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0059827

00-GWVZ-041

MAY 10 2003

Ms. Jane Hedges
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Nuclear Waste Program
State of Washington
Department of Ecology
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EDMC

Mr. Douglas R. Sherwood
Hanford Project Manager
U.S. Environmental Protection Agency
712 Swift Boulevard, Suite 5
Richland, Washington 99352-0539

Dear Ms. Hedges and Mr. Sherwood:

QUARTERLY RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
GROUNDWATER (GW) MONITORING DATA FOR THE PERIOD OCTOBER 1, 1999,
THROUGH DECEMBER 31, 1999

Please find enclosed the subject report. This is being submitted to satisfy the quarterly reporting requirements for RCRA –compliant groundwater monitoring at the Hanford Site. The RCRA groundwater chemistry and water level data for the subject period have been verified and evaluated. The data are publicly available in electronic form in the Hanford Environmental Information System database. The electronic availability of the data and the summary provided below fulfill the reporting requirements of WAC 173-303 (and by reference 40 CFR 265.94). Verification of data included a completion check (requested analyses were received), quality control checks (field blanks, field duplicates, and blind samples), and project scientist evaluation.

Fourteen RCRA sites were sampled during the reporting quarter (see enclosure, Attachment 1). Sampled sites include five monitored under indicator evaluation programs, seven monitored under groundwater quality assessment programs, and two monitored under final-status corrective action. Detailed information on salient issues during this quarter are included in the enclosure.

Ms. Hedges and Mr. Sherwood
00-GWVZ-041

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If you have questions about this quarterly data transmittal, please contact Marvin J. Furman at (509) 373-9630.

Sincerely,



K. Michael Thompson, Acting Program Manager
Groundwater/Vadose Zone Program

GWVZ:MJF

Enclosure

cc w/encl:

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QUARTERLY RESOURCE CONSERVATION AND RECOVERY ACT GROUNDWATER MONITORING DATA FOR THE PERIOD OCTOBER 1 THROUGH DECEMBER 31, 1999.

References:

- (1) M.J. Furman, RL, to J. Hedges, Ecology, "Notification of Exceedance of Critical Mean Value for Specific Conductance at Single-Shell Tank WMA U," February 11, 2000 [00-GWVZ-018].
- (2) M.J. Furman, RL, "Transmittal of Groundwater Quality Assessment Plan for Single-Shell Tank Waste Management Area (WMA) U, PNNL-13185," April 3, 2000 [GWVZ-031].

Resource Conservation and Recovery Act (RCRA) groundwater chemistry and water level data for the period October 1 through December 31, 1999 have been verified and evaluated. Evaluation includes plotting key constituents on maps and trend plots, performing statistical calculations, and examination of data from quality control samples. The analytical data are publicly available in electronic form in the Hanford Environmental Information System database. The electronic availability of the data and the summary provided below fulfill the reporting requirements of WAC 173-303 (and by reference 40 CFR 265.94). Verification of data included a completion check (requested analyses were received), quality control checks (field blanks, field duplicates, and blind samples), and project scientist evaluation.

Fourteen RCRA sites were sampled during the reporting quarter (Table 1). Sampled sites include five monitored under indicator evaluation programs, seven monitored under groundwater quality assessment programs, and two monitored under final-status corrective action.

Comparison to Concentration Limits

Contamination indicator parameter data (pH, specific conductance, total organic halogen [TOX], and total organic carbon [TOC]) from downgradient wells were compared to background values at sites monitored under interim-status, indicator evaluation requirements, as described in 40 CFR 265.93. Sampling for some of the sites scheduled for this quarter was delayed until the

January-March 2000 quarter. If the data for those sites were available by April, the results were evaluated this quarter. However, not all results are available for the 216-S-10 Pond and Ditch, Low-Level Waste Management Area 1, and Single-Shell Tanks waste management area A-AX. Those results will be evaluated next quarter.

216-A-29 Ditch. Specific conductance in downgradient wells 299-E25-35 and 299-E25-48 slightly exceeded the critical mean value, which was recently revised. The recent values are part of an increasing trend in specific conductance, which is caused by increases in sulfate, nitrate, calcium, and sodium. A formal letter of notification and assessment plan/report, if necessary, will be submitted separately.

Liquid Effluent Retention Facility. Specific conductance in downgradient wells 299-E26-10 and 299-E35-2 exceeded the critical mean. The elevated specific conductance in well 299-E26-10 was the subject of an assessment report that was previously submitted to Ecology, and the current exceedances are believed to be caused by the same nonhazardous constituents. A formal letter of notification will be submitted separately.

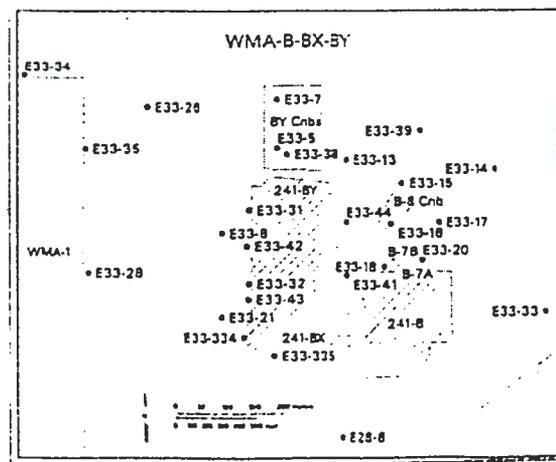
Low-Level Waste Management Area 2. Specific conductance and TOC in upgradient well 299-E34-7 exceeded critical mean values. TOC increased from ~1,200 µg/L in early 1999 to 2,800 µg/L in January 2000. The next sample from this well will be analyzed for volatile organic compounds to determine the cause of the increase in TOC. Because the exceedances occurred in the upgradient well, assessment monitoring is not required.

Contamination indicator parameters in downgradient wells were below the critical mean values for other sites monitored under indicator evaluation requirements that were sampled during the quarter. Hence, there is no indication that these sites are impacting groundwater quality with hazardous waste constituents.

Status of Assessment Programs

Single-Shell Tanks WMA B-BX-BY: Chemical ratios, chemical suites, plume locations, and trend analyses provide evidence of three distinct regions of contamination near this WMA. The bulk of the contamination, most likely associated with the BY cribs, is moving from the north or northeast into the region of the BY Cribs, and Low-Level Burial Grounds WMA 1.

Groundwater flow direction, based on water levels, appears to be toward the west-southwest to southwest. There was no perceptible change in flow rate this quarter. However, without direct verification, flow direction and rate continue to be in question at this site.



