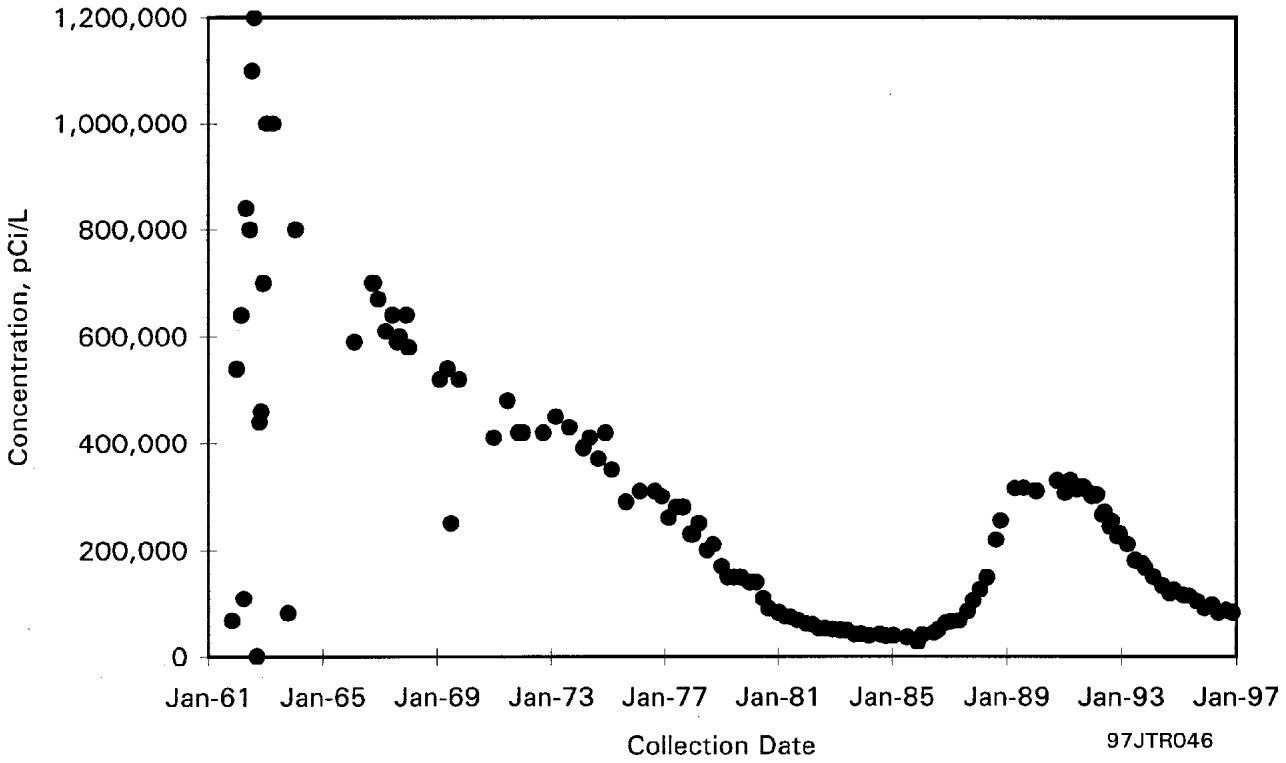

Figure 4.8.15. Tritium Concentrations in Well 699-24-33, 1961 Through 1996

were generally lower than in previous years as a result of dissipation and radioactive decay. Thus, the area of contaminated groundwater downgradient of the Plutonium-Uranium Extraction Plant, with tritium concentrations above 200,000 pCi/L in 1996, was considerably smaller than in previous years. The effects of the second operational period have not been seen near the Columbia River. A trend plot (Figure 4.8.16) of the tritium concentrations in well 699-40-1, located near the shore of the Columbia River, shows the arrival in the mid-1970s of the plume from the first campaign and no indication that the second pulse has yet arrived.

The tritium plume has been monitored since the 1960s and provides information on the extent of groundwater contamination over time. Figure 4.8.17 shows the distribution of tritium in selected years from 1964 through 1988. This figure was created from maps in Wilson (1965), Raymond et al. (1976), Prater et al. (1984), and Jaquish and Bryce (1989). The contours in the original references were recalculated and interpreted to provide uniform contour intervals. Figure 4.8.17 shows that tritium at concentrations greater than the drinking water standard reached the Columbia River in approximately the mid-1970s. Variations in the extent of tritium mapped in the 100 Areas appear to result from differences in the monitoring network and different interpretations of results among investigators.

The eastern portion of the tritium plume continues to move to the east-southeast and discharge into the Columbia River. Figure 4.8.18 shows the trend of tritium concentrations in well 699-S19-E13, located just north of the 300 Area. This well, which has shown an increase in tritium since 1985, decreased from 13,300 pCi/L in November 1995 to a maximum 1996 value of 11,700 pCi/L. The tritium plume extends into the 300 Area, where concentrations in some wells (e.g., well 399-1-18A) are greater than half the drinking water standard. Figure 4.8.19 shows a trend plot for well 399-1-17A, which has also displayed elevated levels of tritium. The increase in tritium at this well resulted from the termination of discharge to the 300 Area process trenches, which allowed the regional tritium plume to migrate to this well. A single sample from well 699-S29-E16A, located south of the 300 Area, showed a tritium concentration of 2,030 pCi/L in 1996, up from 65 pCi/L in 1995. The cause of this apparent increase is unknown and will be evaluated after verification by subsequent sampling. Laboratory error is suspected. The tritium plume is not expected to impact the

