2.6 100-HR-3-H Operable Unit

M. J. Hartman and R. F. Raidl

The scope of this section is the 100-HR-3-H groundwater interest area, which is the east portion of the 100-HR-3 Operable Unit (Figure 2.1-1). Figure 2.6-1 shows facilities, wells, and shoreline monitoring sites in this region. Chromium is the contaminant of greatest significance in groundwater. Groundwater is monitored to assess the performance of an interim action pump-and-treat system for chromium, to track other contaminant plumes, and for the 116-H-6 evaporation basins, a *Resource Conservation and Recovery Act* (RCRA) unit. In addition to the chromium plume, contaminants of concern include nitrate, strontium-90, technetium-99, tritium, and uranium.

Hexavalent chromium is the groundwater contaminant of greatest concern in the 100-H Area. A pump-and-treat system helps reduce the amount reaching the Columbia River.

Groundwater flows primarily from the southwest to northeast, toward the Columbia River (Figure 2.6-2). Groundwater flows generally toward the northeast across the entire horn of the Columbia River north of Gable Mountain, so groundwater approaching the 100-H Area may contain contaminants that originated in the 100-D and 100-N Areas.

The remainder of this section describes contaminant plumes and concentration trends for the constituents of interest under *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA),[a] RCRA, or *Atomic Energy Act of 1954* (AEA) monitoring.

2.6.1 Groundwater Contaminants

This section describes monitoring results for chromium, strontium-90, technetium-99 and uranium, nitrate, and tritium.

2.6.1.1 Chromium

Dissolved chromium is elevated beneath much of the 100-H Area at levels exceeding the remedial action goal of 22 µg/L (see Section 2.6.2) (Figure 2.6-3). The plume had various

Groundwater monitoring in the 100-HR-3-H groundwater interest area includes CERCLA, RCRA, and AEA monitoring:

CERCLA Monitoring

- ***Four compliance wells are sampled monthly for chromium and annually for co-contaminants.***
- ***Up to six extraction wells are sampled quarterly for chromium and semiannually for co-contaminants.***
- ***Fourteen performance wells are sampled semiannually for chromium.***
- ***In fiscal year 2003, all wells were sampled as scheduled.***

RCRA Monitoring – 116-H-6 Evaporation Basins

- ***Four downgradient wells are sampled annually for chromium, nitrate, technetium-99, and uranium.***
- ***Sampling is coordinated with CERCLA to avoid duplication.***
- ***In fiscal year 2003, all wells were sampled as scheduled.***

AEA Monitoring

- ***Twenty-two wells are sampled annually for contaminants and general chemistry.***
- ***Deep wells are sampled triennially (deep unconfined, confined Ringold, and basalt-confined aquifers).***
- ***Sampling is coordinated with CERCLA and RCRA to avoid duplication.***

(a) Past-practice monitoring in this operable unit is regulated under RCRA past-practice, which follows the same groundwater monitoring activities as CERCLA. This report uses the term CERCLA for simplicity.

sources, but the highest concentrations in fiscal year 2003 continued to be near the former 116-H-6 evaporation basins, where well 199-H4-5 detected the maximum value, 84 µg/L. Aquifer tubes in this region yielded results of 8 µg/L in January 2003, but the samples were believed to be diluted by river water. The highest chromium concentration in an aquifer tube near 100-H Area was 43 µg/L in tube 51-D, south of the main 100-H Area. A portion of the chromium plume appears to be migrating along the river (PNNL-14444).

Upgradient wells 699-97-43 and 699-96-43 also have elevated chromium concentrations, probably reflecting movement of an old contaminant plume that originated in the 100-D Area when a water table mound was present there (WHC-SD-EN-TI-023). Chromium concentrations were near or above the 100 µg/L drinking water standard in these wells. Chromium from upgradient sources also is detected in aquifer sampling tubes north of the 100-H Area (e.g., 40 µg/L in November 2001 in tube 44-M).

Chromium concentrations at 100-H Area vary with river stage but are declining overall.

Chromium concentrations vary with river stage but are declining overall. For example, well 199-H4-3, located just downgradient of the former 116-H-6 evaporation basins, historically has had the highest chromium concentrations, but its maximum in fiscal year 2003 was 73 µg/L (Figure 2.6-4).

Chromium concentrations in deeper wells 199-H4-12C and 199-H4-15CS continued to exceed the 100 µg/L drinking water standard (maximum 154 µg/L), but are declining. The source of this deeper chromium is unknown.

2.6.1.2 Strontium-90

Strontium-90 concentrations exceed the 8 pCi/L drinking water standard beneath a portion of the southeast 100-H Area near the former retention basin and disposal trenches. The plume distribution has not changed appreciably in at least 10 years. The highest concentrations in fiscal year 2003 were ~20 pCi/L. Concentrations are somewhat variable but are neither increasing nor decreasing overall. Strontium-90 was undetected in aquifer tubes near the 100-H Area.

2.6.1.3 Technetium-99 and Uranium

Technetium-99 is elevated in groundwater downgradient of the former 116-H-6 evaporation basins, but levels remained below the 900 pCi/L drinking water standard in all but one well.

Well 199-H4-3, immediately downgradient of the 116-H-6 evaporation basins, historically has shown the highest technetium-99 concentrations and detected 321 pCi/L in fiscal year 2003 (Figure 2.6-5). Concentrations have declined two orders of magnitude since the mid-1990s, but remained steadily below the drinking water standard during the past 3 years. Closer to the Columbia River, technetium-99 and uranium concentrations in well 199-H4-4 historically have shown high variability with river stage, with peak concentrations in the fall when river stage is low. For the past 2 years, however, fall values have remained low (Figure 2.6-5).

