2.7 100-FR-3 Operable Unit

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This section describes groundwater flow and chemistry in the vicinity of the 100-F Area. The 100-FR-3 groundwater interest area encompasses the 100-FR-3 Operable Unit and a large section of the 600 Area north of Gable Mountain (Figure 1.0-1). Figure 2.7-1 shows facilities, wells, and shoreline monitoring sites in the 100-F Area.

Near the Columbia River, the direction of groundwater flow beneath the 100-F Area varies with river stage. Figure 2.7-2 shows the water table in March 2008 when the Columbia River was at a moderate level. The map indicates a flow direction toward the east-northeast in the northern part of the 100-F Area and toward the east-southeast in the southern part. The flow directions were the same in November 2007, a time that generally represents low groundwater conditions. The high river stage in June 2008 created a reversed gradient, with the potential for flow toward the southwest beneath part of the 100-F Area (Figure 2.7-3). However, farther from the river (e.g., near the 118-F-1 and 118-F-6 Burial Grounds) the groundwater flow direction remained toward the east-northeast.

There is an upward hydraulic gradient in the 100-F Area, based on evidence from wells 199-F5-43A (unconfined aquifer) and 199-F5-43B (Ringold upper mud unit). In March 2008 the gradient was 0.003.

Some of the main concepts associated with the 100-FR-3 Operable Unit include the following.

- Strontium-90, nitrate, hexavalent chromium, and trichloroethene plumes are present in groundwater at levels above drinking water or aquatic standards.
- Previous assessments have not identified groundwater conditions that warrant interim remedial measures. Final decisions on groundwater cleanup will be reached in coming years.
- One new well was installed to monitor groundwater near a recently-excavated burial ground.
- Most of the former waste sites have been remediated (shallow contaminated sediment has been excavated) and backfilled. Remediation is ongoing at remaining sites.
- All but one of the monitoring wells are screened at the top of the unconfined aquifer, which is ~9 m thick in the 100-F. One well is screened ~36 m below the water table in the Ringold upper mud unit, and it does not detect any contamination.

The following sections provide details about the operable unit activities. Sections 2.7.1 and 2.7.2 describe contaminant plumes and concentration trends for contaminants of concern and operable unit activities, respectively. Groundwater monitoring for the *Atomic Energy Act of 1954* (AEA) is integrated fully with *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) monitoring. Most of the former liquid waste sites in the 100-F Area have been excavated and backfilled. There are no active waste disposal facilities or *Resource Conservation and Recovery Act of 1976* sites in the 100-F Area.

2.7.1 Groundwater Contaminants

Plume areas (square kilometers) in the 100-FR-3 Operable Unit:

Chromium, 20 µg/L — 0.12
Nitrate, 45 mg/L — 16.89
Strontium-90, 8 pCi/L — 0.16
Trichloroethene, 5 µg/L — 0.64

Wells in the 100-FR-3 Operable Unit are sampled for the contaminants of concern provided in DOE/RL-2003-49, *100-FR-3 Operable Unit Sampling and Analysis Plan*: nitrate, strontium-90, tritium, trichloroethene, uranium, gross alpha, and hexavalent chromium. This section describes distribution and trends of the groundwater contaminants of concern beneath the 100-FR-3 groundwater interest area.

2.7.1.1 Nitrate

A large nitrate plume extends southward ~5 km from the 100-F Area, although data are sparse in the 600 Area (Figure 1.0-3). The plume did not change significantly between fiscal year (FY) 2007 and FY 2008.

Wells in the main 100-F Area continued to show levels of nitrate that exceeded the drinking water standard (45 mg/L) in FY 2008. The highest FY 2008 nitrate concentration was 114 mg/L in well 199-F7-3, located in southwestern 100-F Area (Figure 2.7-4). Overall, concentrations in the wells within the nitrate plume are steady or declining.

Nitrate concentrations in 100-F Area aquifer tubes were below the drinking water standard in FY 2008, but above background. The concentration increased to 40.9 mg/L in aquifer tube AT-62-M, north of 100-F Area (Figure 2.7-5). This was the highest observed at that location to date. Located upstream from this tube, monitoring well 199-F1-2 has nitrate concentrations at ~30 mg/L. Aquifer tube AT-75-D, located south of the 100-F Area, historically has nitrate levels above the drinking water standard; however, the concentration was 40.6 mg/L in FY 2008.

2.7.1.2 Strontium-90

Strontium-90 concentrations exceed the drinking water standard (8 pCi/L) beneath the portion of the 100-F Area around the 116-F-14 Retention Basin and nearby disposal trenches (Figure 2.7-6). The extent of the plume has not changed significantly for more than 10 years. In FY 2008, well 199-F5-1 had the highest strontium-90 concentration (25.8 pCi/L). Strontium-90 also exceeded the drinking water standard in well 199-F5-46 (8.25 pCi/L). A few other wells had detectable strontium-90, but concentrations were below the drinking water standard (Figure 2.7-6). Overall, the trends are neither increasing nor decreasing.

During remediation of the 118-F-6 Burial Ground, the excavation reached the water table in one location and a small puddle of water formed (the water table is only 6 to 8 m below the surface in the southwestern 100-F Area). In one water sample, strontium-90 was detected in hundreds of picocuries per liter. A second sample also had elevated strontium-90. In FY 2008, the U.S. Department of Energy (DOE) installed a new monitoring well, 199-F8-7. Preliminary results from FY 2009 showed low, detectable concentration of strontium-90. The well will be sampled quarterly for strontium-90 and other constituents in FY 2009.

