2.11 200-PO-1 Operable Unit

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The scope of this section is the 200-PO-1 groundwater interest area, which includes the 200-PO-1 Operable Unit (see Figure 2.1-1 in Section 2.1). This area encompasses the south portion of the 200 East Area and a large triangle-shaped portion of the Hanford Site extending to the Hanford town site to the east and the 300-FF-5 groundwater interest area to the southeast. The 216-B-3 pond (B Pond) straddles two operable units but is considered part of the 200-PO-1 interest area. The Groundwater Performance Assessment Project (groundwater project) established the interest areas to aid in planning, scheduling, and interpretation. Figure 2.11-1 shows facilities and near-field wells. Figure 2.1-2 in Section 2.1 shows the locations of 600 Area wells including 200-PO-1 Operable Unit far-field well and shoreline monitoring sites in this region. Tritium, nitrate, and iodine-129 are the contaminants of greatest significance in groundwater. Other contaminants of concern include arsenic, chromium, cyanide, manganese, strontium-90, technetium-99, and vanadium.

Tritium, nitrate, and iodine-129 are the contaminants of greatest significance in this operable unit.

The primary monitoring objective is to meet the groundwater monitoring requirements for the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), *Resource Conservation and Recovery Act* (RCRA), Washington Administrative Code (WAC), and the *Atomic Energy Act of 1954* (AEA) as directed in U.S. Department of Energy (DOE) Orders. The long-term goal for CERCLA is to monitor the contaminants of concern until final cleanup decisions are made. Included within the operable unit are six RCRA units

Groundwater monitoring in the 200-PO-1 groundwater interest area includes the following monitoring activities:

CERCLA Monitoring

- ***One-hundred-twenty wells (79 far-field and 41 near-field wells) are sampled annually to triennially for tritium, nitrate, and iodine-129 plus other constituents depending on location. The 79 far-field wells are also the far-field wells of the RCRA PUREX cribs site.***
- ***In FY 2004, 16 of the 120 wells were not sampled as scheduled (see Section 2.11.2 and Appendix A for details).***

Facility Monitoring

- ***Groundwater monitoring of the eight wells at the Integrated Disposal Facility has not started. Construction of the facility began in September 2004.***
- ***Eleven near-field wells are sampled quarterly to triennially at the RCRA PUREX cribs facility for RCRA and AEA monitoring.***
- ***Seven wells at the single-shell tank Waste Management Area A-AX are monitored semiannually for RCRA and AEA monitoring. Two wells were decommissioned after problems with corrosion.***
- ***Nine wells are sampled semiannually at the 216-A-29 ditch for RCRA monitoring.***
- ***Four wells are sampled semiannually sampling at the 216-B-3 pond (B Pond) for RCRA and AEA monitoring.***
- ***Three wells are sampled quarterly at the 200 Area Treated Effluent Disposal Facility under a Washington State waste discharge permit (WAC 173-216).***
- ***Nine wells are sampled semiannually at the Nonradioactive Dangerous Waste Landfill for RCRA and AEA monitoring.***
- ***Ten wells at the Solid Waste Landfill are sampled quarterly under a Washington State solid waste landfill permit (WAC 173-304). One of the downgradient wells went dry in FY 2003.***
- ***Three water supply wells at the 400 Area are sampled quarterly to annually for AEA.***

including the Plutonium-Uranium Extraction (PUREX) cribs (called the RCRA PUREX cribs), Waste Management Area A-AX (single-shell tanks), 216-A-29 ditch, Integrated Disposal Facility, B Pond, and the Nonradioactive Dangerous Waste Landfill. Two other facilities that are not regulated under RCRA but are subject to WAC requirements are the 200 Area Treated Effluent Disposal Facility and the Solid Waste Landfill.

Groundwater in the 200-PO-1 Operable Unit flows to the southeast and east.

Groundwater in the unconfined aquifer generally flows southeastward in the west portion of the operable unit and northeastward, eastward, and southeastward in the east portions of the operable unit as groundwater approaches the Columbia River (see Figure 2.1-3 in Section 2.1). A detailed discussion of 200 East Area hydrogeology can be found in PNNL-12261. Further discussions of more local groundwater flow characteristics are found in Section 2.11.3.

The remainder of this section describes contaminant plumes and concentration trends for the contaminants of concern under CERCLA, RCRA, AEA, and WAC monitoring.

2.11.1 Groundwater Contaminants

This section describes the major contaminants of concern within the 200-PO-1 Operable Unit. They include tritium, nitrate, iodine-129, technetium-99, strontium-90, arsenic, chromium, cyanide, manganese, and vanadium. Greater details at various RCRA or WAC facilities are discussed in Section 2.11.3.

2.11.1.1 Tritium

The source for the large tritium plume that extends from the southeast portion of the 200 East Area to the Columbia River (see Figure 2.1-5 in Section 2.1) is in the vicinity of the PUREX cribs.[(a)] The highest concentrations of tritium (drinking water standard 20,000 pCi/L) in this plume remain near these cribs. The highest level recorded during fiscal year (FY) 2003 was 5.57 million pCi/L at well 299-E17-9 at the north end of crib 216-A-36B for a sample collected in October 2002. This well went dry after that sampling event and was replaced by existing well 299-E17-16, which had a reported level of 231,000 pCi/L for a sample collected in April 2003 and 223,000 pCi/L for a sampled collected October 2003. The highest reported level of tritium during FY 2004 was 616,000 pCi/L for a sample collected January 2004 at well 299-E17-14 (also at the 216-A-36B crib). Thus, the current groundwater monitoring network may not reflect the highest concentration of tritium in the plume.

Concentrations of tritium continue to decline as the plume is attenuating naturally.

Concentrations of tritium continue to decline as the plume is attenuating naturally due to radioactive decay and dispersion combined with the general decreasing source that resulted from the termination of PUREX Plant operations. Wells in the east portion of the 200-PO-1 Operable Unit have tritium concentrations above 80,000 pCi/L (see Figure 2.1-5 in Section 2.1) from an early period of discharge to the PUREX cribs (PNNL-11141). These wells are expected to continue to experience decreasing concentrations as pulses representing the two periods of PUREX Plant operations move beyond the wells into the river. These wells more distant from the source are sampled once ever three years and most were sampled during FY 2004. Generally, wells near the PUREX cribs show a steady to decreasing trend as demonstrated in the trend plot for well 299-E17-14 (Figure 2.11-2).

The zone of lower tritium concentration near Energy Northwest (see Figure 2.1-5 in Section 2.1) may be due to a zone of lower hydraulic conductivity in the unconfined aquifer. At that site, the water table is within the upper portion of the Ringold Formation that locally may have a greater degree of cementation. Tritium at the 618-11 burial grounds located just west of Energy Northwest is discussed in Section 2.12.1.6.

(a) The term "PUREX cribs" refers to all the cribs in the southeast part of the 200 Area and east of the 200 East Area where PUREX wastewater was discharged. Three of these cribs are monitored under RCRA and are termed RCRA PUREX cribs (see Section 2.11.3.2).

Tritium was also detected in the lower portions of the unconfined aquifer, the lower Ringold Formation confined aquifer, and a basalt-confined aquifer. This information was derived from 13 wells screened in the lower portions of the unconfined aquifer (lower Ringold Formation unconfined aquifer), 8 wells in confined aquifers in the lower Ringold Formation, and 5 basalt-confined aquifer wells. (Note: These 26 wells are the only wells providing information on the deep subsurface. The potential for deep aquifer contamination outside of the areas of these 26 wells is unknown.) Locations where tritium was detected in the lower unconfined aquifer include near the Hanford town site, B Pond, 216-A-29 ditch, 400 Area water-supply wells, 200 Area Treated Effluent Disposal Facility, 618-11 burial ground, and the general area immediately southeast of the 200 East Area. Exceedances of the drinking water standard (20,000 pCi/L) were found in the lower portions of the unconfined aquifer at B Pond (21,300 pCi/L) and the Hanford town site (82,000 pCi/L), and in the Ringold confined aquifer only at B Pond (47,500 pCi/L). The only deep basalt well where tritium was found in significant levels was well 699-42-40C at B Pond (5,080 pCi/L).

The iodine-129 plume is dispersing, but at a very slow rate.

2.11.1.2 Iodine-129

The iodine-129 plume (see Figure 2.1-7 in Section 2.1) extends southeast into the 600 Area and appears to coincide with the tritium and nitrate plumes (see Figures 2.1-5 and 2.1-6 in Section 2.1). There is very little difference between this year's map and the corresponding map in last year's groundwater annual report (PNNL-14548, Figure 2.1-7). Although the iodine-129 plume is dispersing, it is doing so at a very slow rate.

The highest iodine-129 concentrations (drinking water standard 1.0 pCi/L) detected in the 200 East Area in FY 2004 were near the PUREX cribs and Waste Management Areas A-AX and C (see Figure 2.1-7 in Section 2.1). The maximum concentration of iodine-129 detected in FY 2004 was 10.2 pCi/L at well 299-E17-14 near the 216-A-36B crib. Concentrations of iodine-129 in groundwater near the PUREX cribs are generally declining slowly or are stable, as shown for wells 299-E17-1 (Figure 2.11-3) and well 299-E17-14 (Figure 2.11-4). Concentrations of iodine-129 in wells near the Columbia River on the east side of the 200-PO-1 Operable Unit continue to be less than 1.0 pCi/L (not detectable).

Iodine-129 was detected in the lower portions (or base) of the Ringold Formation unconfined aquifer near the 216-A-29 ditch and B Pond. In both of these areas, the concentrations exceeded the drinking water standard (1.0 pCi/L) with the highest reported occurrence near the 216-A-29 ditch (5.0 pCi/L). Iodine-129 was not detected during FY 2004 in the eight wells screened in the Ringold Formation confined aquifer.

2.11.1.3 Nitrate

The extent of the nitrate plume that originates from the 200 East Area (see Figure 2.1-6 in Section 2.1) is nearly identical to the tritium plume. However, the area with nitrate concentration above the drinking water standard (>45 mg/L) is more restricted than the area with tritium above its drinking water standard of 20,000 pCi/L. Nitrate at levels above the drinking water standard north of the 400 Area and at Energy Northwest, within the area impacted by the PUREX cribs, can be attributed to wastewater disposal or activities in those areas. The nitrate plume (see Figure 2.1-6 in Section 2.1) appears to have receded slightly over previous years throughout most of its extent except for the south-most portions of the plume near the 300 Area (Section 2.12.1.5) and in the immediate vicinity of the PUREX cribs (PNNL-14187; PNNL-14548).

The nitrate plume appears to have receded slightly over previous years throughout most of its extent.

Near two PUREX cribs (216-A-10 and 216-A-36B), the wells generally showed an increase in nitrate concentration during FY 2004. Furthermore, the highest concentrations of nitrate in the 200-PO-1 Operable Unit during FY 2004 occurred near these two cribs. The maximum nitrate concentration observed was 132 mg/L at well 299-E17-14 at the 216-A-36B crib during July 2004. The general increase in nitrate concentration extends northwestward near an upgradient well (299-E24-18) for the 216-A-10 and 216-A-36B cribs (Figure 2.11-5). Because well 299-E24-18 showed increased concentrations of nitrate,

it is not clear whether there are other localized sources of nitrate or there are some local irregularities in groundwater flow direction that are not fully understood.

Nitrate was detected in the lower portions (or base) of the Ringold Formation unconfined aquifer near the Hanford town site, 216-A-29 ditch, Nonradioactive Dangerous Waste Landfill, B Pond, PUREX cribs, 200 Area Treated Effluent Disposal Facility, and the 400 Area water supply wells. The highest detected level was 9 mg/L at the Hanford town site. Nitrate was also detected in the lower Ringold Formation confined aquifer at B Pond and the 618-11 burial ground. The highest detected level in the confined aquifer was 2.7 mg/L at B Pond. Nitrate did not exceed the 45-mg/L drinking water standard at any of the wells screened in the lower portions of the unconfined aquifer or Ringold Formation confined aquifer.