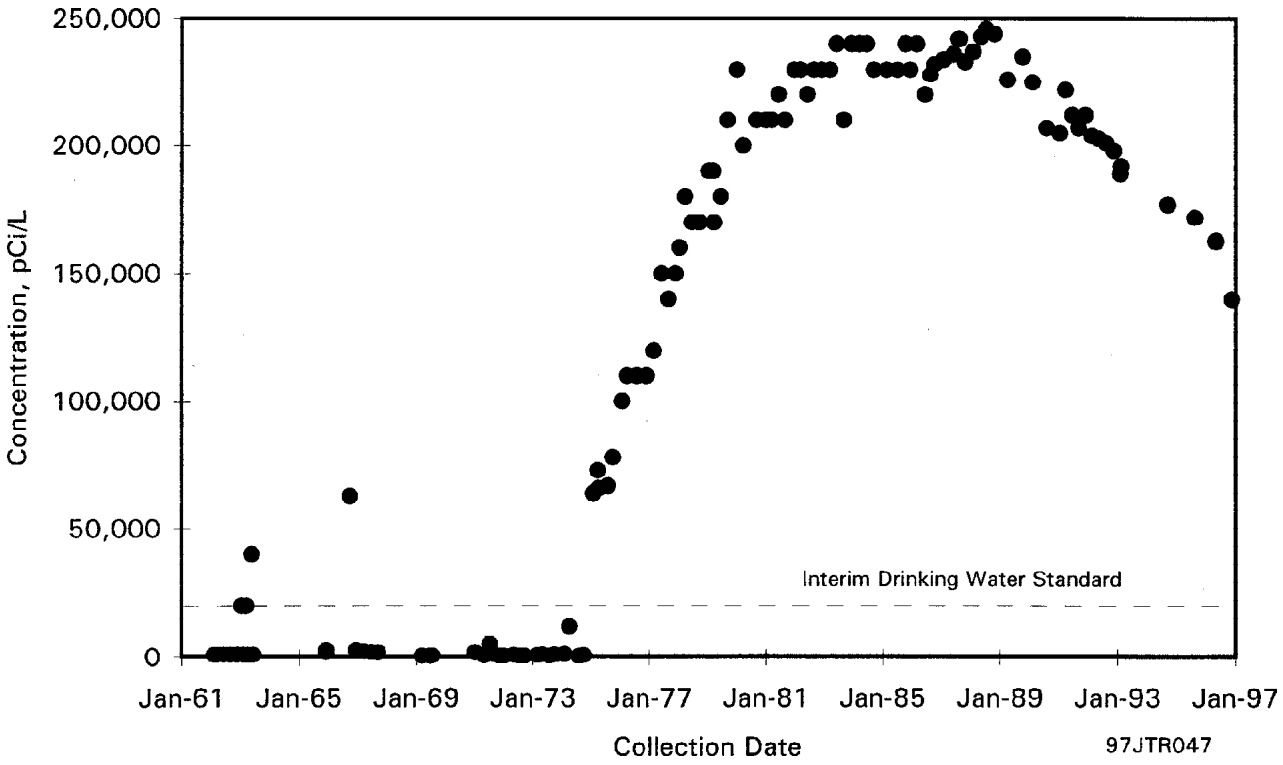

Figure 4.8.16. Tritium Concentrations in Well 699-40-1, 1962 Through 1996

north Richland well field because of the influence on groundwater flow from the Yakima River and recharge from infiltration ponds at the well field (Figure 4.8.20). The Yakima River is at a higher elevation and recharges the groundwater in this area (Newcomer et al. 1991). As a result, groundwater flows from west to east (see Figure 4.8.20), minimizing the southward movement of the contaminant plume. Recharge ponds at the north Richland well field are supplied with Columbia River water, which infiltrates to the groundwater. The amount of recharge water exceeds the amount pumped at the well field by a factor of approximately 2:1, resulting in groundwater flow away from the well field. This further ensures that tritium-contaminated groundwater will not reach the well field. Ongoing monitoring is performed to confirm this interpretation.

The configuration of the western portion of the tritium plume shown in Figure 4.8.12 closely matches previous predictions of the direction of contaminant movement from the 200-East Area (Freshley and Graham 1988). Movement is forced to the south by the flow originating at the groundwater mound beneath B Pond. Flow to the southeast also appears to be controlled by a zone of highly permeable sediments stretching from the 200-East Area toward the 400 Area (Jacobson and Freshley 1990). Tritium is largely absent near B Pond, which produces a spreading area of essentially uncontaminated water. The mound under B Pond is expected to dissipate as flow is diverted to the 200 Areas Treated Effluent Disposal Facility. A new mound will presumably form farther east, under this facility, as long as it is used for disposal of site effluent.

The tritium plume that originated in the 200-East Area extends under the 400 Area. The maximum concentration observed in this area during 1996 was 38,000 pCi/L at well 499-S1-8A. The primary water supply well for the 400 Area (499-S1-8J) is completed in the lower part of the aquifer and had a maximum tritium concentration of 6,800 pCi/L during 1996. Concentrations at wells used for backup water supply were near or slightly above the 20,000-pCi/L drinking water standard. Additional information on the 400 Area water supply is provided in Section 4.3, “Hanford Site Drinking Water Surveillance.”

Tritium is also found at levels above the drinking water standard in the northwestern part of the 200-East Area.