Technetium-99. The prime area of contamination includes wells in the BY Cribs, west of the BY Cribs, and on the west side of the WMA. This contamination is believed to be a plume from the BY Cribs moving back into the area from the north. Technetium-99 at well 299-E33-7 remained stable at 6,960 pCi/L in November 1999, then fell to 5,990 pCi/L in December 1999. Technetium-99 rose sharply in well 299-E33-38 from 5,750 pCi/L in August 1999 to 9,410 pCi/L in December 1999. This was one of the highest technetium-99 values seen in the WMA. West of the BY Cribs, technetium-99 concentrations fell in well 299-E33-26 (from 3,750 pCi/L in August 1999 to 2,990 pCi/L in December 1999). Technetium-99 in well 299-E33-34, located near the northeast corner of Low Level Burial Grounds WMA 1, rose from 3,210 pCi/L of technetium-99 in December 1998 to 3,870 pCi/L in December 1999. Farther south, the concentration fell in well 299-E33-35 from 1,720 pCi/L in August 1999 to 1,280 pCi/L in December 1999. North of the Low Level Burial Grounds WMA 1 at well 699-49-57A, technetium-99 concentrations are steadily increasing from 2,470 pCi/L in March 1999 to 2,820 pCi/L in December 1999. Well 699-49-55A, north of the BY cribs, currently detects no technetium-99. Farther north, well 699-50-53A has 513 pCi/L of technetium-99. Thus the spatial configuration of this technetium-99 plume is not uniform. Low Level Burial Grounds monitoring wells west of WMA B-BX-BY have been placed on quarterly sampling for technetium-99 to delineate and track the westward extent of this plume. With the exception of well 299-E33-35, the groundwater at these wells contains elevated levels of cobalt-60, ranging from 62.7 pCi/L at well 299-E33-7 to 25.6 pCi/L in well 299-E33-34 (drinking water standard is 100 pCi/L). Cyanide ranges from 52 µg/L in well 299-E33-26 to 244 µg/L at well 299-E33-7 (maximum contaminant level is 200 µg/L).

Along the west side of the WMA, well 299-E33-31 showed increases in technetium-99 compared to the previous quarter, rising from 1,560 pCi/L in August to 1,750 in November 1999. Farther south, concentrations rose from 1,500 pCi/L in August to 2,200 pCi/L in November 1999. In well 299-E33-32. Values rose from 875 pCi/L in May 1999 to 1,210 pCi/L in September 1999 in well 299-E33-32 but remained stable this quarter at 1,010 pCi/L in December 1999. Concentrations in well 299-E33-43, on the southwest side of the WMA, also rose sharply this quarter from 86 pCi/L in August to 223 pCi/L in November 1999. East of the BY Cribs, technetium-99 in well 299-E33-13 decreased from 2,900 pCi/L in September to 1,390 pCi/L in November, then rose to 2,440 pCi/L in December.

The second area of contamination is represented by well 299-E33-16, and appears to have a local source associated with the B-8 Crib and tile field. Technetium-99 remained static at 1,830 pCi/L in December 1999. At present it is not clear if a distinct plume or pulse of contamination is moving through the groundwater. Other wells directly to the north, and east have much lower technetium-99 concentrations that rose slightly this quarter. Well 299-E33-18 usually bounds this contamination on the south. However technetium-99 concentrations nearly doubled between August (1,490 pCi/L) and December 1999 (2,480 pCi/L). Technetium-99 also doubled in well 299-E33-41 from 635 pCi/L in June to 1,020 pCi/L in September 1999 to 2,120 pCi/L in December 1999.

The third apparent area of contamination is represented by well 299-E33-44, which was installed in September 1998. Technetium-99 concentrations continued to increase from 3,930 pCi/L in May 1999 to 4,700 pCi/L in September, to 5,640 pCi/L in December, the highest level ever detected in this well. This well has a low nitrate:technetium-99 ratio and a unique chemical suite, consisting of high levels of uranium, technetium-99, and nitrate. Elevated nitrite is also associated with the chemical suite. Sampling began in December at well 299-E33-9, located just west of 299-E33-44 but inside the 241-BY tank farm. Technetium-99 is elevated in this well at 3,020 pCi/L. Co-contaminants are similar to well 299-E33-44 (very high uranium, nitrate and some nitrite). These characteristics distinguish the water chemistry in these wells from chemistry in nearby well 299-E33-16. In general tank waste contains high levels of nitrite and nitrate.

Cobalt-60 was detected at levels below the quantitation limit in the August and December samples from well 299-E33-44, along with 7 µg/L of cyanide. Well 299-E33-9, inside the tank farm, contained 28.9 µg/L of cyanide and 33 pCi/L cobalt-60 in December 1999. This well is extremely high in various metals including iron, indicating rusting of the casing. There is no dedicated pump in this well and the samples may have been collected without an adequate purge. The well is located near surface facilities inside the farm that make routine maintenance difficult. When possible, the well will be cleaned and purged, a pump installed, and put on routine quarterly sampling.

Nitrate. Nitrate concentrations in well 299-E33-7 were 407 mg/L in October and 379 mg/L in December 1999. West of the BY Cribs, nitrate levels in well 299-E33-34 remained static at 198 mg/L in December 1999, while concentrations in well 299-E33-35 dropped from 74 mg/L in August to 66 mg/L in December 1999. North of Low Level Burial Grounds WMA 1 in well 699-49-57A, nitrate levels increased from 115 mg/L in March 1999 to 129 mg/L in December 1999. Concentrations in well 299-E33-13, east of the BY Cribs, increased slightly from 260 mg/L in September 1999 to 268 mg/L in December 1999. On the western boundary of the WMA, nitrate concentrations increased, ranging from 84-138 mg/L in wells 299-E33-31, -32, and -42 this quarter. In well 299-E33-43, nitrate has increased sharply along with the technetium-99 from 18 mg/L in August to 39 mg/L in November 1999. If groundwater flow is to the west-southwest, this well may be reflecting the same source of technetium-99 observed in wells 299-E33-41 and 299-E33-18, located to the northeast.

In well 299-E33-16, the center of greatest nitrate concentration, levels increased from 514 mg/L to 536 mg/L this quarter. Nitrate concentrations in surrounding wells 299-E33-15 and -17 have increased, and currently range from 208 mg/L to ~346 mg/L. Concentrations in well 299-E33-41 decreased slightly from 34 mg/L in September to 31 mg/L in November 1999.

