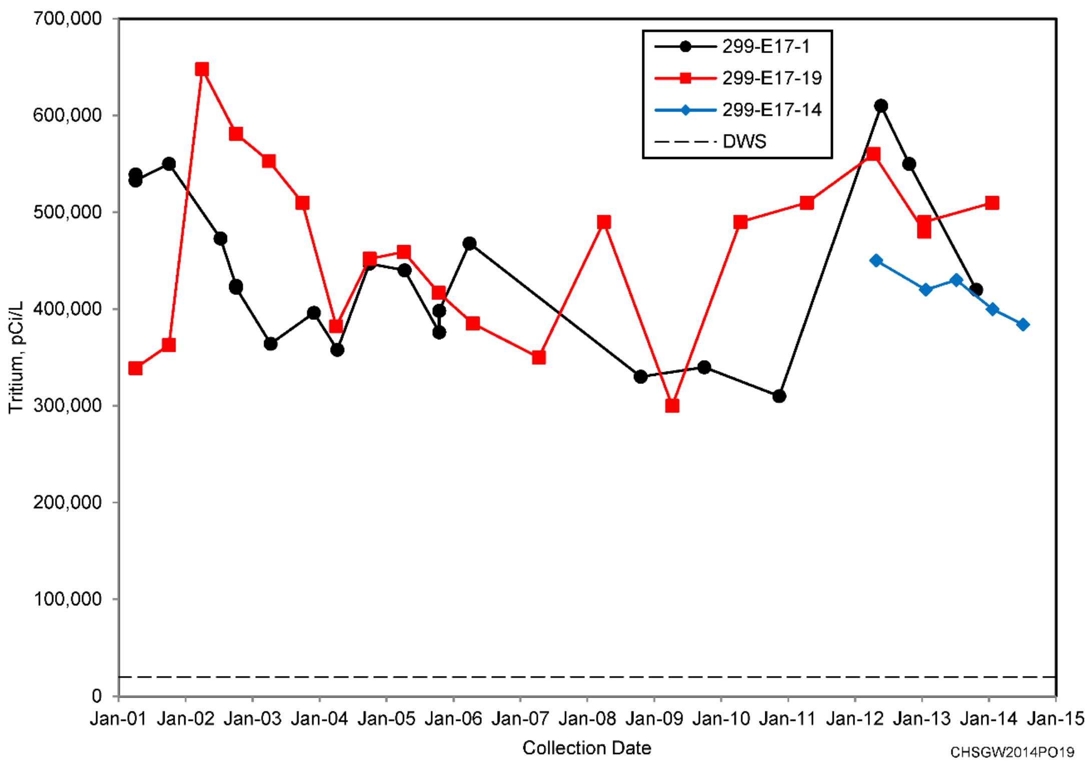

Figure 10-8. 200-PO Tritium Data for Wells 299-E17-1, 299-E17-19, and 299-E17-14

An area of lower tritium concentrations identified in the far field region near the Energy Northwest complex (Figure 10-7) is hypothesized to be due to a zone of lower hydraulic conductivity material in the unconfined aquifer, where the water table is within the upper portion of the Ringold Formation, which has a greater degree of local cementation. The zone of lower hydraulic conductivity has resulted in groundwater flow, and tritium contamination moving around this area.

Well 699-31-31 is one of the wells used to define the boundary of the tritium plume in the area where the plume narrows as it extends to the southeast between the 200 East Area and the distal far field (Figure 10-7). Well 699-31-31 and other wells in the vicinity of the plume in this region have been showing a decreasing concentration trend following peak levels that occurred when a high-concentration slug of tritium passed through the area between 1992 and 1994 (Figures 10-9 and 10-10). From 1992 to 2000, the tritium concentrations in this well usually exceeded the DWS. After 2000, concentrations of tritium detected in the well were approximately one order of magnitude lower than the concentration detected in 2000. The reason for the decrease in the tritium concentration in the well between 2000 and 2001 is not known. The concentration change could be related to a breach of one of the seals within this multi-level (nested) monitoring well or a distinct local groundwater concentration change. Since 2001, this well has had concentrations well below the DWS. In reviewing concentration trending for other wells in the area that are equal distance from the plume margin, current concentration trending for Well 699-31-31 is consistent with the regional pattern. Future utilization of Well 699-31-31 and the potential need to replace it will be further assessed as the FS for 200-PO-1 progresses and remedial alternatives are reviewed.

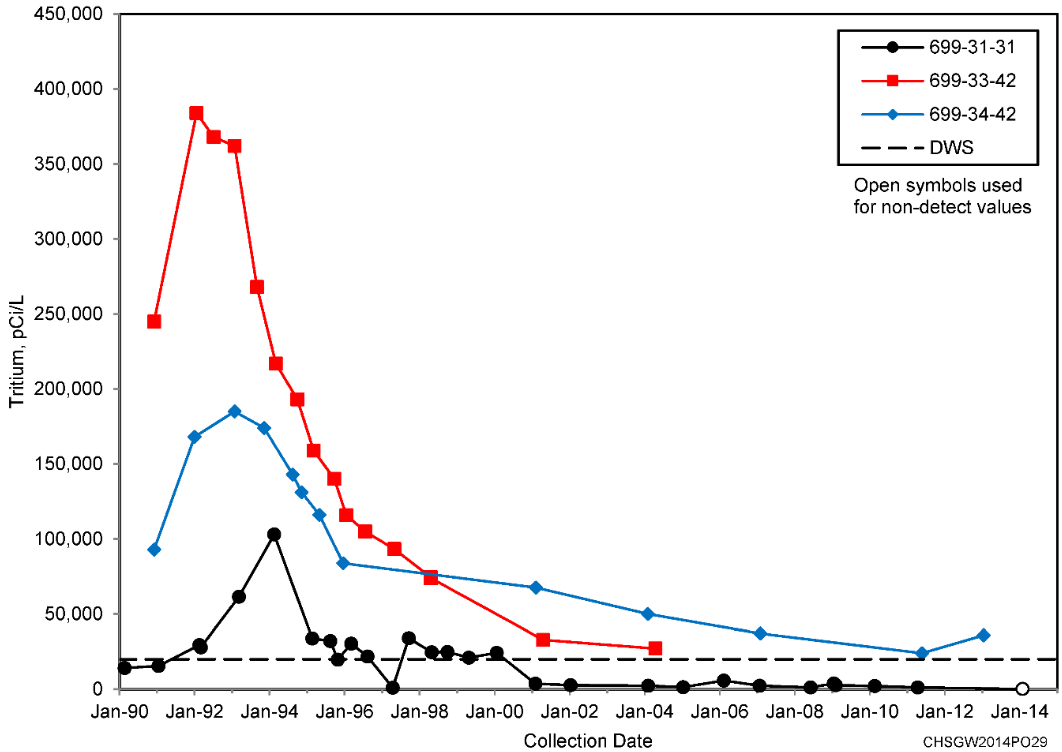

Figure 10-9. 200-PO Tritium Data for Wells 699-31-31, 699-33-42, and 699-34-42

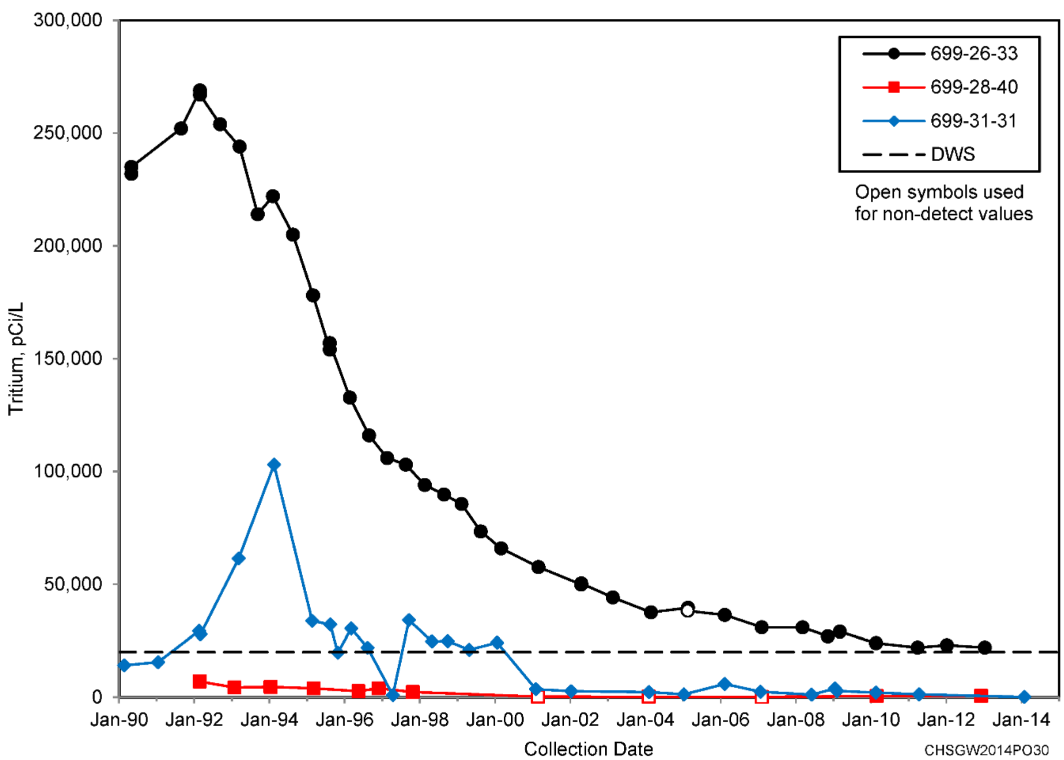

Figure 10-10. 200-PO Tritium Data for Wells 699-31-31, 699-26-33, and 699-28-40

Wells screened (or casings perforated) in the middle or lower portions of the unconfined aquifer had tritium results ranging from nondetect to 9,630 pCi/L (299-E25-29Q) in the near field region in 2014, and from nondetect to 57,000 pCi/L (near-river Well 699-37-E4) in the far field region in 2013. The 2013 concentration of tritium detected in Well 699-37-E4 was consistent with the level detected during the sampling of the well in 2010 (62,000 pCi/L). Similar concentrations in the upper part of the unconfined aquifer are detected near Well 699-37-E4. Tritium has been detected above the DWS in near-river Well 699-37-E4 since sampling for tritium began in the well in 1990. From 1990 to 1995, the concentration of tritium in Well 699-37-E4 increased. Since 1997, concentrations of tritium at this well have decreased.

In 2014, tritium concentrations in wells screened in the Ringold beneath the lower mud ranged from nondetect (699-39-39) to 37,000 pCi/L (699-42-40A). Both wells are located near B Pond (Figure 10-7). The concentration detected in 2013 in Ringold confined Well 699-41-40 (34,000 pCi/L) is consistent with the previous triennial sample which had a tritium concentration of 36,000 pCi/L in 2010. Tritium has been detected above the DWS in Well 699-41-40 since sampling began at this well in 1990. From 1990 to 2010, the tritium concentration in Well 699-41-40 has decreased from 226,000 pCi/L to 34,000 pCi/L. There is no unconfined aquifer at this well location.

Seven wells screened in basalt-confined aquifers are sampled triennially within 200-PO. Wells 299-E16-1 (screened in the Elephant Mountain interflow zone), 699-42-40C (Rattlesnake Ridge Interbed) and LIGO Well 699-S2-34B (with a completion depth of 591.6 m [1,941 ft] bgs is assumed to monitor a deeper confined aquifer) were sampled in 2014. The other four wells will be sampled in 2015. Tritium was not detected in Wells 299-E16-1 and 699-S2-34B in 2014. Tritium has been detected only intermittently at low concentrations below the DWS in samples collected from wells screened in basalt aquifers, with the exception of Well 699-42-40C located near the 216-B-3 Pond. Tritium in Well 699-42-40C has been detected since 1982 (Figure 10-11) up to a maximum concentration of 8,320 pCi/L in 1993. Since 1993 concentrations in Well 699-42-40C have decreased.

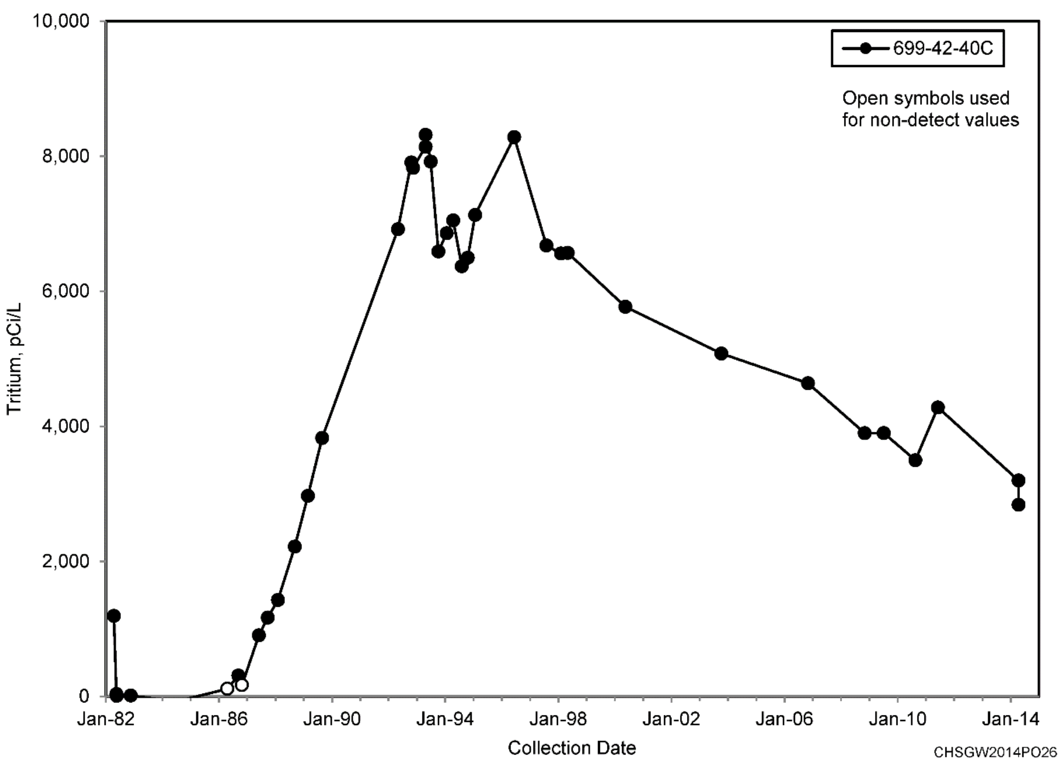

Figure 10-11. 200-PO Tritium Data for Basalt-Confined Well 699-42-40C

10.5 Iodine-129

Iodine-129 at a concentration greater than the 1 pCi/L DWS is found in a relatively dispersed plume that covers a large area within 200-PO (Figure 10-12). The highest historical concentrations have been detected near the PUREX Cribs and Trenches. The 2014 interpolated plume extent above the 1 pCi/L concentration is essentially the same as the 2013 plume presented in DOE/RL-2014-32, since the majority of the far field well sampling (triennial sampling) was completed in 2013.

Iodine-129 concentrations detected in near field wells in 2014 ranged from nondetect to 6.49 pCi/L. The highest concentrations in 2014 were detected near the PUREX Cribs and Trenches, 216-A-29 Ditch, 216-B-3 Pond, and WMA A-AX. None of the detected concentrations exceeded the DOE-derived concentration standard of 330 pCi/L (Table 5 of DOE-STD-1196-2011). In 2014, the highest concentrations of iodine-129 were detected in Wells 699-43-45 (6.49 pCi/L), 299-E25-2 (5.33 pCi/L), 299-E25-34 (5.19 pCi/L), 299-E17-14 (5.15 pCi/L),) and 299-E17-19 (5.15 pCi/L). Iodine-129 concentrations in Well 299-E17-19 near the PUREX Cribs has been relatively stable since sample collection started in 1992 (Figure 10-13) Concentrations in Well 699-43-45, located near 216-B-3 Pond and the north end of the 216-A-29 Ditch, showed an increasing trend between 2004 and 2011, but have decreased in the subsequent years (Figure 10-13). The highest concentrations of iodine-129 detected in 2014 sampling conducted in the far field occurred at Wells 699-32-22A (4.53 pCi/L) and 699-37-47A (3.32 pCi/L).

As with the tritium plume, Well 699-31-31 is one of the wells used to define the boundary of the iodine-129 plume in the area where the plume narrows as it extends to the southeast between the 200 East Area and the distal far field. Iodine-129 concentrations declined sharply between 1994 and 1995 (Figure 10-14). Concentration changes of that magnitude were not observed in wells farther downgradient. From 1991 to 1997, iodine-129 concentrations in Well 699-31-31 generally exceeded the DWS. Consistent with tritium peak levels, the peak iodine-129 concentration in this well occurred in 1994. Beginning in 1995, concentrations of iodine-129 decreased to between nondetect and relatively low detected values generally below the DWS (Figure 10-14). In reviewing concentration trending for other wells in the area that are equal distance from the plume margin, current iodine-129 concentration trending for this well is consistent with the regional pattern. Future utilization of Well 699-31-31 and the potential need to replace it will be further assessed as the FS for 200-PO-1 progresses and remedial alternatives are reviewed (see discussion of Well 699-31-31 in Section 10.4).

Iodine-129 was not detected in in aquifer tube sampling completed for 200-PO in 2014. Iodine-129 results for river transect Well 699-20-E12O did not detect iodine-129, which is consistent with all previous results since sampling was initiated in 1999.

Within the middle and lower part of the unconfined aquifer, iodine-129 was detected in three wells in the near field region at concentrations above the DWS: 3.43 pCi/L in Well 299-E25-28 located near the 216-A-29 Ditch; and 1.79 and 2.4 pCi/L in Wells 299-E25-29Q and 299-E25-32Q, respectively, located near the 216-A-30, 216-A-37-1, and 216-A-37-2 Cribs. Iodine-129 was detected during 2013 in one monitoring well (699-31-11) screened in the middle and lower part of the unconfined aquifer in the far field region at a concentration of 1.21 pCi/L (next scheduled for sampling in 2016) (Figure 10-12).

For 200-PO, the Ringold confined aquifer is monitored near the 216-B-3 Pond and the TEDF in 200-PO. In 2014, iodine-129 was detected at one well (699-42-42B) above the DWS (1.7 pCi/L) near the 216-B-3 Pond (Figure 10-12). Additional results for other Ringold confined wells are provided in Appendix D.