2.11.1.4 Strontium-90

There is a small plume of strontium-90 (a beta-emitter) at the 216-A-10 and 216-A-36B cribs. It is also detected at Waste Management Area A-AX and at the 216-A-37-1 crib. The only well with strontium-90 concentration above the drinking water standard (8 pCi/L) during FY 2004 was well 299-E17-14 with a maximum of 21 pCi/L. Well 299-E17-14 is near the 216-A-36B crib and shows an increasing trend from 1997 to 2001, and then no overall increase or decrease (Figure 2.11-6). The impact is localized because of the low mobility of strontium-90 compared to tritium, iodine-129, and nitrate. This result is consistent, in part, with a gross beta concentration of 64 pCi/L in the same well. The drinking water standard for gross beta is 50 pCi/L.

The newly installed well (299-E25-93) at Waste Management Area A-AX had technetium-99 levels ranging from 8,670 to 13,100 pCi/L during FY 2004.

2.11.1.5 Technetium-99

Technetium-99 is detected at Waste Management Area A-AX in concentrations well above the drinking water standard (900 pCi/L) and is detected indirectly at the PUREX cribs. Although most results at Waste Management Area A-AX were well below the drinking water standard, groundwater samples collected from well 299-E25-93 (a new well installed in late 2003) had technetium-99 concentrations ranging from 8,670 to 13,100 pCi/L during FY 2004. (For more information about technetium-99 at Waste Management Area A-AX, refer to Section 2.11.3.3.)

The result for gross beta (64 pCi/L) at well 299-E17-14 (at the 216-A-36B crib) is more than can be accounted for from the strontium-90 result (21 pCi/L) in the same well. If strontium-90 was the only beta-emitter present, gross beta would be ~42 pCi/L. Therefore, the 64 pCi/L result must include another beta-emitter. The higher result is most likely due to technetium-99, another beta-emitter. (The estimated technetium-99 would be ~66 pCi/L.) The last technetium-99 result from well 299-E17-14 was 209 pCi/L in FY 1994. Technetium-99 is no longer routinely analyzed in PUREX cribs well samples because previous results were significantly less than the drinking water standard (900 pCi/L), and gross beta analysis could be used as a screening tool for technetium-99 and other beta-emitters.

2.11.1.6 Other Constituents

Arsenic, chromium, manganese, cobalt-60, cyanide, and vanadium are also contaminants of concern at various facilities within the 200-PO-1 Operable Unit. Cobalt-60, cyanide, and vanadium are potential contaminants of concern at the BC cribs, and will be analyzed when the new sampling and analysis plan for the 200-PO-1 Operable Unit is implemented in FY 2005.

Filtered arsenic and chromium are routinely analyzed in samples of 200-PO-1 Operable Unit wells. Results show that filtered arsenic was detected (e.g., 3 to 9 µg/L) for PUREX cribs wells for FY 2004 but in concentrations similar to Hanford groundwater background values (DOE/RL-96-61). Filtered chromium continued to exceed the drinking water standard (100 µg/L) at wells near Waste Management Area A-AX (Section 2.11.3.3), but the elevated results are interpreted to be related to the corrosion of the stainless steel casing.

Plume areas (square kilometers) above the drinking water standard at the 200-PO-1 Operable Unit:

Chromium — 0.01
Iodine-129 — 65.79
Nitrate — 0.05
Strontium-90 — 0.01
****Tritium — 126.63***

****Includes portion of plume beneath 300-FF-5 Operable Unit.***

Filtered manganese was not detected above the secondary drinking water standard (50 µg/L) at the PUREX cribs or Waste Management Area A-AX as it has in past years. The trend for filtered manganese at these sites was erratic, supporting the suggestion that these spurious occurrences are possibly related to corrosion of the well casing or screen.

A plume of chromium flowing from the southwest toward the northeast is detected by wells southwest and within the BC cribs area (see Section 2.9.1). However, the most elevated concentration ever detected was 73.3 µg/L in May of 1998. During FY 2004, the maximum concentration at wells monitoring the BC cribs was 41 µg/L.

2.11.2 Operable Unit Monitoring

The 200-PO-1 Operable Unit contains a large section of the Hanford Site (see Figure 2.1-1 in Section 2.1). Its boundaries are generally defined by the largest contamination plume of the operable unit, tritium. The north boundary is the line separating the 200-BP-5 Operable Unit with the 200-PO-1 Operable Unit in the 200 East Area and the 2,000-pCi/L tritium contour line that trends eastward toward the Columbia River. The southwest boundary is the 2,000-pCi/L tritium contour line. The south boundary coincides with the north boundary of the 300-FF-5 Operable Unit, and the east boundary is the Columbia River. The 200-PO-1 Operable Unit also contains the BC cribs area because they are known to have received liquid waste from PUREX plant operations.

Groundwater monitoring at the 200-PO-1 Operable Unit ensures that requirements for CERCLA and AEA are met. The long-term goal is to monitor the groundwater contaminants of concern until final cleanup decisions are made. A record of decision has not been written for this operable unit. The results of 200-PO-1 Operable Unit groundwater monitoring for FY 2004 included in this annual report constitute the official report for FY 2004. There is no separate report as there is for operable units with remediation.

During FY 2004, the 200-PO-1 Operable Unit was monitored under DOE/RL-2003-04, which was based on the results of a data quality objectives process (PNNL-14049). Major groundwater contaminants of concern are tritium, nitrate, and iodine-129. Minor groundwater contaminants of concern are arsenic, chromium, cyanide, manganese, strontium-90, technetium-99, and vanadium (see Section 2.11.1 for maps and descriptions of plumes and trends). Because many of the wells are older designs and have not been sampled recently, groundwater sampling was unsuccessful at 11 of the scheduled wells during FY 2004. Two of these wells were decommissioned, three went dry, and two had safety concerns due to procedural problems with air-lift sampling. In addition, five other wells were not sampled because of scheduling errors. A table of 200-PO-1 Operable Unit monitoring wells, including details of monitoring frequency, constituents analyzed, and sampling difficulties (if applicable) for FY 2004, is provided in Appendix A, Table A.13.

Filtered manganese was the only contaminant discovered above drinking water standards in groundwater samples collected from an exploratory borehole at the BC cribs area.

Thirteen wells near the BC cribs and 11 wells near Waste Management Area A-AX are scheduled for decommissioning during FY 2005. These 24 wells will be sampled early in FY 2005. For the 13 BC cribs wells, this may be the last opportunity to sample these wells. They are being decommissioned because they are in the way of an impermeable cover that is expected to be placed over the BC cribs area. The 11 wells at Waste Management Area A-AX will be sampled and evaluated for possible continued use to monitor cribs and to provide a monitoring location between Waste Management Areas A-AX and C.

An exploratory borehole at the 216-B-26 trench (BC cribs area) was drilled through the vadose zone to groundwater (~105 meters), and sediment samples were collected and analyzed for suspected contaminants. Uranium, cesium-137, and strontium-90 were discovered at shallow depths, and technetium-99 and nitrate were discovered at the 31-meter level (see Chapter 3 for more detailed information about this and other vadose zone studies at the BC cribs area). A groundwater sample collected at the water table showed that the only constituent above background levels was manganese at 208 µg/L (drinking water

standard 50 µg/L). The manganese is probably an artifact of the drilling process. Results from both the vadose zone studies at the BC cribs area (Chapter 3) and the groundwater sampling results from the exploratory borehole will aid in the selection of groundwater constituents monitored in BC cribs in the future.

2.11.3 Facility Monitoring

This section describes results of monitoring individual facilities such as treatment, storage, or disposal units or tank farms. Groundwater at some of these facilities are monitored under the requirements of RCRA for hazardous waste constituents and AEA for radionuclides including source, special nuclear, and by-product materials. Data from facility-specific monitoring are also integrated into the CERCLA groundwater investigations. Hazardous constituents and radionuclides are discussed jointly in this section to provide comprehensive interpretations for each facility. As discussed in Section 2.1, pursuant to RCRA, the source, special nuclear, and by-product material components of radioactive mixed waste are not regulated under RCRA and are regulated by DOE acting pursuant to its AEA authority. Groundwater data for these facilities are available in the Hanford Environmental Information System (HEIS 1994) and on the data files accompanying this report. Additional information including well and constituent lists, maps, flow rates, and statistical tables are included in Appendix B.

The 200-PO-1 Operable Unit contains six RCRA sites, two sites regulated by WAC, and one site regulated exclusively under AEA groundwater requirements (Figure 2.11-1):

RCRA Sites

- PUREX cribs (216-A-10, 216-A-36B, and 216-A-37-1).
- Single-shell tanks at Waste Management Area A-AX.
- 216-A-29 ditch.
- Integrated Disposal Facility (not yet operational).
- 216-3 Pond.
- Non-Radioactive Dangerous Waste Facility (see Figure 2.1-2 in Section 2.1).

Sites Regulated under WAC

- Solid Waste Landfill
- Treated Effluent Disposal Facility

AEA-Regulated Sites

- 400 Area Water Supply Wells

RCRA assessment monitoring shows that the nitrate plume is generally attenuating, except for the area immediately around the PUREX cribs.

This section summarizes results of statistical comparisons, assessment studies, and other developments for FY 2004. Groundwater data are available in the Hanford Environmental Information System and in the data files accompanying this report.

2.11.3.1 Integrated Disposal Facility

The Integrated Disposal Facility will consist of an expandable, lined landfill covering ~20 hectares located in the south-central part of 200 East Area (see Figure 2.11-1 for location of the site and Appendix B for a list of network wells, their locations, and groundwater constituents monitored). The landfill will be divided lengthwise into two distinct cells, one for the disposal of low-level radioactive waste and the other for the disposal of mixed waste. The facility will be a RCRA-compliant landfill (i.e., a double-lined trench with leachate collection system) that is ~410 meters wide by 501 meters in length and up to 13.2 meters deep. The landfill will contain four layers of waste containers separated vertically by 0.9 meter of soil. The approximate volume of waste to be deposited will be 100 hectare-meters. The waste will be segregated into a RCRA-permitted side and a non-RCRA-permitted side.

Construction began in September 2004. DOE submitted a Part B RCRA permit application to the Washington State Department of Ecology (Ecology), and it will be incorporated into the Hanford Facility RCRA Permit after approval.

The groundwater monitoring network will consist of three upgradient wells and five downgradient wells (Appendix B) as required under WAC 173-303-645(G). Three wells remain to be installed; two will be installed in FY 2005; the third will be installed at a future date when required by facility expansion.

The indicator parameters that will be routinely monitored are chromium, specific conductance (field), total organic carbon, total organic halides, and pH (field). Supplemental parameters include alkalinity, anions, inductively coupled plasma metals, and turbidity (Appendix B). The indicator parameters will be used to monitor for hazardous constituents reaching the groundwater as a result of Integrated Disposal Facility operations.

Total organic carbon and total organic halides are indicator parameters selected to monitor impacts of RCRA-regulated organic constituents on the groundwater quality. Specific conductance is selected as an indicator parameter to monitor the effect of metals and anions on groundwater quality; pH is a general indicator of groundwater quality. Chromium is included as an indicator parameter because hexavalent chromium is one of the more mobile of the regulated metals expected at the Integrated Disposal Facility and should be one of the first constituents to enter groundwater if the regulated facility impacts groundwater.

Analyses of alkalinity, anions, and metals are to provide supplemental data on general groundwater chemistry beneath the Integrated Disposal Facility. This information aids data interpretation and quality control. Supplemental parameters will not be used in statistical evaluations. Turbidity is analyzed at the well just before sampling and provides an indication of the amount of particulate matter in suspension at the time of sampling.

Monitoring will begin when all FY 2005 wells are installed. All indicator parameters will be monitored twice each quarter and supplemental parameters once each quarter to determine background concentrations. After the first year, indicator parameters will be monitored by collecting for independent samples twice per year, and supplemental parameters will be monitored once semiannually. In addition, field measurements of temperature and turbidity will be made at each sampling event.