Finally, nitrate levels continued to rise in well 299-E33-44 from 110 mg/L in May to 138 mg/L in September to 145 mg/L in December 1999. Nearby well 299-E33-9 (inside the 241-BY Tank Farm) had nitrate concentrations of 166 mg/L for December 1999.

Uranium. This contaminant is found in the groundwater at WMA B-BX-BY east of 241-BY Tank Farm in wells 299-E33-18, -13, and -44. Uranium is found beneath the 241-BY Tank Farm in well 299-E33-9. It is detected in the southern part of the BY cribs at wells 299-E33-38 and -5.

It is also found west of the BY Crib in wells 299-E33-26 and -34. It is not presently found in well 299-E33-35, which does have increasing nitrate and technetium-99 values. Low levels of uranium continued to be found west of WMA B-BX-BY in wells 299-E33-31 and -42. However, uranium is not elevated in well 299-E33-7 or in wells north of Low Level Burial Grounds WMA 1. The drinking water standard for uranium is 20 µg/L.

Well 299-E33-44 continued to have the highest concentration of uranium this quarter, remaining stable at 283 µg/L in December 1999. Inside the 241-BY Tank Farm, well 299-E33-9 had the next highest uranium level at 234 µg/L. Based on nitrate:technetium-99 ratio comparisons, a unique and distinct contaminant suite, and the location of these wells with respect to other wells displaying elevated uranium, the uranium source at this well may be local.

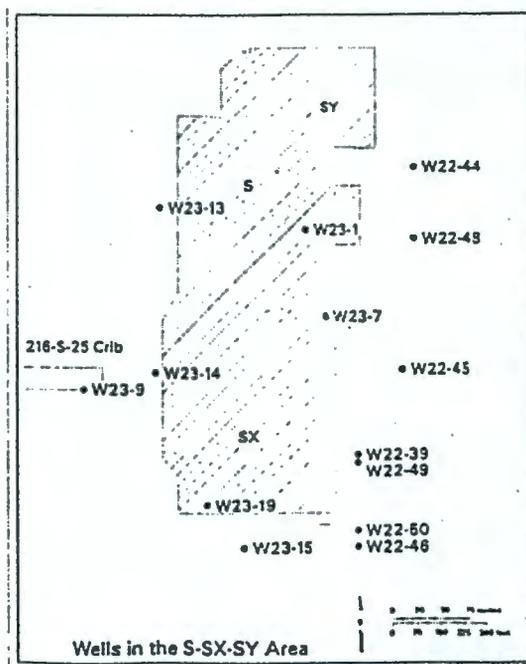
Well 299-E33-18, with the next highest uranium concentration, fluctuated from 153 µg/L in August to 173 µg/L in December 1999. Values in well 299-E33-13 decreased slightly this quarter from 63 µg/L in September to 52 µg/L in December 1999. The uranium concentration at well 299-E33-41 was stable at 23.6 µg/L in December 1999.

Beneath the BY cribs, the uranium concentration increased in well 299-E33-38, from 119 µg/L in August to 127 µg/L in December 1999. Farther to the west, levels remained the same in well 299-E33-26 (45.8 µg/L in August and 42.8 in December 1999). Along the west side of the WMA, uranium continued to increase in well 299-E33-31 from 5.8 µg/L in February to 17 µg/L in September and 19 µg/L in December 1999. Although elevated above the natural background of about 2.5 µg/L, the uranium concentration at well 299-E33-42 remained static below the drinking water standard at about 7 µg/L. Farther south, both wells 299-E33-32 and -43 have uranium at background levels.

Single-Shell Tanks WMA S-SX:

Groundwater beneath this WMA is contaminated with technetium-99, nitrate and hexavalent chromium, primarily from sources assumed to be within the WMA. High concentrations of tritium are also present from upgradient sources. The water table elevation has continued to decline in the vicinity of this WMA but the gradient is relatively stable. The inferred flow direction has gradually shifted from the southeast to a more easterly direction with the decline in water table. The calculated groundwater flow rate, and the inferred flow direction to the east-southeast, remained unchanged for the quarter.

Technetium-99 exceeded the drinking water standard of 900 pCi/L in three downgradient



RCRA wells (299-W22-45, 299-W22-46 and 299-W22-50) and in one new well (299-W23-19) located inside the SX tank farm. Well 299-W22-45 continues to exhibit an upward trend with a technetium-99 concentration of 2,080 pCi/L reported for January 2000. A reversal in the downward trend for well 299-W22-46 appears to have occurred, based on the reported result of 5,330 pCi/L for the January 2000 sampling event. The result reported for the previous quarter was 3,030 pCi/L. [note: Samples from wells 299-W22-45 and -46 were analyzed for technetium-99 using a method that may be influenced by elevated tritium in the samples. The results are being investigated to determine the validity of the measurements.] In addition, a new replacement well (299-W22-50) located 15 meters north of 299-W22-46, was sampled at various depths during drilling in November and December 1999. Results indicated that concentrations are the highest at the very top of the aquifer and decline rapidly with depth. For example, the concentrations for depths of 0.5, 7, and 14 meters were 4,240, 812, and < 10 pCi/L, respectively. In addition to the downgradient wells, initial technetium-99 results for samples collected in October 1999 from new well 299-W23-19 (located immediately adjacent to tank SX-115) ranged from 39,000 to 48,600 pCi/L, the highest concentrations yet observed in Hanford Site groundwater. The proximity of well 299-W23-19 to a known tank leak and the occurrence of high concentrations of technetium-99 in the vadose zone near the well indicate that the tank was the source of the groundwater contamination.

Nitrate exceeded the 45-mg/L maximum contaminant level in upgradient well 299-W23-14, in new well 299-W23-19 in the southwest corner of the SX tank farm, and in downgradient wells 299-W22-45 and 299-W22-46. The concentration for upgradient well 299-W23-14 was 135 mg/L in January 2000 and continued a sharp upward trend. Associated major cations and anions include sulfate, calcium and sodium. Nitrate concentrations for initial samples collected in November 1999 from well 299-W23-19 ranged from 425 to 560 mg/L, consistent with the high technetium-99 in this well. The upward trend in well 299-W22-45 continued and the reported concentration (47 mg/L) for January 2000 was just above the maximum contaminant level for the first time. The trend of increasing concentrations of technetium-99, nitrate and chromium in well 299-W22-45 are indicative of a tank waste source. Nitrate concentration (46 mg/L) was just above the maximum contaminant level in well 299-W22-46.