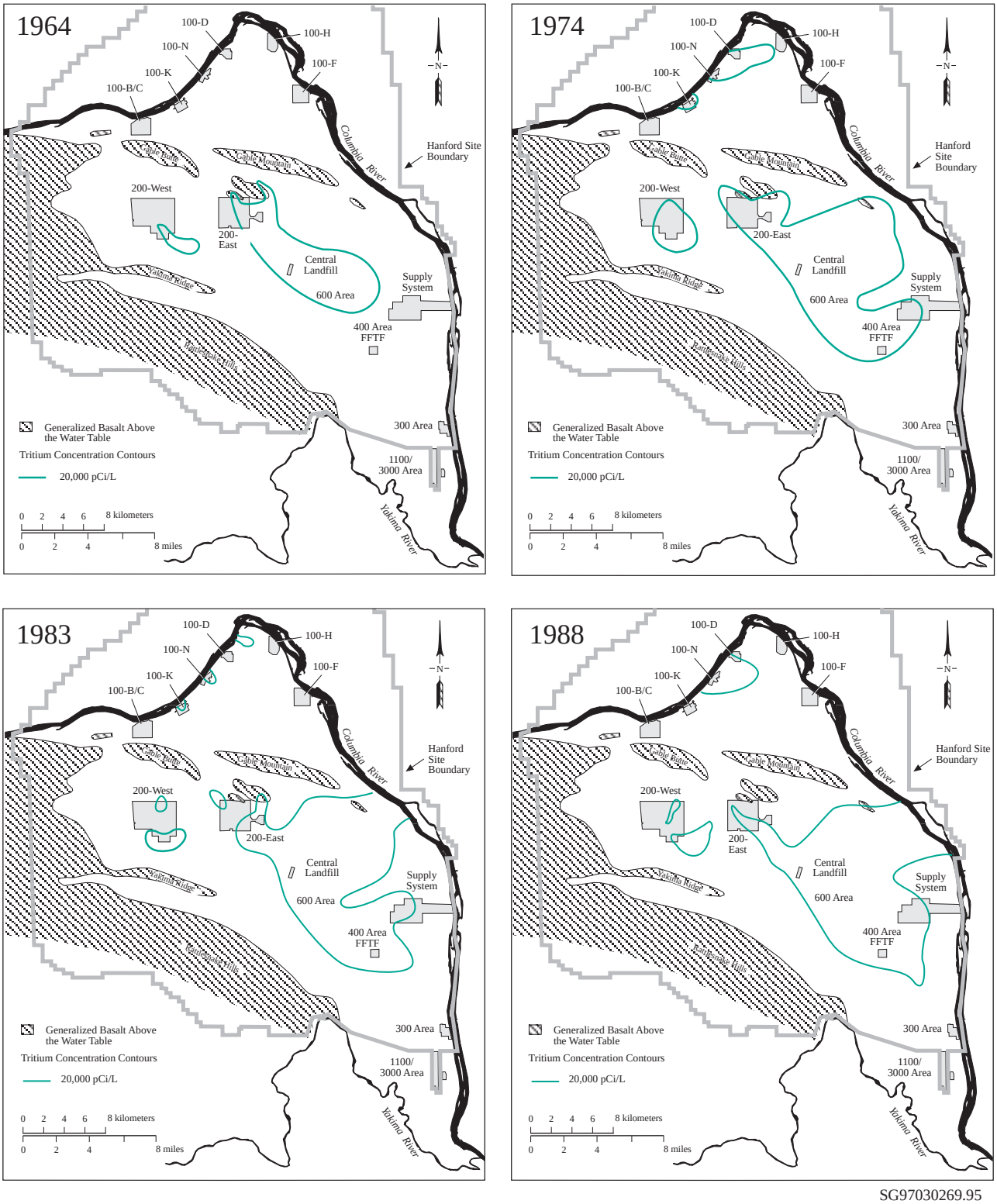

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Figure 4.8.17. Historical Tritium Concentrations on the Hanford Site