Uranium also is elevated in groundwater downgradient of the former 116-H-6 evaporation basins, and exceeded the 30 µg/L drinking water standard in two wells. The maximum concentration was 119 µg/L in well 199-H4-3.

Technetium-99 and uranium concentrations increased sharply in well 199-H4-9 in November 2002, both exceeding their drinking water standards (Figure 2.6-6). This well is located at the northeast corner of the 116-H-6 evaporation basins. The influence of extraction wells 199-H4-12A and 199-H4-15A may have altered flow directions, causing more contaminated groundwater from beneath the former basins to flow through this well.

Technetium-99 was analyzed in one aquifer tube sample in fiscal year 2003, tube 46-D. The tube is located downgradient of the 116-H-6 evaporation basins and no technetium-99 was detected. No tube samples were analyzed for uranium.

Plume areas (square kilometers) above the drinking water standard at the 100-HR-3-H Operable Unit:

Chromium — 0.14
Nitrate — 0.16
Strontium-90 — 0.17
Technetium-99 — <0.01
Uranium — 0.01

2.6.1.4 Tritium

Tritium concentrations are generally below 5,000 pCi/L beneath the 100-H Area. Concentrations vary seasonally in wells near the river and are declining in most inland wells. Concentrations are slightly higher in upgradient wells (e.g., 6,210 pCi/L in well 699-96-43) but are declining.

2.6.1.5 Nitrate

Nitrate concentrations continued to exceed the 45 mg/L drinking water standard in numerous wells near the former 116-H-6 evaporation basins and in several wells in the southeast 100-H Area (Figure 2.6-7). The maximum concentrations are usually detected in well 199-H4-3 (255 mg/L in fiscal year 2003). Trends in that area vary seasonally, but the peaks have diminished over the years, and concentrations are declining overall.

Nitrate concentrations exceed drinking water standards near the former 116-H-6 evaporation basins and in southeast 100-H Area.

The nitrate concentrations in well 199-H4-9, northeast of the basins, increased sharply in fiscal year 2003 to 474 mg/L. Similar increases were observed for technetium-99 and uranium. Nearby well 199-H4-8 also had a sudden increase in nitrate. These changes are believed to be related to flow direction changes due to extraction wells.

Nitrate trends in other wells are variable, and the causes of increases/decreases often are not known.

2.6.2 CERCLA Interim Groundwater Remediation for Chromium

A pump-and-treat system operates in the 100-H Area as part of an interim action for the 100-HR-3-H Operable Unit (ROD 1996a). Interim remedial action monitoring is described in DOE/RL-96-90. Figure 2.6-1 displays locations of extraction and injection wells and Appendix A lists sampling frequencies and constituents.

2.6.2.1 Progress During Fiscal Year 2003

The 100-H Area pump-and-treat system is reducing overall contamination in the operable unit by removing contaminant mass. During fiscal year 2003, the pump-and-treat system extracted ~186 million liters of groundwater from the 100-H Area, removing about 4.8 kilograms of hexavalent chromium.

The pump-and-treat system has removed about 33.2 kilograms of hexavalent chromium from the 100-H Area groundwater since startup in July 1997. This represents a large fraction of the estimated 42 kilograms of chromium estimated in the plume in 1992 (WHC-SA-1674-VA). That estimate did not include chromium from upgradient nor in the vadose zone.

The remedial action objectives for the 100-HR-3 Operable Unit (ROD 1996a) are:

- ***Protect aquatic receptors in the river bottom from contaminants in groundwater entering the Columbia River.***
- ***Protect human health by preventing exposure to contaminant in the groundwater.***
- ***Provide information that will lead to the final remedy.***

The contaminant of concern is hexavalent chromium. The record of decision specifies the cleanup goal at compliance wells as 22 µg/L. EPA specified enhancements needed to the system in their 5-year review (EPA 2001).

All of the wells scheduled for sampling under CERCLA were sampled as scheduled in fiscal year 2003.

2.6.2.2 Influence on Aquifer Conditions

Chromium concentrations in 100-H Area groundwater have declined, and the size of the plume has shrunk since the pump-and-treat system began to operate in 1997. These changes are likely due to a combination of natural processes (e.g., dispersion) and the effects of the pump-and-treat system.

During fiscal year 2003, the pump-and-treat system at 100-H Area extracted ~186 million liters of groundwater, removing about 4.8 kilograms of hexavalent chromium.

Hexavalent chromium concentrations in compliance wells vary inversely with river stage. The ranges of concentration observed in fiscal year 2003 were similar to those observed in fiscal year 2002. Figure 2.6-8 shows chromium trends for two of the compliance wells, 199-H4-4 and 199-H4-63. Chromium declined beneath the remedial action goal (22 μg/L) in both of the wells in the spring and early summer, but exceeded that level for the rest of the year. In the other two compliance wells (199-H4-5 and 199-H4-64), chromium concentrations were above the goal throughout the year, though levels were lowest in the spring and early summer.

Results of performance monitoring are incorporated with the discussion of general contamination in Section 2.6.1. Results of operational monitoring, and additional details about the pump-and-treat system, will be included in an upcoming annual report on the 100-HR-3, 100-KR-4, and 100-NR-2 pump-and-treat systems.