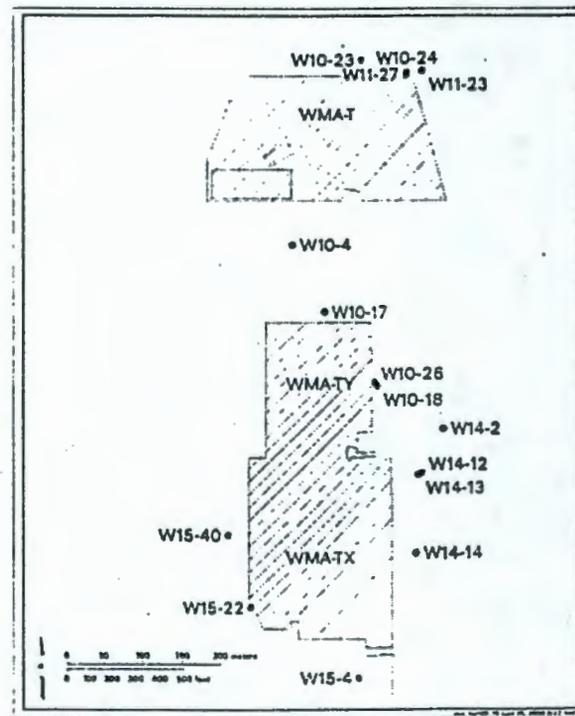
Tritium exceeded the 20,000-pCi/L drinking water standard in three RCRA wells and in one non-RCRA well. The highest concentration in a RCRA well occurred in upgradient well 299-W23-14 (208,000 pCi/L in January 1999), compared to 26,400 pCi/L in downgradient well 299-W22-46 and 25,000 pCi/L in downgradient well 299-W22-39. Concentrations in downgradient well 299-W22-46 appear to be declining from a maximum of 65,200 pCi/L in May 1997. The average tritium concentration in new well 299-W23-19 in the SX tank farm was 92,000 pCi/L in October 1999. The primary source of the tritium in these wells is attributed to residual contamination from past-practice crib disposal sites. For example, the tritium concentrations in the non-RCRA well 299-W23-9, located immediately downgradient from the 216-S-25 crib and upgradient from well 299-W23-14, was 377,000 pCi/L in June 1999.

Neither strontium-90 nor cesium-137 was detected in any RCRA monitoring wells in the network. The 2-sigma uncertainties were approximately 0.2 pCi/L and 2 pCi/L, respectively.

Carbon tetrachloride exceeded the maximum contaminant level of 5 µg/L in four downgradient wells (299-W23-15, 299-W22-44, 299-W22-45 and 299-W22-46). The highest concentration, 140 µg/L, occurred in well 299-W23-15 for the January 2000 sampling event. This well has exhibited a gradual upward trend in TOX and carbon tetrachloride over the past two years. The occurrence of carbon tetrachloride in the vicinity of WMA S-SX is attributed to the past-practice disposal of carbon tetrachloride to various cribs, ditches and ponds associated with the Plutonium Finishing Plant operations. However, the specific location of the source area and pathway to WMA S-SX wells remains uncertain.

Single-Shell Tanks WMA T and TX-TY:

Technetium-99 and other contaminants, presumably from sources within the WMAs, increased during the past quarter. Water levels near these waste management areas continued to decline this quarter. While the water table has continued to drop, the gradient has changed little; therefore the rate and direction of groundwater flow have not changed during the quarter. As reported previously, groundwater flow directions have been affected by the 200-ZP-1 groundwater remediation. Groundwater flow is to the east beneath T tank farm, to the east or east-southeast beneath TY tank farm, and to the south or south-southeast beneath the TX tank farm.



Technetium-99 concentration in well 299-W10-24, the replacement well for 299-W11-27, decreased to 2,170 pCi/L in December. Well 299-W11-23, a non-RCRA well located ~30 meters east of 299-W10-24, was not sampled during this quarter. The highest recorded technetium-99 concentration in this well was 8,540 pCi/L in November 1998.

The nitrate concentration in well 299-W10-4, a non-RCRA well located south of WMA T, reached 1,049 mg/L in December. Nitrate has been increasing in this well over the past several years. Specific conductance is high (2,250 µS/cm) and co-contaminants are chromium (182 µg/L), fluoride (4,200 µg/L), and carbon tetrachloride (1,300 µg/L). The probable origin of these contaminants is waste disposal at facilities associated with the Plutonium Finishing Plant. They were moved northward from the Plant under a previous groundwater flow regime and are now moving eastward across the site.

Groundwater chemistry in WMA TX-TY well 299-W10-17 did not change significantly since the last sampling, i.e., nitrate continued to exceed the maximum contaminant level while chromium and technetium-99 were below applicable standards. Well 299-W10-17, one of the

wells that initially placed WMA TX-TY in assessment, is no longer downgradient of the WMA, but is cross-gradient or marginally upgradient to the northeast corner of the WMA.

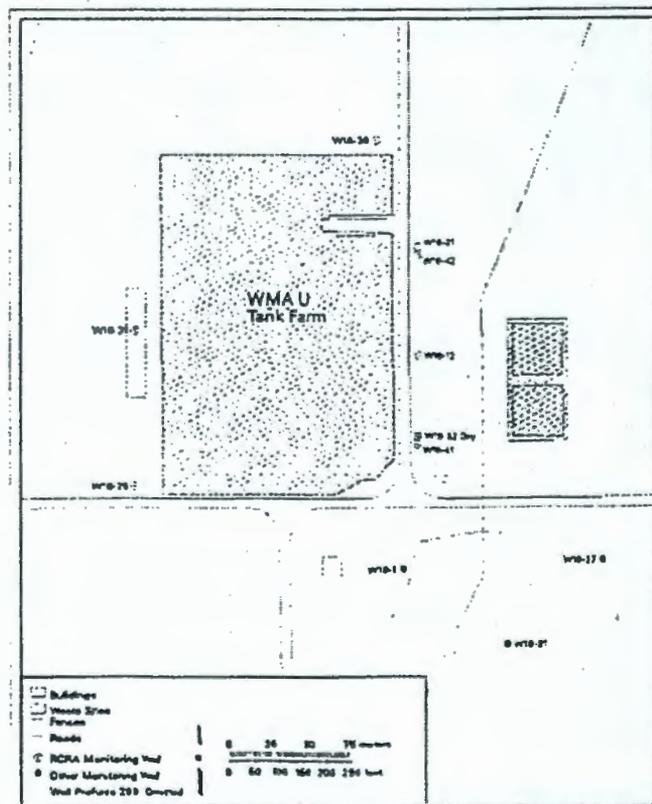
The high tritium groundwater plume first noted in well 299-W14-2 now includes well 299-W14-13, which replaced well 299-W14-12. Results from January 2000 indicated that tritium concentrations in wells 299-W14-2 and 299-W14-13 were 1,900,000 and 2,530,000 pCi/L respectively. The iodine-129 concentration in January was 52 pCi/L in 299-W14-2, and was reported as <27 pCi/L in well 299-W14-13. The technetium-99 concentrations were 5,890 pCi/L in well 299-W14-13 and 327 pCi/L in well 299-W14-2. Chromium was also elevated in well 299-W14-13 (466 µg/L); exceeding the maximum contaminant level. The technetium-99 and chromium are similar to the contaminant signature initially detected in well 299-W14-12. Previous high values of technetium-99 and chromium were detected when groundwater flow was toward the northeast. Presently groundwater flow in the area around well 299-W14-13 is toward the southeast. Thus, the recent increases in technetium-99 and chromium may represent a different source within the tank farms. The source of the high tritium/iodine-129 component is unclear, but the most likely source is operational leaks from the nearby 242-T Evaporator which was closed in the early 1970s. The lack of elevated technetium-99 in well 299-W14-2 indicates the presence of at least 2 plumes in the area.