Strontium-90 shows vertical stratification in the only shallow/deep well pair in the 100-F Area. Deep well 199-F5-43B consistently has no detectable strontium-90, while its shallow counterpart, well 199-F5-43A, typically detects 2 to 4 pCi/L of strontium-90. Strontium-90 concentrations also tend to be higher in shallow aquifer tubes than in deeper aquifer tubes, but all results for FY 2008 were below

the 8 pCi/L drinking water standard. The maximum concentration was 4.4 pCi/L in aquifer tube C6302. This is the shallower of a pair of tubes, but the adjacent, deeper tube (C6303) was not sampled for strontium-90.

2.7.1.3 Tritium

Although elevated, tritium concentrations beneath the southern 100-F Area do not exceed the drinking water standard (20,000 pCi/L). The plume extends to the southeast into the 600 Area at concentrations above 2,000 pCi/L.

Historically, only well 199-F8-3, near the 118-F-1 Burial Ground, has exceeded the tritium drinking water standard. In the mid-1990s, concentrations at this well were nearly 180,000 pCi/L. Concentrations have declined, and the concentration was 15,000 pCi/L in FY 2008. The decline cannot be accounted for by radioactive decay. The contamination apparently is moving downgradient toward the south, where well coverage is sparse. Tritium concentrations in well 699-71-30, located ~1.5 m south of the 100-F Area, are below detection limits. Concentrations in aquifer tubes along the southern shoreline are low (hundreds of picocuries per liter).

2.7.1.4 Trichloroethene

Although above the drinking water standard, trichloroethene concentrations are declining in southwestern 100-F Area.

Trichloroethene concentrations in the southwestern 100-F Area exceed the drinking water standard (5 µg/L) but are declining. The plume appears to be centered west of the 100-F Area. A soil-gas investigation (DOE/RL-95-99, *100-FR-3 Groundwater/ Soil Gas Supplemental Limited Field Investigation Report*) helped define the area of contamination but did not identify the source of contamination. In FY 2008, trichloroethene concentrations continued to decline, with only two wells exceeding the drinking water standard (Figure 2.7-7). The highest concentration was 9.7 µg/L in well 199-F7-1.

2.7.1.5 Uranium and Gross Alpha

Uranium concentrations in 100-F Area groundwater remained below the drinking water standard (30 µg/L). Four wells were sampled for uranium in FY 2008 and the maximum concentration was 17.6 µg/L in well 199-F8-4 in the southeastern 100-F Area. This well also had the highest gross alpha concentration, 12 pCi/L. The drinking water standard for gross alpha is 15 pCi/L.

2.7.1.6 Chromium

Chromium concentrations in 100-F Area groundwater remained below the drinking water standard in FY 2008.

Hexavalent chromium is of potential concern to salmon and other aquatic life. The aquatic standard for hexavalent chromium is 10 µg/L. Chromium concentrations in groundwater beneath the 100-F Area are below the drinking water standard (100 µg/L for total chromium), but some exceed the aquatic standard. Three wells, located near the 116-F-14 Retention Basins and the 116-F-9 Trench, had levels above 20 µg/L in recent data (Figure 2.7-8). The highest chromium concentrations in the groundwater interest area were in well 699-83-47, located west of the 100-F Area (Figure 2.1-1). The FY 2008 results were 51.8 µg/L in an unfiltered sample and 42.5 µg/L in a filtered sample. The highest chromium concentrations within the 100-F Area were in well 199-F5-6 (49.7 µg/L for unfiltered and 41.0 µg/L for filtered samples). Figure 2.7-9 shows chromium trends in the three wells with the highest concentrations. Levels have declined since 2002 or 2003 in wells 199-F5-6 and 199-F5-46, and have increased slightly in well 199-F5-44.

Chromium levels are low in 100-F Area aquifer tubes. Excluding erroneous data, the highest hexavalent chromium concentration was 11.9 µg/L in AT-75-D, which is downstream from the 100-F Area.

2.7.2 Operable Unit Activities

Groundwater sampling requirements are defined in the groundwater sampling and analysis plan (DOE/RL-2003-49) and a Tri-Party Agreement change notice (TPA-CN-228). The change notice, approved in July 2008, added a new well to the network. Well 199-F8-6 was installed near the 118-F-6 Burial Ground. All of the wells scheduled for sampling in FY 2008 were sampled successfully. Three of the aquifer tube sites were not sampled because the tubes had been destroyed or could not be located (Appendix A). Two seeps could not be sampled; seep sampling depends on field conditions and is not always possible.

The DOE installed 12 new aquifer tubes in FY 2008. Results from the new tubes and the older tubes were similar.

Groundwater monitoring in the 100-FR-3 groundwater interest area includes integrated CERCLA and AEA monitoring.

- ***Thirty-four wells are scheduled for annual or biennial sampling.***
- ***Fourteen aquifer tube sites and three seeps are scheduled for annual sampling. Three aquifer tube sites and two seeps could not be sampled in FY 2008.***
- ***The DOE installed one well and 12 aquifer tubes in FY 2008.***

Figure 2.7-1. Facilities and Groundwater Monitoring Wells in the 100-F Area.