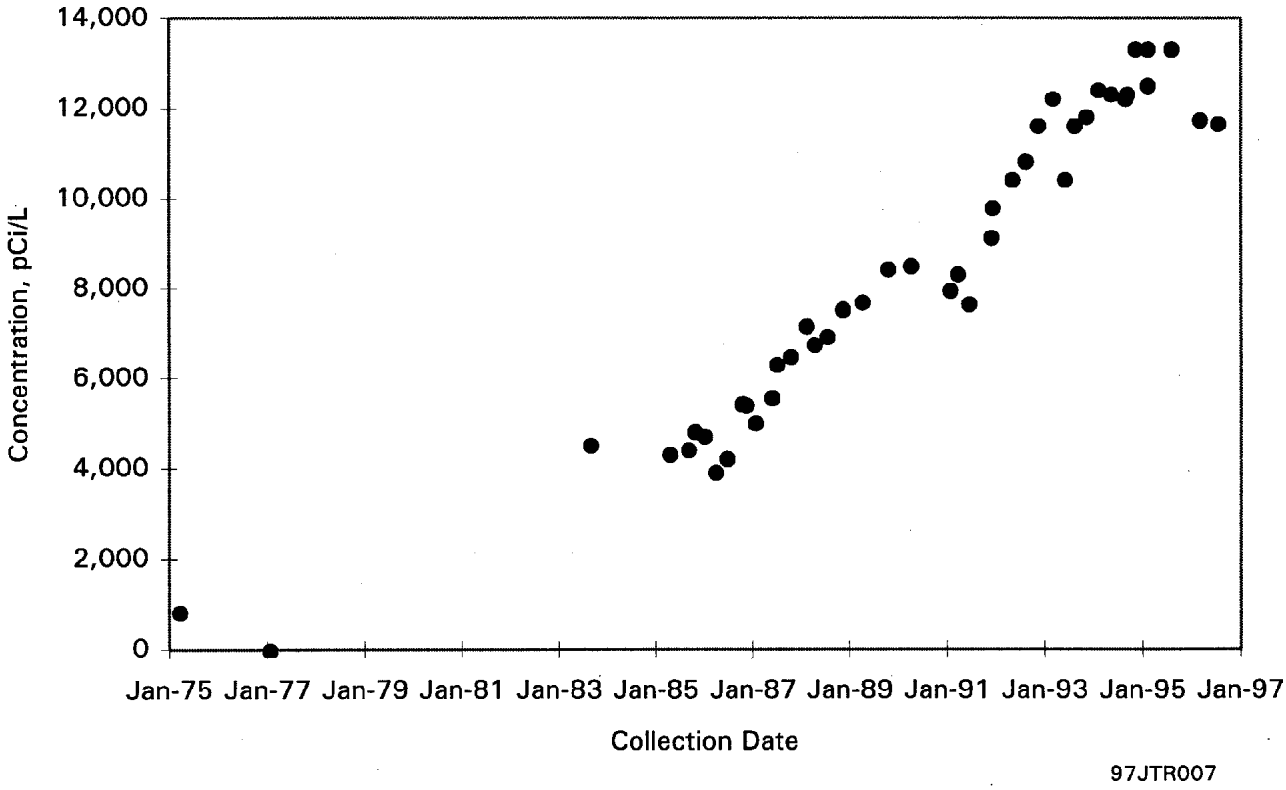


Figure 4.8.18. Tritium Concentrations in Well 699-S19-E13, 1975 Through 1996

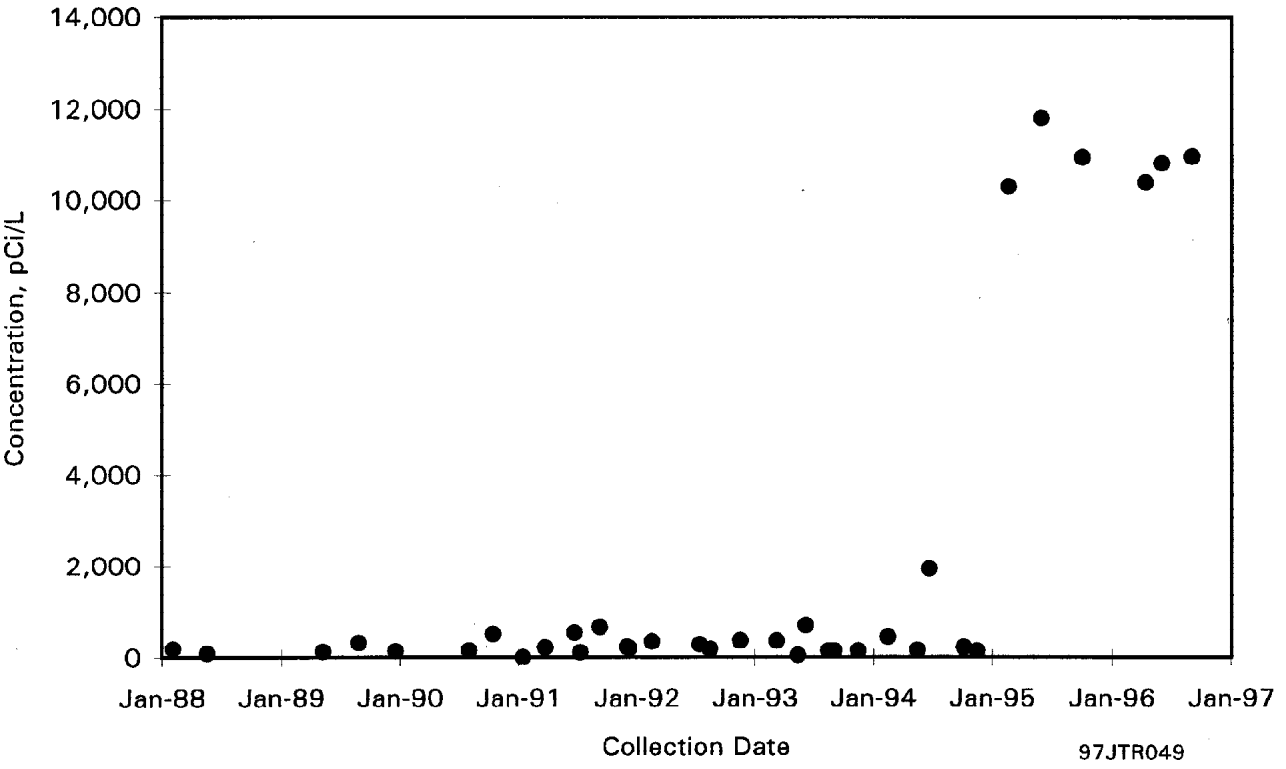
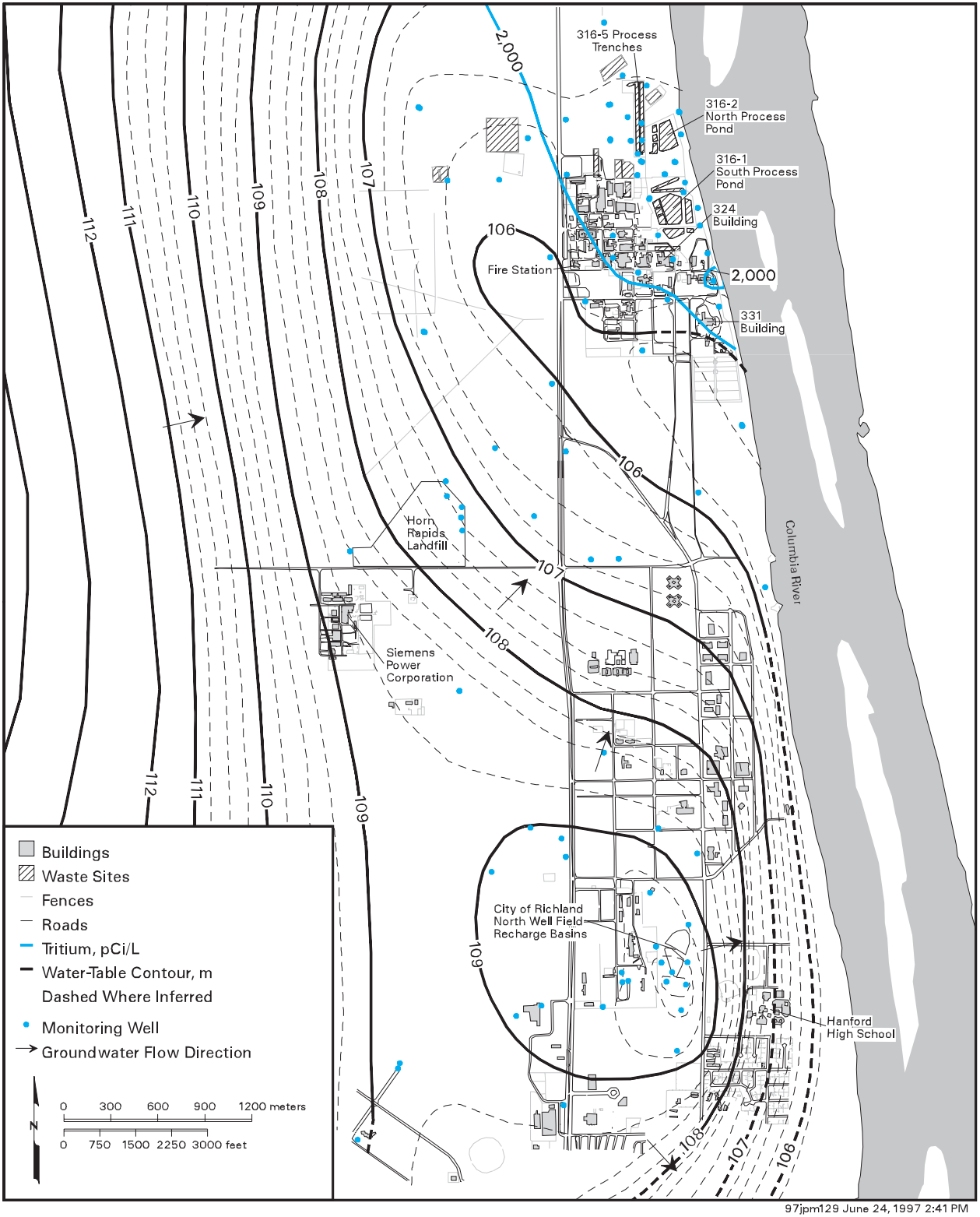


Figure 4.8.19. Tritium Concentrations in Well 399-1-17A, 1986 Through 1996

Figure 4.8.20. Tritium Distribution and Groundwater Flow Near the 300 Area, 1996



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This plume appears to extend to the north through the gap between Gable Mountain and Gable Butte, indicating a divide in groundwater flow direction across the 200-East Area.