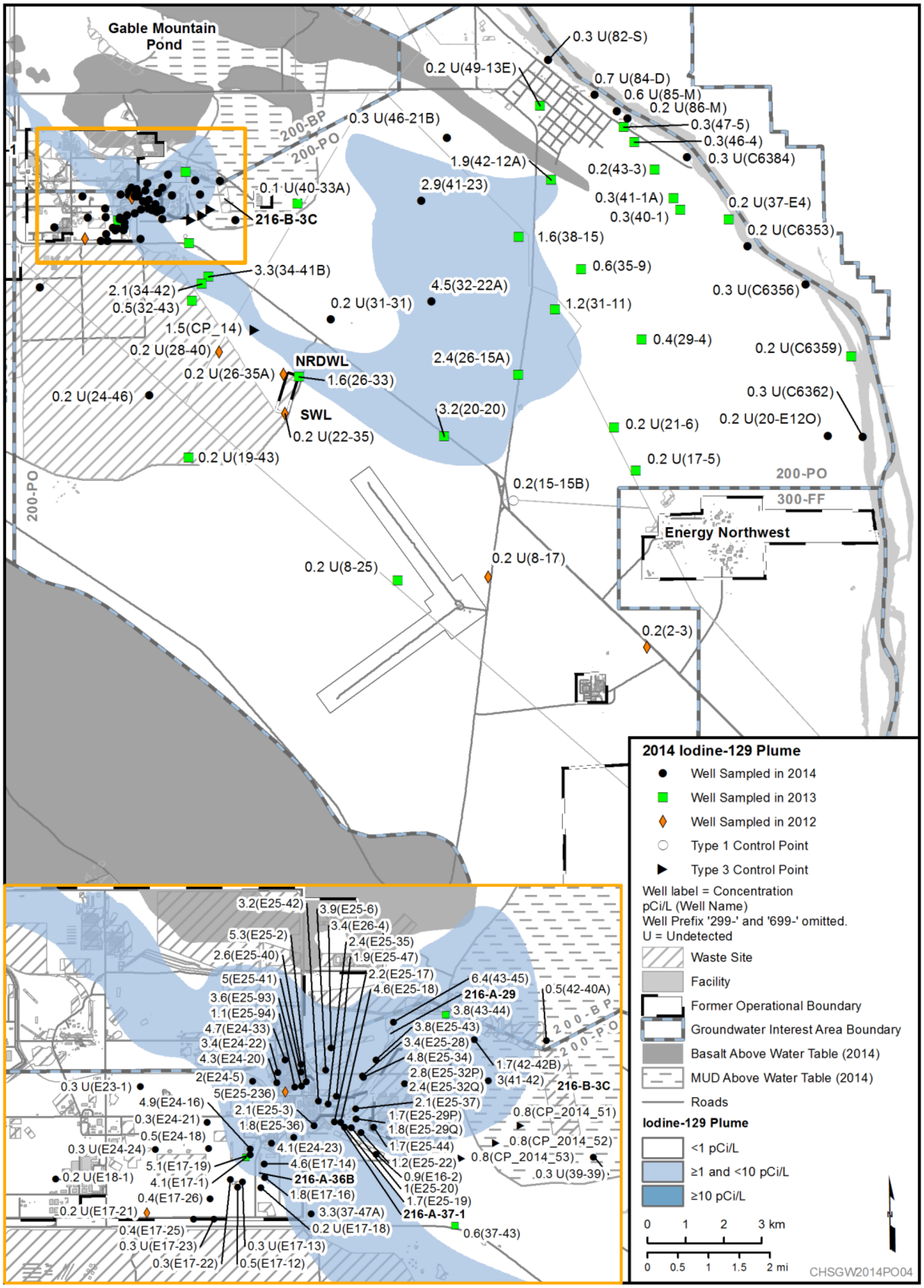

Figure 10-12. 200-PO Iodine-129 Plume, 2014

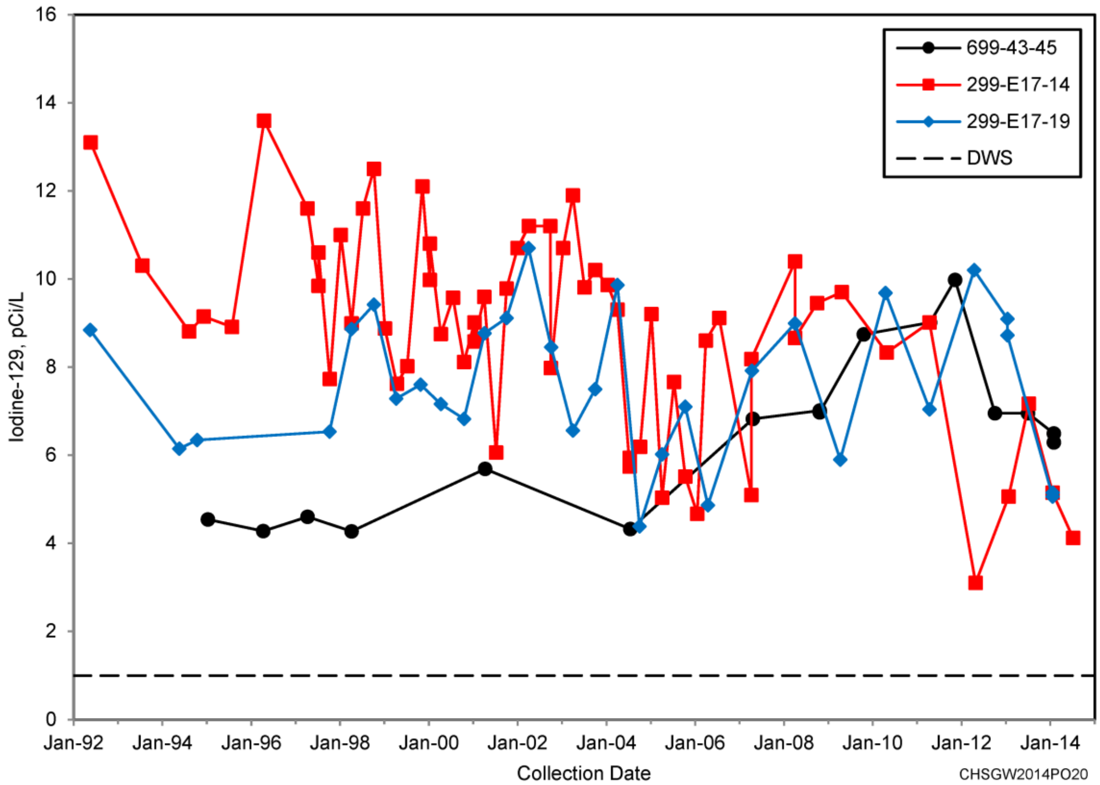

Figure 10-13. 200-PO Iodine-129 Data for Wells 699-43-45, 299-E17-14, and 299-E17-19

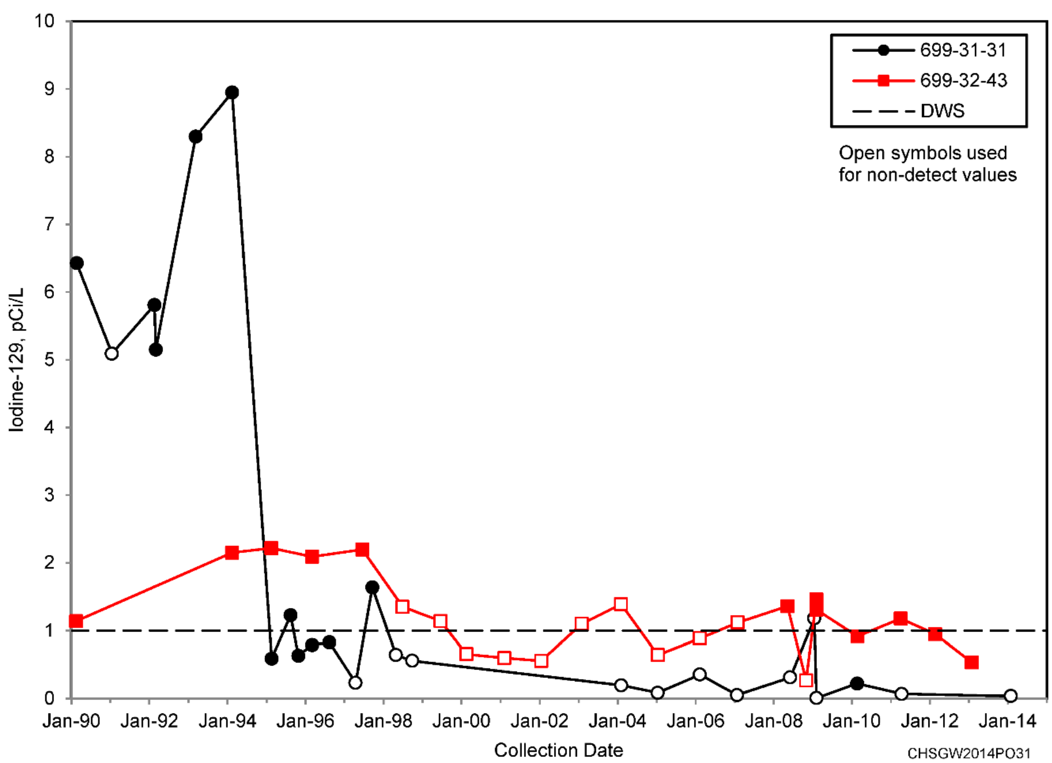

Figure 10-14. 200-PO Iodine-129 Data for Wells 699-31-31 and 699-32-43

Three wells screened in basalt-confined aquifers are sampled triennially within 200-PO for iodine-129. Wells 299-E16-1, 699-32-22B,B and 699-42-40C were sampled in 2014, and no iodine-129 was detected. Iodine-129 was only detected at very low concentrations from basalt wells in the early to mid-1990s, except in Well 699-42-40C located near the 216-B-3 Pond. Iodine-129 concentrations in Well 699-42-40C have been intermittently detected at low concentrations (below the 1 pCi/L DWS) since sampling began in 1988. The last detection was a concentration of 0.29 pCi/L in 2010. The highest concentration detected in the well was 0.36 pCi/L in 1996. Since 2000, the only detections of iodine-129 in the basalt-confined wells beneath 200-PO have been in 699-42-40C.

10.6 Nitrate

The highest historical concentrations of nitrate in 200-PO have been detected near the PUREX Cribs and Trenches. The extent of nitrate at concentrations greater than the 45 mg/L DWS is relatively small within the 200-PO interest area (Figure 10-15). Historically, the nitrate plume was relatively large, but concentrations within the far field region have decreased to below the 45 mg/L DWS equivalent, other than near the 618-10 Burial Ground (see 300-FF discussion in Chapter 7). The 2014 interpolated plume is generally consistent with the 2013 plume presented in DOE-RL-2014-32. Comparing the 2014 plume (Figure 10-15) to the 2013 plume reveals the following notable changes:

- The interpolated extent of the 45 mg/L concentrations are now farther south of the IDF in the 200 East Area. The 2014 interpolation is supported by concentrations greater than 45 mg/L in Wells 299-E17-23, 299-E17-25, and 299-E17-26 that were less than 45 mg/L in 2012. Sharply increasing concentration trends in these wells began in 2012.
- The nitrate plume now extends continuously from WMA C to Well 299-E24-20 along the eastern margin of WMA A-AX.

The highest nitrate concentrations in 200-PO from samples collected during 2014 were 156 mg/L at Well 299-E17-19, located downgradient of the 216-A-10 Crib, and 101 mg/L from Well 299-E17-14, located downgradient of the 216-A-36B Crib (Figure 10-16). Many of the wells near the PUREX Cribs, including Wells 299-E17-1, 299-E17-16, 299-E17-18, 299-E24-16, 299-E25-17, and 699-37-47A in the southeastern portion of the 200 East Area, have exhibited increasing nitrate concentrations since approximately 2002 (e.g., 299-E25-17 and 699-37-47A; Figure 10-17). Migration of the leading edge of nitrate plume to the south to southeast is indicated by the increasing concentrations in Wells 299-E17-25 and 299-E17-23 (Figure 10-17). The cause of the increase in nitrate concentrations in this portion of the 200 East Area may be related to a number of factors, including changing groundwater flow directions associated with cessation of wastewater discharges at B Pond, water table elevation decreases in the 200 East Area, and/or a vadose zone source(s) contribution associated with the PUREX Cribs.

For the wells screened (or casings perforated) in the middle to lower portions of the unconfined aquifer in the near field region (299-E25-29Q and 299-E25-32Q), nitrate did not exceed 45 mg/L in 2014, and concentrations above that level appear to occur within the upper 10 m (33 ft) of the aquifer. The most recent (2013) maximum nitrate concentration in the deeper portion of the aquifer was 33.6 mg/L in far field, near-river Well 699-37-E4. Nitrate levels have been stable in this well since approximately 1991. Within the near-field region, the highest nitrate concentration detected in 2014 in the deeper portion of the aquifer was 42.7 mg/L in Well 299-E25-29Q.

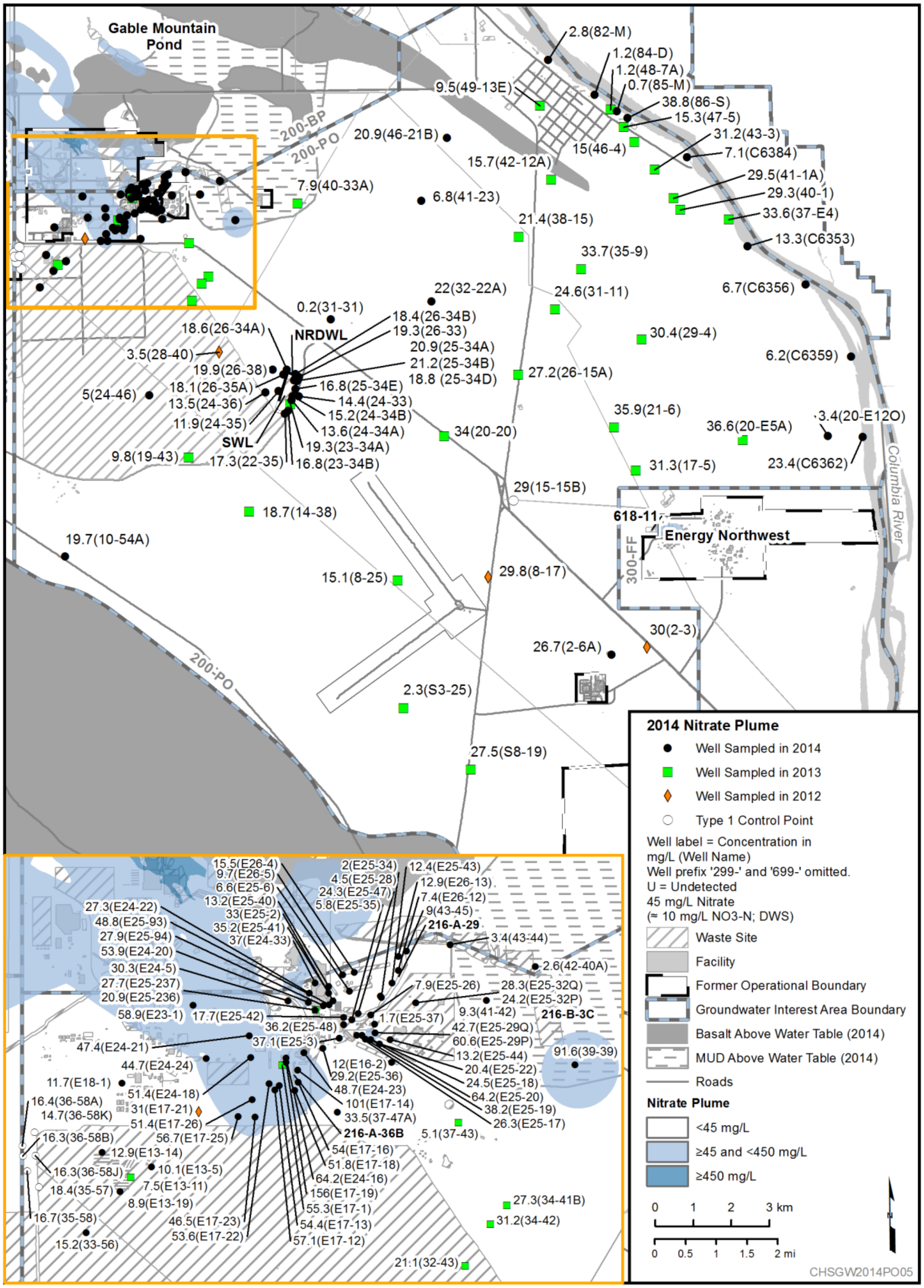

Figure 10-15. 200-PO Nitrate Plume, 2014

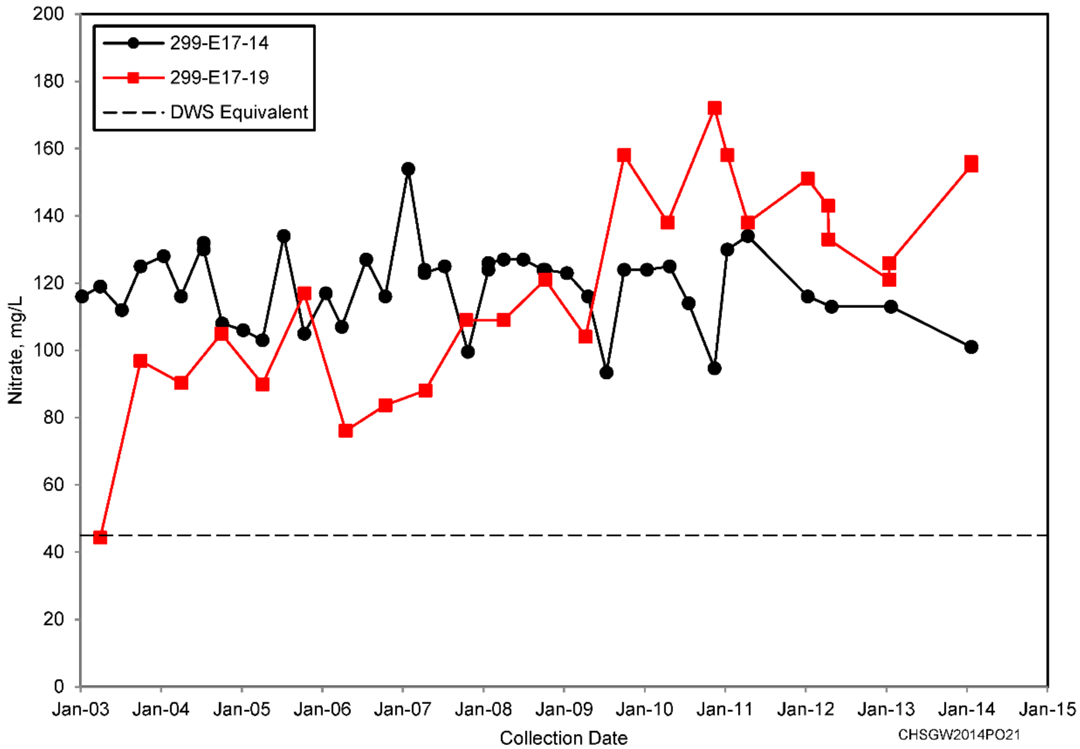

Figure 10-16. 200-PO Nitrate Data for Wells 299-E17-14 and 299-E17-19

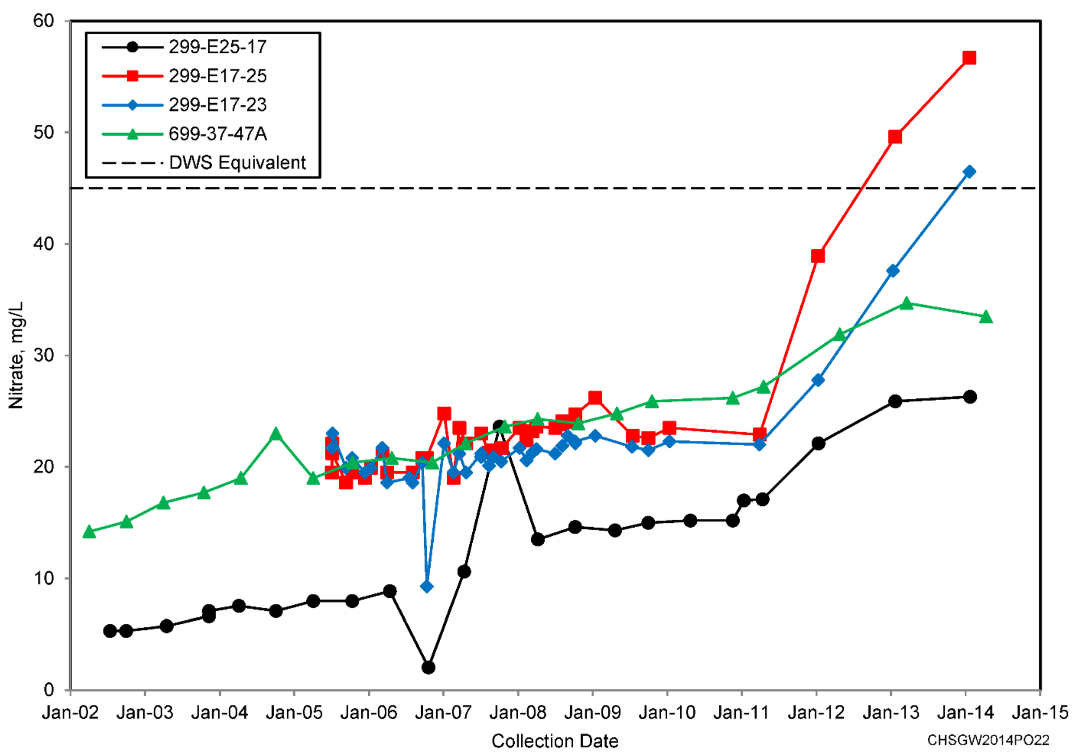

Figure 10-17. 200-PO Nitrate Data for Wells 299-E25-17 and 699-37-47A

Only one well in the far field region had a concentration above the 45 mg/L DWS in 2014. A maximum concentration of 80 mg/L was detected in Well 699-13-3A (see 300-FF discussion in Chapter 7). The source of the nitrate in this well is the 618-10 Burial Ground. Nitrate was near or below detection limits in the main water supply well for the 400 Area (499-S1-8J), which is screened in the deep portion of the unconfined aquifer.

Nitrate was detected in 2014 in one well within the Ringold Formation confined aquifer above 45 mg/L. A concentration of 91.6 mg/L was measured in Well 699-39-39. Nitrate concentrations began to increase substantially in this well starting in the late 1980s. Nitrate concentrations ranging between 85.4 and 94.7 mg/L have have been detected in the well since 2001. Nitrate was sampled from six wells screened in the basalt-confined aquifer beneath 200-PO in 2014 (Appendix A). Basalt-confined wells are sampled triennially, and the next scheduled sampling will occur in 2017. Nitrate concentrations in the basalt-confined aquifer, as indicated in Wells 699-42-40C and 699-S11-E12AP, which have been monitored since 1984, are lower than in the unconfined aquifer because the groundwater is less oxygenated (Figure 10-18).