Technetium-99 concentrations in non-RCRA well 299-W15-4, located at the south end of WMA TX-TY, reached 982 pCi/L in July, exceeding the 900-pCi/L drinking water standard, but decreased to 641 pCi/L in October 1999.

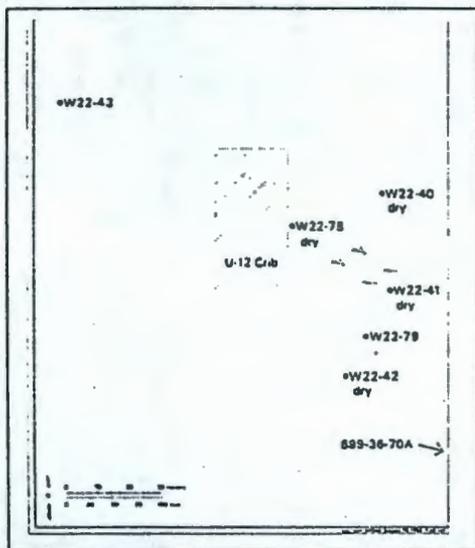
Single-Shell Tanks Waste Management Area U.

Specific conductance in downgradient well 299-W19-41 (330.5 µS/cm in August 1999) exceeded the revised critical mean of 272.5 µS/cm. Verification sampling was not necessary because the value was in line with the historical trend.

A formal notification letter (Reference 1) was transmitted to Ecology on February 11, 2000. An assessment plan (PNNL-13185), allowing for a first determination as allowed under 40 CFR 265.93(d)(5), was transmitted to Ecology on April 3, 2000 (Reference 2). An assessment report will be completed by September 30, 2000.



216-U-12 Crib: The groundwater-monitoring network has been revised because of continued regional groundwater decline. The current network consists of one upgradient well (299-W22-43) and two downgradient wells (299-W22-79 and 699-36-70A). Upgradient well 299-W22-43 now contains too little water to sample. A replacement well is proposed for this year. The sampling round scheduled for the October-December 1999 quarter was delayed until late January 2000 due to scheduling conflicts. The results indicated continued decline in concentrations for all the constituents of interest. Water levels were measured in all the wells including unsampleable wells 299-W22-40, 299-W22-41, and 299-W22-42. The water level data indicated that the current three-well network is adequately monitoring releases from the 216-U-12 Crib.

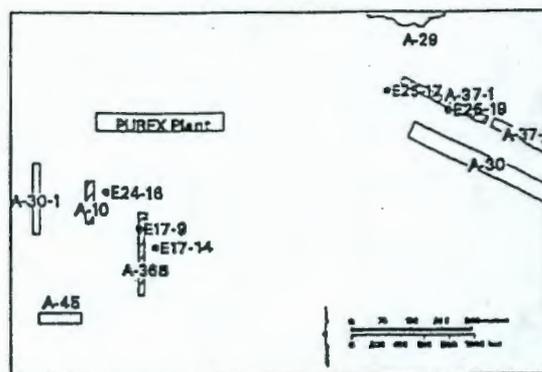


Due to regional changes in the water table the groundwater flow direction beneath the Crib is slowly changing from an east-southeasterly direction to a more easterly direction. As this shift in flow direction progresses it is apparent that the regional contaminants, iodine-129 and tritium, are also shifting northward. This is reflected in increasing concentrations in the downgradient wells from south to north. The current flow direction is to the east-southeast. The rate of flow has not changed.

Specific conductance results in downgradient wells 299-W22-79 and 699-36-70A were 415 and 584 $\mu\text{S}/\text{cm}$, respectively. Well 699-36-70A continued to exceed the critical mean (457.8 $\mu\text{S}/\text{cm}$), while well 299-W22-79 is trending just below the critical mean, similarly to previous values in dry well 299-W22-42, which it replaced. Nitrate values for both wells continue to exceed the 45-mg/L maximum contaminant level. Results for downgradient wells 299-W22-79 and 699-336-70A were 62 and 103 mg/L, respectively.

Radiological chemistry results for technetium-99, tritium, and iodine-129 are not yet available for well 299-W22-79. Results for these three constituents in well 699-36-70A were 126 pCi/L, 76,500 pCi/L, and 12.9 pCi/L, respectively. Tritium and iodine-129 are regional contaminants not associated with the crib.

PUREX Crib (216-A-10, 216-A-36B, 216-A-37-1): Concentrations of nitrate, iodine-129, tritium, strontium-90, and gross beta continued to exceed applicable standards during October-December 1999 at near-field wells monitored for the PUREX Crib. In the vicinity of the cribs, the differences in water table elevations from well to well are very small. Therefore, the water table gradient is too low to determine groundwater flow rate or flow direction reliably. However, groundwater flow directions determined from the movement of contaminant



plumes indicate that the regional flow is toward the southeast.

Nitrate concentration remained above the maximum contaminant level (45 mg/L) near the 216-A-36B crib at one well (299-E17-14, 108.9 mg/L). Nitrate concentrations are declining in the vicinity of the 216-A-10 crib, remain constant to slightly rising near the 216-A-36B crib, and remain fairly constant at the 216-A-37-1 crib.