The extent of tritium plumes in and around the 200-West Area is also consistent with previous observations. Tritium from sources near the Reduction-Oxidation Plant forms the most extensive and highest concentration plume in the 200-West Area. This plume extends into the 600 Area east of the 200-West Area. The Reduction-Oxidation Plant is located in the southeastern part of the 200-West Area and operated from 1951 through 1967. No wells in the 200-West Area showed tritium levels in excess of the derived concentration guide during 1996. Samples from the well in the 200-West Area with the highest tritium concentrations (well 299-W22-9) contained a maximum of 1,290,000 pCi/L of tritium. The declining concentrations in this well are shown in Figure 4.8.21. The movement of groundwater in the 200-West Area is slow because Ringold Formation sediments have low permeability. Movement of the plumes in the 200-West Area is also slow as a result of declining gradients since the closure of U Pond in 1984.

A smaller area of tritium contamination is found in the north-central part of the 200-West Area in the vicinity of the TX-TY single-shell high-level waste tanks (see Figure 4.8.11) and disposal facilities, which received liquid waste from T Plant operations. This plume extends northeast past the boundary of the 200-West Area.

Iodine-129

The presence of iodine-129 in groundwater is significant because of its relatively low drinking water standard (1 pCi/L), its potential for accumulation in the environment as a result of long-term releases from nuclear fuel reprocessing facilities (Soldat 1976), and its long half-life (16,000,000 yr). The relatively low fission yield for production of iodine-129 combined with its long half-life limits its specific activity in Hanford wastes. Iodine-129 may be released as a vapor during fuel dissolution and other elevated-temperature processes and, thus, may be associated with process condensate wastes. At Hanford, the main contributor of iodine-129 to groundwater has been liquid discharges to cribs in the 200 Areas. Iodine-129 has essentially the same high mobility in groundwater as tritium and nitrate. The highest concentrations observed

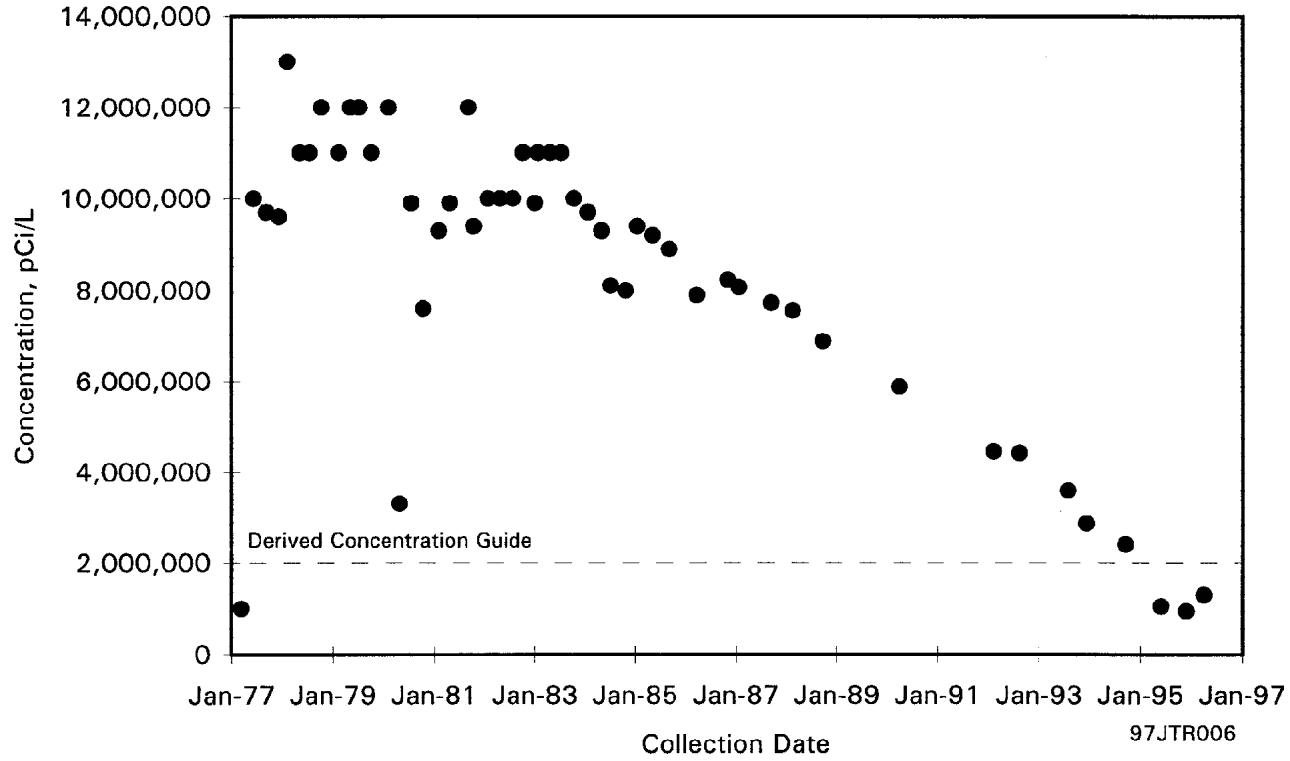

Figure 4.8.21. Tritium Concentrations in Well 299-W22-9, 1977 Through 1996

onsite are downgradient from the Reduction-Oxidation Plant in the 200-West Area and the Plutonium-Uranium Extraction Plant in the 200-East Area. Iodine-129 contamination extends into the 600 Area as shown in Figure 4.8.22. No iodine-129 samples were above the 500-pCi/L derived concentration guide in 1996.

The highest iodine-129 concentrations in the 200-East Area are in the northwest near the BY Cribs and in the southeast near the Plutonium-Uranium Extraction Plant. The maximum concentration of iodine-129 detected in 1996 in the 200-East Area was 13.6 pCi/L in well 299-E17-14. This well is located south of the Plutonium-Uranium Extraction Plant near the 216-A-36B Crib. The iodine-129 plume from the Plutonium-Uranium Extraction Plant area extends southeast into the 600 Area and appears coincident with the nitrate and tritium plumes. The iodine-129 plume appears smaller than the tritium plume because of the lower initial concentration of iodine-129. Iodine-129 contamination can be detected as far as the Columbia River but at levels below the drinking water standard. Current data indicate that iodine-129 at levels above the drinking water standard is approaching the Columbia River (see Figure 4.8.22). The iodine-129 plume likely had the same sources as the nitrate and tritium plumes. Iodine-129 is also present in groundwater at levels above the drinking water standard in the northwestern 200-East Area near the BY Cribs and the B-BX-BY single-shell high-level waste tanks. This plume extends northwest into the gap between Gable Mountain and Gable Butte.