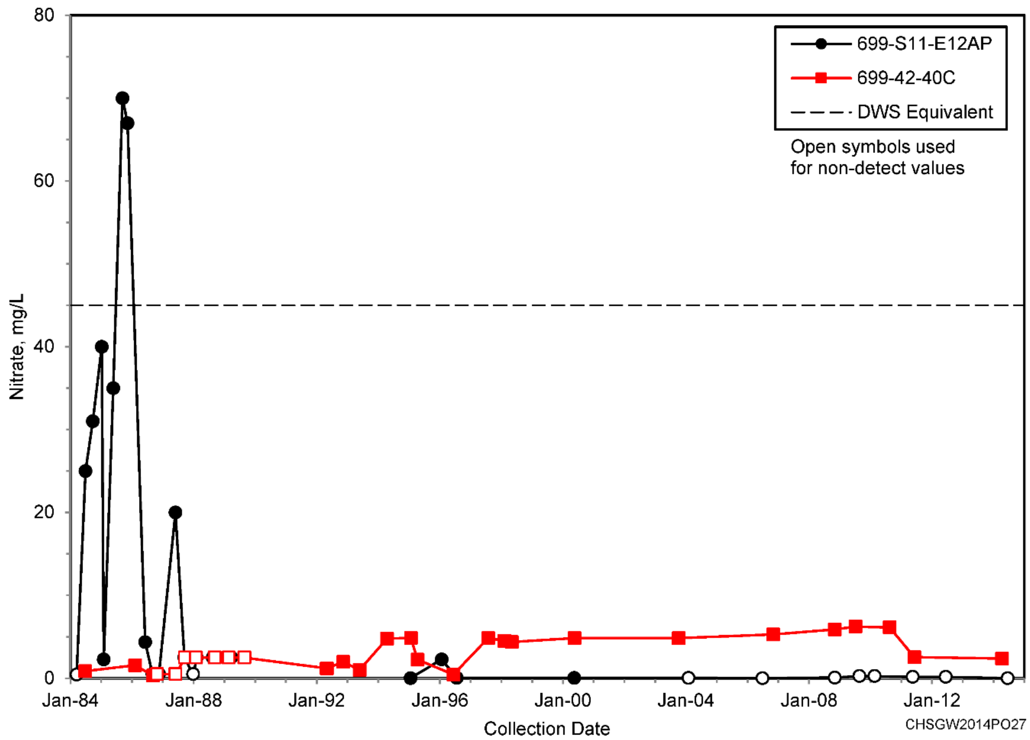

Figure 10-18. .200-PO Nitrate Data for Basalt-Confined Wells 699-S11-E12AP and 699-42-40C

10.7 Strontium-90

Strontium-90 has historically been detected in a relatively small area at concentrations greater than the DWS of 8 pCi/L near the 216-A-5, 216-A-10, and 216-A-36B Cribs. A small plume remains near the 216-A-36B Crib (Figure 10-19). Concentrations of strontium-90 near the 216-A-5 and 216-A-10 Cribs have only exceeded the 8 pCi/L DWS in one sampling event in one well (299-E24-16 at a concentration of 8.19 pCi/L in 2004). Concentrations in the well have historically ranged from 5.2 to 7.8 pCi/L (Figure 10-20).

Strontium-90 was detected above the DWS of 8 pCi/L during 2014 at Well 299-E17-14 near the 216-A-36B Crib. Since sampling was started for strontium-90 in this well in 1988, the general concentration trend has been relatively stable, ranging from 11 to 30 pCi/L (Figure 10-20), suggesting a potential for continuing contribution from the vadose zone. The 2014 result for Well 299-E17-14 was 15 pCi/L, the same as the 2013 and 2012 results.

In 2014, strontium-90 was detected in other wells near the PUREX Cribs and Trenches within the 200-PO near field region, but at concentrations below the DWS. These included 5.3 pCi/L in Well 299-E24-16 and 2.2 pCi/L in Wells 299-E17-19 near the 216-A-10 Crib; 2.2 pCi/L in Well 299-E17-16 near the 216-A-36B Crib; 2.1 pCi/L at Well 299-E25-18; and 1.1 pCi/L at Well 299-E25-17 near the 216-A-37-1 Crib. In 2013, strontium-90 was detected in one far field well (299-E13-11) located near the BC Cribs and Trenches, at a concentration of 2.4 pCi/L.

The middle or deep unconfined aquifer wells were not analyzed for strontium-90, with the exception of the three water supply wells in the 400 Area (499-S0-7, 499-S0-8, and 499-S1-8J). Strontium-90 was not detected in 2012 in samples collected from these wells, but a low-level concentration of 0.95(±0.93) pCi/L was measured in 2014 from Well 499-S0-7. The Ringold confined aquifer wells are not analyzed for strontium-90.

Strontium-90 is not currently required to be monitored in the seven basalt-confined aquifer wells (TPA-CN-205). Strontium-90 was sampled intermittently in the wells from 1988 to 2011. During that time, strontium-90 was detected in one sample from Well 699-42-40C (located near the 216-B-3 Pond), and one sample in Well 699-S11-E12AP (located southwest of the 400 Area). Both detections were reviewer qualified as suspect.

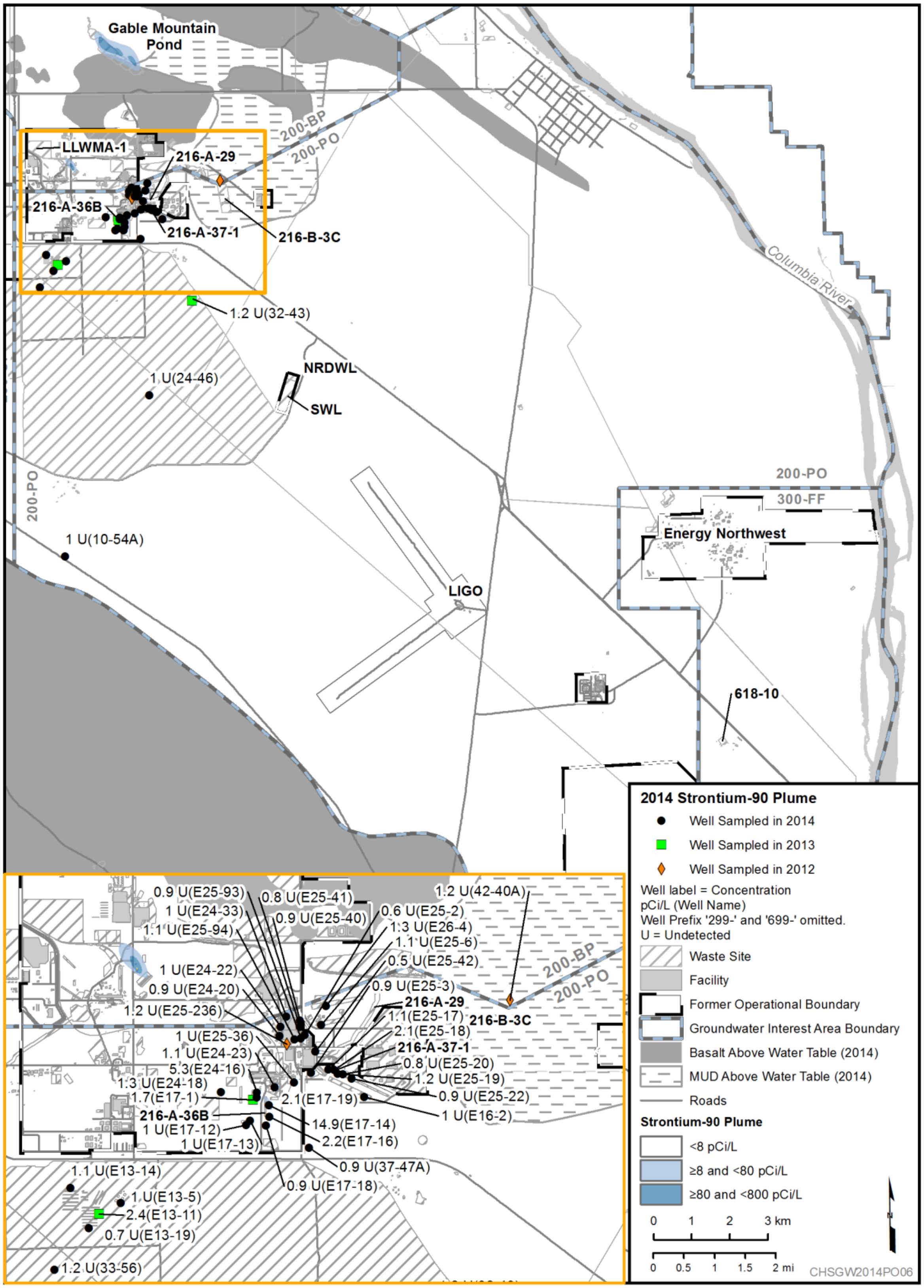

Figure 10-19. 200-PO Strontium-90 Plume, 2014

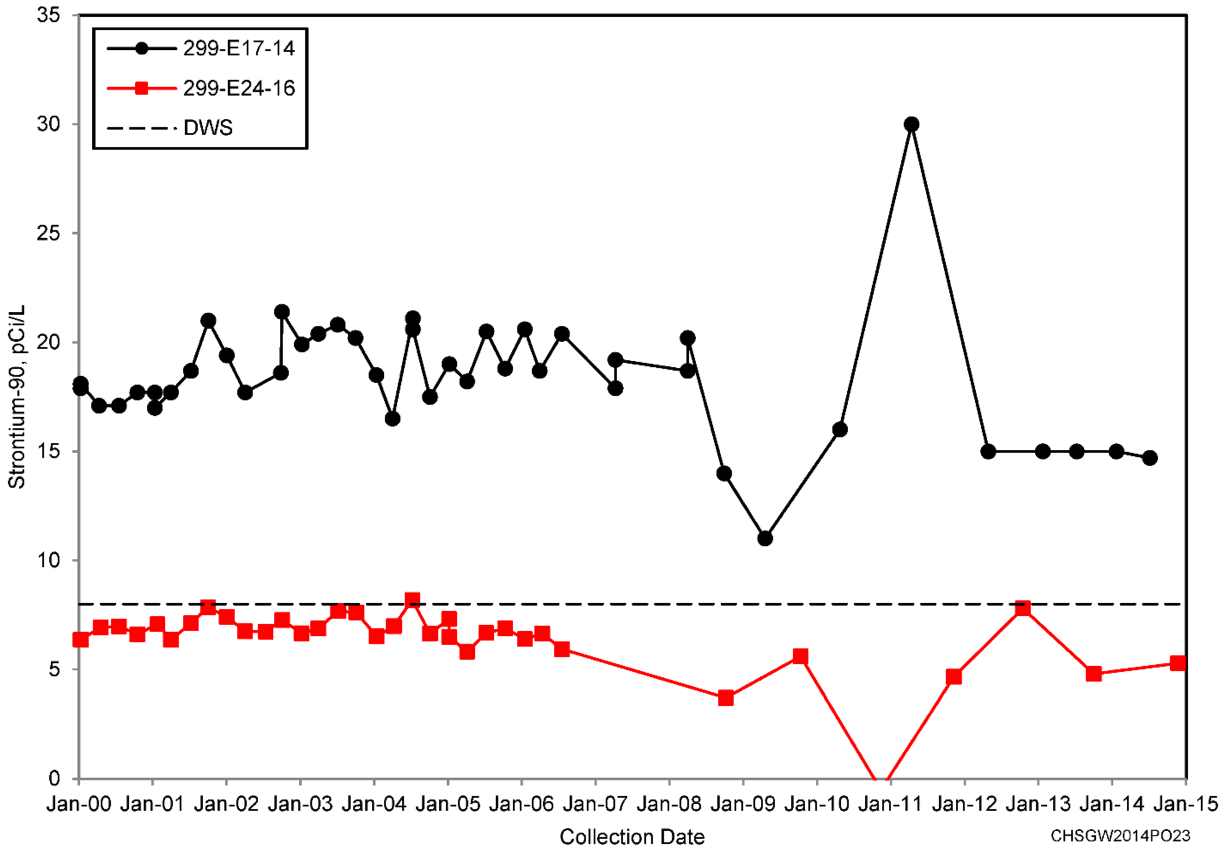

Figure 10-20. 200-PO Strontium-90 Data for Wells 299-E17-14 and 299-E24-16

10.8 Technetium-99

Technetium-99 has historically been detected in one relatively small area in the 200-PO near field region around WMA A-AX (Figure 10-21). This plume appears to have sources both in WMA C (in 200-BP) and in WMA A-AX (in 200-PO). WMA A-AX is hydraulically downgradient of WMA C. Concentrations greater than the 900 pCi/L DWS have been detected in groundwater near WMA A-AX since 2003. The 2014 interpolated plume extent above the 900 pCi/L concentration is consistent with the 2013 plume presented in DOE/RL-2014-32 and shows continued southeasterly migration and encroachment of higher concentrations of technetium-99 derived from WMA C. The interpolated 2014 boundary of the 900 pCi/L concentration extends from WMA C to the southeast toward the upgradient portion of WMA A-AX as defined by Well 299-E24-22. The leading edge of the technetium-99 plume migrating from WMA C is now projected as extending beneath the central portion of WMA A-AX. Well 299-E25-41, located along the northeast side of WMA A-AX, has been exhibiting an increasing concentration trend for technetium-99, which appears to represent a lower concentration portion of the technetium-99 plume migrating from WMA C and extending beneath WMA A-AX. The detections above the 900 pCi/L concentration southeast and downgradient of WMA A-AX (299-E25-93 and 299-E25-236) are inferred to be associated with WMA A-AX rather than WMA C. This interpretation is supported by differences in the historical technetium-99 concentration trends in upgradient Wells 299-E24-33 and 299-E24-22 in comparison to downgradient Wells 299-E25-93 and 299-E25-236 (Figure 10-21).

In 2014, technetium-99 was detected above a concentration of 900 pCi/L at three wells near WMA A-AX. Concentrations above the 900 pCi/L DWS occurred at Wells 299-E25-93 and 299-E25-41, located downgradient of WMA A-AX, and Well 299-E24-22, located upgradient of WMA A-AX and downgradient of WMA C. Until 2014, the highest concentrations were detected in Well 299-E25-93. Concentrations were elevated when the well was drilled in 2003 and have declined with time (Figure 10-22), with 2014 detections ranging from 1,000 to 1,700 pCi/L. Downgradient Well 299-E25-236 was decommissioned in July 2013 due to casing corrosion identified in 2012. Replacement Well 299-E25-237, located at the same location, was drilled in late 2014. The water table at the time drilling occurred was measured at 90.32 m (296.31 ft) bgs. Depth-discrete samples collected for technetium-99 during drilling showed concentrations of 1,110 pCi/L at 94.66 m (310.57 ft) bgs, 641 pCi/L at 99.39 m (326.08 ft) bgs, and nondetect at 112.43 m (368.85 ft) bgs. Final well construction should be completed in January 2015. Concentrations of technetium-99 in upgradient Well 299-E24-22 (Figure 10-22) have been increasing since 2011. Quarterly sampling concentrations detected in 2014 ranged from 1,420 to 1,840 pCi/L.

In the far field region to the east and southeast of the 200 East Area, technetium-99 was detected at concentrations ranging from nondetect to 32 pCi/L (699-13-3A). Well 699-13-3A is co-sampled with 300-FF and the well is associated with the 618-11 Burial Ground site. The technetium-99 concentration at this well decreased from the 2013 values. Technetium-99 continued to be detected at low levels in some aquifer tubes in 200-PO used to monitor groundwater adjacent to the Columbia River. In January 2015, a concentration of 19.2 pCi/L was detected in Aquifer Tube C6384 (a decrease from 51 pCi/L detection from 2013), and a concentration of 20.4 pCi/L was detected in C6374 (first data point).

In the Ringold confined aquifer, technetium-99 was monitored in one well (699-42-42B located near the 216-B-3 Pond) in 2011 and 2012. Technetium-99 was not detected and is no longer monitored at this well (TPA-CN-205). Basalt-confined aquifer wells are not currently required to be analyzed for technetium-99 (TPA-CN-205) beneath 200-PO. Basalt-confined wells were analyzed intermittently from 1988 to 2012, with only three very low-concentration detections (one in 1988 [13.2 pCi/L in 699-42-40C], one in 1994 [0.44 pCi/L in 699-S11-E12AP], and one in 1995 [0.32 pCi/L in 299-E16-1]).

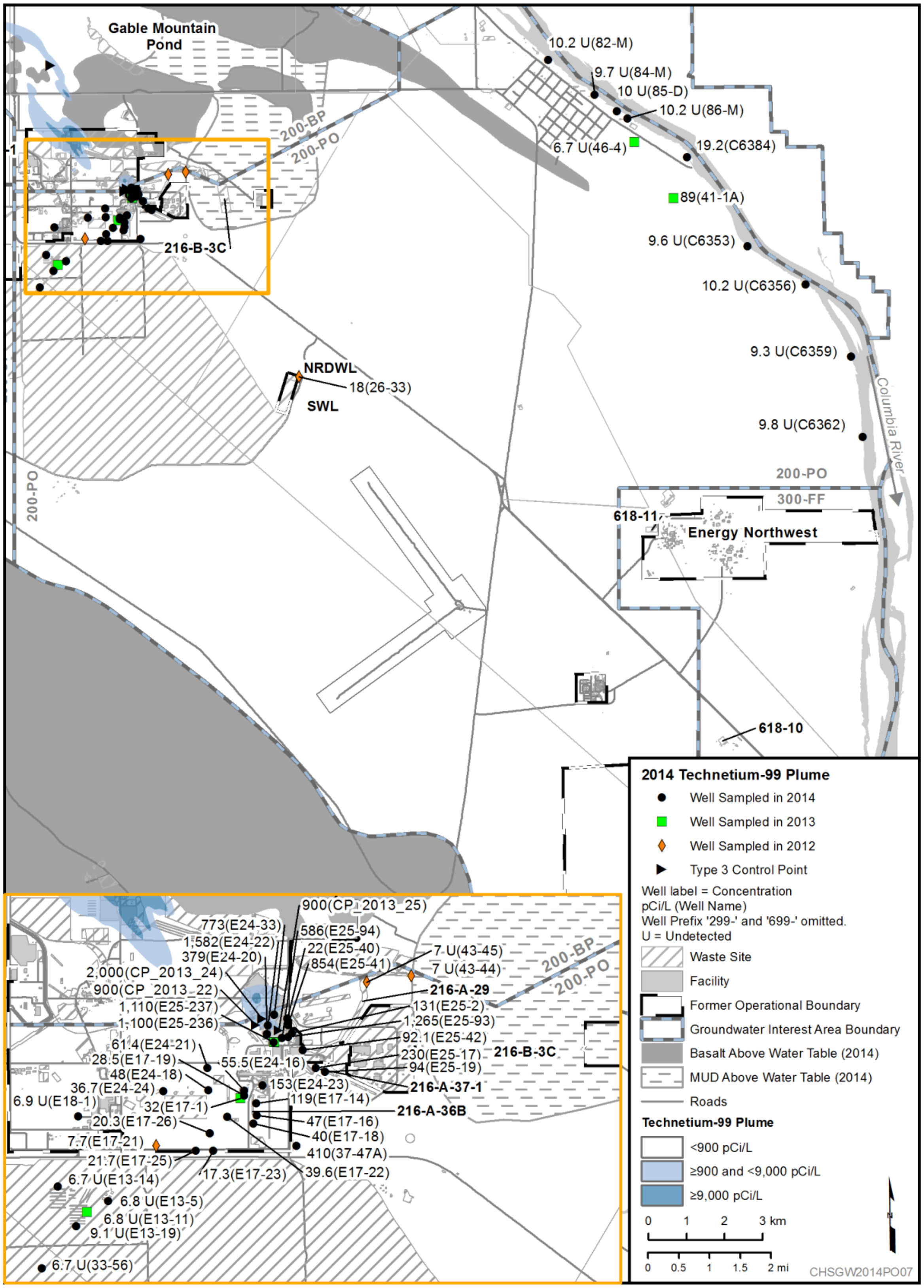

Figure 10-21. 200-PO Technetium-99 Plume, 2014

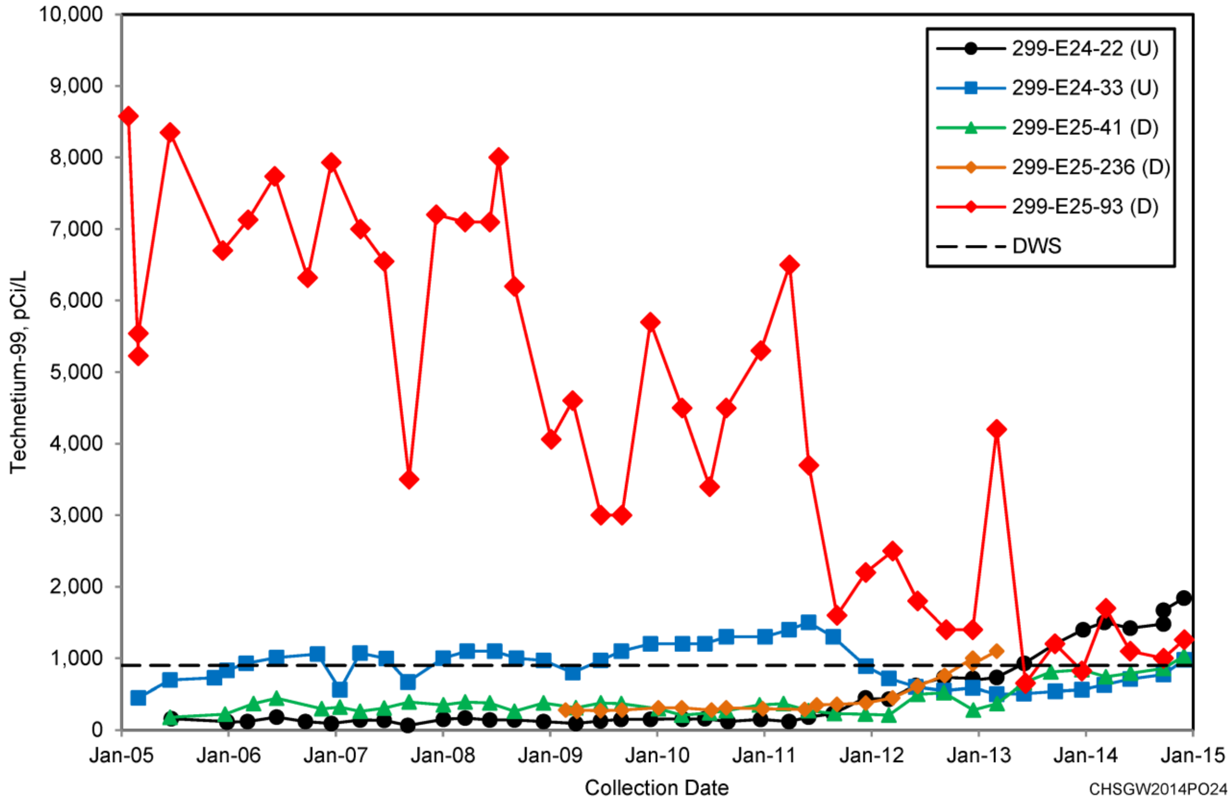

Figure 10-22. 200-PO Technetium-99 Data for Wells 299-E24-22, 299-E24-33, 299-E25-41, 299-E25-236 and 299-E25-93

10.9 Uranium

Uranium has been identified historically as a relatively small plume (Figure 10-23) near the PUREX Cribs and Trenches in the near field area and adjacent to the 618-10 Burial Ground (which is currently part of 300-FF) located in the far field area.