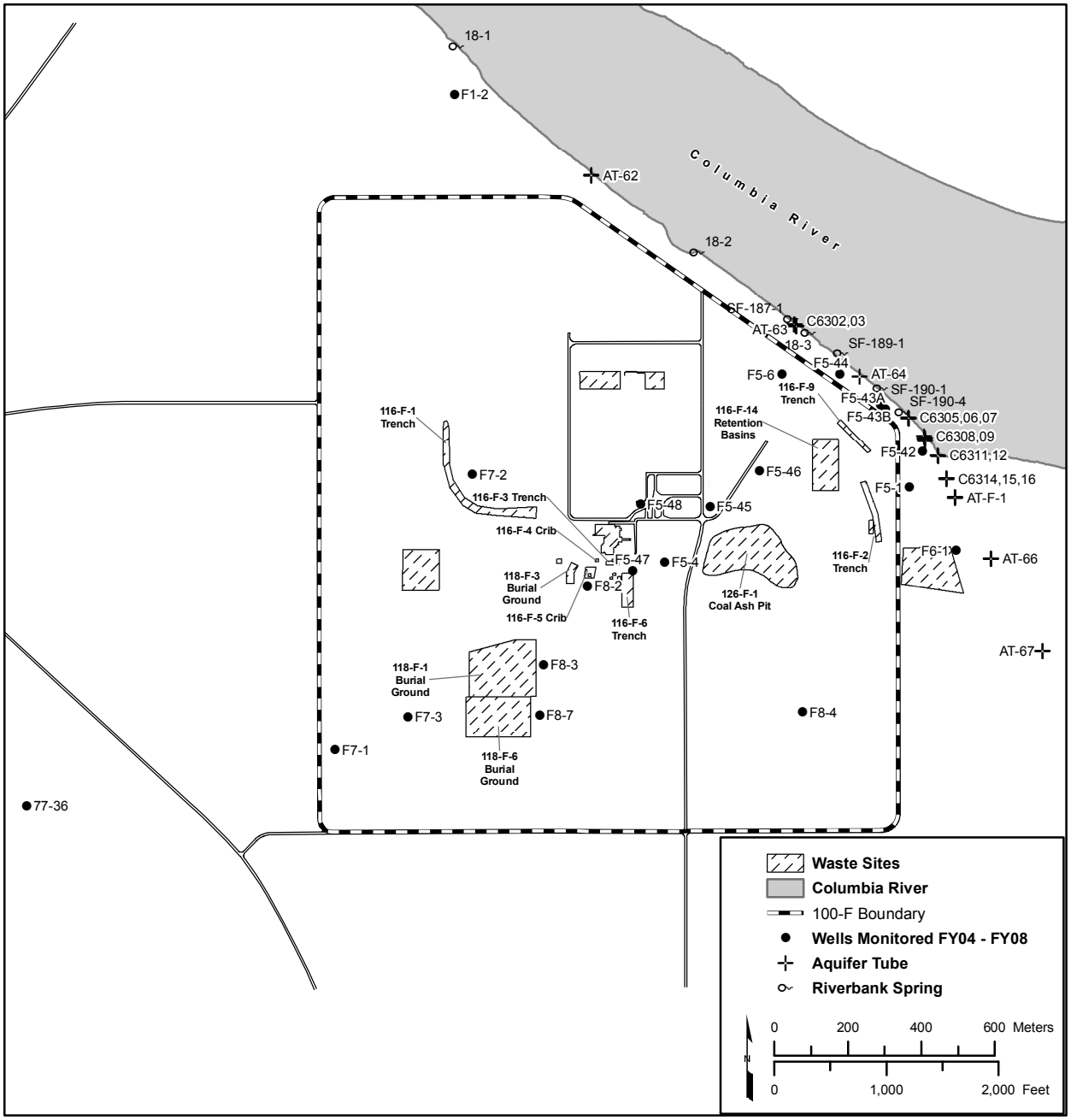

Figure 2.7-2. 100-F Area Water-Table Map, March 2008.