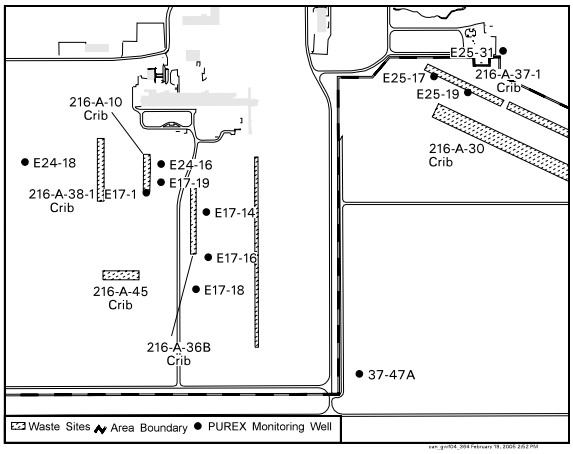
During the first sampling event at each well, samples will be collected for analysis of the Appendix IX constituents (40 CFR 264) included in Chapter 1 of the Integrated Disposal Facility permit application. During FY 2005, an operational monitoring plan will be written and implemented that will include radioactive groundwater constituents such as tritium, iodine-129, and technetium-99.

The Integrated Disposal Facility will be divided lengthwise into two distinct cells, one for the disposal of low-level radioactive waste and the other for the disposal of mixed waste.

2.11.3.2 RCRA PUREX Cribs

The RCRA PUREX cribs are located in the southeast part of the 200 East Area and include three cribs (216-A-10, 216-A-36B, and 216-A-37-1) monitored under RCRA interim status to assess groundwater quality. Other nearby cribs also received PUREX waste (e.g., 216-A-45 crib) but are not regulated as RCRA treatment, storage, and disposal units. They are monitored collectively under the 200-PO-1 Operable Unit. Vadose zone characterization near the RCRA PUREX cribs during FY 2004 are discussed in Section 3.1.1.

The objective of RCRA monitoring at these cribs is to assess the nature and extent of groundwater contamination with hazardous constituents and determine their rate of movement in the aquifer [40 CFR 265-93(d) as referenced by WAC 173-303-400]. Groundwater monitoring under AEA tracks radionuclides at the cribs and surrounding vicinity. Appendix B includes a well location map and lists of wells and constituents monitored for the RCRA PUREX cribs.



Groundwater flow for the two west cribs (216-A-10 and 216-A-36B) is most likely toward the southeast; for the 216-A-37-1 crib, it is south or southwest. (See Appendix B for more information on flow direction and rate information). The RCRA PUREX cribs are located in a region where several groundwater contamination plumes contain constituents that exceed drinking water standards. The similarities in effluent constituents disposed to these cribs, as well as to the 216-A-45 crib, make determining the contribution of the RCRA PUREX cribs difficult. During FY 2004, tritium, iodine-129, nitrate, strontium-90, and gross beta exceeded drinking water standards in RCRA PUREX cribs wells (see Sections 2.11.1.1 to 2.11.1.5 for more information on these constituents).

During FY 2004, tritium, iodine-129, nitrate, strontium-90, and gross beta exceeded drinking water standards in wells monitoring the RCRA PUREX cribs.

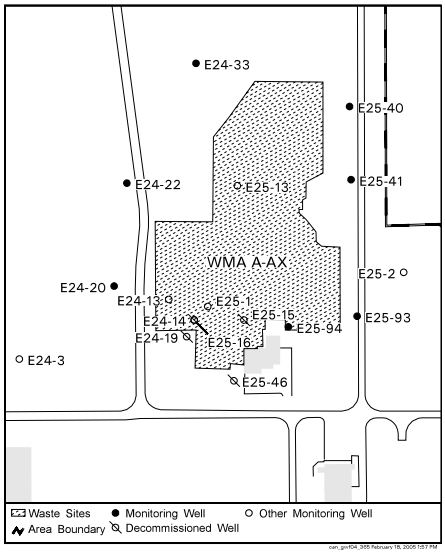
The RCRA PUREX cribs groundwater monitoring plan (PNNL-11523) organized the downgradient wells into two groups, near-field wells and far-field wells. The 11 near-field wells are shown in Figure 2.11-1 and Appendix B. The far-field wells include 78 wells that coincide with the same wells used for monitoring the major plumes of the 200-PO-1 Operable Unit (see Figure 2.1-2 in Section 2.1). The far-field wells are necessary to monitor the large tritium, nitrate, and iodine-129 plumes (see Figures 2.1-5, 2.1-6, and 2.1-7 in Section 2.1) that extend southeastward of the PUREX cribs area to the Columbia River and are discussed in Sections 2.11.1.1 through 2.11.1.3.

The tritium, iodine-129, and nitrate plumes (see Figures 2.1-5, 2.1-6, and 2.1-7 in Section 2.1), throughout the majority of their extent, are generally attenuating, except for nitrate in the area of the RCRA PUREX cribs. In recent years, the concentration of nitrate in RCRA PUREX cribs near-field wells has either held steady or risen (Section 2.11.1.3). The reason for the increased concentrations of nitrate in recent years is not known. However, it may be related to vadose zone inventory that continues to migrate to the saturated zone or to changes in groundwater flow paths due to the decreased amount of groundwater flow from B Pond and a greater contribution of groundwater flow from the northwest.

Strontium-90, a beta-emitter, occurs as a small plume at the 216-A-10 and 216-A-36B crib (Section 2.11.1.4). The plume there exceeded the drinking water standard for strontium-90 (8 pCi/L) at one well where there has been an increasing trend since 1997.

The well with the highest concentration of tritium went dry during FY 2003 and was replaced with an existing well with historically lower activity levels of tritium. Therefore, the zones of highest tritium levels are most likely no longer being monitored (north end of the 216-A-36B crib). However, the well network is adequate for determining the plume extent of the major and minor contaminants of concern and general concentrations throughout most of the plume areas.

2.11.3.3 Single-Shell Tank Waste Management Area A-AX



Located along the east border of the 200 East Area, Waste Management Area A-AX consists of the A Tank Farm, AX Tank Farm, 244-AR vault, ancillary waste transfer lines, and seven diversion boxes.

Groundwater monitoring at Waste Management A-AX continued under a RCRA interim status indicator evaluation program in FY 2004 (PNNL-13023-ICN-1). The objective of RCRA monitoring at this waste management area is to determine if groundwater quality has been compromised by dangerous waste constituents associated with the tank farms. Groundwater monitoring at A-AX Tank Farm continued under an interim status indicator evaluation program in FY 2004 [40 CFR 265.93(b) as referenced by WAC 173-303-400]. Radionuclides are tracked under AEA monitoring at the site. Appendix B includes a well location map, lists of wells and the constituents monitored for Waste Management Area A-AX.

The flow direction, determined by using local hydrographs and in situ flow measurements with the colloidal borescope, is east southeast to southeast (PNNL-14187). The saturated screen interval ranges from 1.7 to 3.5 meters in

RCRA network wells while the aquifer thickness is ~27 meters. The average rate of water-table decline was 9 centimeters in 2004. Some downgradient RCRA-compliant wells may be dry in ~7 years. The estimated flow rate at Waste Management Area A-AX is 1.2 to 2.2 meters per day (see Appendix B, Table B.2) depending on the hydraulic conductivity value used in the Darcy equation.

The monitoring network includes two monitoring wells installed in FY 2004, two installed in FY 2003, and five older wells. The network now meets the requirements of the groundwater monitoring plan (PNNL-13023).

Two wells were decommissioned in FY 2004 after a borehole video survey confirmed that they were corroded.

One of the new wells installed in FY 2004 is a downgradient well that replaces wells 299-E24-19 and 299-E25-46. These wells were decommissioned this year after it was confirmed with a borehole video survey that each well suffered from extensive corrosion of the casing in the vadose zone in proximity to a wet silt zone. Figure 2.11-7 shows the extent of the damage in wells 299-E24-19 and 299-E25-46. The silt layer is at a depth of ~84 to 86 meters below top of casing, corresponding to the location of the rotted out casings. The groundwater at both well locations displayed high levels of dissolved chromium, nickel, and manganese (PNNL-13788; PNNL-14548). Chromium levels began rising in well 299-E24-19 shortly after installation in 1991. However, chromium did not begin to appear in well 299-E25-46 until 1997 rising to over 6,000 µg/L by early 2003 during an extensive purge test. Installed in 1992, the corrosion in this well appears to have developed later, but rapidly dissolved the casing in 5 to 6 years. Sampled water was frequently described as green or yellow tinged. Local to the well bore, the pH is as low as 5.8 (measured during well purging), a result of the corrosive activity. Prior studies with extensive purge testing combined with the inverse relationship between chromium and pH plus the lack of correlation with processing waste constituents indicated that casing corrosion was the cause of the elevated metals in the groundwater (PNNL-13788; PNNL-14187; PNNL-14548).

Well maintenance reports from borehole videos surveys conducted in 1990 for two older wells (299-E25-16 and 299-E25-15 that are not compliant with WAC 173-160), located inside the A Tank Farm, describe rusted out or rotted casings at approximately the same depths as the corroded casings in the RCRA wells. A silt layer appears to be located once again at the approximate depth of the corrosion. These wells, installed in 1969, are cased with carbon steel.

A vadose zone investigation into the cause of casing corrosion is currently being conducted by the CH2M HILL Hanford Group Vadose Zone Project. Early results suggest that chloride introduced with the bentonite seal combined with damaged casing and the moisture in the silt may be the cause of the corrosion. Consequently, newly installed wells in the area have been sealed through this zone with cement instead of the usual bentonite. Further discussion of the results from this study can be found in Chapter 3 of this report.

Nitrate and technetium-99 exceeded drinking water standards in the new downgradient well 299-E25-93 at Waste Management Area A-AX.

Increasing levels of chromium (73.7 µg/L) at downgradient well 299-E25-40 prompted a recent borehole video in this well. Although corrosion is not extensive enough to detect elevated nickel and manganese, the video did confirm that the upper section of the screen is beginning to suffer from stainless steel corrosion. Groundwater monitoring will continue in this well along with regular borehole video surveys to document the progression of the corrosion and the resulting effect on groundwater quality. This study should assist in identifying when casing corrosion may be occurring in other Hanford wells.

In FY 2004, Waste Management A-AX wells were sampled twice for groundwater contamination indicators and site-specific parameters (Appendix B, Table B.29). Table B.30 in Appendix B lists updated upgradient/downgradient comparison values for statistical evaluations in FY 2005. Indicator parameter data from monitoring wells were statistically evaluated, and values from downgradient wells were compared to those established from the upgradient well. Except as noted below for total organic carbon, the indicator parameters (specific conductance, total organic carbon, pH, and total organic halides) did not exceed critical mean values in downgradient wells during FY 2004. However, the inclusion of

specific conductance data from upgradient well 299-E24-22 has lowered the critical mean for FY 2005 from 647 µS/cm, used in FY 2004, to 522 µS/cm for FY 2005 (Figure 2.11-8). The December 2004 values ranged from 533 to 535 µS/cm for specific conductance at well 299-E25-93, which exceeded the critical mean value of 522 µS/cm. However, confirmation sampling results were lower than the critical mean.

Although results from four quarters of data, collected at the new well 299-E24-22, show that the groundwater is relatively clean upgradient from the waste management area, initial data from the new downgradient well 299-E25-93 showed high levels of contamination for the first sampling event in December 2003. The total organic carbon value, averaged over four duplicate samples, was 3,600 µg/L, well over the FY 2004 critical mean of 2,360 µg/L for this site. Results from verification sampling in March 2004 averaged 1,700 µg/L, which, although below the critical mean, is above the limit of quantitation of 1,370 µg/L. Unless a stable trend of elevated total organic carbon above the limit of quantitation is established, it is not clear whether elevated total organic carbon is an issue at this site.

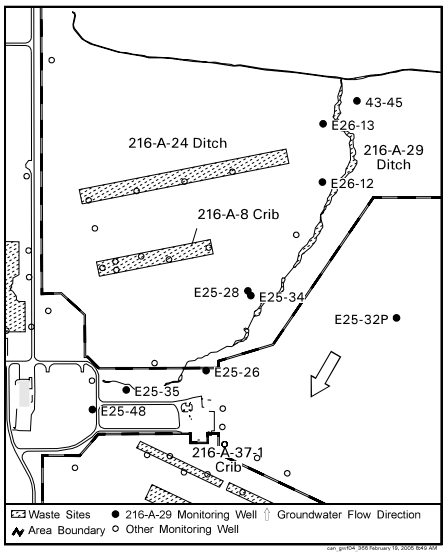
Along with the high total organic carbon, downgradient well 299-E25-93 is elevated in nitrate (maximum of 46.9 mg/L) and technetium-99 (maximum of 13,100 pCi/L). The drinking water standard for nitrate is 45 mg/L and 900 pCi/L for technetium-99. Although nitrate values range from 12.8 to 46.9 µg/L upgradient of the A Tank Farm, technetium-99 levels are low ranging from 18.7 to 36.5 pCi/L for the last sampling event. The next highest technetium-99 value of 274 pCi/L in downgradient wells is found at well 299-E25-41 where this level has been observed for the last 2 years.