2.6.3 RCRA Groundwater Monitoring for the 116-H-6 Evaporation Basins

The 116-H-6 (183-H) evaporation basins are the only RCRA site in the 100-H Area. The site is monitored during the post-closure period under corrective action monitoring requirements of WAC 173-303-645(11). The objective of monitoring is to track contaminant trends during the operation of the CERCLA interim action for chromium. Additional information is included in Appendix B.

The four wells in the RCRA network were sampled as scheduled in fiscal year 2003 for the constituents of interest listed in the groundwater monitoring plan: chromium, fluoride, nitrate, technetium-99, and uranium. The latter two constituents are not regulated under RCRA but were included in the monitoring plan for completeness and were incorporated by reference in the Hanford Facility RCRA Permit (Ecology 1994). The permit will be modified in fiscal year 2004 to revise the constituent list.

Trends in the constituents of interest (except fluoride) were discussed in Section 2.6.1. Fluoride concentrations remained low (<300 μg/L) in groundwater downgradient of the 116-H-6 evaporation basins.

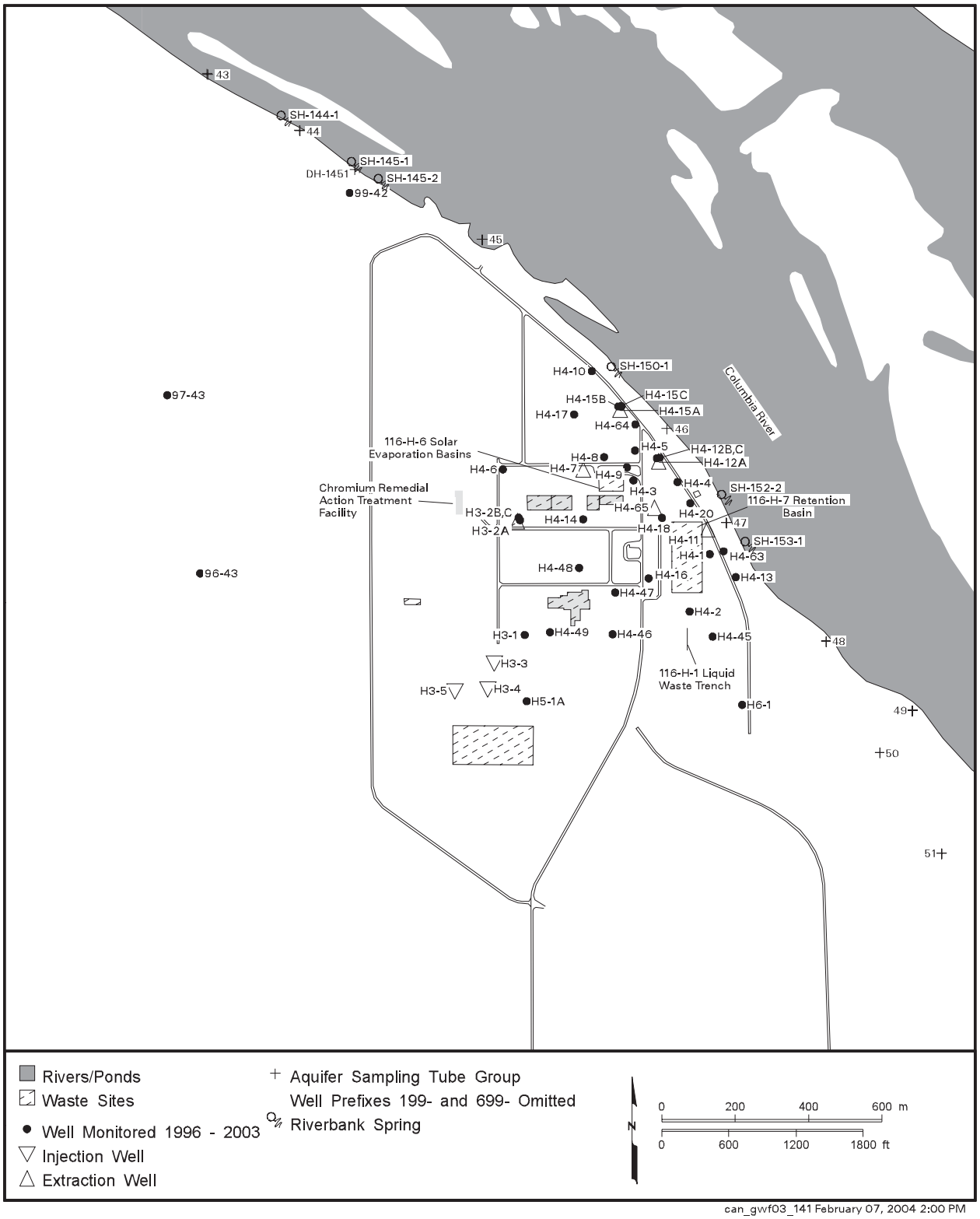


Figure 2.6-1. Groundwater Monitoring Wells in the 100-H Area

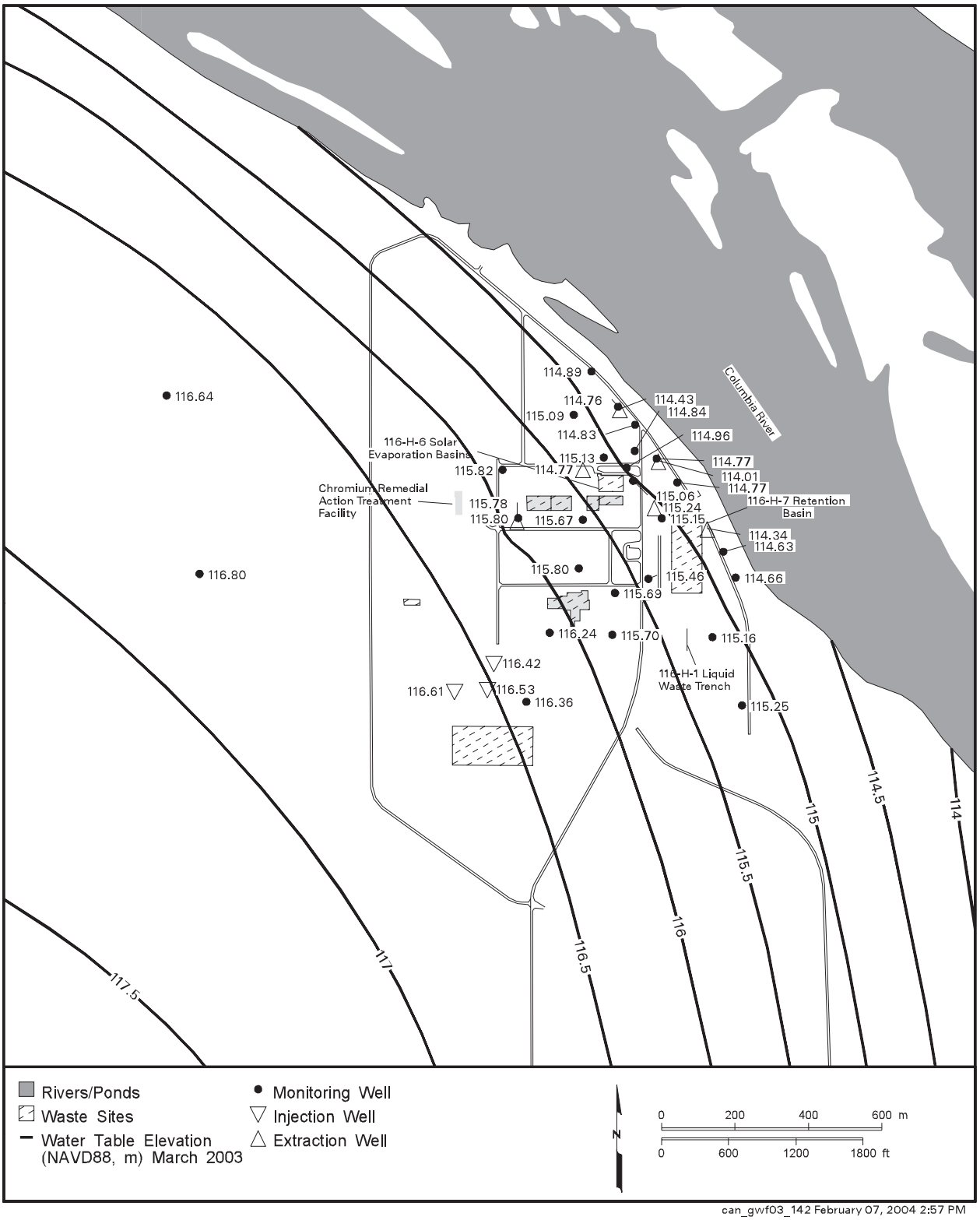


Figure 2.6-2. Water Table Beneath 100-H Area, March 2003

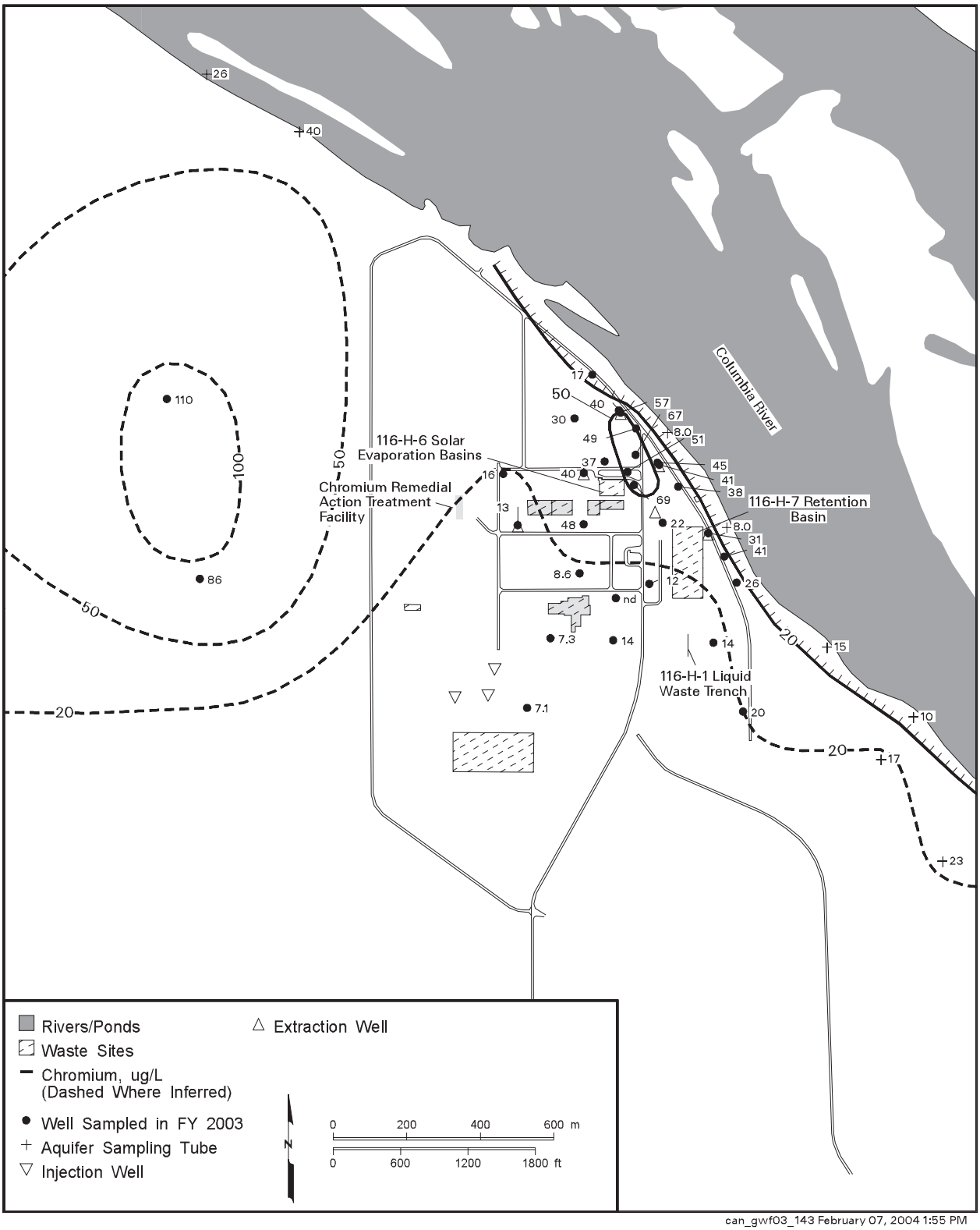


Figure 2.6-3. Average Chromium Concentrations in the 100-H Area, Top of Unconfined Aquifer

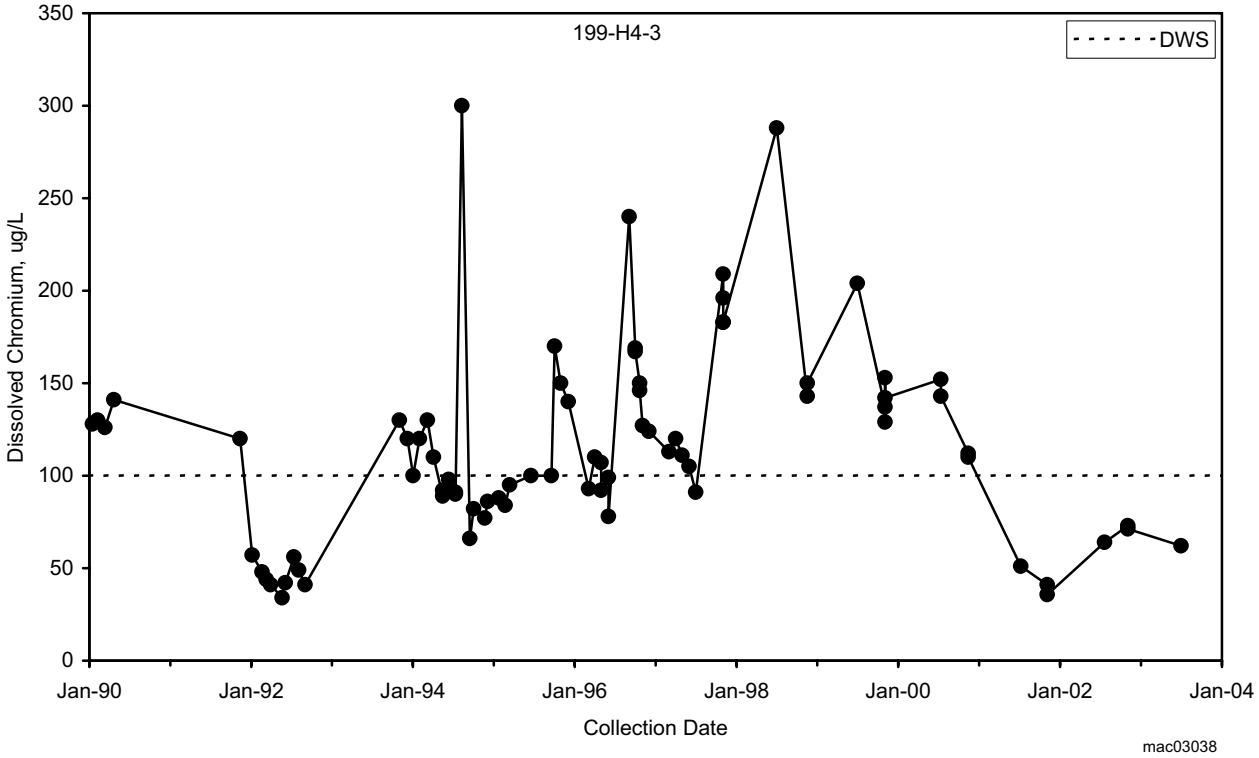


Figure 2.6-4. Dissolved Chromium Concentrations East of 116-H-6 Evaporation Basins