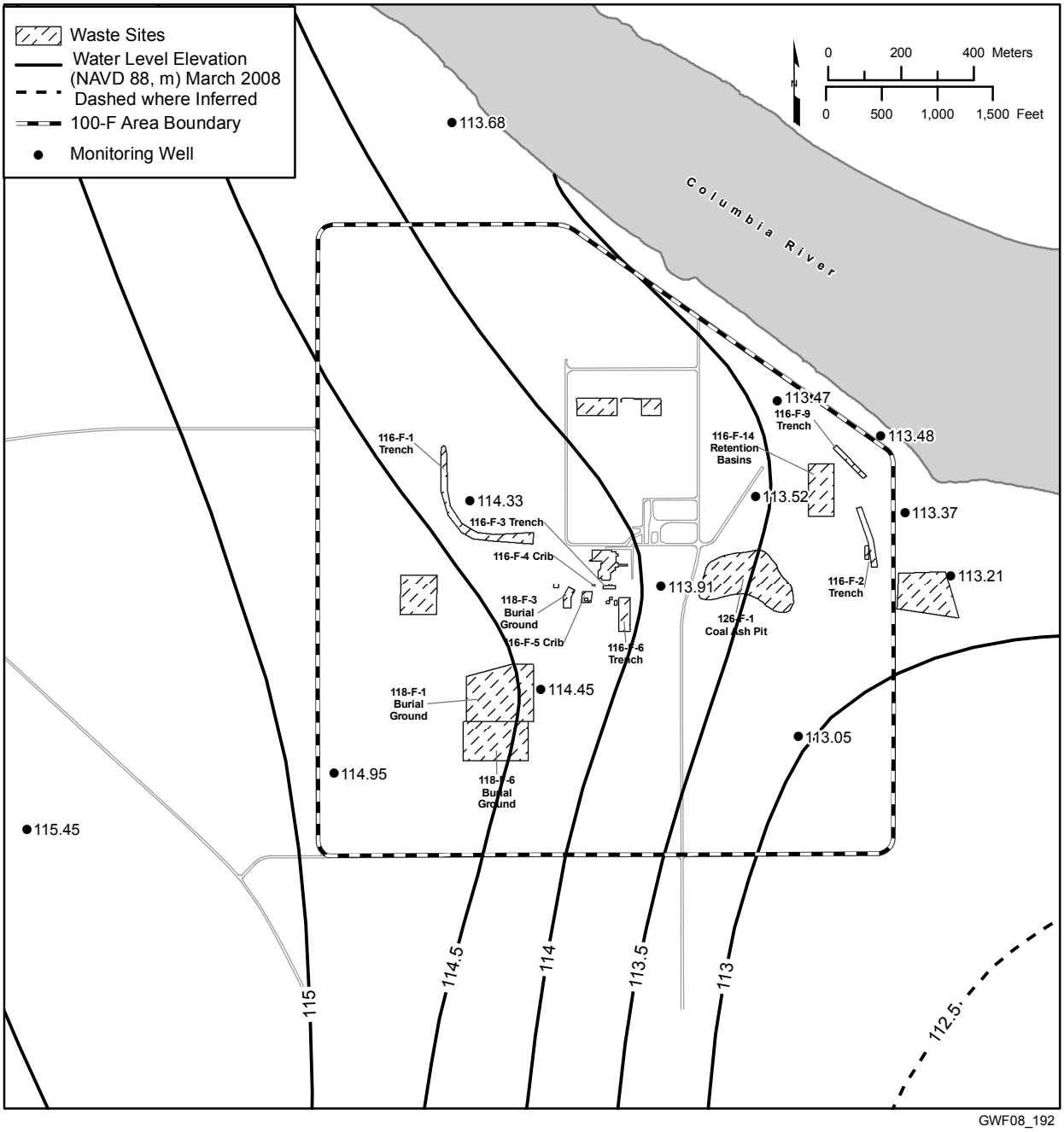

Figure 2.7-3. 100-F Area Water-Table Map, June 2008.

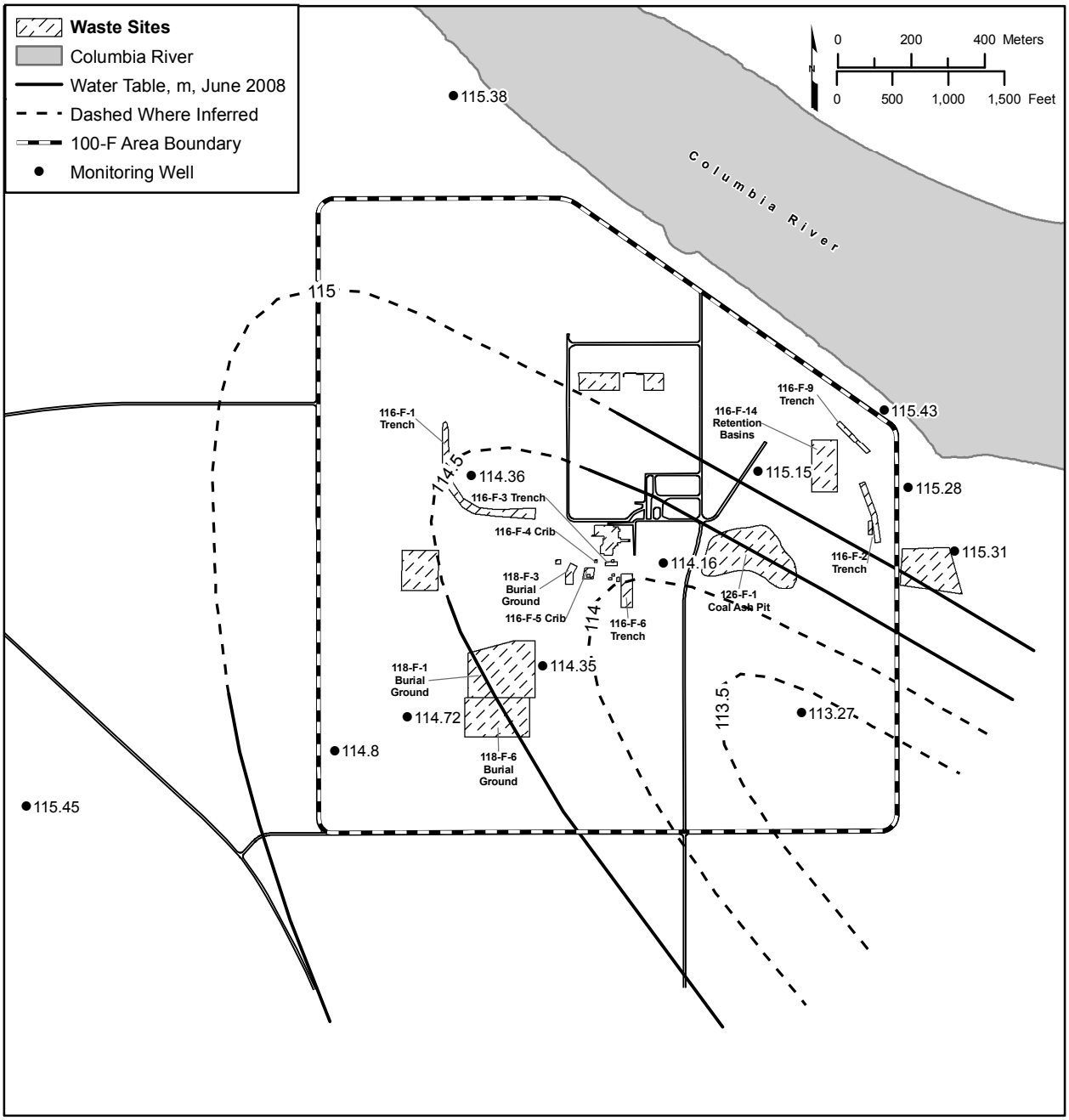

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Figure 2.7-4. Nitrate Concentrations in Southwestern 100-F Area.