The pH is consistently elevated at all the near-field PUREX Cribs monitoring wells with a range of 8.01 to 8.78. Only one well exceeded the maximum contaminant level (8.5) during the quarter. The exceeding value was 8.78, collected in October 1999 from well 299-E25-31, an upgradient well northeast of the 216-A-37-1 crib. The overall values of pH at the PUREX Cribs near-field monitoring wells are holding steady, neither rising nor declining with time.

Iodine-129 concentrations remained above the interim drinking water standard (1.0 pCi/L) at all of the near-field monitoring wells for the PUREX Cribs. However, the overall trend is steady or decreasing. The range in values for the quarter was 1.43 pCi/L at well 299-24-18 (an upgradient well northeast of the 216-A-37-1 crib) to 12.1 pCi/L at well 299-17-14 (a downgradient well near the 216-A-36B crib).

Strontium-90 concentrations remained elevated at wells near the 216-A-10 and 216-A-36B cribs. The highest reported value during the quarter was 19.1 pCi/L at well 299-E17-14 (near the 216-A-36B crib). This reported value was the only one exceeding the interim drinking water standard (8 pCi/L). Because strontium-90 is a beta-emitter, the strontium-90 results are consistent with elevated gross beta (interim drinking water standard = 50 pCi/L). In well 299-E17-14 the gross beta level was 62.5 pCi/L. One well at the 216-A-10 crib (299-E24-16) and one well at the 216-A-36B crib (299-E17-14) have increasing levels of strontium-90. The other wells show that strontium-90 levels are steady or are declining.

Tritium concentrations remained above the interim drinking water standard (20,000 pCi/L) at both the up- and downgradient wells at the 216-A-10 and 216-A-36B cribs. At the 216-A-37-1 crib, tritium concentrations remained above the interim drinking water standard at one downgradient well (299-E25-19), but the upgradient well (299-E25-31) and the other downgradient well (299-E25-17) had tritium levels below the standard. The highest tritium level reported near the PUREX Cribs for the quarter was 712,000 pCi/L at well 299-E17-14 (216-A-36B crib). The overall trend of tritium in the near-field wells is decreasing.

Quality Control

Results of the RCRA quality control program for the October through December quarter are discussed in the attachment. Quality control data that are not available in HEIS are available in electronic form upon request. The quality control program indicated that the data were acceptable for use in the statistical comparisons discussed above.

Table 1. Status of RCRA Sites, October-December 1999.

Site	Routine sampling Oct-Dec 1999 ¹	Statistical exceedance
Indicator Evaluation Sites [40 CFR 265.93(b)] (sampled semiannually)		
1301-N Facility	No	Not applicable
1325-N Facility	No	Not applicable
1324-N/NA Site	No	Not applicable
B-Pond	No	Not applicable
A-29 Ditch	Yes	Yes
B-63 Trench	Yes	No
S-10 Pond and Crib	No ²	Not applicable
LERF	Yes	Yes
LLBG WMA 1	No ²	Not applicable
LLBG WMA 2	Yes	Yes ³
LLBG WMA 3	No	Not applicable
LLBG WMA 4	No	Not applicable
SST WMA A-AX	No ²	Not applicable
SST WMA C	Yes	No
NRDWL	No	Not applicable
Groundwater Quality Assessment Sites [40 CFR 265.93(d)] (sampled quarterly)		
Seven sites ⁴	Yes	Not required
Final Status Sites (WAC 173-303-645)		
300 Area Process Trenches	Yes ⁵	Yes
183-H Basins	Yes ⁵	Yes

LERF = Liquid Effluent Retention Facility
 LLBG = Low-Level Burial Grounds
 NRDWL = Nonradioactive Dangerous Waste Landfill
 SST = Single-Shell Tanks
 WMA = Waste Management Area

¹ Sites scheduled for October-December 1999 but was delayed until January-March 2000 because of scheduling conflicts; if data were available, they were evaluated.

² Sampling delayed until January-March 2000; data not available for evaluation.

³ No indication of hazardous waste contamination from facility; see text for explanation.

⁴ U-12 Crib, PUREX Cribs, SST WMAs B-BX-BY, S-SX, T, TX-TY, and U.

⁵ Site has entered corrective action because of previous exceedances.

Attachment: Quality Control Results, October through December 1999.

This quality control (QC) report presents information on laboratory performance and field QC sample results for the 4th quarter of CY 1999.

Completeness. The determination of completeness is made by dividing the number of results judged to be valid by the total number of results evaluated and multiplying by 100. Data judged to be valid are data that have not been flagged with an Y, R, Q, or H, or qualified to indicate laboratory blank contamination. Out of a total of 11,492 results, 84% of the results were considered valid for the 4th quarter of 1999. This percentage is slightly lower than the value from 3rd quarter (88%). Approximately 86% of the 4th-quarter flags resulted from detection of anions, conductivity, metals, and total organic carbon in field and method blanks. The majority of these results were at levels near the method detection limits; thus, the overall impact of sample contamination or false-detection on data quality is believed to be minor. 216 results were flagged with an H to signify missed hold times. This value is significantly higher than the 3rd quarter total of 37. Constituents affected for 4th quarter were laboratory-measured conductivity (4) and pH (3), total dissolved solids (21), anions (69), alkalinity (6), mercury (3), phenols (51), volatile organic compounds (46), total organic carbon (2), and coliform (11). Many of the missed holding times were caused by shipping problems near the holidays and scheduling mistakes at the laboratory, which has taken steps to minimize future occurrences.

Field QC Data

Field QC samples include field duplicates, split samples, and field blanks. Quadruplicate samples collected at many wells for TOC and TOX analyses also provide useful QC data. Field blanks included full trip blanks, field transfer blanks, and equipment blanks. In general, the desired collection frequency for field duplicates and full trip blanks is one sample per 20 well trips. The target collection frequency for field transfer blanks is one blank on each day in which routine well samples are collected for analysis of volatile organic compounds. Equipment blanks are normally collected once per 10 well trips for portable pumps or as needed for special projects. Split samples are also collected on an as-needed basis. The results from each type of QC sample are summarized below.

Field duplicates. Field duplicates provide a measure of the overall sampling and analysis precision. Evaluation of field-duplicate data is based on the relative percent difference (RPD) statistic, which is calculated for each matching pair of results. Field duplicates with at least one result greater than 5 times the method detection limit (MDL) or minimum detectable activity (MDA) must have RPDs less than 20% to be considered acceptable. Duplicates with RPDs outside this range are flagged with a Q in the database.

For the 4th quarter of 1999, 15 field duplicates were collected and analyzed to produce 417 pairs of results. Overall, the results indicate excellent sampling and analysis precision, with only 11 pairs of qualifying duplicate results had relative percent differences greater than 20%.