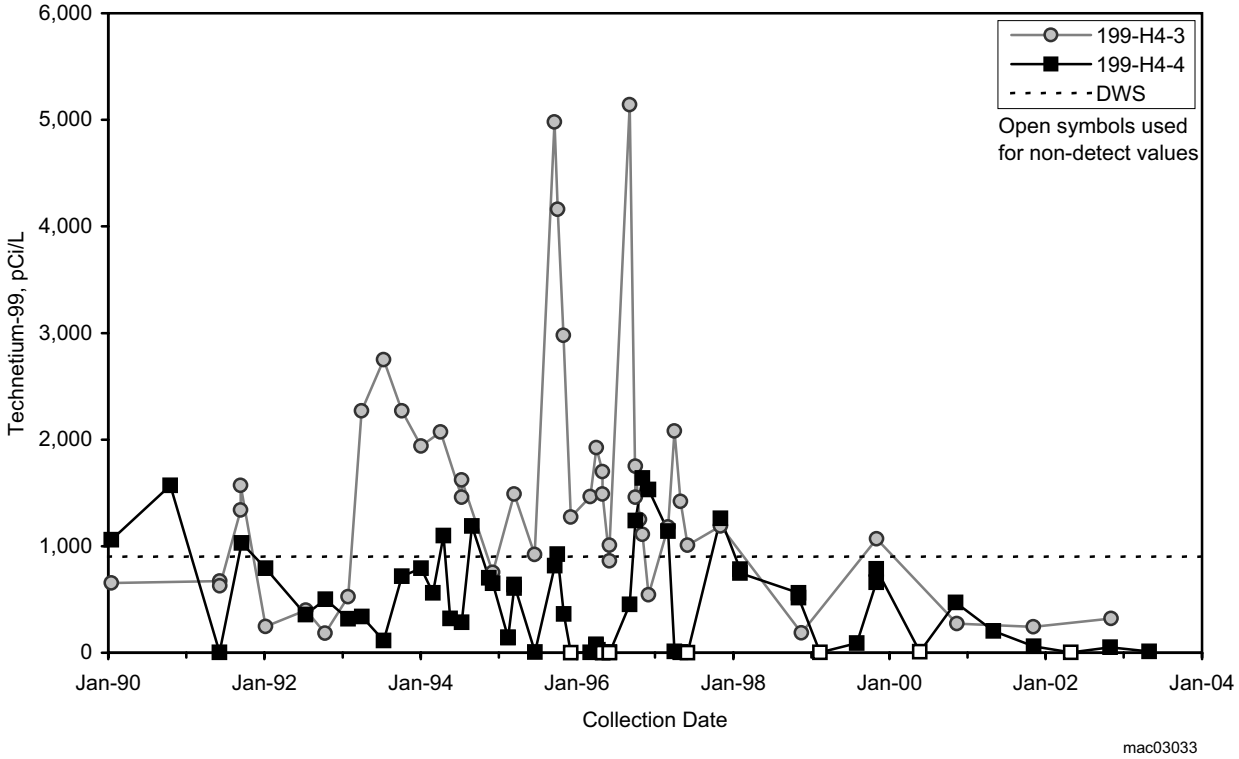
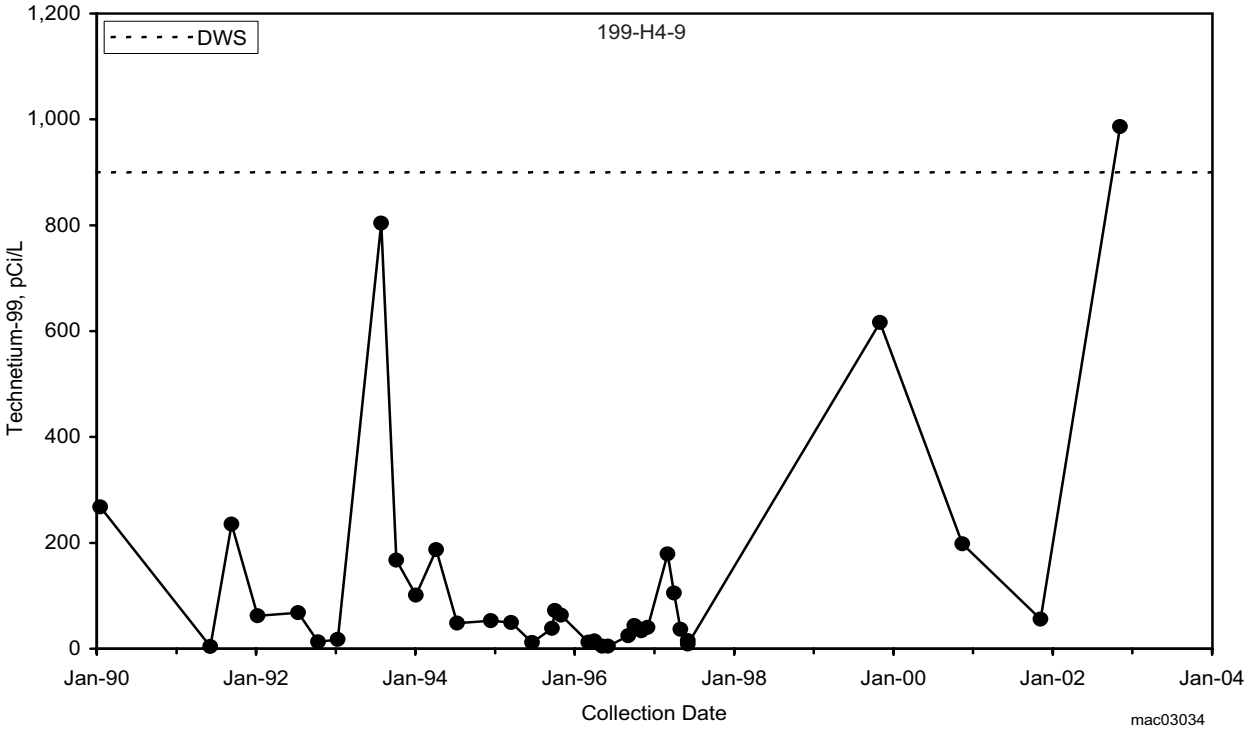