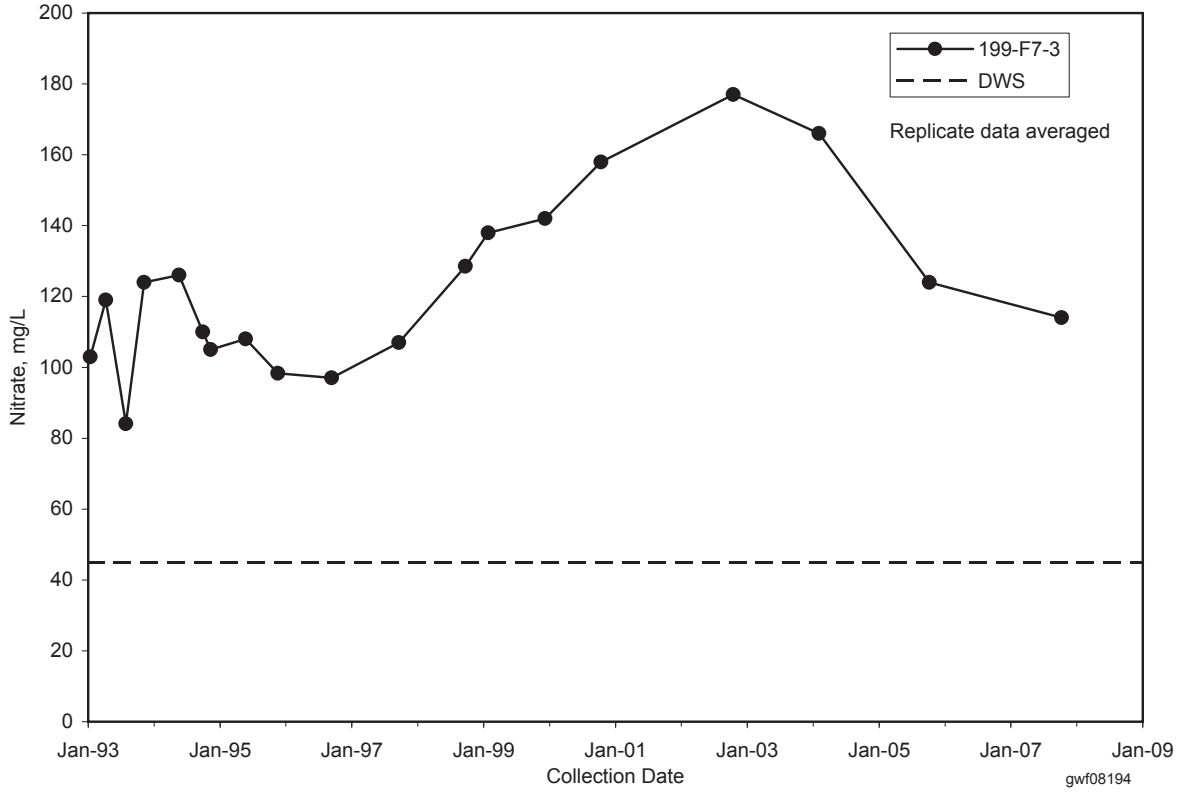

Figure 2.7-5. Nitrate Concentrations in Aquifer Tubes Upstream (62-M) and Downstream (75-D) of 100-F Area.