In 2014, concentrations of uranium above the 30 µg/L DWS were detected in three wells: Well 299-E25-36 at a concentration of 57.8 µg/L, compared to 58.5 µg/L in 2013; Well 299-E24-23 at a concentration of 39.5 µg/L, compared to 36.9 µg/L in 2012; and Well 299-E17-16 at a concentration of 34.8 µg/L, compared to a concentration of 17.0 µg/L in 2013. The value of 34.8 µg/L detected at Well 299-E17-16 is anomalous compared to all other measured uranium values at this well; the concentrations returned to normal in January 2015 (15 µg ug/L). These wells are located near the PUREX Cribs and Trenches in the near field region. Uranium concentrations at Well 299-E25-36 sharply increased between 1992 and 2007, but have been decreasing since 2010 (Figure 10-24). Uranium concentrations at Well 299-E17-14 are typically near or slightly above the DWS (Figure 10-24). Uranium remains somewhat mobile in groundwater at 200-PO, and the concentration changes observed are consistent with continued slow migration of uranium away from source areas.

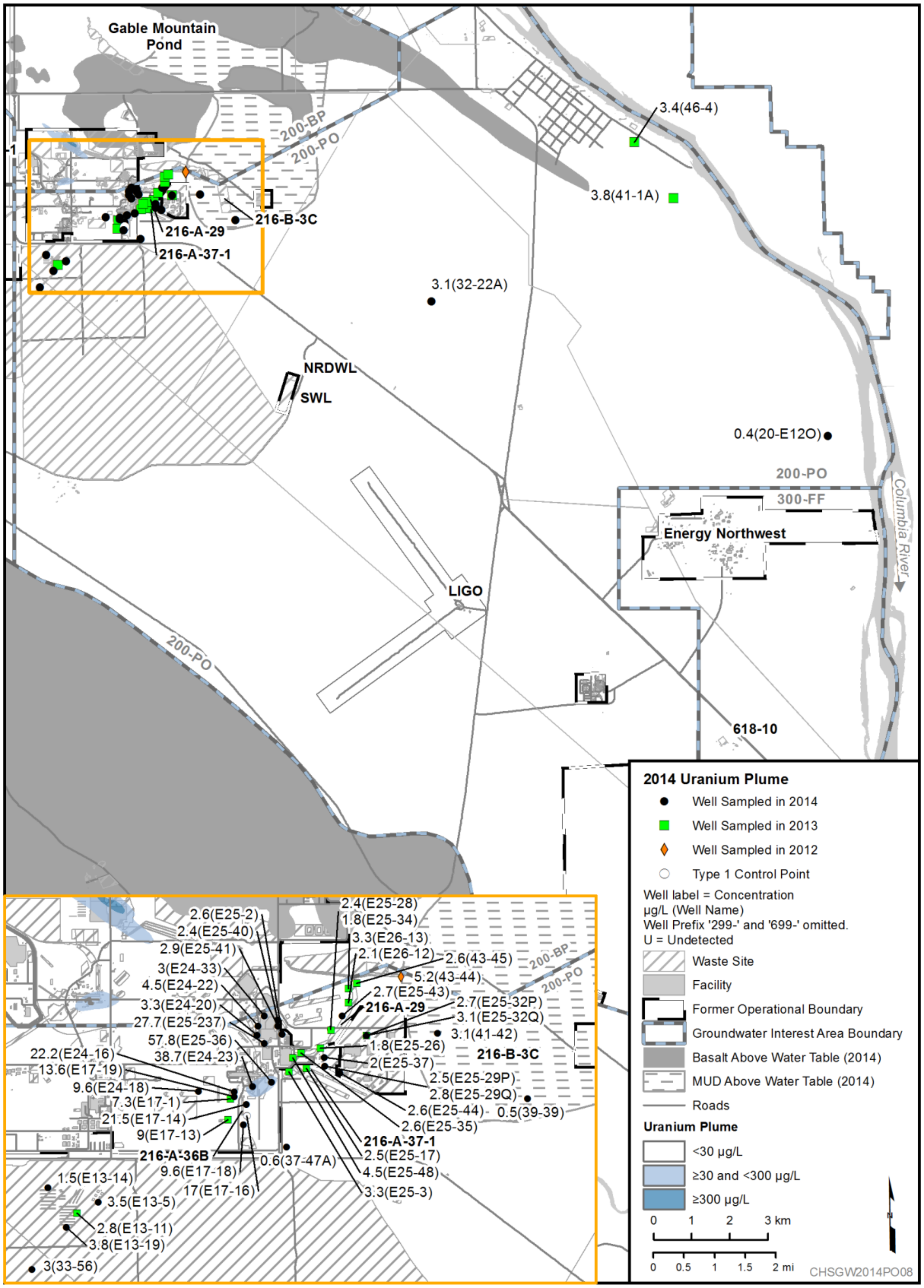

Figure 10-23. 200-PO Uranium Plume, 2014

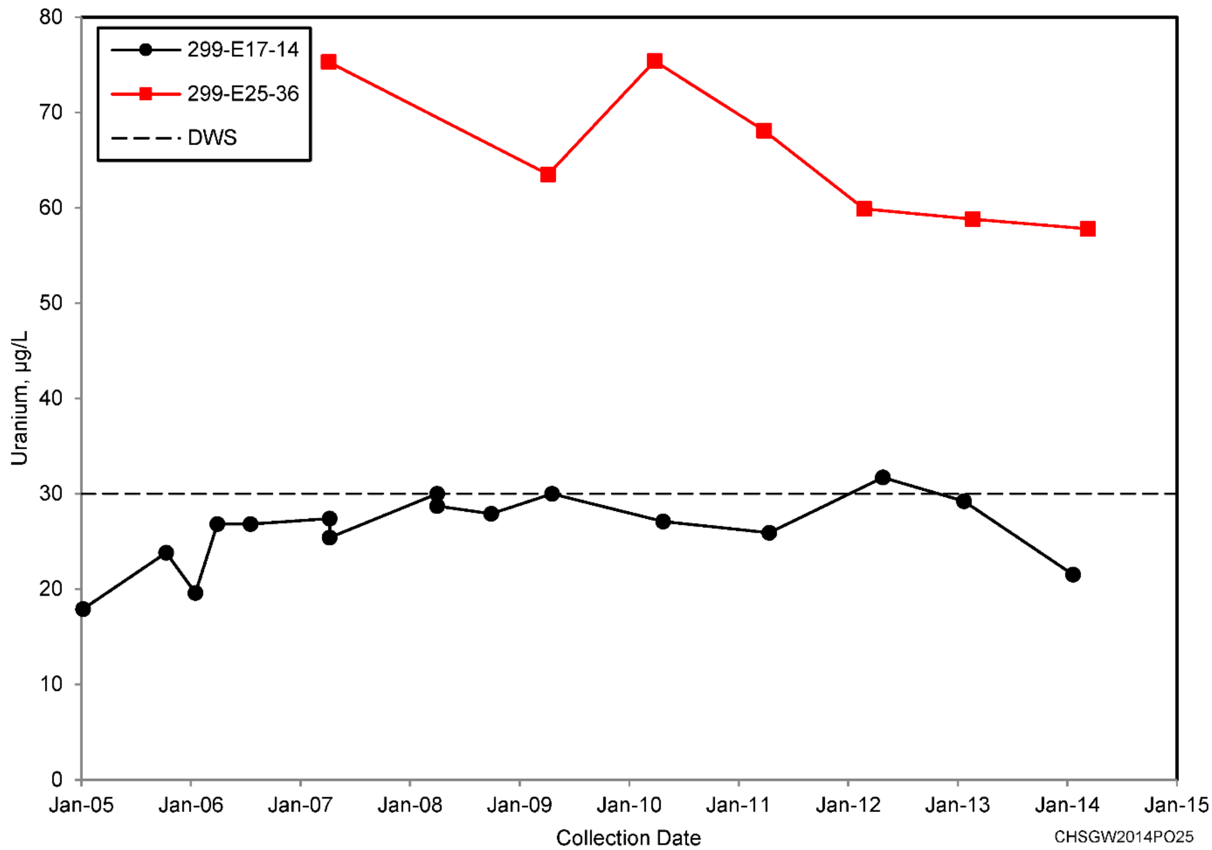

Figure 10-24. 200-PO Uranium Data for Wells 299-E17-14 and 299-E25-36

10.10 Tetrachloroethene

In 2014, PCE was detected in samples collected from monitoring Well 699-26-33 located downgradient of the NRDWL, at concentrations of 0.45 and 0.52 µg/L. The samples were "J" qualified by the laboratory. The laboratory "J" flag indicates that the value is estimated and the detection is uncertain, and the value reported is less than the practical quantitation limit but greater than or equal to the method detection limit. Low-level detections of PCE were common in a few wells near NRDWL and SWL before about 2007, but most results since then have been near or below detection limits. Results for PCE presented here are with respect to the CERCLA monitoring well network. Additional information concerning VOC results from wells utilized for RCRA monitoring are presented in Section 10.13.

10.11 Trichloroethene

TCE was detected within 200-PO in 2014 near the 216-A-36B Crib. TCE was detected in Well 299-E17-19 at concentrations ranging from 0.88 (J) µg/L to 1.53 µg/L and Well 299-E17-14 at a concentrations ranging from 1.3 to 1.47 µg/L. Monitoring for VOCs at the 216-A-36B Crib is part of the RCRA monitoring program. Additional discussion is provided in Section 10.13. CERCLA monitoring for VOCs is also performed in conjunction with RCRA monitoring at NRDWL and WAC monitoring at the SWL. TCE was not detected at the SWL in CERLCA network Well 699-25-33A. In 2014, TCE was not detected in 200-PO far field network wells, other than Well 699-S6-E4L, which is sampled as part of 300-FF in the vicinity of the 618-11 Burial Ground. In 2014, TCE concentrations at this well ranged from nondetect to 2.18 (J) µg/L.

10.12 AEA Monitoring

AEA monitoring for the 200-PO interest area is implemented through the CERCLA SAP (DOE/RL-2003-04, Rev. 1, as amended by TPA-CN-205). Additional AEA monitoring is described in RPP-PLAN-26534, *Integrated Disposal Facility Operational Monitoring Plan to Meet DOE Order 435.1*. Specific AEA monitoring that is part of the CERCLA SAP (DOE/RL-2003-04) includes monitoring of three water supply wells (499-S1-8J, 499-S0-7, and 499-S0-8) in the Hanford 400 Area. Well 49-S1-8J is the main water supply well, but occasionally Wells 499-S0-7 and 499-S0-8 are used for water supply. Wells selected for AEA monitoring are shown in Figure 10-25.

10.12.1 400 Area

The 400 Area is located 16.2 km (10.1 mi) southeast of the 200 East Area. The 400 Area includes the Fast Flux Test Facility (FFTF), ancillary facilities, and waste sites. Monitoring is conducted to provide information on the potential impact of site wide contamination (primarily tritium, nitrate, and iodine-129) on the water supply wells, which provide drinking water and emergency supply water for the 400 Area (Section 8.2.4 of DOE/RL-2011-119).

The wells have been sampled annually since 2009 for AEA monitoring including gamma scan, gross alpha, gross beta, iodine-129, strontium-90, technetium-99, and tritium, as well as additional analytes including ammonium, anions, metals (including uranium), and VOCs. Sampling of these three wells was conducted in February and October 2014.

Elevated levels of tritium associated with the groundwater plume originating in the 200 East Area were identified in the 400 Area water supply wells. Well 499-S1-8J has lower tritium levels because it is screened at a greater depth (top of screen 61 m [200 ft] below the water table) than the other two water supply Wells 499-S0-8 and 499-S0-7 (19 and 9 m [62 and 30 ft], respectively) (Figure 10-26). In 2014, tritium was measured at levels below the DWS (20,000 pCi/L) in all three water supply wells. A maximum tritium concentration of 11,400 pCi/L was detected in Well 499-S0-8 during October 2014. Tritium concentrations in Wells 499-S0-7 and 499-S0-8 have been stable and at similar levels from 2012 to 2014. Current levels are substantially lower than historical concentrations observed in these wells (e.g., greater than 80,000 pCi/L in the early to mid-1980s).

Other constituents detected in samples collected from the 2014 sampling event included several metals (e.g., uranium, chromium, nickel, arsenic, copper, and lead), gross alpha (499-S0-8), gross beta, nitrate, technetium-99, and tritium. These constituents, except for gross beta, nitrate, and tritium, were found in relatively low concentrations, and all below DWSs. The gross beta results ranged from 6.4 to 26 pCi/L (Well 499-S0-8), which is the highest value that has been detected in Well 499-S0-8. In 2012, gross beta was also elevated in this well with a concentration of 21 pCi/L. The next highest gross beta value detected in Well 499-S0-8 was 14.9 pCi/L in 1988. Technetium-99 levels increased in Well 499-S0-8 from 8.30 pCi/L in January 2012, to 21.20 pCi/L in September 2012, to 24.20 pCi/L in October 2014. Tritium also increased in this well from 2,700 pCi/L in 2011, to 12,000 pCi/L in 2012, and 11,400 pCi/L in 2014. In recent years, nitrate increased from 0.2 mg/L in 2012 to 19.4 mg/L in 2014. For 2014, Well 499-S0-8 often had the highest concentrations reported for the constituents detected among these three wells.

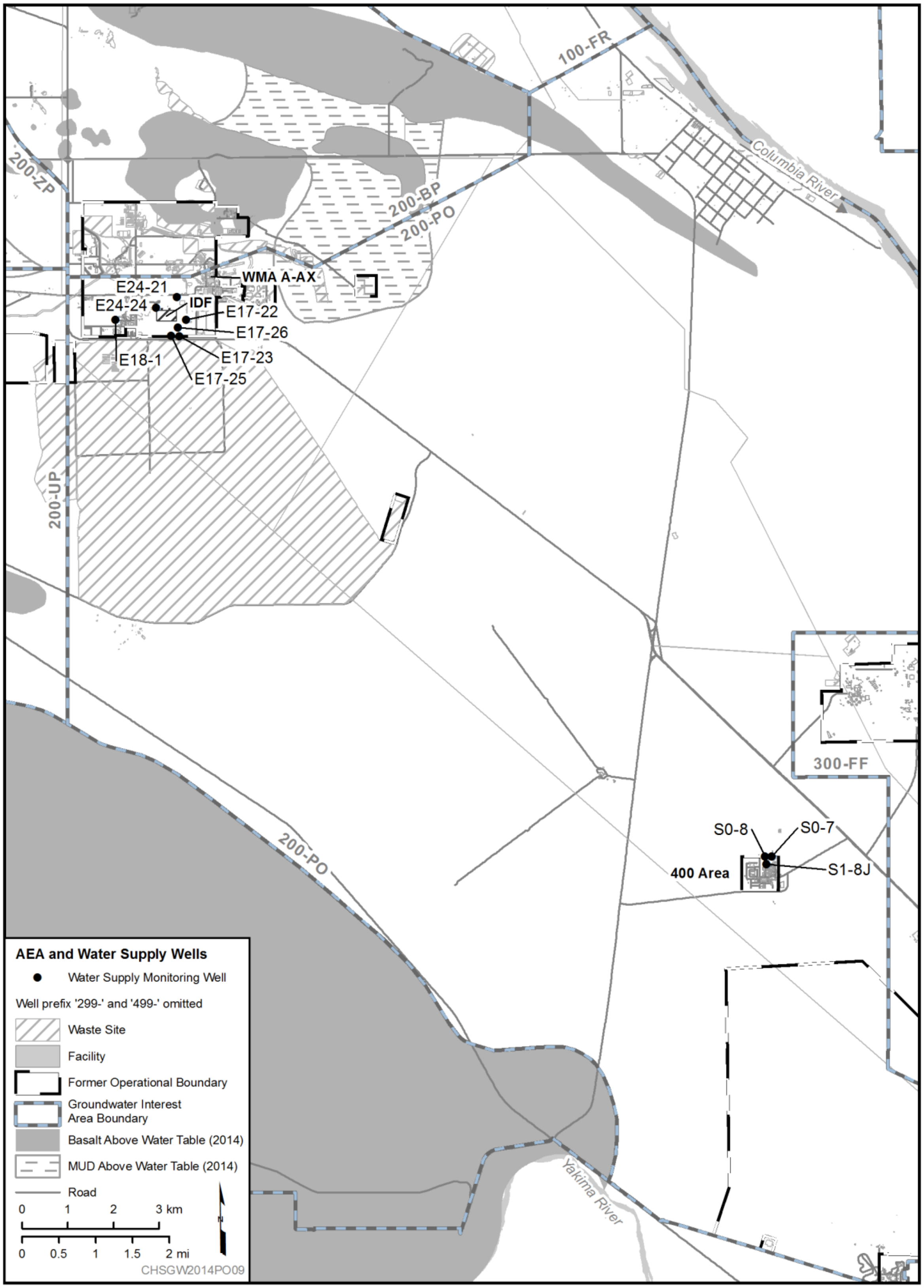

Figure 10-25. 200-PO AEA Monitoring and Water Supply Well Locations

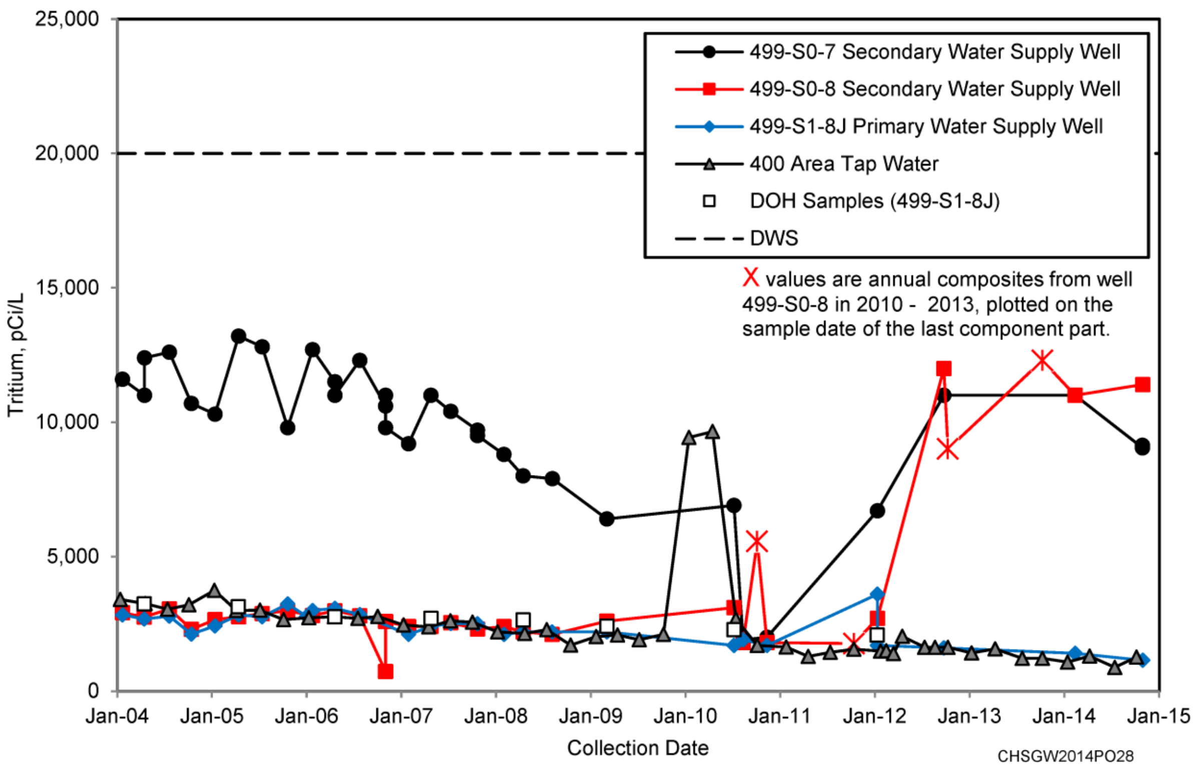

Figure 10-26. 200-PO Tritium Data for Wells 499-S0-7, 499-S0-8, and 499-S1-8J and 400 Area Tap Water

10.12.2 Integrated Disposal Facility

The IDF consists of an expandable, double-lined landfill with approximately 0.07 km^2 (0.027 mi^2) of liner. The landfill is divided into two distinct cells: (1) the east cell for the disposal of low-level radioactive waste, and (2) the west cell for the disposal of mixed waste. The landfill is not yet in use. It is a permitted RCRA facility and has additional groundwater sampling requirements under the AEA, as described in RPP-PLAN-26534. The plan describes sampling of two upgradient wells (299-E18-1 and 299-E24-24) and five downgradient wells (299-E17-22, 299-E17-23, 299-E17-25, 299-E17-26, and 299-E24-21) semiannually for gross alpha, gross beta, iodine-129, and technetium-99. Gross alpha was detected in wells (299-E17-22, 299-E17-23, 299-E17-26, and 299-E24-21) at concentrations ranging from 3.09 pCi/L (299-E17-26) to 11.1 pCi/L (299-E17-22), which is consistent with previous detections in these wells. Gross beta was detected in all of the wells at concentrations ranging from 6.96 pCi/L (299-E18-1) to 46 pCi/L (299-E24-21) and corresponds to changes in technetium-99 levels. The gross beta concentrations detected in 2014 were higher than the 2012 and 2013 values in most wells. Iodine-129 concentrations ranged from nondetect (299-E18-1) to 0.663 pCi/L (Well 299-E17-22). Technetium-99 concentrations ranged from nondetect (299-E18-1) to 69 pCi/L (299-E24-21).