The highest iodine-129 concentration observed in 1996 in Hanford groundwater was 56.9 pCi/L in well 299-W22-9, in the southern part of the 200-West Area near the Reduction-Oxidation Plant. This plume is essentially coincident with the nitrate and tritium plumes, though there appears to be a contribution from cribs to the north near U Plant. A second iodine-129 plume originates near the T single-shell tank farm and nearby disposal facilities and extends northeast toward T Plant, coincident with the technetium-99 and tritium plumes in this area.

Strontium-90

Strontium-90 was produced as a high-yield fission product and was present in waste streams associated with fuel reprocessing. Reactor operations also resulted in the release of some strontium-90 associated with fuel element breaches. Strontium-90 mobility in Hanford groundwater is reduced by adsorption onto sediment particles. Because this adsorption is much weaker than for cobalt-60, cesium-137, and plutonium isotopes, the strontium-90 is still moderately mobile. Because of sorption, a significant portion of the strontium-90 in the subsurface is not in solution. If groundwater concentrations of strontium-90 decrease as a result of natural processes or remediation activities, the sorbed strontium-90 will desorb and remobilize. This limits the options for groundwater remediation.

Concentrations of strontium-90 greater than the 8-pCi/L drinking water standard were found in one or more wells in each of the following areas: 100-B, 100-D, 100-F, 100-H, 100-K, 100-N, 200, and 600 Areas. Concentrations of strontium-90 were greater than the 1,000-pCi/L derived concentration guide in the 100-K, 100-N, and 200-East Areas. This is the first year on record in which strontium-90 values above the derived concentration guide were detected in the 100-K Area.

Strontium-90 in the 100 Areas. Strontium-90 is found at levels greater than the drinking water standard in the 100-B Area and extends into the 600 Area to the east. The maximum concentration detected in the 100-B Area in 1996 was 33.5 pCi/L at monitoring well 199-B3-46. The extent of strontium-90 greater than the drinking water standard in the 100-B Area is shown in Figure 4.8.23. The sources for the strontium-90 appear to be liquid waste disposal sites near B Reactor and liquid overflow trenches near the Columbia River (DOE 1993b). The extent of strontium-90 east of the 100-B Area is not completely defined by the current monitoring network.

Strontium-90 continues to be detected at levels greater than the drinking water standard in the 100-D Area, in well 199-D5-12 near D Reactor. The maximum concentration in 1996 was 25.7 pCi/L, down from 38.7 in 1995. This is the only well in the 100-D Area with strontium-90 concentrations greater than the drinking water standard.

Groundwater within a small part of the 100-F Area has strontium-90 concentrations greater than the drinking water standard. The maximum concentration detected in 1996 was 282 pCi/L in monitoring well 199-F5-3. This is more than twice the concentration of 136 pCi/L measured at this well in 1995. The 100-F Area strontium-90 plume is shown in Figure 4.8.24.

The extent of strontium-90 contamination at levels greater than the drinking water standard in the 100-H Area is shown in Figure 4.8.25. The maximum concentration detected in the 100-H Area in 1996 was 39 pCi/L at monitoring well 199-H4-63. This is slightly higher than the maximum level detected in 1995.