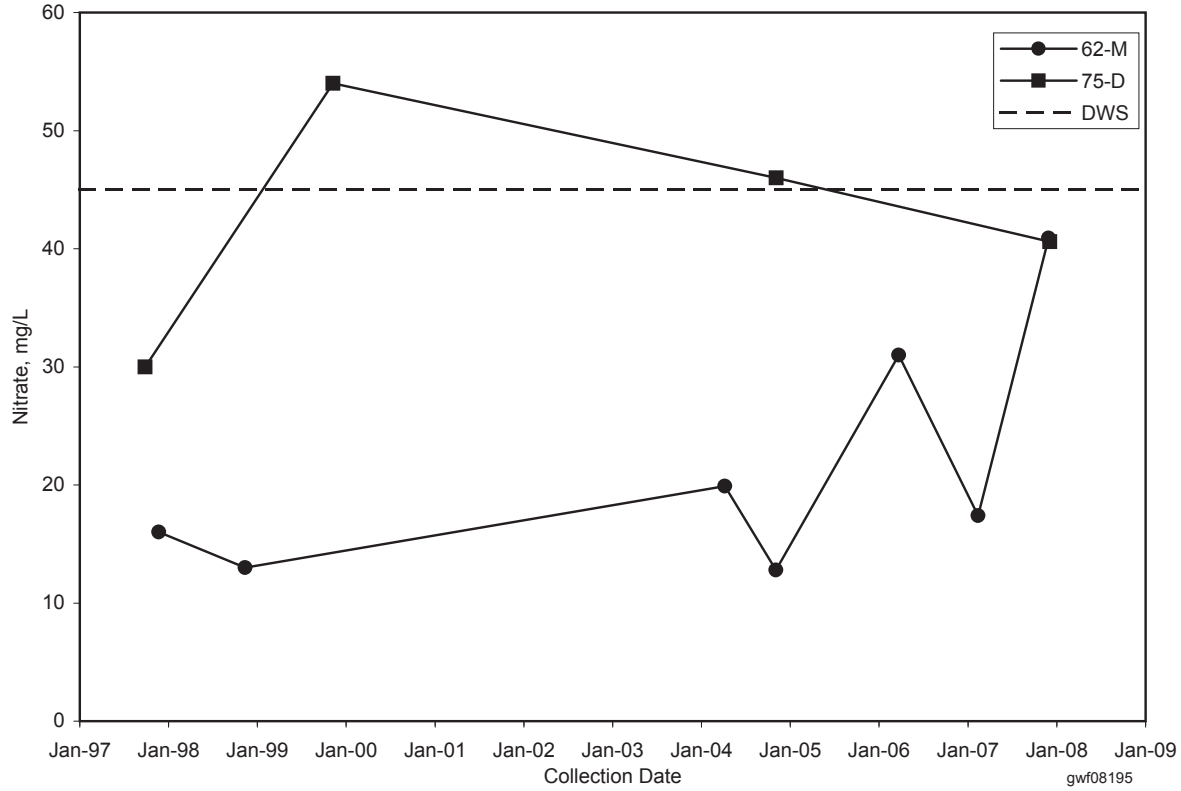

Figure 2.7-6. Average Strontium-90 Concentrations in the 100-F Area, Upper Part of Unconfined Aquifer.

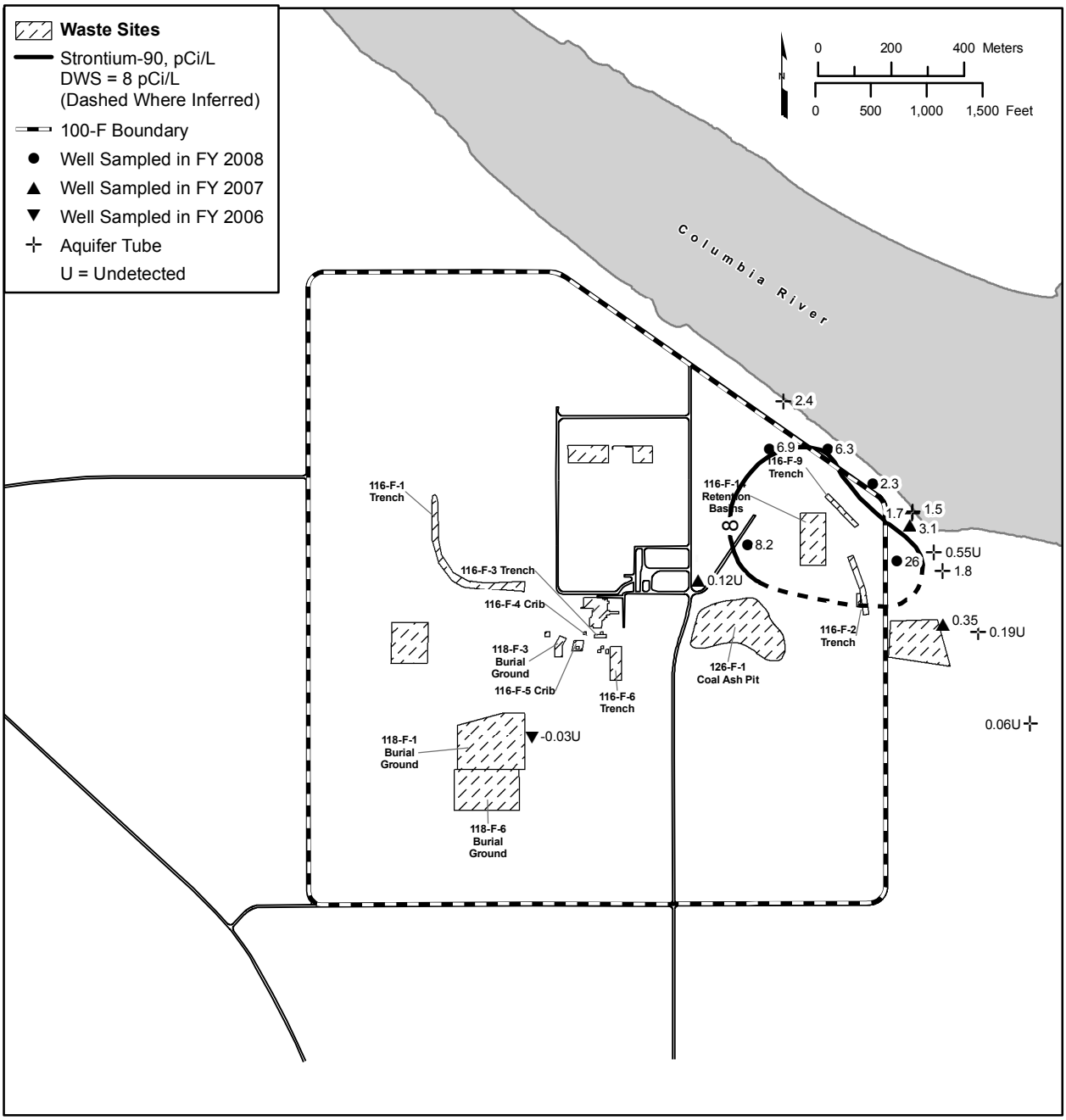

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Figure 2.7-7. Trichloroethene Concentrations in Southwestern 100-F Area.