10.13 RCRA Monitoring

The following describes the results of monitoring at seven individual waste management/disposal facilities within the 200-PO interest area, conducted in accordance with RCRA regulations: 216-A-29, 216-A-36B, 216-A-37-1, 216-B-3, IDF, NRDWL, and WMA A-AX (Figures 10-1 and 10-5). Interim status groundwater quality assessment monitoring is conducted at WMA A-AX (40 CFR 265.93[d], as referenced by WAC 173-303-400). Interim status detection monitoring for indicator parameter evaluation is conducted at five sites: 216-A-29, 216-A-36B, 216-A-37-1, 216-B-3, and NRDWL (40 CFR 265.92, as referenced by WAC 173-303-400). The IDF is not operational but is monitored as incorporated into the Hanford Facility RCRA Permit (WA7890008967) to obtain baseline information.

10.13.1 Waste Management Area A-AX

The WMA A-AX is located in the southeast quarter of the 200 East Area (Figure 10-27), and consists of 10 underground storage tanks. Five of the 10 single-shell tanks are assumed or confirmed to have leaked. Significant uncertainty is associated with the extent of vadose zone contaminant migration from the tanks. Although none of the releases have been attributed with dangerous waste groundwater contamination, the site is in an interim status assessment program because an indicator parameter, specific conductance, exceeded the critical mean value in 2005.

The elevated specific conductance is associated with elevated nitrate at Well 299-E25-93. In 2014, nitrate continued to exceed the DWS in Well 299-E25-93 in 3 of 4 quarters sampled and remained above the DWS in Well 299-E24-20 during all of 2014. Nitrate in Well 299-E24-20 exceeded the DWS previously in 2004, 2005, 2008, 2010, and 2013. Nitrate levels in Well 299-E25-93 exceeded the DWS in 2004 and 2006 through 2013.

The well network was sampled quarterly to assess if dangerous waste/dangerous waste constituents are present in the groundwater and, if so, their extent and rate of migration. In 2014, the wells were monitored in accordance with PNNL-15315. All of the active network wells were sampled quarterly, as required, during 2014 (Table B-70, Appendix B). Appendix B (Table B-70) includes a list of WMA A-AX wells and constituents monitored, and it indicates if the wells were sampled as scheduled. Results for the assessment parameters are provided in Table B-72 of Appendix B.

Well 299-E25-236 was decommissioned in June 2013 as the result of accelerated casing corrosion and consequently was not sampled in 2014. Drilling of replacement Well 299-E25-237 was started in November 2014 and completed in January 2015. Three depth-discrete groundwater samples were collected during drilling at 94.7, 99.4, and 110.6 m (310.6, 326.1, and 363 ft) bgs for selected constituents. The water table at the time drilling occurred was measured at 90.32 m (296.31 ft) bgs. Nitrate concentrations detected were 27.7 mg/L at 94.7 m (310.6 ft) bgs, 24.8 mg/L at 99.4 m (326.1 ft) bgs, and 0.558 mg/L at 110.6 m (363 ft) bgs. Depth-discrete technetium-99 sampling results are provided in the technetium-99 plume section of this report. The WMA A-AX remained in assessment monitoring in accordance with 40 CFR 265.93[d], as referenced by WAC 173-303-400 during 2014. A revised assessment plan will be prepared in 2015 that will evaluate conditions that may have contributed to the casing degradation at Well 299-E25-236.

The groundwater flow direction in the unconfined aquifer near WMA A-AX is to the southeast, based on slightly higher hydraulic heads to the northwest (Figures 10-3 and 10-4), the orientation of a southeast trending paleochannel in the area (DOE/RL-2011-118, Appendix E), and the configuration and migration patterns of the nitrate and technetium-99 contamination plumes. Based on the 2014 low-gradient groundwater contour map that covers this area, the estimated hydraulic gradient is approximately 5×10^{-6}, with an estimated groundwater flow rate of approximately 0.1 m/d (0.33 ft/d). Additional gradient network evaluation near WMA A-AX is currently ongoing to provide greater certainty in calculations of groundwater flow in this area. The depth of the water column in monitoring wells ranges from 1.28 to 11.9 m (4.2 to 39.0 ft). These wells all have adequate water columns in the screened interval for continued sampling (Table B-71, Appendix B).

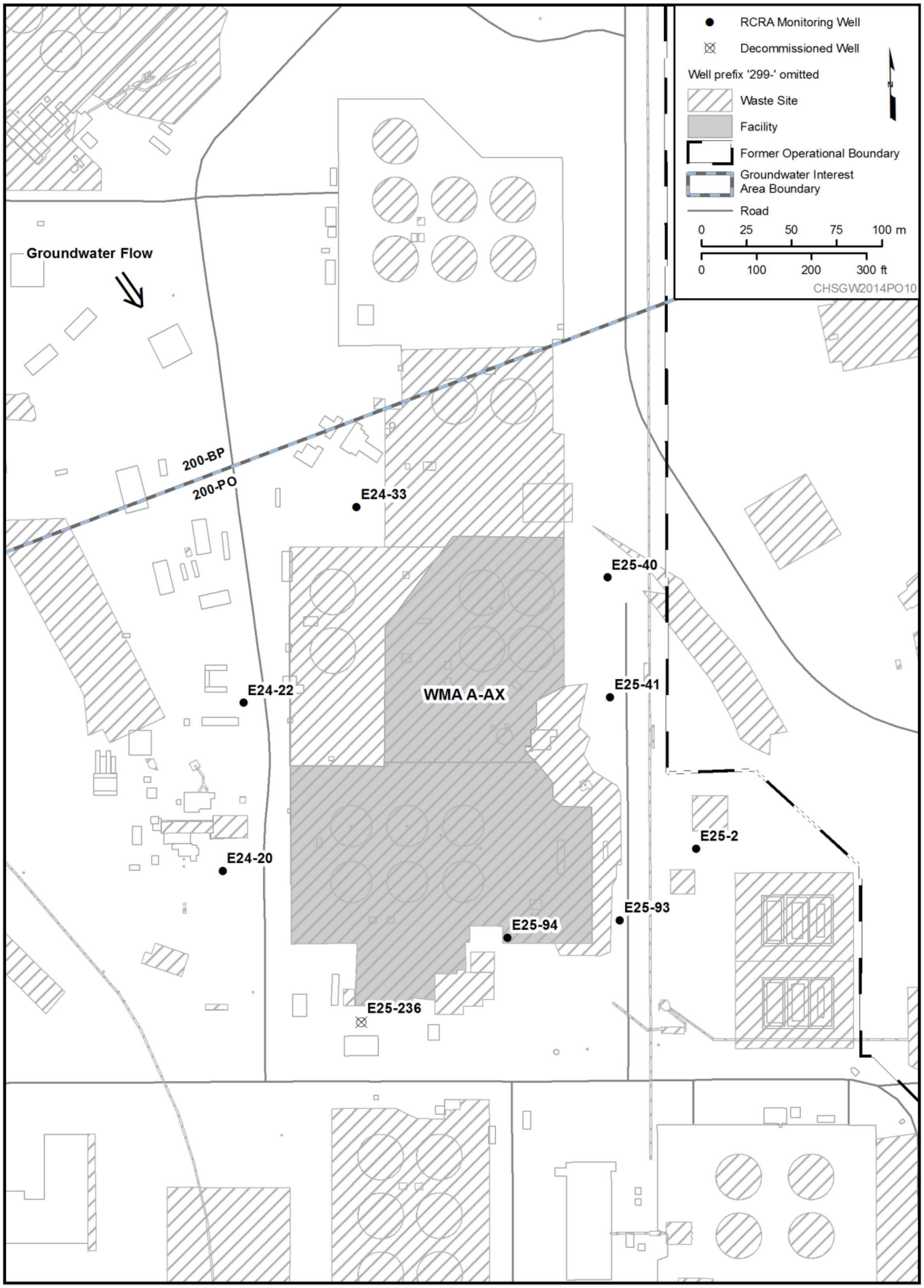

Figure 10-27. 200-PO RCRA WMA A-AX Monitoring Well Locations

10.13.2 216-A-36B Crib

The 216-A-36B Crib is located in the southeastern portion of the 200 East Area (Figure 10-28) and is 7 m (23 ft) deep, 150 m (490 ft) long, and 2.3 to 3.4 m (7.5 to 11.2 ft) wide at the base; the sides slope at 1:1.5. The crib was originally part of the 180 m (590 ft) long 216-A-36 Crib, which received PUREX effluent from September 1965 through March 1966. In March 1966, the northernmost 30 m (98 ft) of the crib were isolated and a grout barrier was established between it and the southern portion of the crib, now known as 216-A-36B. 216-A-36B was operational from March 1966 through October 1972, and it was reactivated in November 1982 for the PUREX Plant restart. The site received discharges of PUREX ammonia scrubber distillate totaling 290 million L (76.6 million gal). It was permanently removed from service in August 1987. After final receipt of waste, the crib was covered with 7 m (23 ft) of clean soil and revegetated. Additionally, in May 2010, 15 cm (6 in.) of clean gravel was added the 216-A-36B Crib as an interim stabilization measure.

Since January 2011, the 216-A-36B Crib has been monitored under interim status contamination indicator evaluation regulations to determine if dangerous waste constituents have impacted groundwater (DOE/RL-2010-93). Revision 1 of the plan was released in June 2011 to provide more detail pertaining to the constituent list and sampling frequency. Before 2011, the 216-A-36B Crib, along with two other PUREX Cribs (216-A-10 and 216-A-37-1), were monitored in a RCRA interim status groundwater quality assessment program. However, the 216-A-10 Crib was officially closed March 30, 2010, and was removed from Part A of the Hanford Facility Dangerous Waste Permit (WA7890008967). The two remaining cribs, 216-A-36B and 216-A-37-1, remain in RCRA interim status but were returned to indicator evaluation programs because groundwater constituents detected were not dangerous wastes or dangerous waste constituents. Other nearby cribs also received PUREX waste (e.g., 216-A-45 Crib); however, these other cribs are not regulated as RCRA treatment, storage, and disposal units, but are monitored under CERCLA through the 200-PO-1 OU instead.

The 216-A-36B Crib network groundwater wells were monitored in 2014 semiannually for the RCRA indicator parameters of TOC, TOX, pH, and specific conductance. Wells are also monitored annually for water quality parameters including alkalinity, anions (chloride, sulfate, and nitrate), metals (including calcium, magnesium, potassium, and sodium), phenols, temperature, and turbidity. Water level measurements are also collected semiannually. One upgradient well (299-E17-19) and three downgradient wells (299-E17-14, 299-E17-16, and 299-E17-18) are monitored for the site (Figure 10-28; Table B-19, Appendix B). Sampling details and site history are provided in DOE/RL-2010-93.

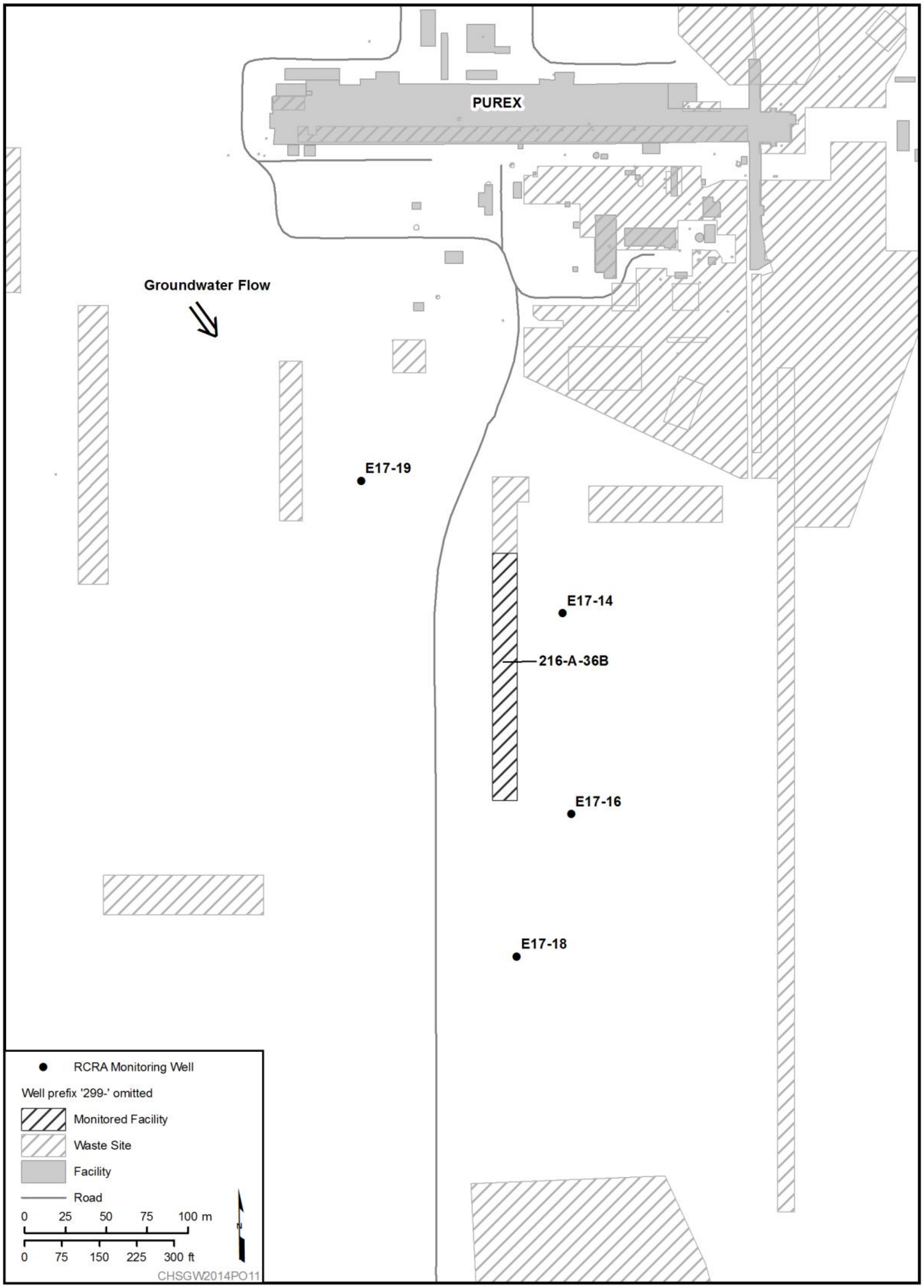

Figure 10-28. 200-PO RCRA 216-A-36B Monitoring Well Locations

10.13.2.1 Sampling Results

Sampling was conducted as planned in 2014. Several wells had initial analytical results exceeding critical mean values, but in all cases, verification sampling results were within critical mean ranges or did not exceed established values. During the first half the year, reported concentrations were compared to 2013 critical mean values. The 2014 critical mean values were established and utilized during the second half of the year. January samples from Wells 299-E17-14 and 299-E17-18 showed an initial exceedance for TOX in comparison with the 2013 critical mean value, but did not exceed the 2014 critical mean (Table B-21, Appendix B). January samples from Wells 299-E17-16 and 299-E17-18 had concentrations above the critical mean for TOC in comparison to both the 2013 and 2014 values (Table B-21, Appendix B). The January sample from Well 299-E27-14 had a value below the lower-bound 2013 pH critical mean, but was within the 2014 pH critical mean range. Details regarding calculation of the critical mean values are provided in ECF-Hanford-13-0013, Rev. 1, *Calculation of Critical Means for Calendar Year 2013 RCRA Groundwater Monitoring*, and ECF-Hanford-14-0043, Rev. 0, *Calculation of Critical Means for Calendar Year 2014 RCRA Groundwater Monitoring*.

Groundwater quality constituents monitored for the site include chloride, iron, manganese, nitrate, phenols, sodium, and sulfate. Samples for analyses of alkalinity, calcium, magnesium, and potassium are collected to support charge balance calculations for the calcium-bicarbonate type groundwater. A summary of water quality parameters is provided in Table B-22 of Appendix B. The primary constituent of interest at the 216-A-36B Crib is nitrate because it is a breakdown product of nitric acid, which was disposed to the nearby 216-A-10 Crib. Nitrate concentrations in all four wells continue to exceed the DWS, and these exceedances are associated with a relatively large Central Plateau nitrate plume (Figure 10-15). Concentrations of volatile organic compounds were monitored at 216-A-36B in 2014 to evaluate if previous historical intermittent low-level detections of TCE were still occurring at the site. During 2014, two network wells had detections. TCE was detected in upgradient Well 299-E17-19 at concentrations ranging from 0.88(J) to 1.53 µg/L. Downgradient Well 299-E17-14 detected TCE at a concentrations ranging from 1.3 to 1.47 µg/L.

10.13.2.2 Water-Level and Well Network Evaluation

Beginning in 2008, efforts have been undertaken to improve the accuracy of the water-level measurements and resultant estimates of groundwater gradient near the PUREX Plant and associated waste sites. The results of these efforts, which include vertical offset surveys of well casings and high-resolution water-level measurements, are provided in Section 3.2 of DOE/RL-2011-01. The well network for the trend surface analyses extends from the west side of IDF to east and southeast of the 216-A-36B Crib. Trend surface analysis of water-level measurements from June 16, 2008, through March 18, 2011, indicated an average hydraulic gradient magnitude of 2.2×10^{-5} ($\pm 0.3 \times 10^{-5}$) m/m with a northeast direction (64 [±12] degrees azimuth). Measurements between June 20, 2011, and December 31, 2012, showed an average hydraulic gradient magnitude of 2.4×10^{-5} ($\pm 0.2 \times 10^{-5}$) m/m with an eastward direction (95 [±5] degrees azimuth), indicating a change in flow from east northeast to east. Low-gradient groundwater contour maps constructed using 2013 and 2014 low- gradient well network data in the vicinity of the 216-A-36 Crib indicate a southeastward direction of flow (Figures 10-3 and 10-4). Data collection efforts continue to better define hydraulic gradients near the PUREX Cribs area. The groundwater flow rate is calculated to range between 0.0013 and 0.22 m/d (0.0043 to 0.72 ft/d) (Table B-1 in Appendix B).

Based on the current groundwater flow interpretations, the 216-A-36B Crib well network is capable of meeting the monitoring objective of determining if groundwater has been impacted with dangerous waste constituents. Table B-20 in Appendix B summarizes water-level information for the 216-A-36B monitoring network. An updated RCRA groundwater monitoring plan for the 216-A-36B Crib will be developed in 2015. The new plan will incorporate the most current groundwater flow direction data obtained from the low-gradient monitoring network; present new geologic cross sections derived from data incorporated in the Hanford South Geoframework Model (ECF-HANFORD-13-0029, *Geologic Framework Model to Support Fate and Transport Modeling for Remedial Investigation/Feasibility Studies of the 200-BP-5 and 200-PO-1 Groundwater Operable Units*); review and summarize historical monitoring results with the relationship to changing flow directions; and update the conceptual site model.

10.13.3 216-A-37-1 Crib

The 216-A-37-1 Crib is located east of the 200 East Area (Figure 10-29) and is 5.2 m (17.1 ft) deep, 213 m (699 ft) long, and 33 m (108 ft) wide at the base; the sides slope at 1:1. The crib was operational from March 1977 through April 1989 and was used for percolation of 242-A Evaporator process condensate to the soil column. The crib received spent halogenated and nonhalogenated solvents and ammonia. During its operational life, the 216-A-37-1 Crib received a total of 370 million L (98 million gal) of process condensate. Discharge of the evaporator process condensate to the 216-A-37-1 Crib continued through April 1989, when the crib was removed from service. In 1994, the bottom of the diversion box was filled with grout to physically preclude the potential for inadvertent discharges to the crib. In July of 2000, vent risers from the crib were sealed to prevent potential passive radioactive emissions.