Two downgradient wells at the 216-A-29 ditch continue to have exceedances of specific conductance critical mean.

Well 299-E25-93 was placed on quarterly sampling in June 2004 to establish a more detailed trend in the observed contamination. Although the source of the technetium-99 observed in well 299-E25-93 may appear to be associated with the A Tank Farm, sampling is currently being conducted at nearby cribs to determine if the groundwater under the cribs shows similar chemistry and contaminant levels. DOE and the regulatory agencies will investigate technetium-99 and other radionuclides under the operable unit (CERCLA) and related dangerous waste constituents (RCRA).

2.11.3.4 216-A-29 Ditch

The groundwater beneath the 216-A-29 ditch is monitored for evidence of hazardous waste migration as required by interim status RCRA regulations [40 CFR 265.93(b) as referenced by WAC 173-303-400]. The groundwater monitoring network at this facility is sampled twice annually for constituents that include contamination indicator parameters, annual groundwater quality parameters, and site-specific constituents (PNNL-13047; see Appendix B for list of network wells, their locations, and groundwater constituents monitored). The well network is adequate for the current groundwater flow directions. Vadose zone characterization was accomplished at the 216-A-29 ditch during FY 2004 and is discussed in Section 3.1.1.



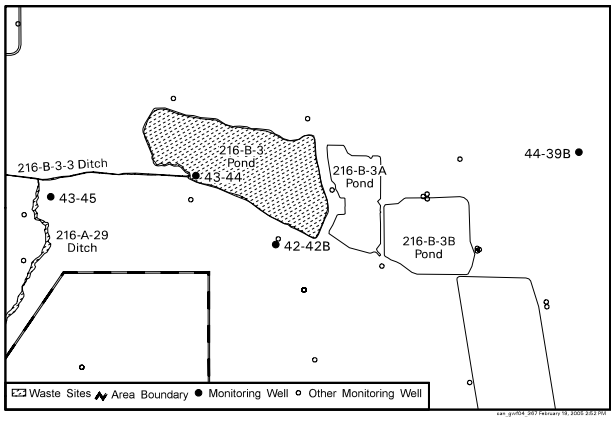
Except for specific conductance, indicator parameters in downgradient wells did not exceed critical mean values in FY 2004. Specific conductance exceeded its critical mean value in three downgradient wells during FY 2003 (299-E26-13, 299-E25-48, and 299-E25-35). During FY 2004, specific conductance did not exceed the critical mean in well 299-E26-13, although the other two wells still showed the exceedance. The reason for the exceedance at wells 299-E25-48 and 299-E25-35, which lie at the head end of the 216-A-29 ditch, is the high sulfate concentrations in groundwater associated with discharges of sulfuric acid. The reason for the elevation in wells in other portions of the ditch is unknown.

Two of the three wells that exceeded the critical mean for specific conductance in FY 2003 continued to exhibit an increasing trend. The trend for the third well has reached a plateau. Elevated sulfate levels have been shown to increase specific conductance at the 216-A-29 ditch in the past (WHC-SD-EN-EV-032). Sulfate

levels continued to rise in network wells – most of them with concomitant rise in specific conductance. This association has also been reported near the Liquid Effluent Retention Facility, Low-Level Waste Management Area 2, and Waste Management Areas A-AX and C. All of these facilities are located at the west edge of the decommissioned B Pond. Dissipation of the pond may have slowed the procession of a sulfate plume front that is moving southeast toward the east boundary of 200 East Area.

The direction of groundwater flow near the 216-A-29 ditch is generally to the south-southwest and the gradient is largely flat. The tritium plume emanating from the southeast corner of 200 East provides indirect evidence of the groundwater flow direction. The causes for the low gradient and indecipherable flow direction include the desaturation of the vadose zone beneath B Pond and the interaction of the lower mud with the unconfined unit beneath the 216-A-29 ditch. The B Pond continues to create a small hydraulic barrier that contributes to now localized reversals of groundwater flow. The lower mud unit of the Ringold Formation inhibits flow to the east near the 216-A-29 ditch and groundwater is, therefore, forced to the south. The resulting groundwater flow rate is low, not exceeding ~0.1 meter per day.

2.11.3.5 216-B-3 Pond Facility (B Pond)



The B Pond system includes the main pond and three expansion ponds. The main pond and an adjacent portion of 216-B-3-3 ditch are regulated under RCRA and require groundwater monitoring under 40 CFR 265.93(b) as referenced by WAC 173-303-400. These features are the regulated remnants of a more expansive system of ponds and ditches, most of which have been clean closed (PNNL-13367).

The B Pond system returned to a conventional RCRA interim status, detection monitoring schedule beginning in January 2004. This change marked the end of a period of experimental approach to groundwater monitoring at the B Pond system (PNNL-13367-ICN-1). Through a variance agreement with Ecology, the experimental approach allowed intrawell comparisons of site-specific parameters, gross alpha, gross beta, and specific conductance using a control-chart method with the Shewhart-CUSUM statistical analyses. The agreement also required monitoring of cadmium, lead, mercury, and silver annually for a 4-year period (that concludes in January 2005), then to discontinue monitoring if concentrations remain below drinking water standards. The specific results of this trial approach are presented in PNNL-14521.

The B Pond system returned to a conventional RCRA interim status, detection monitoring schedule beginning in January 2004 after a period of experimental approach to monitoring.

In summary, well 699-43-45 was the only well in the network during the entire trial period that produced results exceeding the lowest control limit (mean + 2 sigma). One result for gross beta in this well (8.61 pCi/L) briefly exceeded the mean + 2 sigma control limit of 8.08 pCi/L for the Shewhart and CUSUM in early 2002, then returned to levels below the control limit.

In January, 2004, gross beta activity rose to an all-time maximum of 9.54 pCi/L before again returning to a lower activity (6.25 pCi/L) in July 2004. Temporal trends in the B Pond system wells for specific conductance, gross beta, and, to a lesser degree, gross alpha, likely represent a recovery of groundwater to natural concentrations of these parameters, following the historical diluting effects of the B Pond discharges (PNNL-13367). Of the four metals (cadmium, lead, mercury, and silver), all were below detection limits for January 2004 sampling. These results were the same as for FY 2003, except for silver that was detected during FY 2003.

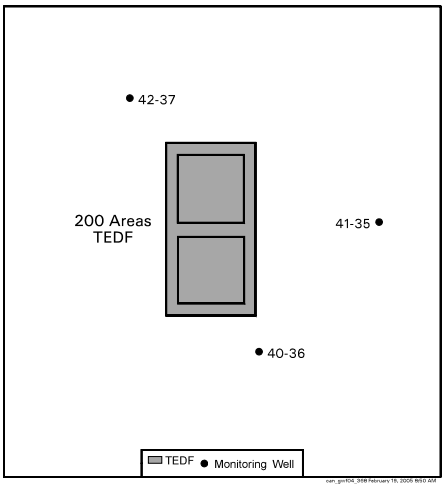
The current network wells and hydraulic gradient configuration allows upgradient/downgradient comparisons as prescribed by RCRA/WAC procedures for interim-status facilities. The groundwater monitoring well network for the B Pond system consists of a total of four wells (see Appendix B). Well 699-44-39B, is located in an area currently

upgradient of the B Pond, with three wells (699-42-42B, 699-43-44, and 699-43-45) located at the downgradient edges of the main pond and 216-B-3-3 ditch.

Background calculations of critical means for total organic carbon, total organic halides, specific conductance, and pH are based on the four most recent sampling events, including the two events in FY 2004 (see Table B.11, Appendix B). The earliest of these events go back to calendar year 2000, because total organic halides and total organic carbon were discontinued during the period of variance. In FY 2004, no results exceeded the critical means for total organic halides, total organic carbon, and field parameters are well within historical ranges, with the exception of pH and specific conductance in well 699-43-45. These two parameters indicate a slight upward trend over the past several years, and probably represent a gradual return to pre-operational conditions in the aquifer.

Based on July 2004 water-level measurements, groundwater flows west-southwest beneath the B Pond system at an estimated rate of 0.016 meter per day (Appendix B). Head measurements in vertically separated wells 699-43-41E and 699-43-41G indicated that a downward flow potential still exists near the main pond, although it is diminishing. The head difference between these two wells, as determined by March 2003 water levels, was 0.58 meter, compared with the March 2004 difference of 0.16 meter.

2.11.3.6 200 Area Treated Effluent Disposal Facility



The 200 Area Treated Effluent Disposal Facility is located southeast of the B Pond RCRA facility and has received effluent since June 1995. Groundwater beneath the facility is monitored under a Washington State waste discharge permit (WAC 173-216; PNNL-13032). Three wells, 699-40-36, 699-41-35, and 699-42-37 (Figure 2.11-1), monitor groundwater beneath the facility.

Because there was no unconfined aquifer beneath the 200 Area Treated Effluent Disposal Facility at the time of construction, the groundwater monitoring wells were installed in the Ringold Formation confined aquifer, which was the uppermost aquifer beneath the facility (see also Section 2.14). Thus, these three wells are isolated from the effects of the effluent by the relatively impermeable Ringold unit 8 silt and clay stratum (PNNL-14098). The quarterly analytical results from the wells are used to demonstrate continuation of the isolation.

Based on hydraulic head calculations for March 2004, and estimates of effective porosity and hydraulic conductivity, groundwater flow potential in the confined aquifer beneath the 200 Area Treated Effluent Disposal Facility is directed southwest at 0.004 meter per day. Historically, major ionic composition and extremely low tritium concentrations have suggested that groundwater in the confined Ringold Formation beneath this facility is older than groundwater in the adjacent unconfined aquifers, and thus unaffected chemically and radiologically by Hanford Site operations. Results of annual low-level tritium analyses confirm this assumption. However, hydraulic head continues to decline in all three wells at the Treated Effluent Disposal Facility, as a result of the dissipating pressure effects of historical discharges at the nearby B Pond facility.

At the 200 Area Treated Effluent Disposal Facility, all scheduled groundwater samples were collected during FY 2004 and no enforcement limits were exceeded.

Groundwater samples are collected quarterly from wells for a list of constituents required by the state waste-discharge permit ST-4502 (Ecology 2000). Three of the constituents (cadmium, lead, and pH) are compared with specific enforcement limits set by the permit (see Appendix B). All scheduled samples were collected during FY 2004, and no enforcement limits were exceeded. Most results for anions, metals, and radionuclide indicators have been below Hanford Site groundwater background levels (e.g., WHC-EP-0595 and DOE/RL-96-61) since monitoring began at the site.

2.11.3.7 Nonradioactive Dangerous Waste Landfill

The Nonradioactive Dangerous Waste Landfill is located southeast of the 200 East Area next to the Solid Waste Landfill. The two landfills are collectively called the Central Landfill (see Figure 2.1-2 in Section 2.1). The objective of RCRA monitoring at the Nonradioactive

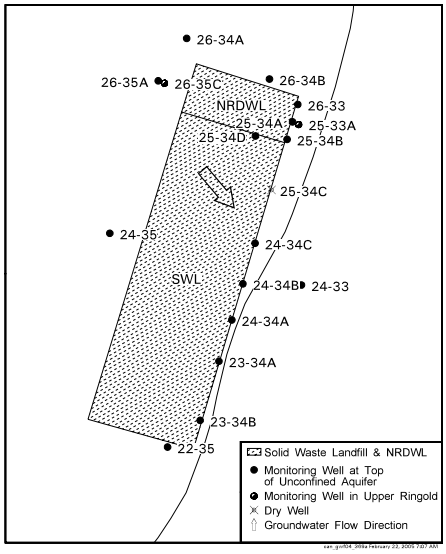
Dangerous Waste Landfill is to determine if hazardous waste constituents from the landfill have contaminated groundwater [40 CFR 265.93(b) as referenced by WAC 173-303-400]. Groundwater monitoring under AEA tracks radionuclides (from upgradient areas) in groundwater at the landfill and surrounding area. Appendix B includes a well location map and lists of wells and constituents monitored for the landfill.