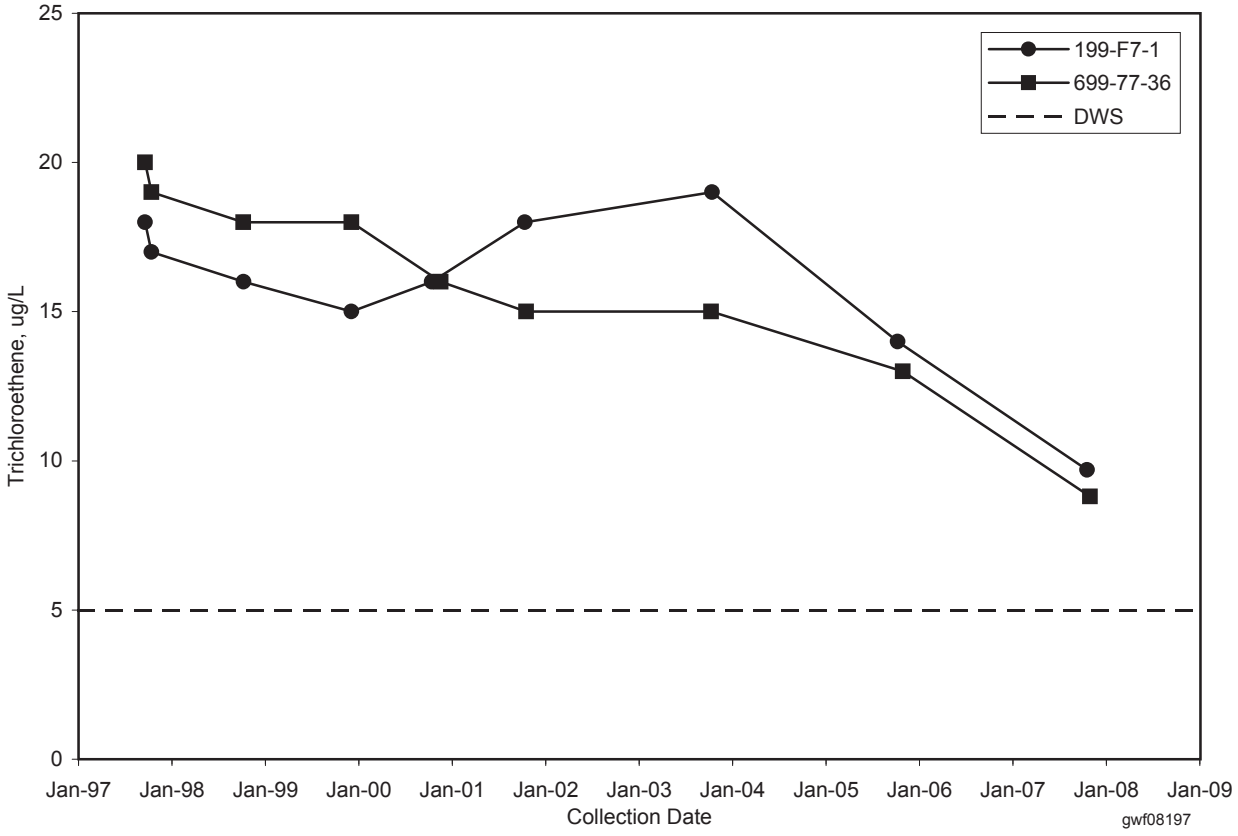

Figure 2.7-8. Average Chromium Concentrations in the 100-F Area, Upper Part of Unconfined Aquifer.