Since January 2011, the 216-A-37-1 Crib has been monitored under interim status regulations to determine if dangerous waste constituents have impacted groundwater (DOE/RL-2010-92). Revision 1 of the plan was released in June 2011 to provide more detail pertaining to the constituent list and sampling frequency. Before 2011, the 216-A-37-1 Crib, along with two other PUREX Cribs (216-A-10 and 216-A-36B), were monitored in a RCRA interim status groundwater quality assessment program. However, the 216-A-10 Crib was officially closed March 30, 2010, and was removed from Part A of the Hanford Facility Dangerous Waste Permit (WA7890008967). The two remaining cribs, 216-A-36B and 216-A-37-1, remain in RCRA interim status but were returned to indicator evaluation programs because groundwater constituents detected were not dangerous wastes or dangerous waste constituents. Other nearby cribs also received PUREX waste (e.g., 216-A-45 Crib); however, these other cribs are not regulated as RCRA treatment, storage, and disposal units, but are monitored under CERCLA through the 200-PO-1 OU instead. An updated closure plan for the 216-A-37-1 Crib was submitted to Ecology in 2014 (*216-A-37-1 Ditch Closure Plan (D-2-10)*, DOE/RL-2005-88, Rev. 0) and is currently under review.

The 216-A-37-1 Crib network groundwater wells are monitored semiannually for RCRA indicator parameters of TOC, TOX, pH, and specific conductance, as well as temperature and turbidity. Wells are also monitored annually for water quality parameters including alkalinity, anions (chloride and sulfate), metals (including calcium, iron, manganese, magnesium, potassium, and sodium), and phenols. Water-level measurements are also collected semiannually. Sampling details and site history are described in DOE/RL-2010-92. One upgradient well (299-E25-47) and three downgradient wells (299-E25-17, 299-E25-19, and 299-E25-20) are monitored for the site (Figure 10-29; Table B-23, Appendix B).

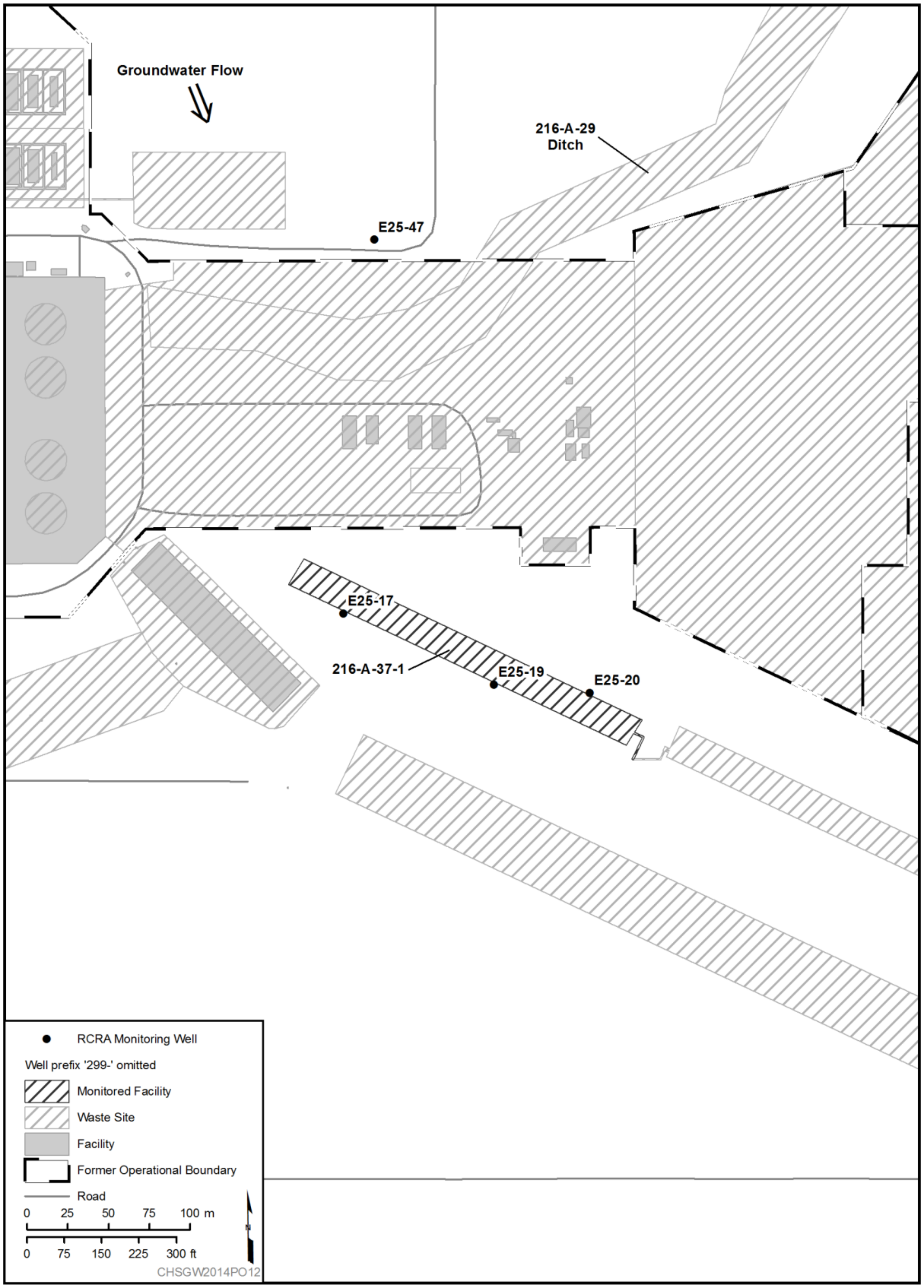

Figure 10-29. 200-PO RCRA Facility 216-A-37-1 Monitoring Well Locations

10.13.3.1 Sampling Results

Sampling events were delayed at two wells in 2014. Scheduled July sampling at Well 299-E25-17 did not occur until August due to an electrical issue with the pump. The annual sampling event for upgradient Well 299-E25-47 was missed in January due to inaccessibility of the sampling van. The semiannual event planned for July was completed as scheduled at this well.

The critical mean for TOC was exceeded in Well 299-E25-17 for the samples collected in July. This well had no previous history of elevated concentrations of TOC and had not been showing increasing levels. To determine if a laboratory analytical error was an issue, the laboratory reanalyzed the samples with results available in early November. High TOC concentrations were confirmed. Verification sampling was conducted at the well in late November, with two sets of quadruplicate samples sent to two laboratories. Both sets showed elevated TOC concentrations. Considering the anomalous nature of the elevated TOC values, the operational maintenance history at the well was reviewed. The increased TOC concentrations occurred following removal of the pump and connection piping required because of pump failure. It was suspected that some natural organic material may have been dislodged from the well inner casing wall during pump removal activities. In early December, as a precaution, the well screen was swabbed and brushed and the well was redeveloped with a new pump and connection piping. In mid-December the well was sampled again with two quadruplicate sample sets collected using a 7-day analytical turnaround, with separate analyses performed by two laboratories. Analytical results from both laboratories showed TOC concentrations below the critical mean.

All other indicator parameter analytical results for the 216-A-37-1 Crib network groundwater wells did not exceed the 2014 critical mean values for pH, specific conductance, TOC, and TOX; therefore, the site remains in interim status detection monitoring (Table B-25, Appendix B). Details regarding calculation of the critical mean values are provided in ECF-Hanford-14-0043, *Calculation of Critical Means for Calendar Year 2014 RCRA Groundwater Monitoring*.

Groundwater quality constituents monitored for the site include chloride, iron, manganese, phenols, sodium, nitrate, and sulfate (Table B-26 in Appendix B). Samples for analyses of alkalinity, calcium, magnesium, and potassium are collected to support charge balance calculations for the calcium-bicarbonate type groundwater. Nitrate continued the historical trend of being detected above the DWS of 45 mg/L at 299-E25-20. Manganese continues to intermittently exceed the secondary DWS in unfiltered samples from Wells 299-E25-19 and 299-E25-20. The secondary DWS for iron was exceeded in 2014 in unfiltered samples at Wells 299-E25-17, 299-E25-19, and 299-E25-20.

10.13.3.2 Water-Level and Well Network Evaluation

Near the 216-A-37-1 Crib, groundwater flow is estimated to be toward the southeast. Flow directions are influenced by a northwest-southeast trending paleochannel with high permeability Hanford formation sediments near the crib, the Ringold lower mud unit at the water table east of the 200 East Area, and the higher water table elevations to the west and north. These flow directions are supported mainly by the distribution of plumes emanating from near the crib and recent efforts to improve the accuracy of water level measurements in the southeastern portion of the 200 East Area (Section 10.13.2). The gradient magnitude is assumed to be similar to the 216-A-29 Ditch, which is 2.0×10^{-5} m/m. The groundwater flow rate is estimated to range between 0.0036 and 0.6 m/d (0.012 and 2.0 ft/d) (Table B-1 in Appendix B). Additional gradient network evaluation near 216-A-37-1 is currently being conducted to provide greater certainty in calculations of groundwater flow in this area. Table B-24 in Appendix B summarizes water-level data for the monitoring network.

Based on the current groundwater flow interpretations, the 216-A-37-1 Crib well network is capable of meeting the groundwater monitoring objectives to determine if groundwater has been impacted with dangerous waste constituents. An updated RCRA groundwater monitoring plan for the 216-A-37-1 Crib will be developed in 2015. The new plan will incorporate the most current groundwater flow direction data obtained from the low-gradient monitoring network; present new geologic cross sections derived from data incorporated in the Hanford South Geoframework Model (ECF-HANFORD-13-0029, *Geologic Framework Model to Support Fate and Transport Modeling for Remedial Investigation/Feasibility Studies of the 200-BP-5 and 200-PO-1 Groundwater Operable Units*); review and summarize historical monitoring results with the relationship to changing flow directions; and update the conceptual site model.

10.13.4 216-A-29 Ditch

The 216-A-29 Ditch is located just east of the 200 East area fence line (Figure 10-30) and is planned for closure. An updated closure plan was submitted to Ecology in 2014 (*216-A-29 Ditch Closure Plan (D-2-3)*, DOE/RL-2008-53, Rev. 1). The 216-A-29 Ditch is a regulated unit because it received nonradioactive dangerous waste regulated by 40 CFR 261, "Identification and Listing of Hazardous Waste," after November 19, 1980. The site is designated as a surface impoundment, as defined in WAC 173-303-400. The ditch was excavated to convey liquid effluent from the PUREX chemical sewer to the B Pond and was placed in service in November 1955. Flow from the chemical sewer (low-level contaminants) was continuous, with an average flow of 3,700 L/min (970 gpm). The 216-A-29 Ditch received continuous discharge of corrosive waste and potentially hazardous spilled chemical materials from the PUREX Plant. The most significant chemical discharges included acidic and caustic effluents associated with backwashing for the regeneration of demineralizer columns. The ditch also received spills from the PUREX Plant chemical sewer (low-level contamination). A complete, estimated inventory of materials discharged to the 216-A-29 Ditch is provided in WHC-SD-EN-AP-045, Appendix A.

The 216-A-29 Ditch is currently backfilled with material from the ditch sides and spoils piles in the bottom. The portion of the 216-A-29 Ditch inside the 200 East Area security fence was brought to grade with clean material. The portion of the ditch outside of the 200 East Area security fence was topped with clean material in a series of 11 terraces progressing down the length of the ditch. Both areas have been revegetated and appropriately signed (the 216-A-29 Ditch is an underground radioactive material area).

In accordance with WAC 173-303-400 and 40 CFR 265.92, the 216-A-29 Ditch network groundwater wells are monitored semiannually for RCRA indicator parameters of TOC, TOX, pH, and specific conductance. Wells are also monitored annually for water quality parameters including alkalinity, anions (chloride, fluoride, sulfate, nitrate, and nitrite), metals (including calcium, iron, manganese, magnesium, potassium, and sodium), oxidation/reduction potential, phenols, temperature, and turbidity. Water-level measurements are collected semiannually. Sampling details and site history are described in DOE/RL-2008-58. The current monitoring well network includes three upgradient wells (299-E26-12, 299-E26-13, 699-43-45) and six downgradient wells (299-E25-26, 299-E25-28, 299-E25-32P, 299-E25-34, 299-E25-35, and 299-E25-48) (Figure 10-30; Table B-15, Appendix B). Historically, Well 699-43-45 has served as an upgradient well for the 216-A-29 Ditch. With the continual shift in groundwater flow direction from the southwest to the southeast, this well is no longer upgradient of the unit. Wells 299-E26-12 and 299-E26-13, which have always been included in the network, became the new upgradient wells starting in 2011.

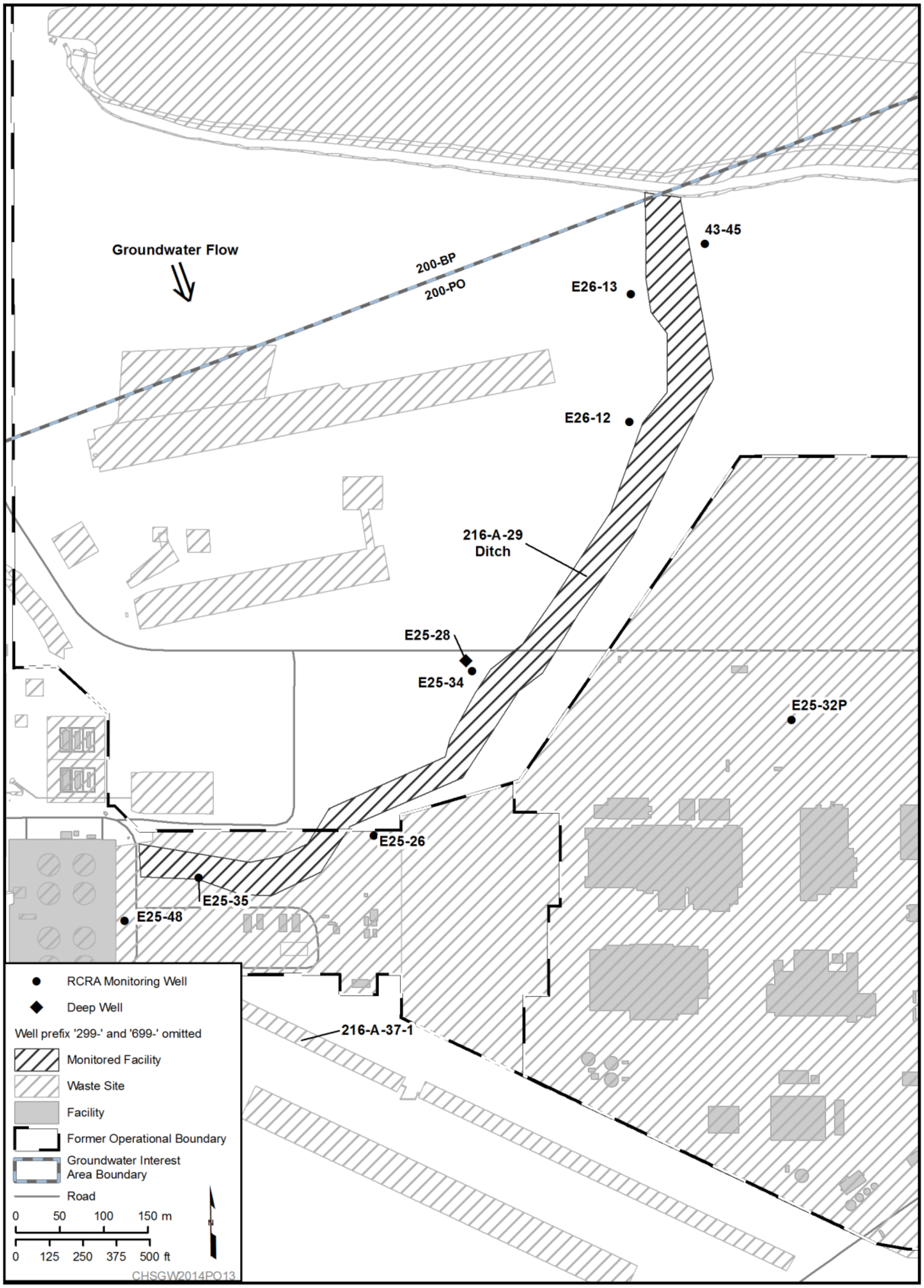

Figure 10-30. 200-PO RCRA Facility 216-A-29 Monitoring Well Locations

10.13.4.1 Sampling Results

The monitoring network was sampled as planned in 2014 with one exception. A software-generated paperwork error for the April-scheduled annual sampling event of network wells required the collection of annual samples for indicator parameters TOX and TOC at Well 299-E25-34 to be collected later, and was included with the subsequent semiannual sampling event conducted in October. As shown in Table B-17 of Appendix B, an exceedance of the critical mean for pH, specific conductance, and TOC occurred during 2014. The critical mean for specific conductance was exceeded in downgradient Wells 299-E25-35, 299-E25-48, and 299-E25-32P during each of the 2014 semiannual sampling events. The critical mean for specific conductance in Well 299-E25-35 has been exceeded since the early 1990s. A groundwater assessment for the specific conductance detected was performed in the early 1990s as described in WHC-SD-EN-EV-032, *Results of the Groundwater Quality Assessment Program at the 216-A-29 Ditch RCRA Facility*. The assessment concluded that the specific conductance exceedance at the site was caused by elevated calcium, sodium, and sulfate. These are nondangerous waste constituents, so the site remains in an indicator parameter program.

Due to the number of nondetects in upgradient wells, a 2014 critical mean was not calculated for the TOX. In lieu of a critical mean, sampling results were compared to the laboratory limit of quantitation (LOQ). Two new laboratories were utilized for groundwater analyses beginning in May 2014, requiring the determination of new LOQ values for TOC and TOX for each laboratory.

The mean of quadruplicate samples collected from Well 299-E25-26 for the October 2014 sampling event exceeded the 2014 critical mean that was established using upgradient data collected in 2012 and analyzed by WSCF. Until May 2014, WSCF had been utilized as the primary laboratory for groundwater analyses. The October TOC analytical result for Well 299-E25-26 was based on analyses performed by Test America St. Louis (TASL). The mean of quadruplicate samples from Well 299-E25-26 and the other downgradient wells were was less than the TASL LOQ for TOC.

Samples collected to support analysis of groundwater quality (chloride, iron, manganese, phenol, sodium, and sulfate) showed one exceedance in 2014 (Table B-18 in Appendix B). Iron has intermittently exceeded the secondary DWS in Well 299-E25-32P in unfiltered samples and in 2014 an exceedance occurred. The most recent exceedance in Well 299-E25-32P prior to 2012 was in 1995. Similarly, manganese has exceeded the secondary DWS intermittently in filtered and unfiltered samples from Well 299-E25-19, with the last exceedance in 1995. No exceedance of the manganese DWS occurred in 2014.

10.13.4.2 Water-Level and Well Network Evaluation

Near the north end of the ditch and immediately west and north of the 216-A-29 Ditch and the adjacent 216-B-3 Pond, flow in the unconfined aquifer is south to southwest (Figure 2-4 in DOE/RL-2008-59). Further east of the 216-A-29 Ditch, groundwater flow is more generally to the southeast. Trend surface analysis utilizing the low-gradient well network near the 216-A-29 Ditch indicates a water table gradient of 2.0×10^{-5} m/m with a south-southeast flow direction. Based on the current groundwater flow interpretation, the current monitoring network was capable of monitoring the 216-A-29 Ditch throughout 2014. The calculated average flow velocity is 0.0036 m/d (0.012 ft/d) (Table B-1, Appendix B). Similar to the 216-A-37-1 Crib and WMA A-AX, additional gradient network evaluation near 216-A-29 is currently ongoing to provide greater certainty in calculating groundwater flow direction in this area. Table B-16 of Appendix B summarizes water-level data for the monitoring network.

An updated RCRA groundwater monitoring plan for the 216-A-29 Ditch will be developed in 2015. The new plan will incorporate the most current groundwater flow direction data obtained from the low-gradient monitoring network; present new geologic cross sections derived from data incorporated in the Hanford South Geoframework Model (ECF-HANFORD-13-0029, *Geologic Framework Model to Support Fate and Transport Modeling for Remedial Investigation/Feasibility Studies of the 200-BP-5 and 200-PO-1 Groundwater Operable Units*); review and summarize historical monitoring results with the relationship to changing flow directions; and update the conceptual site model.

10.13.5 216-B-3 Pond

The inactive 216-B-3 Pond was located east of the 200 East Area (Figure 10-31). The location was within a natural topographic depression. During operations, the pond covered approximately 16.2 ha (40 ac) with a depth of up to 6.1 m (20 ft). Total discharge to the pond since 1945 is estimated to have exceeded 10 billion L (260 billion gallons) (PNNL-15479). The B Pond is classified as a treatment, storage, and disposal unit because it received dangerous waste after implementation of dangerous waste regulations. The dangerous waste received came from three primary sources: corrosive and dangerous waste resulting from regeneration of demineralizer columns at PUREX, spills of dangerous or mixed waste from PUREX and other facilities, and off-specification chemical makeups at PUREX. The last known reportable discharge of chemical waste, sodium nitrite, occurred in 1987. The 216-B-3 Pond was decommissioned in 1994 by backfilling with coarse-grained material and then covering the pond with fine-grained material.