Figure 2.6-5. Technetium-99 Concentrations East of 116-H-6 Evaporation Basins



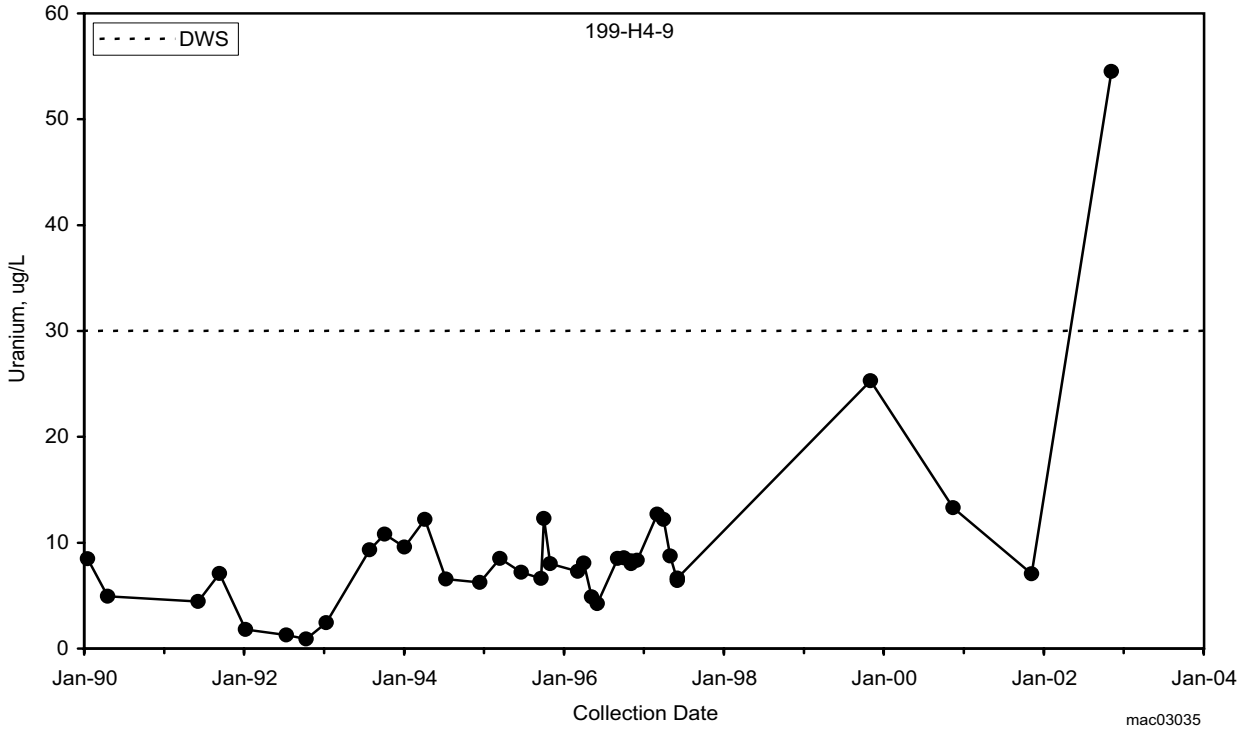


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Figure 2.6-6. Technetium-99 and Uranium Concentrations Northeast of 116-H-6 Evaporation Basins