Figure 4.8.22. Distribution of Iodine-129 in the Unconfined Aquifer, 1996

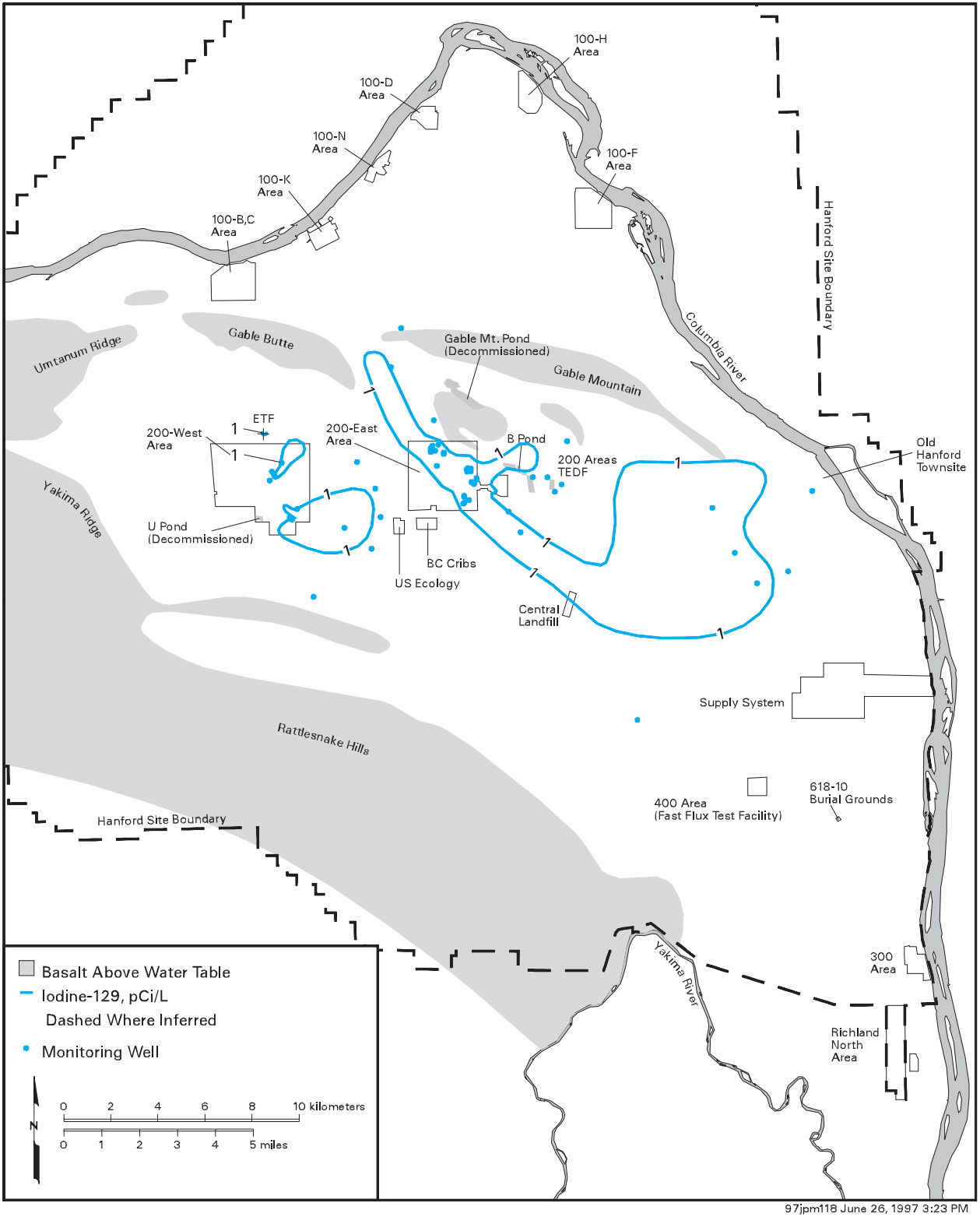

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Figure 4.8.23. Concentrations of Strontium-90 in the Unconfined Aquifer in the 100-B Area, 1996

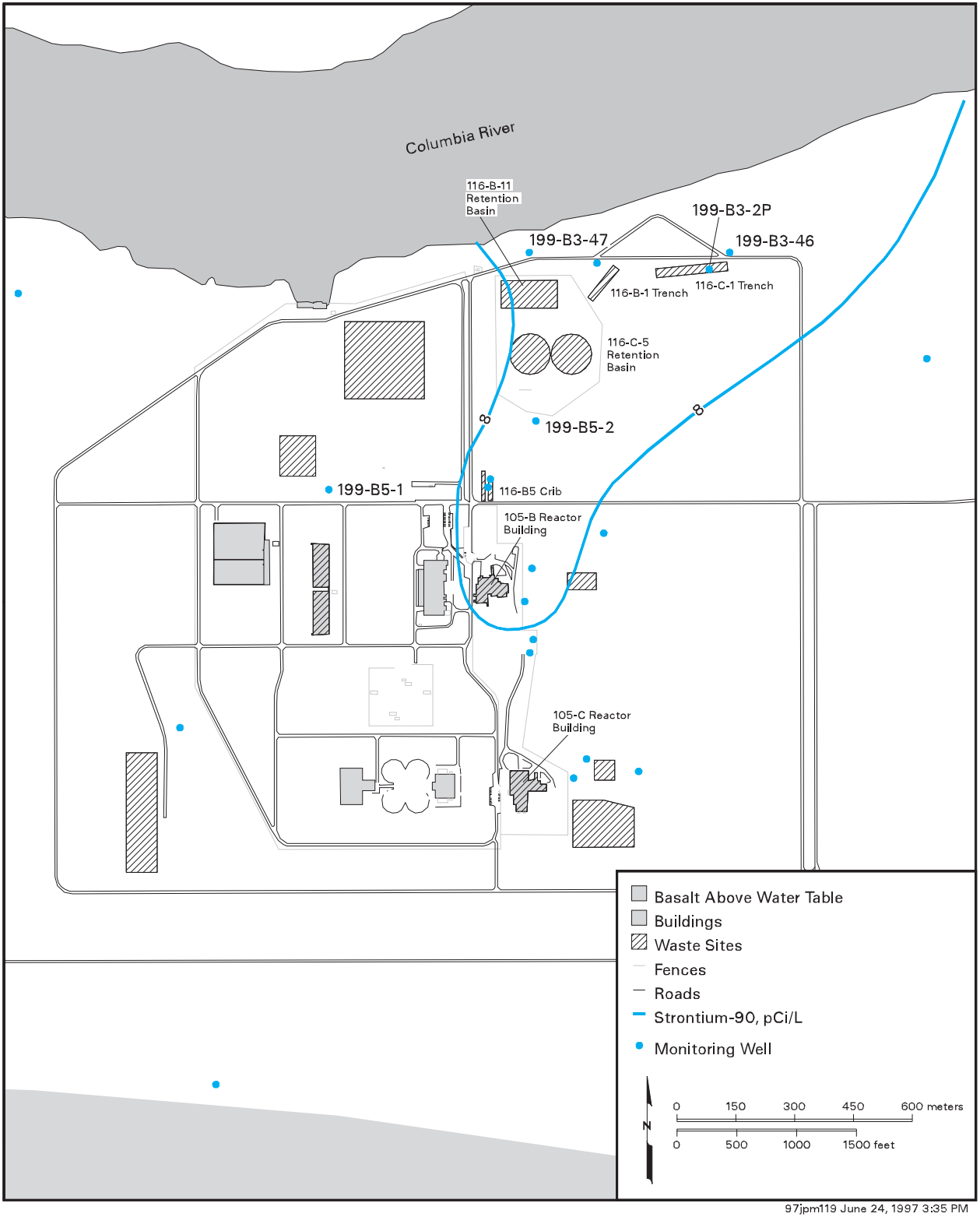

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Figure 4.8.24. Concentrations of Strontium-90 and Uranium in the Unconfined Aquifer in the 100-F Area, 1996