In accordance with WAC 173-303-400 and 40 CFR 265.92, the 216-B-3 Pond network groundwater wells are monitored semiannually for RCRA indicator parameters of TOC, TOX, pH, and specific conductance. Wells are also monitored annually for water quality parameters including chloride, iron (unfiltered), manganese (unfiltered), phenols, sodium, and sulfate. Water-level measurements are also collected semiannually. Sampling details and site history are described in DOE/RL-2008-59. The well network in 2014 consists of one upgradient (699-44-39B) and three downgradient wells (699-42-42B, 699-43-44, and 699-43-45) (Figure 10-31; Table B-27, Appendix B). The wells were sampled semiannually, as required, during 2014.

10.13.5.1 Sampling Results

As shown in Table B-29 in Appendix B, no exceedances of the critical mean for pH, specific conductance, or TOC were detected at the site in 2014. Due to the number of nondetects in the upgradient well, a 2014 critical mean was not calculated for TOX. In lieu of a critical mean, sampling results were compared to the laboratory LOQ. In addition to the use of WSCF for the first half of the year, two new laboratories were utilized for groundwater analyses beginning in May 2014, requiring the determination of new LOQ values for TOX from each laboratory. With respect to TOX, no exceedances of the laboratory LOQs occurred for the sampling events completed at the 216-B-3 Pond.

Groundwater quality constituents monitored for the site include chloride, iron (unfiltered), manganese (unfiltered), phenols, sodium (unfiltered), and sulfate (Table B-30 in Appendix B). No groundwater quality constituents exceeded the respective DWS in 2014. Additional contaminants of interest monitored for the site include arsenic (filtered and unfiltered), cadmium (filtered and unfiltered), and nitrate. Additional supporting constituents monitored for the site include dissolved oxygen, temperature, turbidity, alkalinity, anions, and metals (unfiltered).

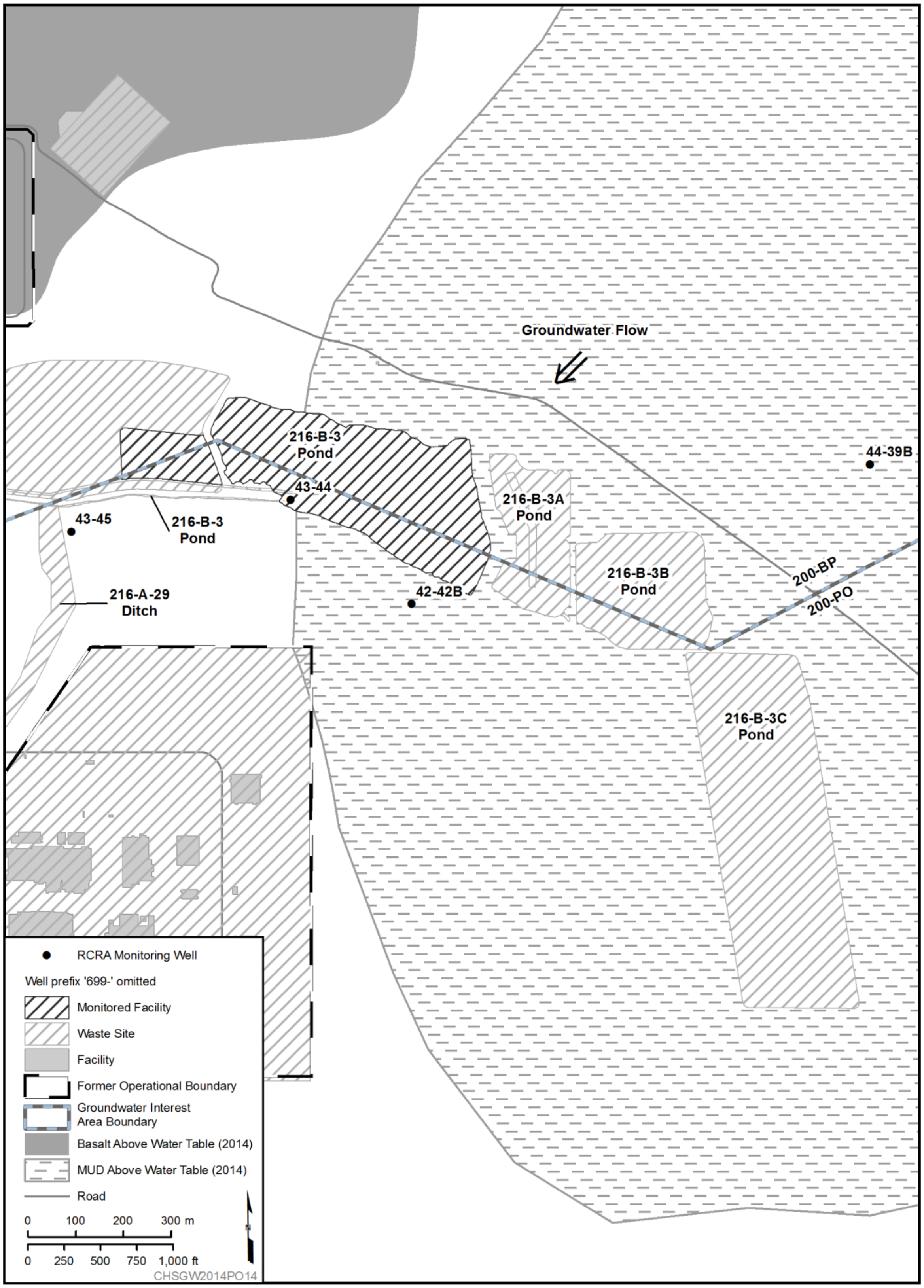

Figure 10-31. 200-PO RCRA Facility 216-B-3 Monitoring Well Locations

10.13.5.2 Water-Level and Well Network Evaluation

The monitoring network, as defined in DOE/RL-2008-59, consists of one upgradient and three downgradient wells, based on a groundwater flow direction to the west (see Section 2.4 of DOE/RL-2008-59). The 2014 flow rate is estimated to be 0.0056 m/d (0.018 ft/d) to the southwest. The network well screens range from 1.5 to 6.5 m (4.9 to 21 ft) into the aquifer. These current network wells have adequate water columns in the screened interval available for sampling (Table B-28 in Appendix B). An updated RCRA groundwater monitoring plan for the 216-B-3 Pond will be developed in 2015. The new plan will incorporate the most current groundwater flow direction data obtained from the low-gradient monitoring network; present new geologic cross sections derived from data incorporated in the Hanford South Geoframework Model (ECF-HANFORD-13-0029, *Geologic Framework Model to Support Fate and Transport Modeling for Remedial Investigation/Feasibility Studies of the 200-BP-5 and 200-PO-1 Groundwater Operable Units*); review and summarize historical monitoring results with the relationship to changing flow directions; and update the conceptual site model.

10.13.6 Integrated Disposal Facility

The IDF consists of an expandable, double-lined landfill with approximately 0.07 km^2 (0.027 mi^2) of liner. The landfill is divided into two distinct cells: (1) the east cell for the disposal of low-level radioactive waste, and (2) the west cell for the disposal of mixed waste. The landfill is not yet in use.

Construction of the first phase for IDF was completed in April 2006 (Figure 10-32). DOE submitted a Part B RCRA Permit application to Ecology, which was incorporated into the Hanford Facility RCRA Permit (WA7890008967) on April 9, 2006. The start date for IDF operations has not been determined. IDF is currently monitored as part of a detection monitoring program as described in Section III.11.E.1.b of 10-EMD-0080. The wells are monitored annually for the following indicator parameters: chromium (filtered), pH, specific conductance, TOC, and TOX. In addition, groundwater is monitored for supplemental constituents of alkalinity, anions, metals, and turbidity. Based on the current southeasterly groundwater flow direction, the monitoring network consists of one upgradient well (299-E24-24) and two side-gradient wells (299-E18-1 and 299-E24-21), and four downgradient wells (299-E17-22, 299-E17-23, 299-E17-25, and 299-E17-26) (Figure 10-32; Table B-42, Appendix B). Since the facility is not yet operational, the current monitoring objective is to collect baseline groundwater information. All seven network wells were sampled as scheduled during 2014.

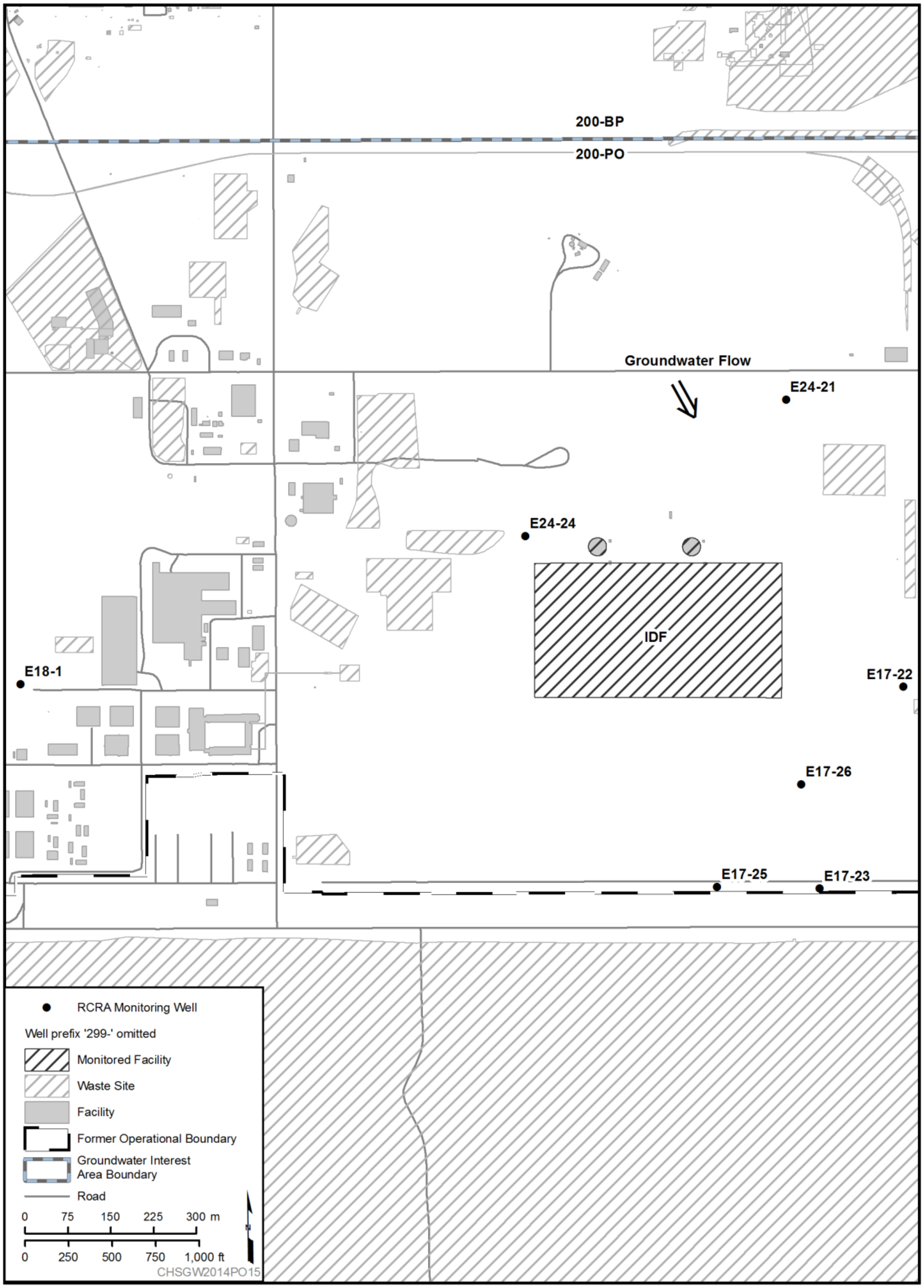

Figure 10-32. 200-PO RCRA Facility IDF Monitoring Well Locations

10.13.6.1 Sampling Results

A summary of the 2014 indicator parameter results is provided in Table B-44 of Appendix B. No upgradient/downgradient comparisons are required because the facility is not yet in use. With respect to the supplemental constituents, nitrate exceeded the DWS during 2014 in five wells at the IDF (299-E24-21, 299-E17-22, 299-E17-23, 299-E17-25, and 299-E17-26). Changes in the plume configuration and concentration trending shown at individual wells indicates that nitrate is migrating to the southeast in the vicinity of the IDF facility. The maximum nitrate concentration was 56.7 mg/L in Well 299-E17-25. This well is in the regional 200 East Area nitrate plume.

10.13.6.2 Water-Level and Well Network Evaluation

Groundwater modeling was conducted in 2000 (PNNL-13400) to support the assessment of flow and transport conductions during future utilization of IDF and to assist in positioning of wells to be installed as part of the facility's monitoring network. These early model results indicated a southeastward flow direction. Beginning in 2008, data collection efforts were started to improve the accuracy of the water-level measurements so that the groundwater flow direction beneath the PUREX Cribs and the nearby IDF could be evaluated in greater detail (Section 3.2 of DOE/RL-2011-01).

Trend surface analysis of water-level measurements from June 2008 through March 2011 indicated an average hydraulic gradient magnitude of 2.2×10^{-5} ($\pm 0.3 \times 10^{-5}$) m/m with an east-northeast direction (64 [±12] degrees azimuth). Measurements between June 2011 and December 2012, indicated an average hydraulic gradient magnitude of 2.4×10^{-5} ($\pm 0.2 \times 10^{-5}$) m/m with an eastern flow direction (95 [±5] degrees azimuth). The low-gradient network water-level data for 2013 and 2014 indicate a southeast flow direction in the vicinity of the IDF (Table B-1, Appendix B). The groundwater flow rate is estimated to range from 0.004 to 0.0045 m/d (0.013 to 0.015 ft/d) (Table B-1, Appendix B). The most recent assessment of flow direction completed utilizing 2013 and 2014 water-level data again indicates southeastward flow, as previously determined in 2000 (PNNL-13400). Based on current groundwater flow interpretations, the monitoring network is considered adequate. Work continues to better define groundwater flow in the area of IDF and the PUREX Cribs. Table B-43 in Appendix B summarizes water-level data for this facility.

10.13.7 Nonradioactive Dangerous Waste Landfill

The NRDWL is located southeast of the 200 East Area next to the SWL (Figure 10-33). The landfill has an area of 0.045 km^2 (0.017 mi^2) consisting of 19 parallel unlined trenches, each approximately 122 m (400 ft) long, 4.9 m (16 ft) wide at the base, and 4.6 m (15 ft) deep. The landfill received chemical waste, asbestos, and nonhazardous waste between 1975 and 1985.

The vadose zone beneath the NRDWL is approximately 40 m (131 ft) thick, composed of sand, silty-sandy gravel, and gravel of the Hanford formation. The uppermost aquifer consists of approximately 9 m (30 ft) of additional Hanford formation, 8 m (26.2 ft) of the Cold Creek unit (a pre-Missoula gravel deposit), and 6 m (20 ft) of undifferentiated Ringold Formation sandy gravel. The base of the aquifer is a low-permeability unit composed of silt and silty sand. Detailed geology of 200-PO is shown in Figure 10-2.

The objective of RCRA monitoring at the NRDWL is to determine if dangerous waste constituents from the landfill have contaminated groundwater (40 CFR 265.92, as referenced by WAC 173-303-400) through an interim status indicator evaluation monitoring program. The groundwater sampling well network and associated monitoring constituents are described in PNNL-12227 and associated PNNL interim change notice ICN-PNNL-12227, R0.1, *Interim Change Notice to the Groundwater Monitoring Plan for the Nonradioactive Dangerous Waste Landfill*.

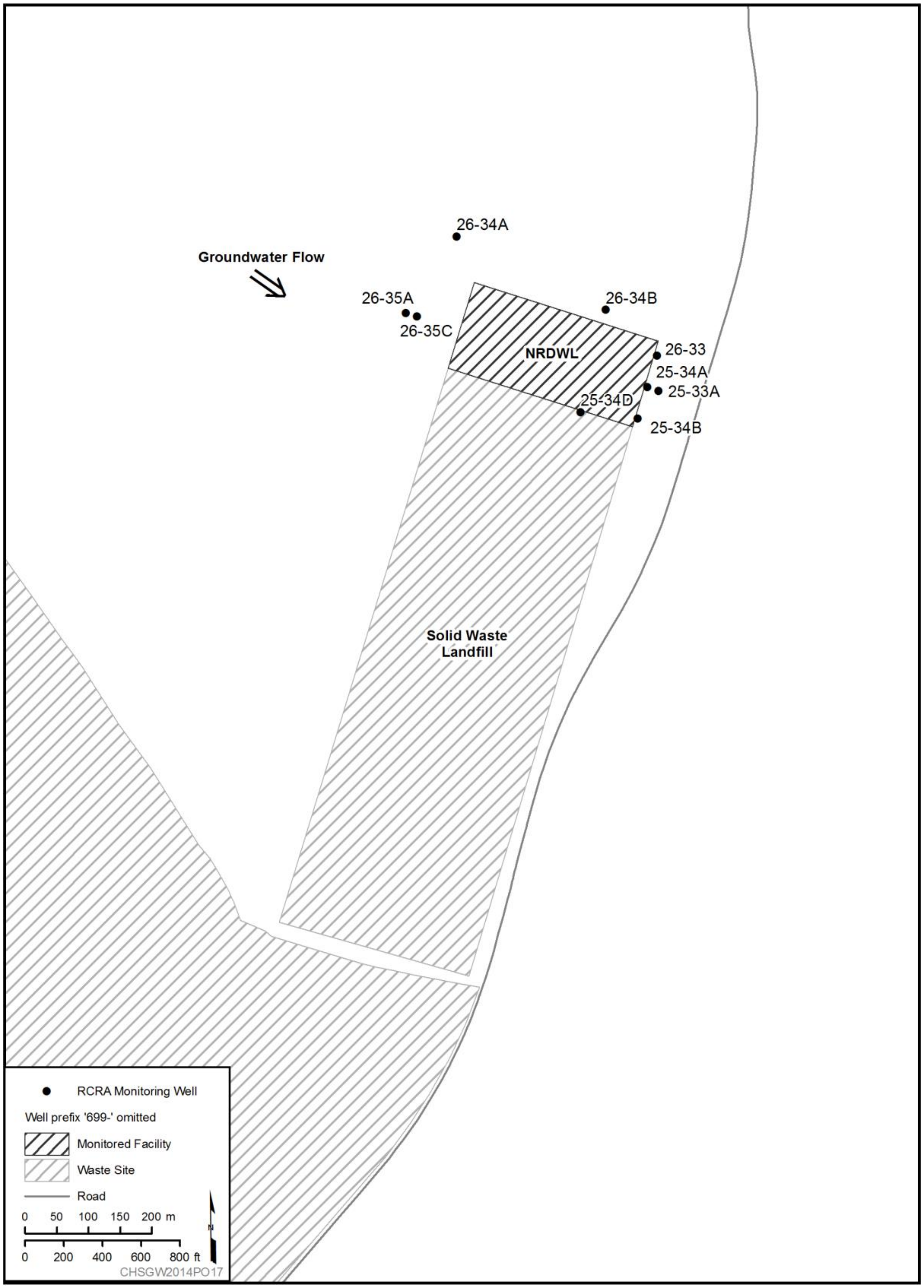

Figure 10-33. 200-PO RCRA Facility NRDWL Monitoring Well Locations

NRDWL is curently being monitored under PNNL-12227. During 2010, a new combination RCRA groundwater monitoring plan was released for NRDWL and SWL to combine the two units under one monitoring plan (DOE/RL-2010-28). The new monitoring plan was developed in association with the NRDWL/SWL closure/post-closure plan (DOE/RL-90-17, Rev. 2). The new monitoring plan specified phased changes to the existing well system, including the addition of two new far field upgradient wells during Phase 1 and one new far field downgradient well during Phase 2. Wells would be installed far enough away from the landfill to minimize the effects of VOCs from soil vapor in the vadose zone to groundwater. Monitoring under PNNL-12227 will continue until all three new wells are installed per DOE/RL-2010-28), and an associated Hanford Site RCRA Permit modification is approved.

New far field upgradient Wells 699-26-36 (upgradient of the solid waste landfill) and 699-24-38 (upgradient of the NRDWL) were completed in 2014 per DOE/RL-2010-28. New upgradient Well 699-26-38 will be integrated with the existing NRDWL monitoring network defined in PNNL-12227. Because a number of well network changes have occurred over the last several years, such as addition of a new upgradient well and anticipated loss of two downgradient wells that are going sample dry, a new monitoring plan will be prepared in 2015 to update PNNL-12227.