Indicator parameters remained below their critical mean values in downgradient wells at the Nonradioactive Dangerous Waste Landfill.

Monitoring of the Nonradioactive Dangerous Waste Landfill focuses on the RCRA interim status indicator parameters: pH, specific conductance, total organic carbon, and total organic halides (PNNL-11523; Appendix B). Volatile organic compounds are monitored because they may represent groundwater contamination originating from this landfill. Nitrate is present in groundwater and has a source in the 200 East Area (see Section 2.11.1.3). The groundwater quality parameters (chloride, iron, manganese, phenols, sodium, and sulfate) are required analytes but during FY 2004 were either not detected or were not reported in concentrations significantly above background concentrations.

Wells at the Nonradioactive Dangerous Waste Landfill (Appendix B) are sampled semiannually, usually in February and August. All of the wells of the network were sampled as scheduled during FY 2004, although one well experienced problems and was sampled ~1 month later.

There were no exceedances of indicator parameters in downgradient wells where valid upgradient/downgradient comparisons could be made. Reported results for required phenol, anion, and inductively coupled plasma metal analytes were all either non-detects or at levels consistent with reported background values.



Seven volatile organic compounds were detected in the Nonradioactive Dangerous Waste Landfill network wells during FY 2004 including 1,1,1-trichloroethane, 1,1-dichloroethane, 1,4-dichlorobenzene, acetone, chloroform, tetrachloroethene, and trichloroethene. The levels reported were all well below drinking water standards. The source of volatile organic compounds in these wells could be either the Solid Waste Landfill (see Section 2.11.3.7) or the Nonradioactive Dangerous Waste Landfill.

Two wells experienced minor sampling difficulties during FY 2004, but the problems were quickly remedied and the wells were quickly restored to use. Therefore, the current well network is deemed adequate to monitor groundwater at the Nonradioactive Dangerous Waste Landfill, and at this time there are no changes planned for the well network.

2.11.3.8 Solid Waste Landfill

The Solid Waste Landfill is located with the Nonradioactive Dangerous Waste Landfill at the Central Landfill (see Figure 2.1-2 in Section 2.1). It is regulated by Ecology under WAC 173-304. WAC 173-304 constituents and site-specific constituents (including volatile organic compounds and filtered arsenic) are analyzed on groundwater samples collected quarterly (PNNL-13014; Appendix B). Compliance is determined by comparing results from monitoring downgradient wells with statistically derived background threshold values from upgradient wells. Groundwater flow direction is southeast as determined from the general direction of movement of major 200 East Area plumes (see beginning of Section 2.11). The well network for the Solid Waste Landfill includes two upgradient and seven downgradient wells and is shown in Appendix B.

Disposed waste at the Solid Waste Landfill has impacted groundwater including minor volatile organic compound contamination.

Disposed waste at the Solid Waste Landfill has impacted groundwater including minor volatile organic compound contamination (Table 2.11-1). The contamination (tetrachloroethene) was below drinking water standards but exceeded levels defined in WAC 173-200 (Washington State groundwater quality criteria) for the same analyte (0.8 µg/L). Some downgradient wells show higher specific conductance, chloride, sulfate, and coliform bacteria levels, and lower pH than upgradient wells. The lower pH apparently is a result of high concentrations of carbon dioxide in the vadose zone resulting

from the degradation of sewage material disposed to the Solid Waste Landfill (see Section 5.3 of DOE/RL-93-88; PNL-7147; WHC-SD-EN-TI-199).

WAC 173-304 Parameters. Each WAC 173-304 parameter is discussed separately below. See Appendix B for a complete list of all results for required constituents at the Solid Waste Landfill during FY 2004. Table 2.11-1 shows the results for the volatile organic compounds during the same period.

Downgradient concentrations continued to exceed background threshold values for several constituents including specific conductance, pH, chloride, sulfate, chemical oxygen demand, and coliform bacteria.

- ***Temperature*** – Groundwater temperatures measured during sampling in downgradient wells of the Solid Waste Landfill network ranged from 16.9°C to 21.8°C. The reported value of 21.8°C was from the downgradient well 699-24-33 and is the only reported temperature above the 20.7 background threshold value for the Solid Waste Landfill during FY 2004. Temperatures at this well have been relatively steady for several years. See Appendix B for a total list of FY 2004 background threshold values for WAC 173-304 required parameters.
- ***Specific Conductance*** – Specific conductance measurements on samples taken from all downgradient wells during FY 2004 exceeded the background threshold value of 583 µS/cm. The range in downgradient wells was 662 to 849 µS/cm. All seven of the downgradient wells also exceeded the maximum contaminant level (700 µS/cm; WAC 246-290-310) in FY 2004. Since 2001, the trend for specific conductance in Solid Waste Landfill network wells has been holding steady.
- ***Field-measured pH*** – Measured values in network wells ranged from 6.59 to 7.35 during FY 2004. Reported results were lower than the background threshold range (6.68 to 7.84) in three downgradient wells: 699-23-34A, 699-23-34B, and 699-24-34B.
- ***Total organic carbon*** – The only reported result that exceeded the background threshold value (1,510 µg/L) during FY 2004 was 1,600 µg/L for a sample collected from downgradient well 699-22-35 on August 26, 2004. In previous years, spurious values for total organic carbon as high as 8,700 µg/L have been reported in Solid Waste Landfill wells providing reasonable doubt about the representativeness of these high results. However, elevated total organic carbon is consistent with what might be expected when groundwater is contaminated with sewage as it has at the Solid Waste Landfill.
- ***Chloride*** – The August 26, 2004, sample (result 8.4 mg/L) was the only one during FY 2004 to exceed the background threshold value for chloride (7.8 mg/L). Chloride concentrations have been increasing in this well since 1998.
- ***Nitrate*** – Nitrate concentrations in downgradient wells ranged from 2.7 to 3.7 mg/L during FY 2004. Neither the background threshold value (29 mg/L) nor the drinking water standard (45 mg/L) were exceeded in any well downgradient of the Solid Waste Landfill. The source of nitrate contamination at the Solid Waste Landfill is from upgradient sources in the 200 East Area (see Section 2.11.1.3).
- ***Nitrite*** – Nitrate was not detected in any Solid Waste Landfill well during FY 2004. Background threshold value for nitrite was 59.0 µg/L.
- ***Ammonium*** – Results for ammonium ion in all Solid Waste Landfill wells during FY 2004 were below the method detection limit (21.6 µg/L). Background threshold value for nitrate was 118 µg/L.
- ***Sulfate*** – Reported results in downgradient wells ranged 38.7 to 50.3 mg/L during FY 2004. The background threshold value was 47.2 mg/L and was exceeded at five downgradient wells. Sulfate trends are holding steady to rising since 1998 in downgradient Solid Waste Landfill wells.
- ***Filtered iron*** – Values for filtered iron ranged from 28.2 to 70.7 µg/L in downgradient wells. The background threshold value was 160 µg/L, which was not exceeded at any of the downgradient wells.

- ***Filtered zinc*** – Reported values for filtered zinc during FY 2004 ranged from less than the analysis method detection limit (1.5 µg/L) to 21.1 µg/L in downgradient wells. The background threshold value was 42.3 µg/L, and none of the results exceeded it during FY 2004.
- ***Filtered manganese*** – Reported values for filtered manganese in downgradient wells ranged from 0.99 µg/L (the method detection limit) to 5.1 µg/L. The background threshold value (10 µg/L) was not exceeded at any Solid Waste Landfill well during FY 2004.
- ***Chemical oxygen demand*** – Chemical oxygen demand at downgradient Solid Waste Landfill wells during FY 2004 ranged from 3.6 mg/L (the method detection limit) to 18 mg/L. The background threshold value (10 mg/L) was exceeded at five of the seven downgradient wells. Historically, chemical oxygen demand results have been mostly below the method detection limit with the exception of a few spurious values. During FY 2004, the spurious values were during the third and four quarters (the May and August 2004 sampling events). However, elevated chemical oxygen demand values could be typical of groundwater contaminated by sewage, which was known to be discharged to Solid Waste Landfill trenches.
- ***Coliform bacteria*** – Two downgradient wells and one upgradient well had reported results that exceeded the background threshold value (3.7 colonies/100 ml). The highest value reported during FY 2004 was 120 colonies/100 ml at the upgradient well 699-24-35. Elevated results for coliform bacteria at Solid Waste Landfill wells have historically been random and sporadic and, therefore, suspicious. However, like total organic carbon and chemical oxygen demand, elevated levels of coliform bacterial are expected in groundwater contaminated when sewage was known to be disposed at the Solid Waste Landfill.

Site-Specific Parameters. Site-specific parameters at the Solid Waste Landfill include chlorinated hydrocarbons and two constituents (1,4-dioxane and filtered arsenic) detected by the leachate collection system (see Section 3.2.2). Slightly elevated concentrations of chlorinated hydrocarbons continued to be detected at the Solid Waste Landfill during FY 2004. Tetrachloroethene and filtered arsenic exceeded the groundwater criteria set forth in WAC 173-200. The range of reported concentrations of chlorinated hydrocarbons is given in Table 2.11-1.

Slightly elevated concentrations of chlorinated hydrocarbons continued to be detected at the Solid Waste Landfill during FY 2004.

Chlorinated hydrocarbons were detected in all Solid Waste Landfill network wells, including the upgradient wells. The chlorinated hydrocarbons detected included 1,1,1-trichloroethane, 1,2-dichloroethane, 1,4-dichlorobenzene, chloroform, cis-1,2-dichloroethene, tetrachloroethene, and trichloroethene.

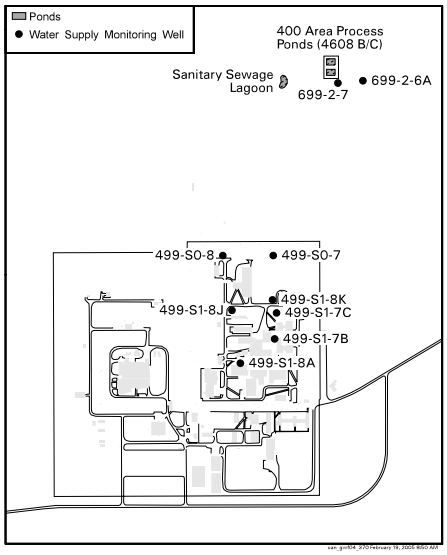
Of those chlorinated hydrocarbons detected, only tetrachloroethene exceeded the WAC 173-200 concentration limit of 0.8 µg/L during FY 2004, and the exceedance was at all seven of the downgradient wells and one of the upgradient wells. The highest concentration recorded was at well 699-24-34B with a value of 1.9 µg/L. The historical trend at all of the downgradient wells is slightly downward, and this trend continued during FY 2004. None of the reported results for tetrachloroethene (or any of the chlorinated hydrocarbons) exceeded drinking water standards.

The most likely cause of the widespread, low-level chlorinated hydrocarbon contamination at the Solid Waste Landfill, including the upgradient wells and the adjacent Nonradioactive Dangerous Waste Landfill wells, is the dissolution of vadose zone vapors into groundwater. However, the source of the vapors is uncertain. Possible sources include chlorinated hydrocarbons dissolved in the liquid sewage or the catch tank liquid from the 1100 Area heavy equipment garage and bus shop that were disposed to the Solid Waste Landfill (PNNL-13014).

Filtered arsenic (drinking water standard 10 µg/L; WAC 173-200 limit 0.05 µg/L) was detected at all Solid Waste Landfill wells. The highest concentration detected was 3.4 µg/L (at well 699-26-35A, an upgradient well). Although filtered arsenic was discovered in the leachate collection system at the trenches, the occurrence of arsenic in groundwater at the Solid Waste Landfill is probably due to natural processes (i.e., occurs naturally in Hanford Site groundwater – Hanford Site background is ~10 µg/L; DOE/RL-92-23), or there is an upgradient source (e.g., 200 East Area).