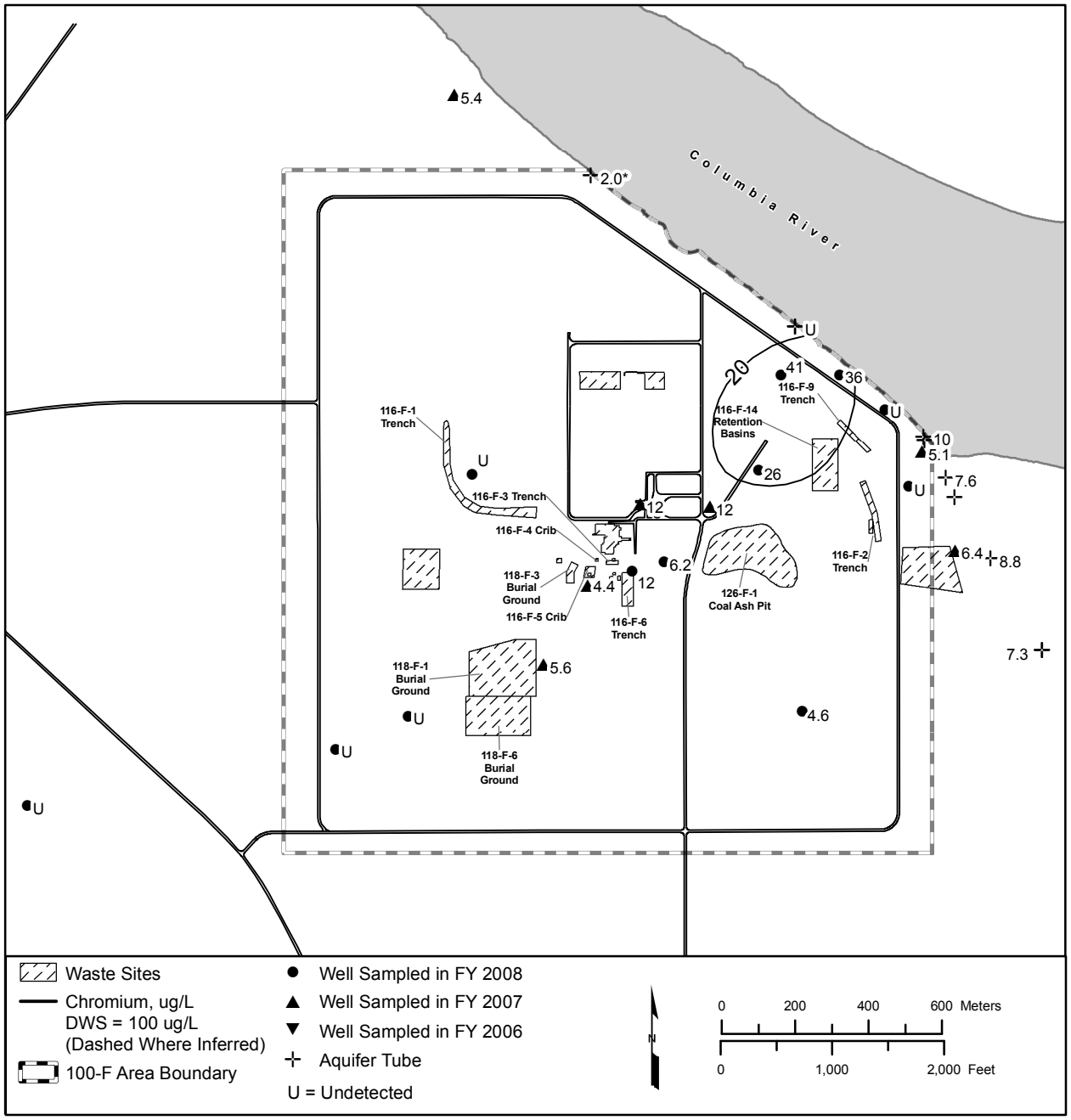
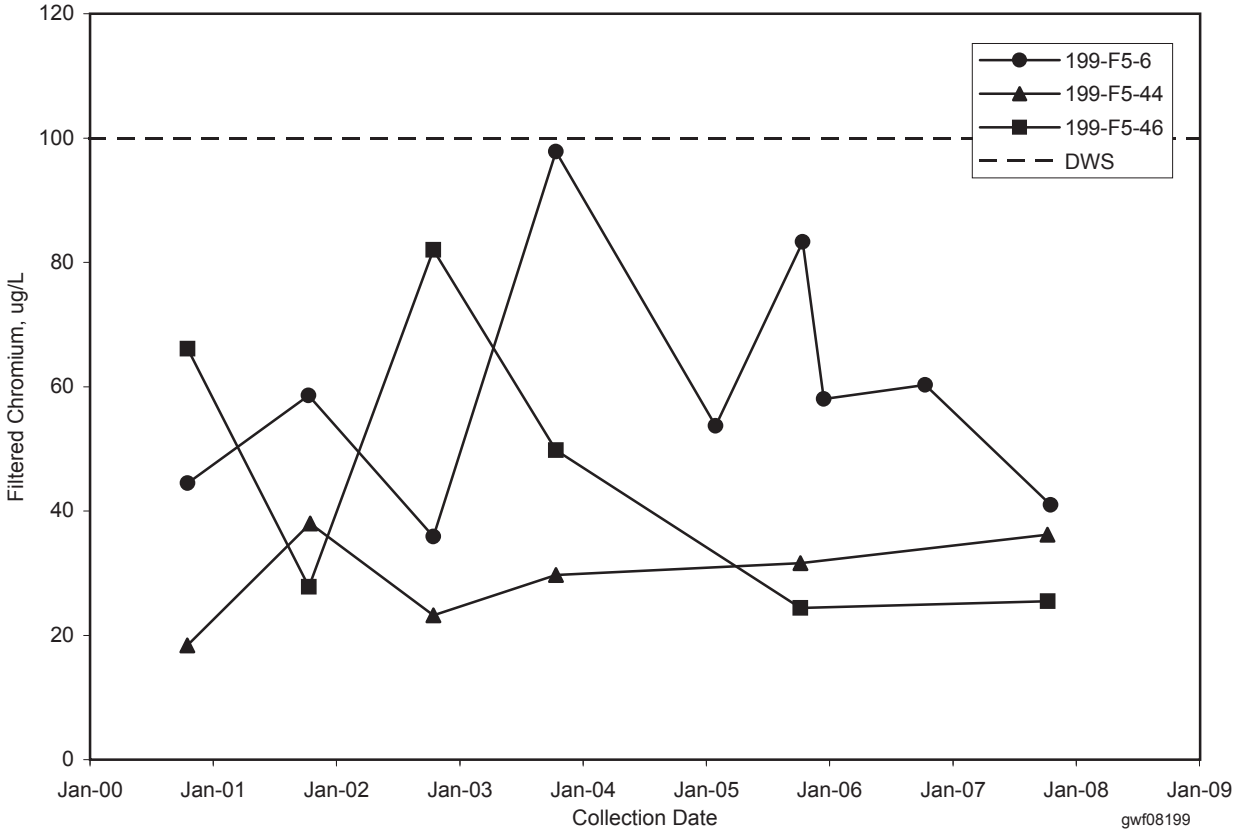
Figure 2.7-9. Chromium Concentrations in the 100-F Area.