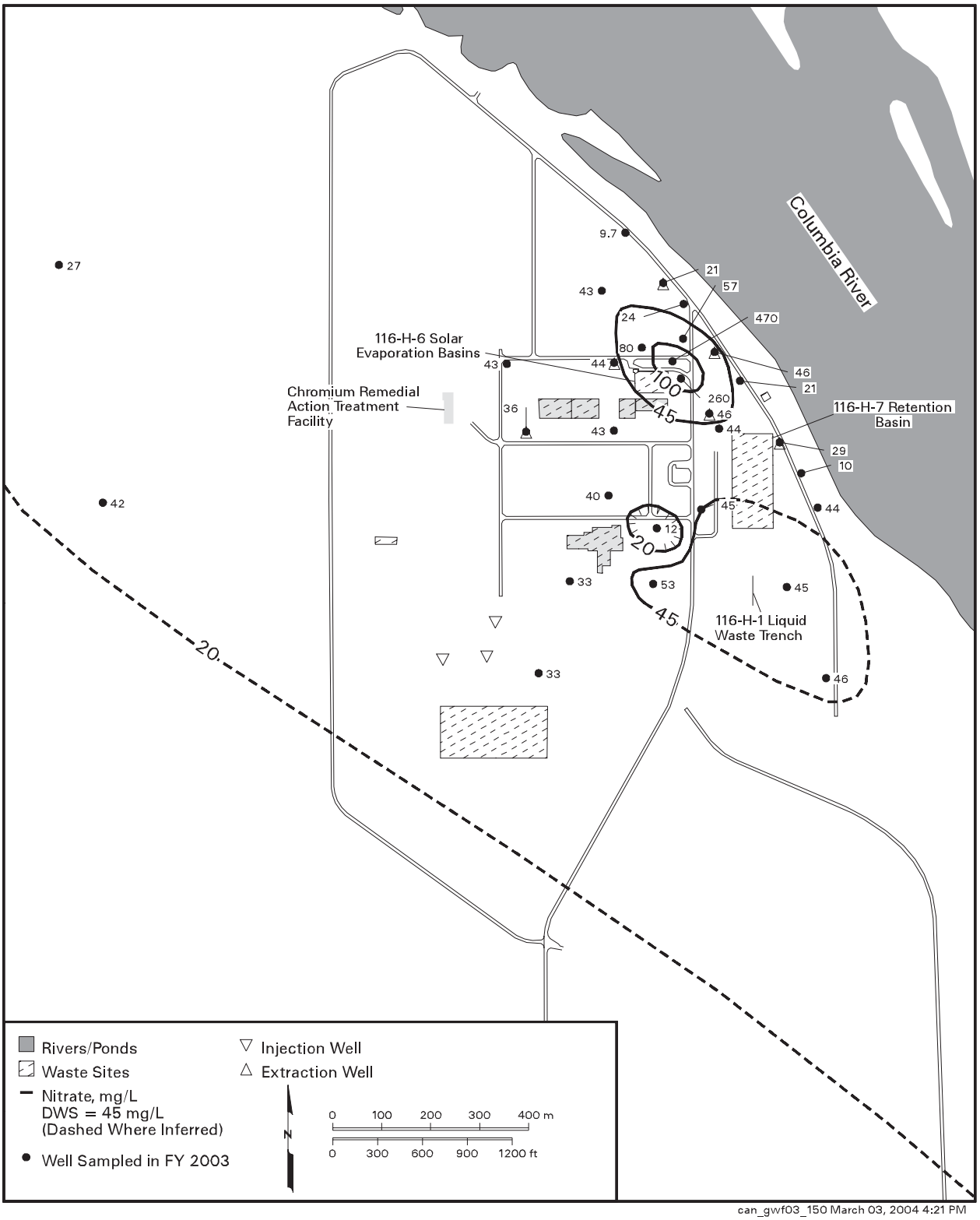

Figure 2.6-7. Average Nitrate Concentrations in the 100-H Area, Top of Unconfined Aquifer

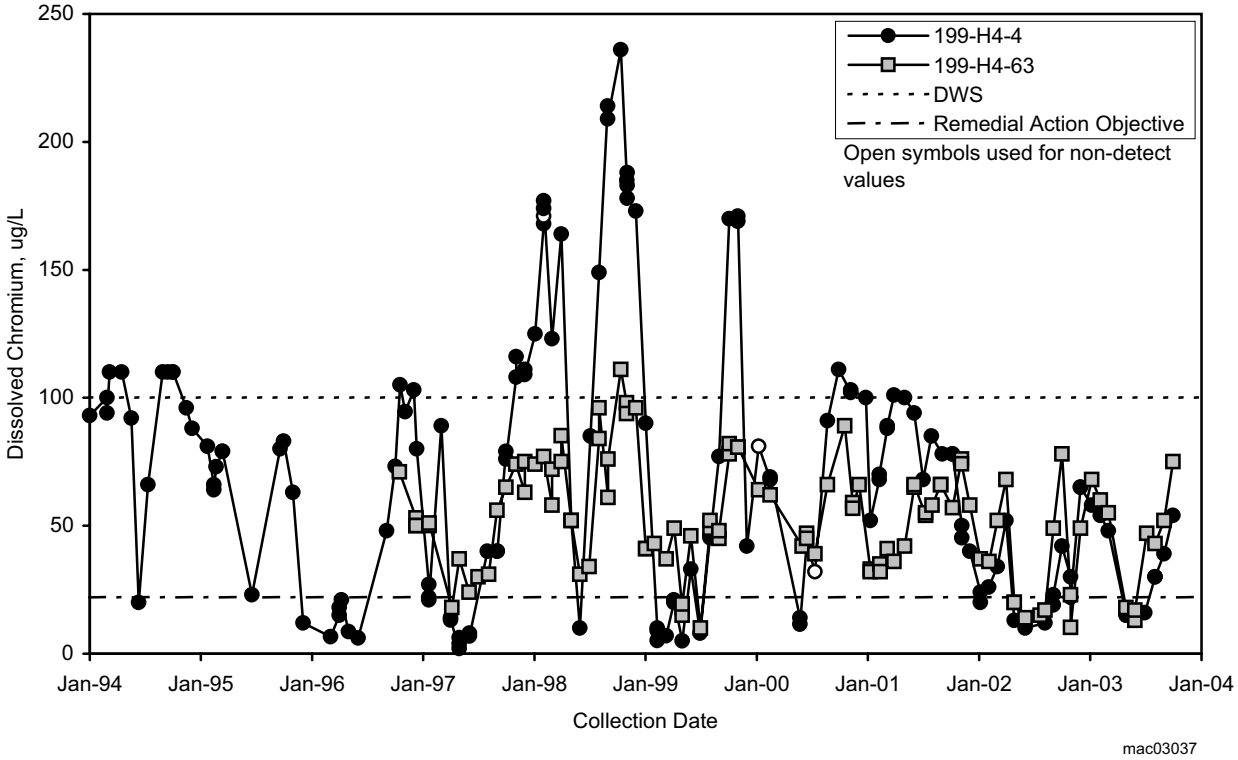

Figure 2.6-8. Dissolved Chromium Concentrations in Compliance Wells for the 100-HR-3 Pump-and-Treat System at 100-H Area