Another constituent found in the leachate collection system of the Solid Waste Landfill is 1,4-dioxane. Therefore, groundwater samples were specifically tested for this constituent also. It was not detected in any of the network wells. However, the instrument detection limit for 1,4-dioxane in the analytical method used was 11 µg/L. The WAC 173-200 limit is 7 µg/L.

During FY 2003, sampling difficulties at well 699-25-34C became severe enough that it was dropped from the sampling schedule. With the loss of this well, the number of downgradient wells dropped from eight to seven. An early analysis indicated that the well simply went dry. However, the local elevation of the water table is ~2 meters above the bottom of the well screen. An investigation is continuing to determine the reason for sampling difficulties at this well. Even if the well is eventually determined to be permanently out of service, well 699-24-33 is downgradient of well 699-25-34C and may eliminate the need for a replacement well.



2.11.3.9 400 Area Water Supply Wells

The 400 Area on the Hanford Site is the location of the Fast Flux Test Facility, a liquid-metal (sodium) cooled test reactor. DOE awarded a contract to SEC Closure Alliance at the end of September 2004 to finish shutting down the Fast Flux Test Facility. However, protests were filed with the Government Accountability Office by two of the competing companies. On January 13, 2005, the Government Accountability Office dismissed one protest but sustained the second. DOE will review the decision by the Government Accountability Office and determine the most appropriate course of action.

Primary groundwater monitoring activities in the 400 Area involve monitoring of the 400 Area water supply wells. Monitoring is also conducted to provide information needed to describe the nature and extent of site-wide contamination (primarily nitrate, tritium, and iodine-129). This section discusses the monitoring of the 400 Area water supply wells, specifically tritium, and general aspects of groundwater chemistry in the 400 Area. The water supply wells were sampled quarterly as scheduled in FY 2004.

Monitoring of the 4608-B/C ponds (also called the 400 Area process ponds) was previously conducted for compliance with a waste discharge permit. Groundwater monitoring of this site under the waste discharge permit was discontinued after FY 2003 in accordance with a recent modification of the permit (September 18, 2003). Groundwater monitoring of the two wells at the 400 Area process ponds will continue under the 200-PO-1 Operable Unit well network.

Tritium concentrations in all samples from 400 Area water supply wells were below the drinking water standard in FY 2004.

The Hanford Site water-table map (see Figure 2.1-3 in Section 2.1) indicates that flow is generally to the east-southeast across the 400 Area. The water table is located near the contact of the Hanford and Ringold Formations, which is ~49 meters below ground surface (WHC-EP-0587). Hanford formation sediment dominates groundwater flow in the 400 Area because of its relatively high permeability compared to that of sediment in the Ringold Formation.

Elevated levels of tritium associated with the groundwater plume from the vicinity of the PUREX Plant in the 200 East Area were identified in 400 Area wells as in previous years (see Figure 2.1-6 in Section 2.1). The lower concentrations of tritium north of the 400 Area are

probably related to discharge at the process ponds. Groundwater tritium levels are relevant to the water supply wells, which provide drinking water and emergency supply water for the 400 Area. Well 499-S1-8J serves as the main water supply well, while wells 499-S0-7 and 499-S0-8 are backup supply wells. Well 499-S1-8J has lower tritium concentrations because it is screened at a greater depth than the other two water supply wells. The tritium concentrations in wells 499-S0-7, 499-S0-8, and 499-S1-8J are compared in Figure 2.11-9 to that of the 400 Area drinking water supply. Tritium was measured at levels below the drinking water standard (20,000 pCi/L) in all three of the water supply wells in FY 2004. Tritium levels in well 499-S1-8J (the main water supply well) during FY 2004 ranged from 2,680 to 2,970 pCi/L.

Tritium remained below the drinking water standard (20,000 pCi/L) and the 4-millirem-per-year dose equivalent in the drinking water supply, sampled at a tap, for all sampling events in FY 2004 (Figure 2.11-9). Nitrate remained below the drinking water standard in FY 2004 for the water supply wells. Data from FY 2004 and earlier from 400 Area and surrounding wells indicates no other constituents are present at levels above their drinking water standards.

Table 2.11-1. Ranges of Reported Volatile Organic Compound Concentrations in Solid Waste Landfill Wells during FY 2004

Constituent	Limit (µg/L)[a]	699-22-35	699-23-34A	699-23-34B	699-24-33	699-24-34A
1,1,1-trichloroethane	WAC 200	<0.17 - 2.2	<1.17 - 1.9	1.5 - 2.1	1.1 - 1.3	1.5 - 1.8
1,1,2-trichloroethane	MCL 5.0	<0.2	<0.2	<0.2	<0.2	<0.2
1,2-dichloroethane	WAC 0.5	<0.2	<0.2	<0.2	<0.2	<0.2
1,4-dichlorobenzene	WAC 4.0	<0.11	<0.11 - 0.2	1.6 - 2.2	<0.11	<0.11
1,4-dioxane	WAC 7.0	<11	<11	<11	<11	<11
Carbon tetrachloride	WAC 0.3	<0.15	<0.15	<0.15	<0.15	<0.15
Chloroform	WAC 7.0	0.16 - 0.21	0.19 - 0.29	0.31 - 0.56	<0.11 - 0.08	<0.07 - 0.10
cis-1,2-dichloroethene	MCL 70	<0.11	<0.11	<0.11	<0.11	<0.11
Tetrachloroethene	WAC 0.8	0.71 - 1.1	**1.1 - 1.7**	0.76 - **1.1**	**1.4 - 1.9**	**1.2 - 1.4**
trans-1,2-dichloroethene	MCL 100	<0.17	<0.17	<0.17	<0.17	<0.17
Trichloroethene	WAC 3.0	0.35 - 0.54	0.35 - 0.61	0.35 - 0.51	0.63 - 0.83	0.59 - 0.7

Constituent	Limit (µg/L)[a]	699-24-34B	699-24-34C	699-24-35	699-26-35A
1,1,1-trichloroethane	WAC 200	1.3 - 1.7	0.9 - 1.2	1.2 - 1.4	0.7 - 0.9
1,1,2-trichloroethane	MCL 5.0	<0.2	<0.2	<0.2	<0.2
1,2-dichloroethane	WAC 0.5	<0.2	<0.2	<0.2	<0.2
1,4-dichlorobenzene	WAC 4.0	<0.11 - 0.12	<0.11	<0.11	<0.11
1,4-dioxane	WAC 7.0	<11	<11	<11	<11
Carbon tetrachloride	WAC 0.3	<0.15	<0.15	<0.15	<0.15
Chloroform	WAC 7.0	<0.11 - 0.08	<0.07 - 0.08	<0.11	0.12 - 0.15
cis-1,2-dichloroethene	MCL 70	<0.11 - 0.2	<0.11	<0.11	<0.11
Tetrachloroethene	WAC 0.8	**1.4 - 1.9**	**1.2 - 1.6**	0.7 - **1.0**	0.56 - 0.74
trans-1,2-dichloroethene	MCL 100	<0.17	<0.17	<0.17	<0.17
Trichloroethene	WAC 3.0	0.56 - 0.77	0.58 - 0.76	0.32 - 0.45	<0.09 - 0.42

(a) MCL = Maximum contaminant level.
WAC = Washington Administrative Code.
Values in **bold** type equal or exceed WAC 173-200-40.

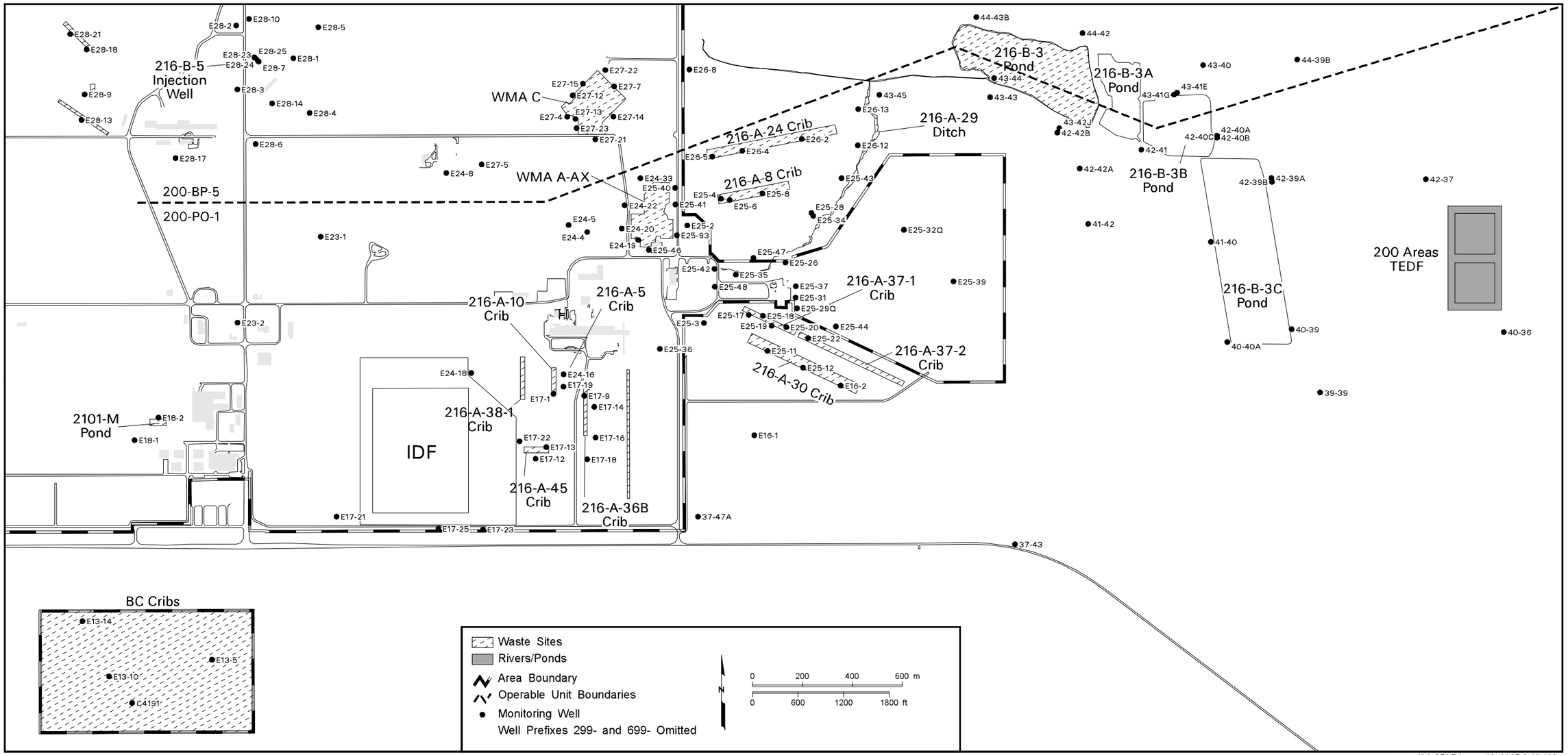


Figure 2.11-1. Groundwater Monitoring Wells in the North Portion of 200-PO-1 Operable Unit