Split samples. Split samples are replicate samples that are sequentially collected from the same location and analyzed by different laboratories. The results from split samples are useful for confirming out-of-trend results and assessing one laboratory's performance relative to another laboratory. Like field duplicates, split samples should have RPDs less than 20% to be considered acceptable. However, because the two laboratories can have different detection limits, concentrations that are quantifiable at one laboratory may go undetected at the other laboratory. Therefore, the 20% RPD criterion applies only to those results that are quantifiable at both laboratories.

During the 4th quarter of 1999, 59 wells were co-sampled by long-term and interim-action (i.e., CERCLA) groundwater monitoring projects. Eight split samples were collected from the co-sampled wells and submitted to both sets of laboratories. The purpose of the split samples was to provide information on data comparability between the laboratories. The samples were analyzed for anions, carbon-14, stontium-90, tritium, and uranium to produce 36 pairs of results. Most of the split-sample results showed good agreement between the corresponding laboratories. Future evaluations of split-sample data may provide additional insights into possible biases introduced by the laboratories.

TOC and TOX Quadruplicates. Samples for TOC and TOX analyses are normally collected in quadruplicate in accordance with RCRA requirements. While these samples are not intended as QC samples, quadruplicates may provide useful information about the overall sampling and analysis precision for organic indicator parameters. For the purposes of this discussion, TOC and TOX quadruplicate data were evaluated based on the relative standard deviation (RSD) for each set of quadruplicate results. Each quadruplicate set having an RSD greater than 20% and at least one result greater than 5 times the method detection limit was considered to have poor precision. Most of the quadruplicate data sets did not include a result greater than 5 times the MDL. Of the others, 1 out of 51 TOC quadruplicates and 2 out of 52 TOX quadruplicates failed to meet the evaluation criteria. The poor precision in each case was caused by an outlier value that was not in trend with previous data and was rejected.

Field Blanks. Full trip blanks, field transfer blanks, and equipment blanks are used to check for contamination resulting from field activities and/or bottle preparation. In general, the QC limit for blank results is 2 times the method detection limit (MDL) or instrument detection limit for chemistry methods and 2 times the total propagated error for radiochemistry methods. For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the QC limit is 5 times the MDL. Blank results that exceed these limits may indicate a contamination or false-detection problem for regular groundwater samples. Results from groundwater samples that are associated with an out-of-limit field blank are flagged with a Q in the database.

A total of 1,162 results were produced from the 4th-quarter field blank samples. Approximately 5% of the results (i.e., 53 results) exceeded the QC limits for field blanks. This percentage is similar to the 3rd quarter value of 6%. Most of the unacceptable results were for anions and ICP metals; however, results were also flagged for total organic carbon, chloroform, and uranium. The potential impacts on the data are minor in most cases. Several constituents (calcium, chloride, fluoride, magnesium, sodium, and uranium) had field blank results that were greater than the QC limits, but the values were insignificant compared to the concentrations of these constituents in almost all 4th-quarter groundwater samples. Some additional observations about the field blanks are noted below.

As described last quarter, the number of out-of-limit field-blank results for TOC has decreased during the past three quarters. For the 4th quarter, only 1 out of 16 (i.e., 6%) total organic carbon results was greater than 2 times the MDL, and the result of 620 µg/L was close to the QC limit. Eleven percent of the 3rd-quarter field blanks exceeded the QC limits for total organic carbon. These results suggest that there is currently little problem with false detection or sample contamination for TOC.

Several metal results exceeded the QC limits. However, except for the sodium data, most of the results were within a factor of 2 of the QC limits. Sodium is a common contaminant that has been observed in field blanks at similar levels in previous quarters. Many of the out-of-limit metal results are believed to be false detections resulting from the use of the instrument detection limit as a reporting limit.

Two field blanks had chloroform results that were greater than 2 times the MDL. The concentrations were low (0.9 µg/L and 2.4 µg/L) but were comparable to the results for a few 4th-quarter groundwater samples. As noted in previous quarters, it is suspected that chloroform was present in the water used to prepare some of the field blanks due to incomplete removal by the water purification system.

Several anion concentrations were well above the QC limits in a full trip blank associated with well 199-H4-15A (not sampled for RCRA). None of the ICP metal concentrations were unusually high for this sample; thus, the reasons for the elevated concentrations are unknown. It is suspected that the blank was inadvertently swapped with another sample in the field or at the laboratory.

In general, the concentrations of constituents detected in equipment blanks were not significantly different than the corresponding full-trip blank values. None of the out-of-limit equipment-blank results were substantial compared to 4th-quarter Hanford groundwater concentrations except for 2 zinc results (10 µg/L and 11 µg/L) and a chloroform result of 2.4 µg/L. Therefore, the use of non-dedicated sampling equipment at some wells did not appear to introduce any significant contamination problems.

Laboratory QC Data

Blind Standards. Double-blind standards containing known amounts of selected anions, organic compounds, TOC, TOX, and radionuclides were prepared and submitted to the laboratories in August. All of the standards except those for cyanide were prepared using groundwater from background wells. Cyanide standards were prepared in deionized water.

The acceptance limits for blind standard recoveries are generally 75 – 125% except for specific radionuclides, which have a $\pm 30\%$ acceptance range. The majority of the 4th-quarter results were acceptable, indicating good analytical performance overall. However, one lab had high recoveries for TOC and gross beta and low recoveries for cyanide. In addition, other labs had unacceptable results for TOC, TOX, gross alpha and gross beta.

EPA Water Supply/Water Pollution Programs. In these programs, the EPA distributes standard water samples as blind samples to participating laboratories. These samples contain specific organic and inorganic analytes at concentrations unknown to the participating laboratories. After analysis, the labs submit their results to the EPA. Regression equations are used to determine acceptance and warning limits. The results of these studies independently verify the level of laboratory performance and are expressed as a percentage of EPA-acceptable results.

The laboratory has responded to the unacceptable results in the WP study reported in December 1999 (WP-56). The unacceptable result for total hardness was caused by a calculation error. The unacceptable result for magnesium may have been caused by a sample dilution problem. No cause has been found for the unacceptable results for alkalinity, orthophosphate, and tetrachloroethylene. The results for alkalinity and magnesium were only slightly above the acceptance limits and were thought to be anomalies. The method required by the EPA for orthophosphate (i.e., Method 365.1, EPA-600/4-79-020) is not routinely used for analysis of Hanford Site groundwater samples. Therefore, the unacceptable orthophosphate result should have no effect on the interpretation of data for the Hanford samples. Tetrachloroethylene results have been unacceptable twice within the past year (WP-50 and WP-56) with unknown cause, though the laboratory has analyzed performance evaluation samples for New York State with acceptable results during this same time period. No new results have been received this quarter.