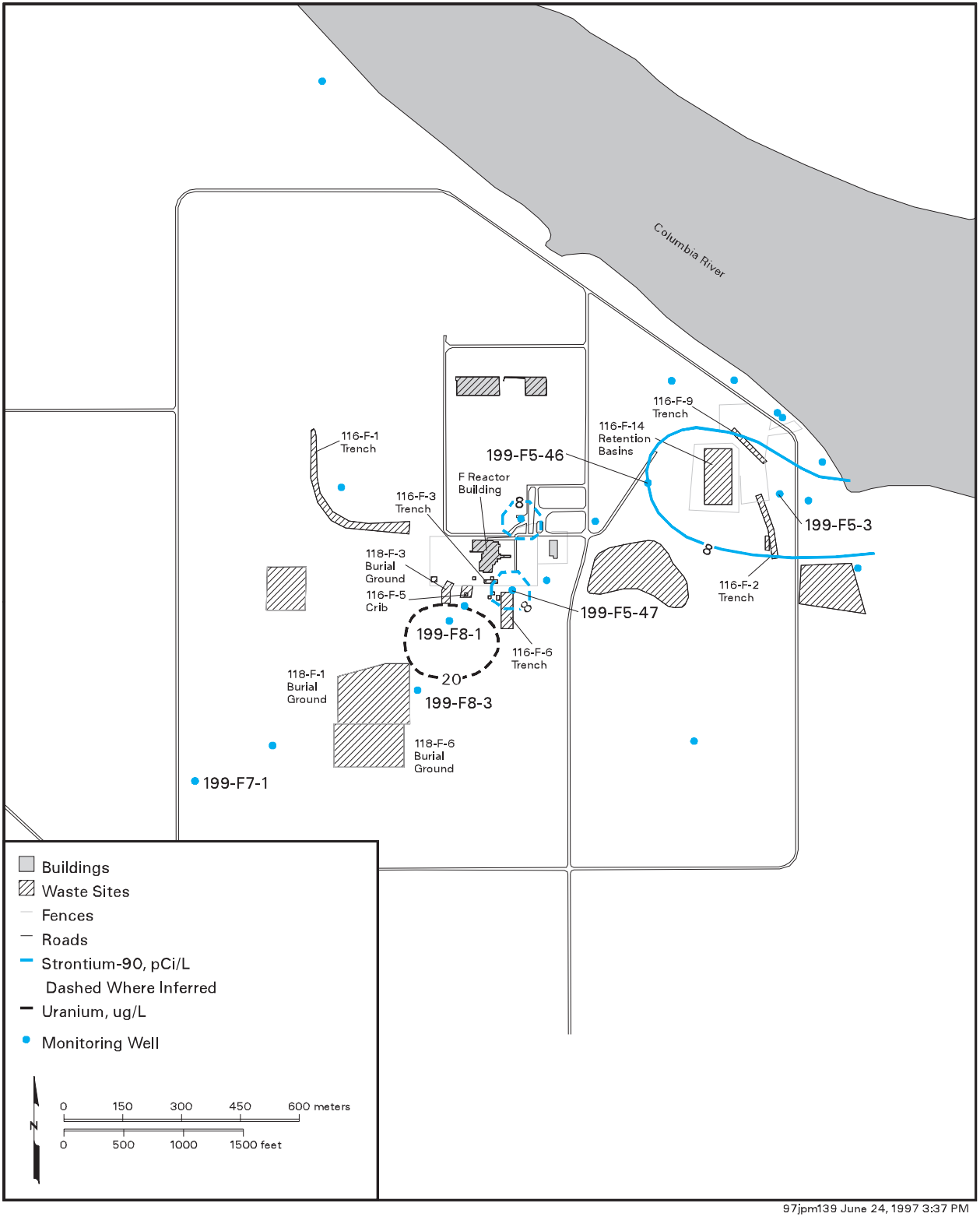

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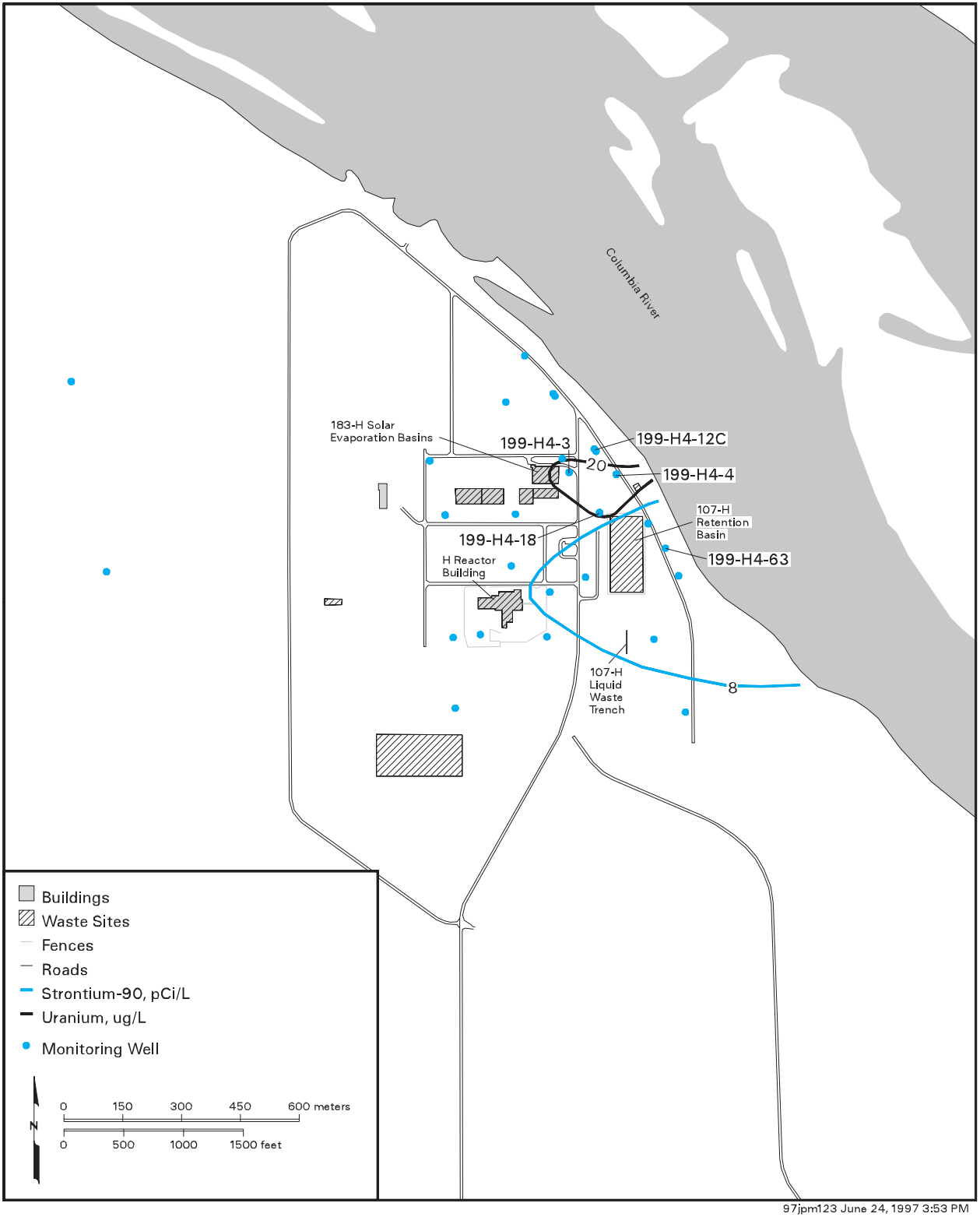
Figure 4.8.25. Concentrations of Strontium-90 and Uranium in the Unconfined Aquifer in the 100-H Area, 1996



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