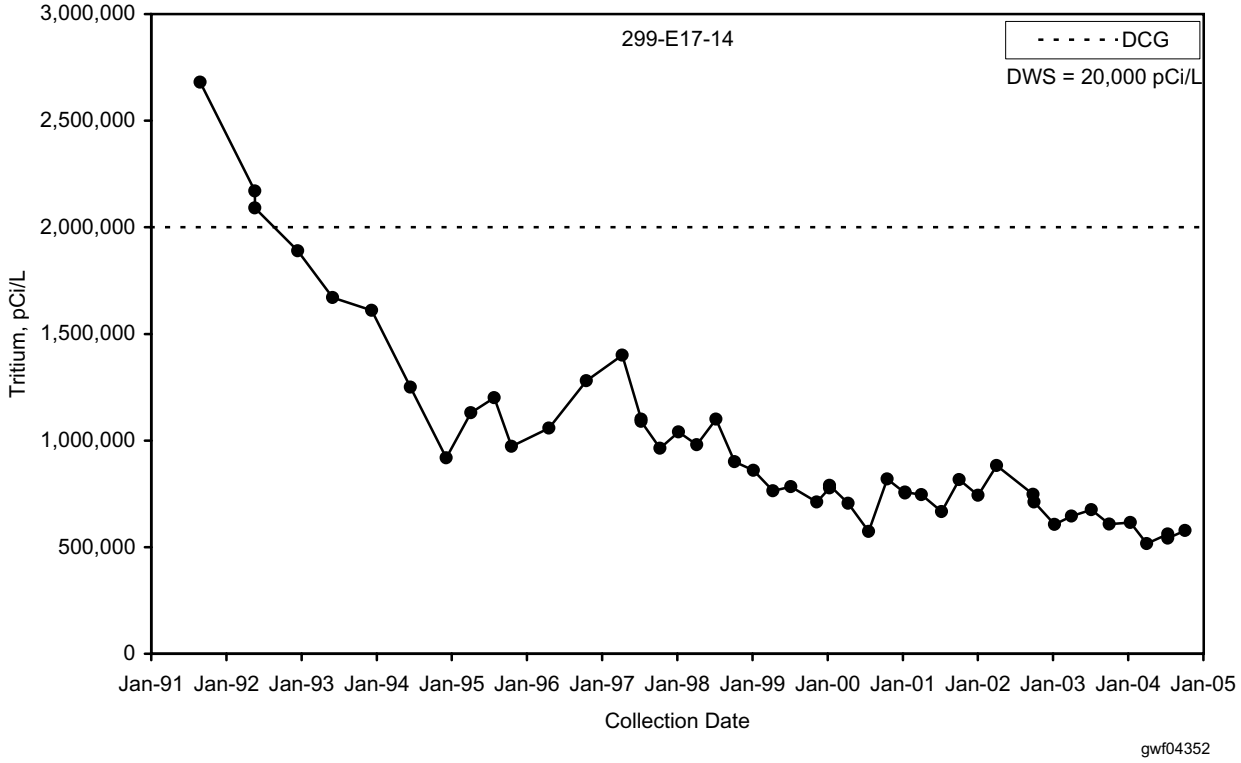


Figure 2.11-2. Tritium Concentrations at the 216-A-36B Crib, Well 299-E17-14

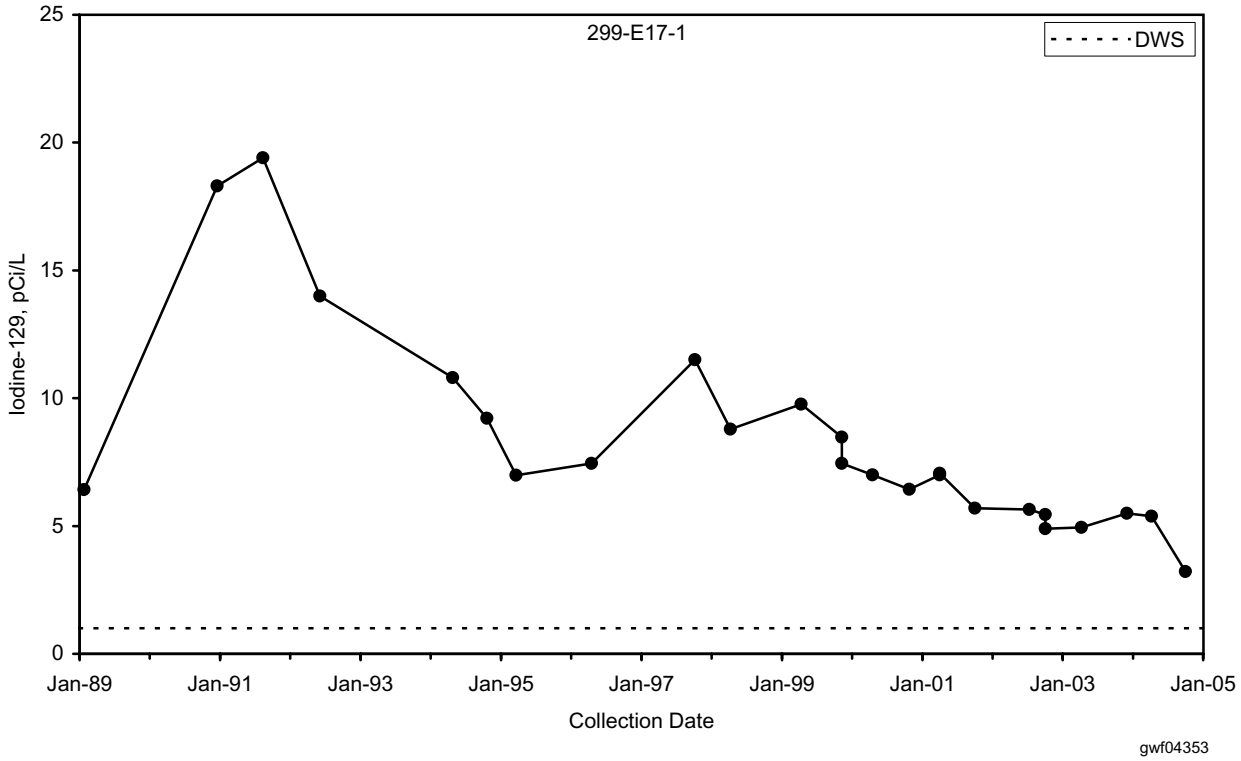


Figure 2.11-3. Iodine-129 Concentrations at the 216-A-10 Crib, Well 299-E17-1

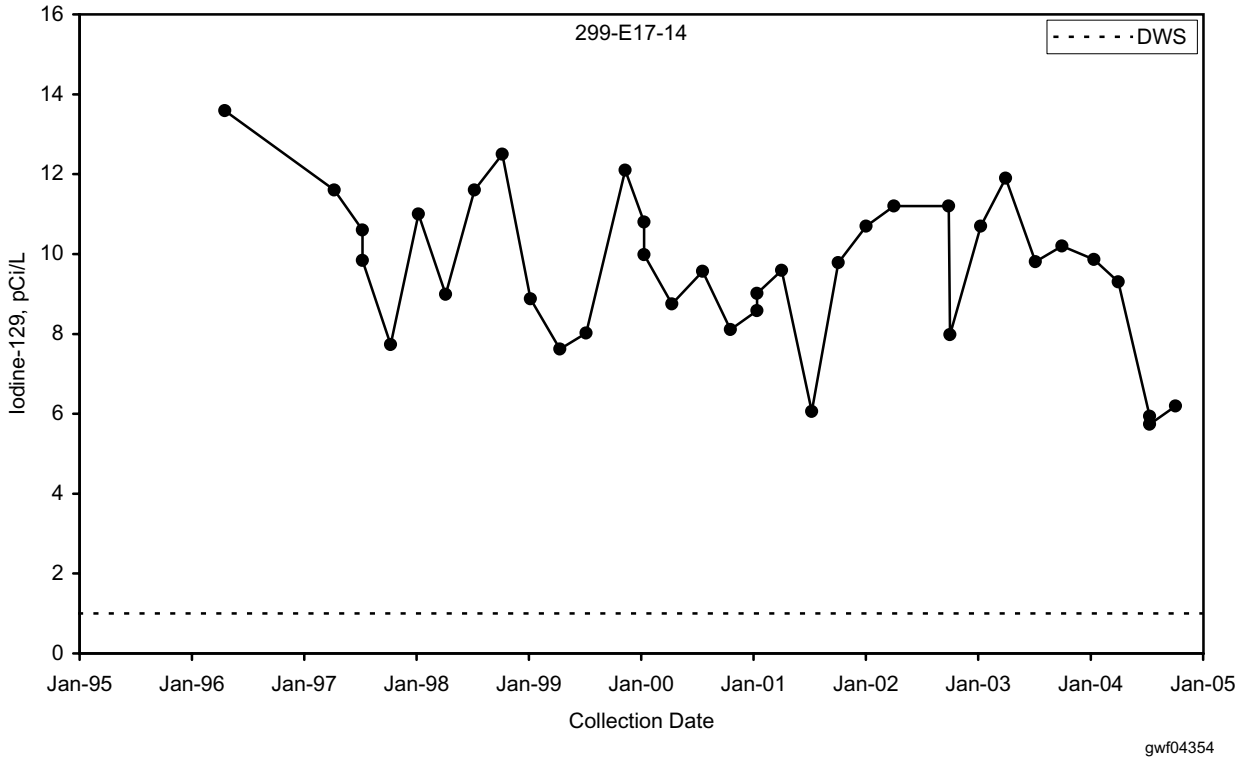


Figure 2.11-4. Iodine-129 Concentrations at the 216-A-36B Crib, Well 299-E17-14

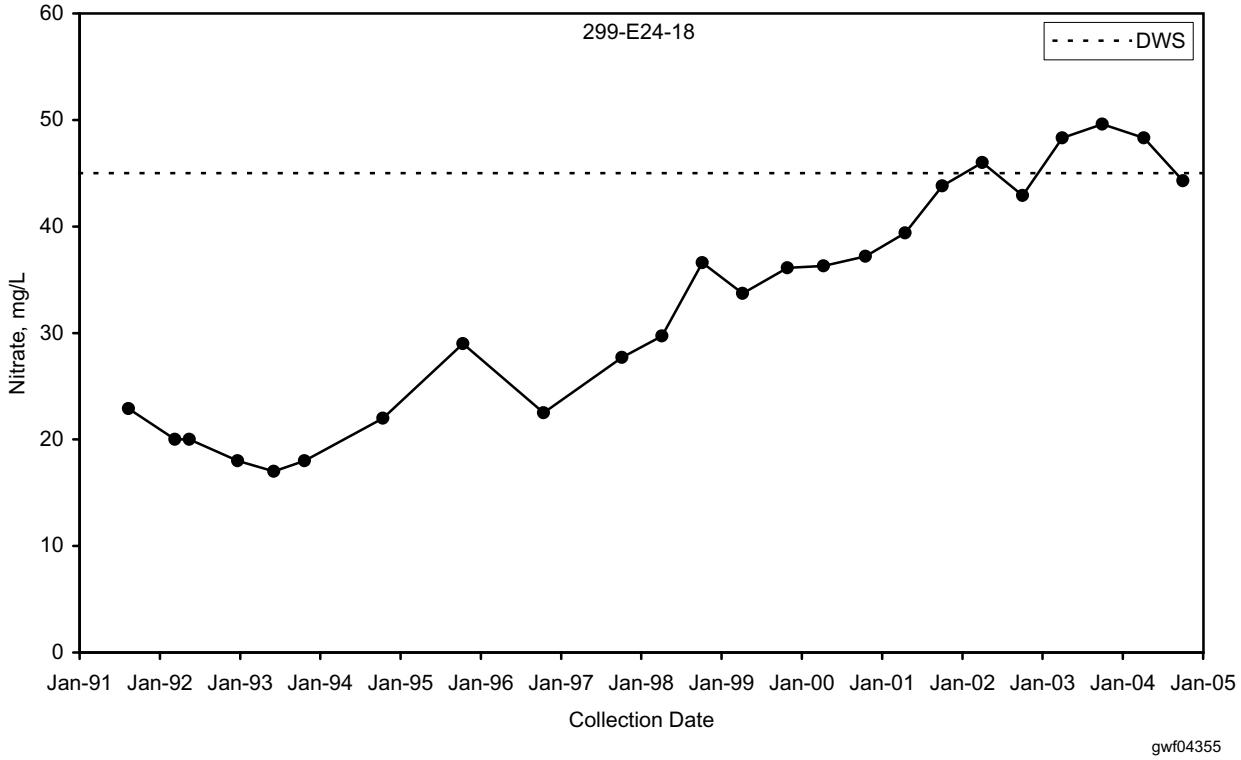


Figure 2.11-5. Nitrate Concentrations at Upgradient Well 299-E24-18 for the RCRA PUREX Cribs