Mixed Analyte Performance Evaluation Program. The Mixed Analyte Performance Evaluation Program (MAPEP) is conducted by the Department of Energy. In this program, samples containing metals, volatile and semivolatile organic compounds, and radionuclides are sent to participating laboratories in January and July. No new MAPEP results were available this quarter.

InterLaB RadChem Proficiency Testing Program Studies. As of January 1999, the InterLaB RadChem Proficiency Testing Program study, conducted by Environmental Resource Associates (ERA), replaced the EPA's National Exposure Research Laboratory PE studies. Control limits are based on the National Standards for Water Proficiency Testing Studies Criteria Document, December 1998.

The results from four RadChem PE studies were reported in January and February 2000 (RAD-12 through RAD-15). The following constituents were analyzed in these studies: cesium-134, cesium-137, cobalt-60, gross alpha, gross beta, iodine-131, radium-226, radium-228, strontium-89, strontium-90, and uranium. All of the results from the primary laboratory were within the control limits; cobalt-60 and gross beta results were acceptable with warning.

Department of Energy Quality Assessment Program. This program is conducted by the Environmental Measurements Laboratory (EML) and is designed to evaluate the performance of participating laboratories through the analysis of air filter, soil, vegetation, and water samples containing radionuclides. Only the water results are considered in this report. Control limits established by the EML are based on historic data distributions from data collected by the EML from 1982 to 1992. Acceptable results should fall within the 15th and 85th percentile of the cumulative normalized distribution. Results are within warning limits if they fall between the 5th and 15th percentile or the 85th and 95th percentile. Results less than the 5th percentile or greater than the 95th percentile are "not acceptable" (DOE 1995). Final results reported for QAP 51 were the same as the preliminary results reported in the last quarterly report.

Laboratory QC Data. Laboratory QC data includes the results from method blanks, laboratory control samples, matrix spikes, matrix spike duplicates, surrogates, and matrix duplicates. This information provides a means of assessing laboratory performance and the suitability of a method for a particular sample matrix. Laboratory QC data are not currently used for in-house validation of individual sample results unless the lab is experiencing unusual performance problems with an analytical method. Most of the 4th-quarter laboratory QC results were within acceptance limits, suggesting that the analyses were in control and reliable data was generated. Nevertheless, several parameters had unacceptable results, and some were "significantly" out of limits. For method blanks, this means some results were greater than twice the QC limit. For laboratory control samples, matrix spikes, and duplicates, significantly out means the results were outside the range of the QC limits plus or minus 10 percentage points (e.g., if the QC limits are 80-120%, significantly out would mean less than 70% or greater than 130%).

Results for method blanks were evaluated based on the frequency of detection above the blank QC limits. In general, these limits are 2 times the method detection limit (MDL) or instrument detection limit (IDL) for chemical constituents and 2 times the total propagated error for radiochemistry components. For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the QC limit is 5 times the MDL. The general chemistry parameters and metals categories had the greatest percentage of method blank results exceeding the QC limits, with 16.8% and 9.9% exceeding twice the MDL or IDL, respectively. For metals, most of the out-of-limit results were for aluminum, iron, and zinc, although beryllium, calcium, copper, nickel, sodium, and vanadium each had one value out-of-limits as well. For general chemistry parameters, most of the high method blank results were for conductivity, with 100% above the QC limit. However, the out-of-limit method blank results for conductivity are not a significant problem because almost all 4th-quarter groundwater samples had conductivity values that were at least 100 times higher than the highest blank value. For all other categories, the QC limits were exceeded by fewer than 3% of the method blanks. The only constituent in these categories with ten or more measurements that had greater than 10% of method blanks outside the QC limits was chloride (11.3%). The highest method blank result for chloride was 0.088 mg/L or 2.5 times the QC limit. For the analysis dates on which chloride method blanks were above the QC limits, the chloride measured in groundwater samples was at least 20 times higher than that measured in the blanks; thus, the out-of-limit method blank results are not a significant problem. Other parameters that had out-of-limit results are as follows: total dissolved solids, total organic halides, tetrahydrofuran, technetium-99, and tritium. Total dissolved solids was the only constituent that was significantly out-of-limits, as defined in the preceding paragraph.

Almost all laboratory control sample recoveries were acceptable. The percentages of out-of-limit results were as follows: 1.1% for general chemistry parameters, 0% for ammonia and anions, 0.2% for metals, 0% for volatile organic compounds, 0% for semivolatile organic compounds, and 0.9% for radiochemistry parameters. No constituents with 10 or more measurements had greater than 10% of laboratory control samples outside QC limits. Parameters that had out-of-limit results were alkalinity, zinc, and neptunium-237. Of these, zinc was the only constituent with a significantly out-of-limit result.

For matrix spikes and matrix spike duplicates, the percentages of out-of-limit results were as follows: 4.3% for general chemistry parameters, 19.4% for ammonia and anions, 0.6% for metals, 0% for volatile organic compounds, 0% for semivolatile organic compounds, and 28.2% for radiochemistry parameters. Constituents with 10 or more measurements that had greater than 10% of matrix spikes outside QC limits included chloride, nitrate, nitrite, technetium-99, and uranium. Each of these constituents had one or more matrix spikes that were significantly outside the QC limits. Additional parameters that had out-of-limit results are as follows: total organic carbon, total organic halides, fluoride, sulfate, antimony, chromium, iron, thallium, and neptunium-237.

For matrix duplicates with values five times greater than the MDL or MDA, percentages of out-of-limit results were as follows: 3.7% for general chemistry parameters, 0% for ammonia and anions, 0.2% for metals, 0% for volatile organic compounds, 0.7% for semivolatile organic compounds, and 1.4% for radiochemistry parameters. The only constituent with at least 10 measurements that had greater than 10% of matrix duplicates outside QC limits was total dissolved solids. Other parameters that had out-of-limit results are as follows: alkalinity, antimony, 2,3,4,6-tetrachlorophenol, carbon-14, gross alpha, gross beta, and uranium-235.

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Surrogate recoveries were also evaluated. The percentages of out-of-limit results were as follows: 0.1% for volatile organic compounds and 0% for semivolatile organic compounds. 4-Bromofluorobenzene was the only constituent with out-of-limit results.