As defined in PNNL-12227, the monitoring well network (Figure 10-33; Table B-66, Appendix B) consists of two upgradient wells within the top of the unconfined aquifer (699-26-34A and 699-26-35A), four downgradient wells within the top of the unconfined aquifer (699-25-34A, 699-25-34B, 699-25-34D, and 699-26-33), one upgradient well directly above the low-permeability unit that forms the base of the unconfined aquifer (699-26-35C), one downgradient well directly above the low-permeability unit that forms the base of the unconfined aquifer (699-25-33A), and one side-gradient well (699-26-34B). Quadruplicate samples are not collected for Wells 699-25-33A and 699-26-35C, and results from these wells are not used for statistical comparisons with or calculations of critical mean values. The NRDWL groundwater wells are monitored semiannually for RCRA indicator parameters of TOC, TOX, pH, specific conductance, and site-specific parameters of VOCs and nitrate. Wells are monitored annually for the water quality parameters of chloride, iron, manganese, phenols, sodium, and sulfate. Wells 699-26-33 and 699-25-34A are planned to be replaced in 2015 in anticipation that there will be insufficient water within the screen interval for sample collection during future sampling events.

10.13.7.1 Sampling Results

Well 699-25-34D, which was not sampled as planned in January 2014 due to pump issues, was sampled successfully on March. Semiannual sampling of Wells 699-25-34A and 699-26-33 was not completed in January as planned because of a suspected pump issue, since no water could be retrieved. A camera survey was performed to inspect the well screens in April. The survey revealed 0.6 to 0.9 m (2 to 3 ft) of sediment fill in the bottom of the well, which was limiting the water available for sample collection. Removal of the sediment from the wells was completed and the wells were successfully sampled during the July event.

The mean of the quadruplicate specific conductance measurements in downgradient Wells 699-25-34A, 699-25-34B, and 699-25-34D from the July sampling event exceeded the critical mean (Table B-68 of Appendix B). A groundwater assessment performed in 2001 concluded elevated specific conductance at the site was due to the nondangerous waste constituents bicarbonate, sulfate, calcium, and magnesium. Between the late 1980s and about 2000, concentrations of common cations (e.g., calcium and magnesium) increased along with specific conductance in these three wells, and considering the results of the previous assessment, the site remains in interim status detection monitoring. Specific conductance measurements in 2014 were generally lower than those observed during the period from 2000 to 2013 in Wells 699-25-34D, 699-25-34A, and 699-24-34B. Over the last decade, specific conductance values have been showing an overall very gradual decline in these wells.

Low-level detections of several VOCs were noted in 2014 as the result of lower analytical method detection limits being available. All detected constituent concentrations were "J" qualified by the analytical laboratories. The laboratory "J" flag indicates that the value is estimated and the detection is uncertain, and the value reported is less than the practical quantitation limit, but greater than or equal to the method detection limit. The highest nitrate result was 23.5 mg/L in Well 699-25-34B, which is consistent with sitewide nitrate in the area. An elevated iron unfiltered concentration exceeding the secondary DWS occurred for a November sample collected from Well 699-25-34A.

10.13.7.2 Water-Level and Well Network Evaluation

From 2011 to March 2013, efforts were undertaken to improve the accuracy of the water-level measurements and resultant estimates of groundwater gradient near the NRDWL/SWL. The efforts included vertical offset surveys of well casings, high-resolution water-level measurements, and consideration of barometric effects. The results from the data collection and analysis yielded an average hydraulic gradient from January 2011 to March 2013 of 3.3×10^{-5} m/m and a flow direction of 101 degrees azimuth (southeast). Data compiled during 2014 and utilized for trend surface analysis indicate a flow direction of 125 degrees azimuth (southeast) and a hydraulic gradient of 2.4×10^{-5} m/m. This flow direction generally agrees with the southeastward flow direction inferred from historical plume migration in this area, and hydraulic head differences in the NRDWL/SWL area compared to the 200 East Area. For example, during 2012, the average water-level elevation near NRDWL/SWL (121.66 m [399.61 ft], NAVD88 for April 2012) was 0.14 m (0.46 ft) lower than the average elevation in the 200 East Area (121.80 m [399.61 ft], NAVD88 for April 2012), yielding a regional hydraulic gradient magnitude of 1.8×10^{-5} m/m. The wells continue to be located appropriately to accomplish the objectives of the interim status detection monitoring program.

An updated RCRA groundwater monitoring plan specifically for the NRDWL will be developed in 2015 to replace PNNL-12227. The new plan will incorporate the most current groundwater flow direction data obtained from the low-gradient monitoring network; present new geologic cross-sections derived from data incorporated in the Hanford South Geoframework Model (ECF-HANFORD-13-0029, *Geologic Framework Model to Support Fate and Transport Modeling for Remedial Investigation/Feasibility Studies of the 200-BP-5 and 200-PO-1 Groundwater Operable Units*); review and summarize historical monitoring results with the relationship to changing flow directions; and update the conceptual site model.

10.14 WAC Monitoring – Solid Waste Landfill

The SWL is located south of and adjacent to the NRDWL (Figure 10-34). The landfill is regulated by Ecology in accordance with WAC 173-350, which requires monitoring of leachate, soil gas, and groundwater. Per the groundwater monitoring plan, PNNL-13014, and WAC 173-304, constituents and site-specific constituents (including selected VOCs and filtered arsenic) are analyzed in groundwater samples collected quarterly. Compliance is determined by comparing results from downgradient monitoring wells with statistically derived background threshold values (BTVs) from upgradient wells.

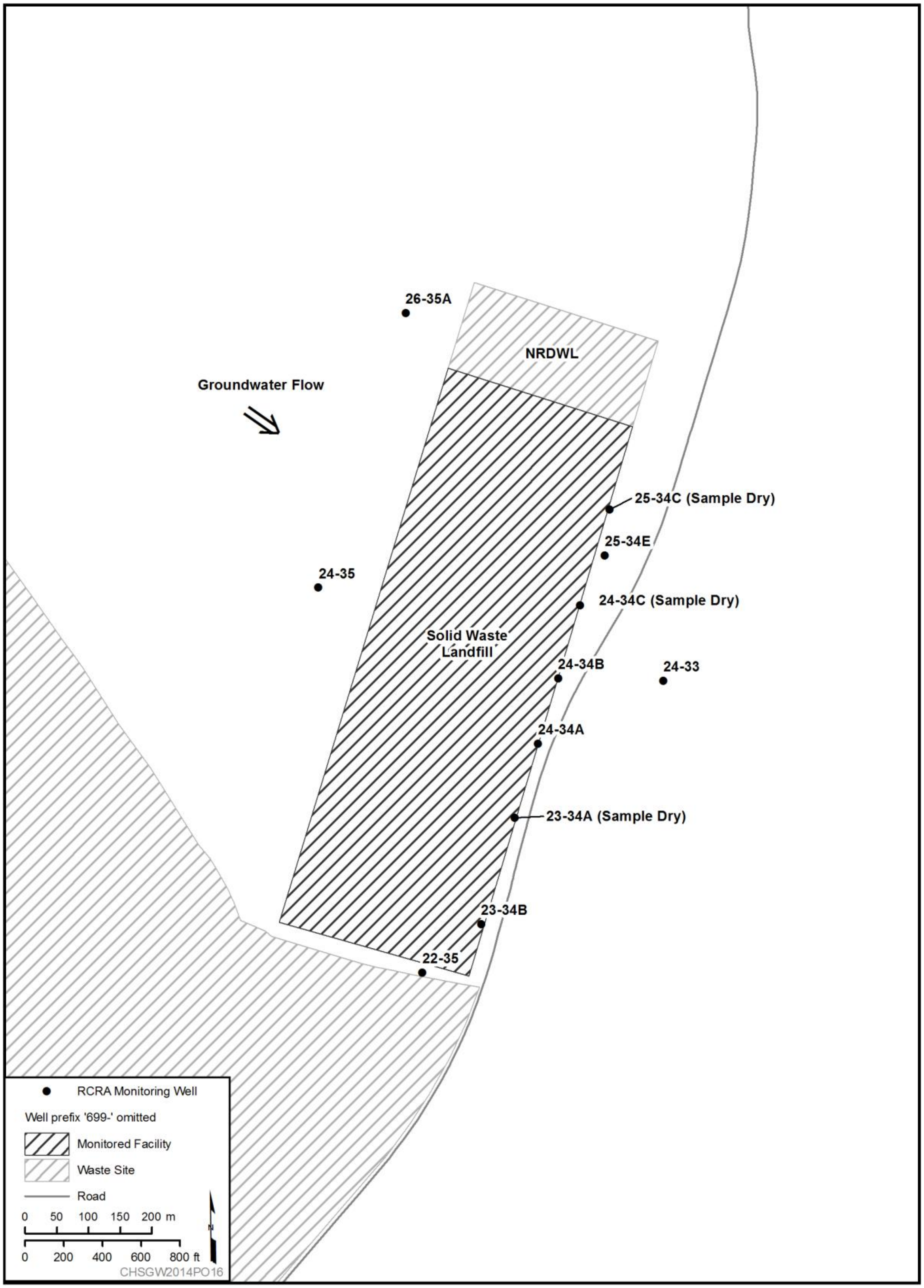

Figure 10-34. 200-PO WAC Facility SWL Monitoring Well Locations

In 2014, the monitoring well network consisted of two upgradient wells (699-24-35 and 699-26-35A) and six downgradient wells (699-22-35, 699-23-34B, 699-24-33, 699-24-34A, 699-24-34B, and 699-25-34E) (Table B-92 in Appendix B). Wells 699-24-34C and 699-25-34C that were part of the original network described in PNNL-13014 became sample dry prior to 2013 and can no longer be sampled. In addition, Well 699-23-34A became sample dry in October 2013 and can no longer be sampled. Replacement Well 699-25-34E was completed in 2014 and was sampled during the last quarterly event.

Per PNNL-13014, the wells are sampled quarterly for ammonium, chemical oxygen demand, chloride, iron (filtered), manganese (filtered), nitrate, nitrite, pH, specific conductance, sulfate, temperature, total coliform, TOC, and zinc (filtered) per WAC 173-304-490. The wells are also sampled for arsenic (filtered) and VOCs. Note that SWL is currently regulated by WAC 173-350; however, WAC 173-350 was not yet promulgated at the time that PNNL-13014 was written in 2000, so the plan was developed in accordance with WAC 173-304.

10.14.1 Sampling Results

The results of the leachate, soil gas, and groundwater monitoring are reported annually in a separate report prepared by MSA, (*Hanford Site Solid Waste Landfill Annual Monitoring Report, October 2013 through September 2014*). The following paragraphs provide a summary.

10.14.1.1 Leachate and Soil Vapor Monitoring

A leachate collection system (lysimeter) underlying one set of double trenches within SWL is sampled quarterly. Therefore, the results are not necessarily representative of total leachate volume or chemistry by all the trenches in the landfill.

Some of the inorganic analytes were detected, but the VOCs were generally not detected. Some of the leachate results, including dissolved iron, dissolved manganese, arsenic and total dissolved solids exceeded WAC 173-200 standards; however, the fact that contaminants are above compliance levels in the leachate does not necessarily mean they are present in the groundwater.

The soil gas monitoring network consists of eight shallow monitoring stations located around the perimeter of the SWL. In addition to the eight soil gas monitoring stations positioned around the SWL, an additional station is located between the SWL and NRDWL. Each monitoring station consists of two dedicated soil gas probes driven to depths of about 2.7 and 4.6 m (8.9 and 15 ft), respectively. The soil gas is monitored quarterly to determine concentrations of carbon dioxide and methane. The soil gas is also analyzed for several key VOCs: methylene chloride, 1,1-dichloroethane, chloroform, 1,1,1-trichloroethane, carbon tetrachloride, TCE, 1,1,2-trichloroethane, and PCE. Soil gas at the SWL was analyzed in November 2013, February 2014, May 2014, and August 2014 (*Hanford Site Solid Waste Landfill Annual Monitoring Report, October 2013 through September 2014*). The concentrations for the VOCs, methane, and carbon dioxide continue to be consistent with results from previous monitoring. The concentrations for volatile organic constituents were at or below the detection limits. Methane concentrations remain low or are not detected. Carbon dioxide concentrations continue to be consistent with previous results.

10.14.2 Groundwater Monitoring Results

Groundwater monitoring results for the analytes listed in the sampling plan per WAC 173-304-490 are detailed in Table B-93 of Appendix B. The results are summarized below.

10.14.2.1 Ammonium

Ammonium did not exceed the BTV of 90 µg/L in 2014 with concentrations ranging from less than 6.44 µg/L (nondetect) to 64.9 µg/L. Historically, ammonium has been detected intermittently, and has only exceeded the BTV one time in Well 699-24-34A in 2009.

10.14.2.2 Chemical Oxygen Demand

In 2014, chemical oxygen demand (COD) ranged from less than 10 (nondetect) to 17.4 mg/L. COD exceeded the BTV of 10 mg/L in 2014 in downgradient Wells 699-24-34A, 699-24-34B, 699-23-34B, and 699-24-35 and upgradient Well 699-22-35.

10.14.2.3 Chloride

Chloride concentrations detected in 2014 ranged from 5.41 to 8.30 mg/L. Well 699-24-34E exceeded the BTV of 7.82 mg/L in the July sampling event. Since the current sampling plan was implemented at SWL in 2001, chloride has exceeded the BTV intermittently in all 10 of the network wells.

10.14.2.4 Coliform Bacteria

Coliform bacteria concentrations in 2014 ranged from less than 1 colony/100 mL (nondetect) to 12 colonies/100 mL. Coliform bacteria was detected above the BTV in Wells 699-24-34A, 699-24-34E, and 699-24-35. Well 699-24-34B had the maximum detected concentration in 2014 of 12 colonies/100 mL. Since sampling began per PNNL-13014 in January 2001, COD has exceeded the BTV intermittently in 9 of the 10 network wells, including both of the upgradient wells (699-24-35 and 699-26-35A).

10.14.2.5 Iron (Filtered)

In 2014, dissolved (filtered) iron concentrations ranged from less than 12.8 µg/L (nondetect) to 85.4 µg/L, which were all below the BTV of 160 µg/L. Only two iron results from Well 699-22-35 (at a concentration of 259 µg/L in 2011) and in Well 699-24-34A at a concentration of 211 µg/L in 2004, have exceeded the BTV.

10.14.2.6 Manganese (Filtered)

Dissolved (filtered) manganese concentrations ranged from less than 1 µg/L (nondetect) to 2.7 µg/L in the SWL wells. The reporting limit in 2014 was well below the BTV of 18 µg/L. Concentrations of dissolved manganese in the SWL wells have never been detected above the BTV since sampling was initiated under the current sampling plan in 2001. The maximum concentration detected was 17.9 µg/L in 2004 in Well 699-24-34A.

10.14.2.7 Nitrate

In 2014, nitrate concentrations were detected at concentrations ranging from 11.1 to 19.0 mg/L. Since 2001, the highest nitrate concentration detected in the SWL well network was 20.4 mg/L in Well 699-23-34A in 2011. The detected concentrations have been below the BTV of 29.0 mg/L. The SWL is near the southwestern extent of elevated nitrate concentrations that emanated from 200 East Area sources. Concentrations of nitrate detected in the SWL have been consistent with the regional interpretation of nitrate groundwater impacts.

10.14.2.8 Nitrite

All analyses for nitrite concentrations at the SWL in 2014 were nondetect. Detection limit values ranging from less than 131 to less than 9.85 µg/L were all below the BTV for nitrite of 266 µg/L. Since sampling began per the current sampling plan in 2001, nitrite has exceeded the BTV intermittently in 8 of the 10 network wells, including both of the upgradient wells (699-2-35 and 699-26-35A).

10.14.2.9 pH Measurements

In 2014, pH measurements ranged from 6.55 to 7.04 in downgradient wells. The pH measurements did not exceed the upper bound BTV of 7.84. The pH measurements were less than the lower bound BTV of 6.68 in the January quarterly samples from Wells 699-24-34A, 699-24-34B, and 699-24-25-34E and in the July sampling event for Well 699-23-34B. Historically, pH measurements have exceeded the lower bound of the BTV intermittently in 6 of the 10 network wells, including upgradient Well 699-24-35, and have only been detected once above the upper-bound BTV in Well 699-25-34C in 2003.

10.14.2.10 Specific Conductance

In 2014, specific conductance was field measured at concentrations ranging from 627 to 808 µS/cm in downgradient wells. In 2014 as in 2013, all six downgradient wells had specific conductance that exceeded the BTV of 583 µS/cm. Three downgradient wells in 2014 had measurements above the 700 µS/cm limit of WAC 246-290-310. Specific conductance measurements in upgradient wells were below the BTV. Elevated specific conductance is principally caused by an increase of bicarbonate concentration in the groundwater at the SWL (Section 3.4 of DOE/RL-94-143). Since sampling began per the current sampling plan in 2001, specific conductance has exceeded the BTV intermittently in 6 of the 10 network wells, including upgradient Well 699-24-35.

10.14.2.11 Sulfate

Sulfate ranged in concentration from 38.8 to 47.8 mg/L during 2014. Sulfate exceeded the BTV of 47.2 mg/L in downgradient Well 699-23-34B during the July sampling events. Since 2000, sulfate has intermittently exceeded the BTV in 9 of 10 network wells.

10.14.2.12 Temperature

In 2014, only one temperature measurement in the third quarter (July) from Well 699-24-34A exceeded the BTV of 20.7°C (69.3°F). Excluding that one measurement, temperatures ranged from 17.7 to 20.3°C (63.9 to 68.5°F) in network wells. Since 2000, the temperature has been measured one time above the BTV in downgradient Wells 699-23-34A, 699-24-33, 699-24-34C, 699-24-34B, and 699-23-34B; two times in Well 699-24-34A; and three times in Well 699-22-35.

10.14.2.13 Total Organic Carbon

TOC concentrations ranged from less than 270 to 1,630 µg/L in 2014. TOC exceeded the BTV of 1,200 µg ug/L in downgradient Well 699-24-33 in April and October. Since 2000, TOC has been detected in all of the network wells ranging from 3 times in Well 699-24-34C (sample dry since 2001) to 22 times in Well 699-23-34B.

10.14.2.14 Zinc (Filtered)

In 2014, dissolved zinc concentrations ranged from less than 5 µg/L (not detected) to 33.6 µg/L, all below the BTV of 42.3 µg/L. Since 2000, dissolved (filtered) zinc has not been detected above the BTV of 42.3 µg/L.

10.14.2.15 Site-Specific Parameters

Additional site-specific parameters monitored for the SWL include filtered arsenic and VOCs. Filtered arsenic was detected in 2014 from well samples at concentrations ranging from 1.54 to 7.61 µg/L. In 2014, arsenic concentrations exceeded the MTCA Method A value of 5 µg/L in third quarter sampling at downgradient Well 699-24-34A, with a concentration of 7.61 µg/L. Since 2000, filtered arsenic has been detected above the MTCA Method A value of 5 µg/L in three samples from three downgradient wells in 2012 (during second quarter sampling in Wells 699-24-35 and 699-23-34B; and third quarter sampling in Well 699-23-34A). The Hanford Site groundwater background value for arsenic is 11.8 µg/L (Table 1-2).

Five VOCs (PCE, TCE, chloroform, 1,1-dichloroethane, and 1,1,1-trichloroethane) were detected in samples at low concentrations that were "J" qualified by the laboratory. Concentrations ranged from 0.1 to 1.23 µg/L. Detections occurred at both upgradient and downgradient wells. The laboratory "J" flag indicates that the value is estimated and the detection is uncertain, and the value reported is less than the practical quantitation limit, but greater than or equal to the method detection limit.

Since 2000, a total of 20 VOCs have been detected in samples collected from the SWL monitoring network. Five of the VOCs (1,1,1-trichloroethane, 1,1-dichloroethane, chloroform, PCE, and TCE) have been detected most frequently. A large number of the detections were "J"-qualified values. These constituents have generally decreased in concentration since sampling began in 2000 (e.g., 1,1,1-trichloroethane)

10.14.3 Water-Level and Well Network Evaluation

From 2011 to March 2014, efforts were undertaken to improve the accuracy of the water-level measurements and resultant estimates of groundwater gradient near the NRDWL and SWL. The efforts included vertical offset surveys of well casings, high-resolution water-level measurements, and consideration of barometric effects. The results from the data collection and analysis yielded an average hydraulic gradient from January 2011 to March 2013 of 3.3×10^{-5} m/m and a flow direction of 101 degrees azimuth (southeast). Data compiled during 2014 and utilized for trend surface analysis indicate a flow direction of 125 degrees azimuth (southeast) and a hydraulic gradient of 2.4×10^{-5} m/m. This flow direction generally agrees with the southeastward flow direction inferred from historical plume migration in this area, and hydraulic head differences in the NRDWL/SWL area compared to the 200 East Area. For example, during 2012, the average water level elevation near NRDWL and SWL (121.66 m [399.15 ft], NAVD88 for April 2012) was 0.14 m (0.46 ft) lower than the average elevation in the 200 East Area (121.80 m [399.61 ft], NAVD88 for April 2012), yielding a regional hydraulic gradient magnitude of 1.8×10^{-5} m/m.

An updated WAC compliant groundwater monitoring plan for the SWL will be developed in 2015 to replace PNNL-13014. The new plan will incorporate the most current groundwater flow direction data obtained from the low-gradient monitoring network; present new geologic cross sections derived from data incorporated in the Hanford South Geoframework Model (ECF-HANFORD-13-0029, *Geologic Framework Model to Support Fate and Transport Modeling for Remedial Investigation/Feasibility Studies of the 200-BP-5 and 200-PO-1 Groundwater Operable Units*; review and summarize historical monitoring results with the relationship to changing flow directions, and update the conceptual site model.

This page intentionally left blank.