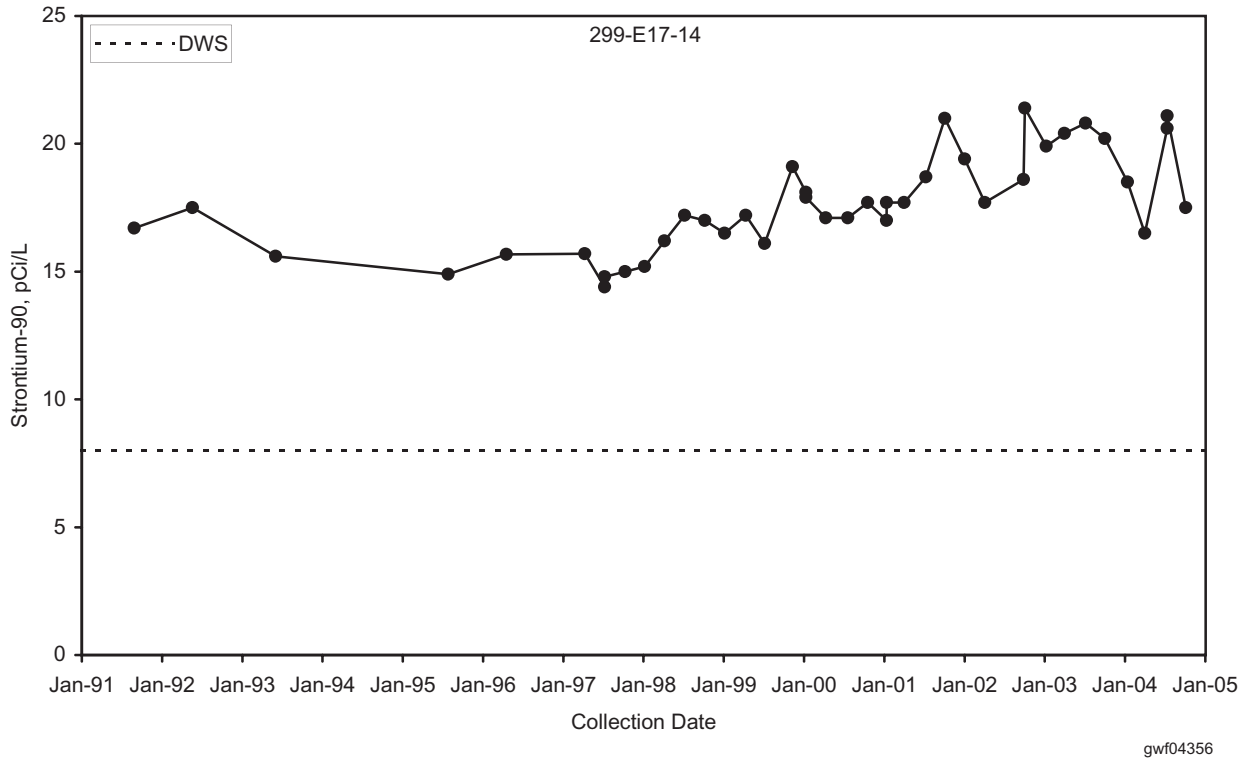
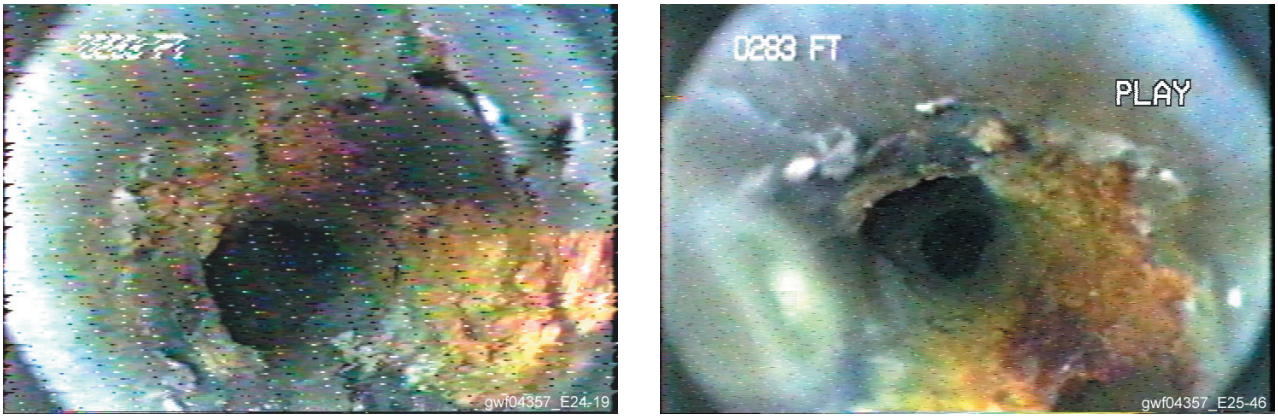


Figure 2.11-6. Strontium-90 Concentrations at the 216-A-36B Crib



(a) (b)

Figure 2.11-7. Borehole Photos of Corroded Casing in Wells 299-E24-19 (a) and 299-E25-46 (b). The corrosion corresponds to a wet silt layer at a depth of 84 to 86 meters.

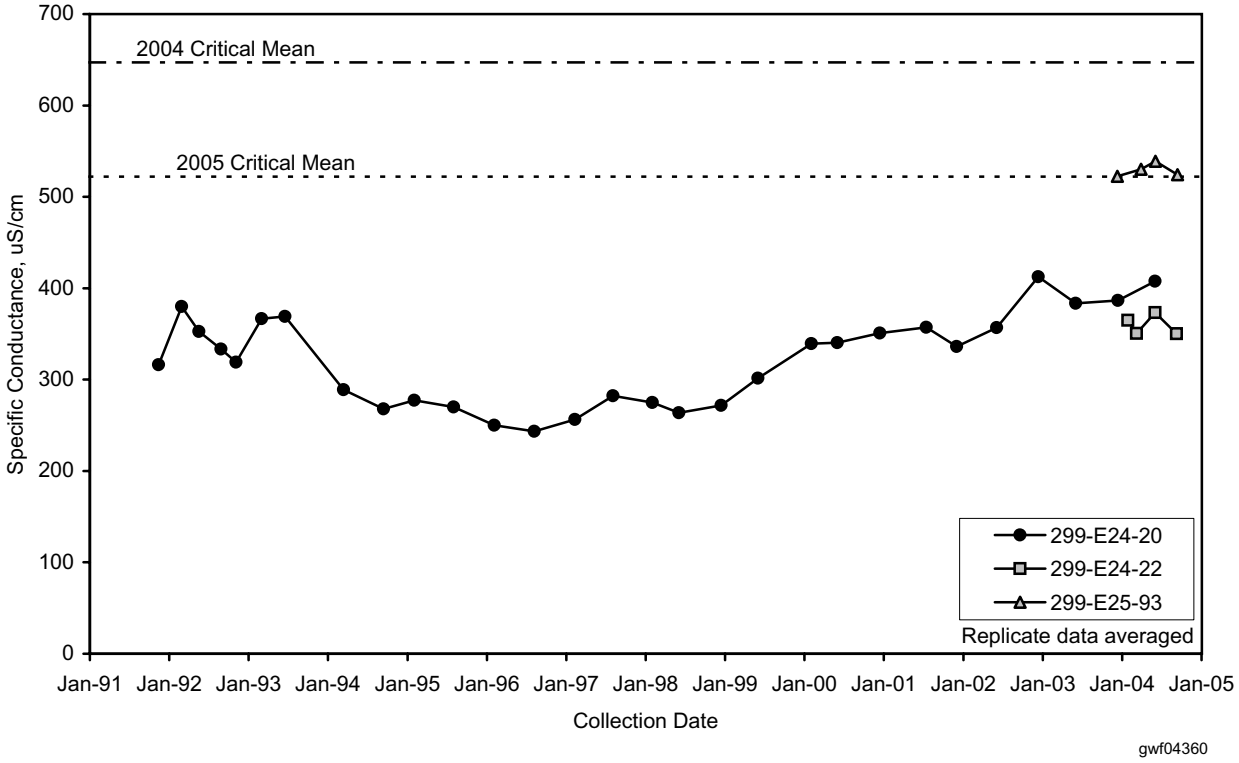


Figure 2.11-8. Trends in Specific Conductance for Upgradient Wells 299-E24-20 and 299-E24-22 Compared to Data from New Downgradient Well 299-E25-93 at Waste Management Area A-AX

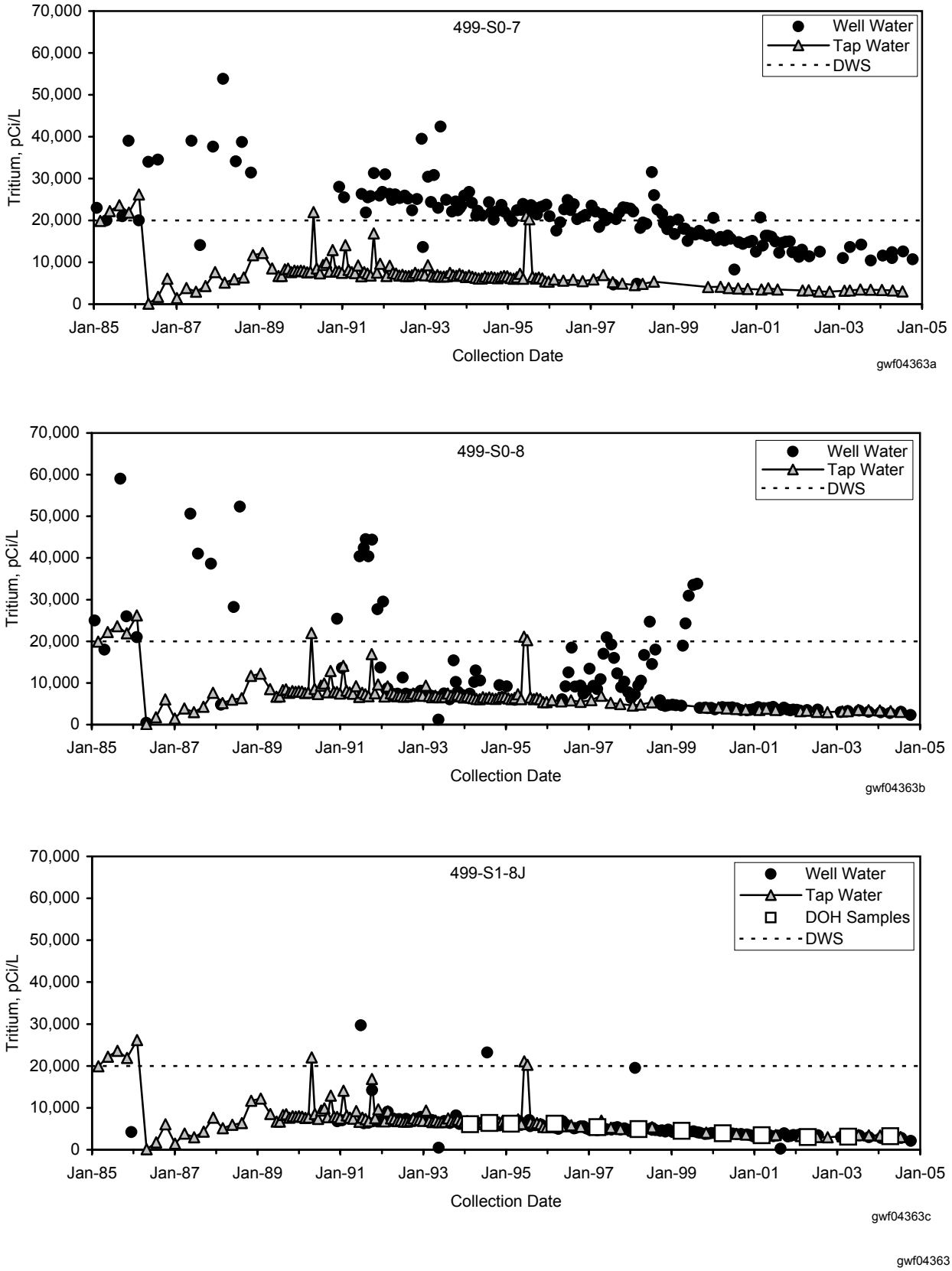


Figure 2.11-9. Comparison of Tritium Concentrations in 400 Area Water Supply Wells