

Locating the Source of a Chromium Groundwater Plume at the Hanford Site

Scott W. Petersen, Fluor Hanford, Inc.

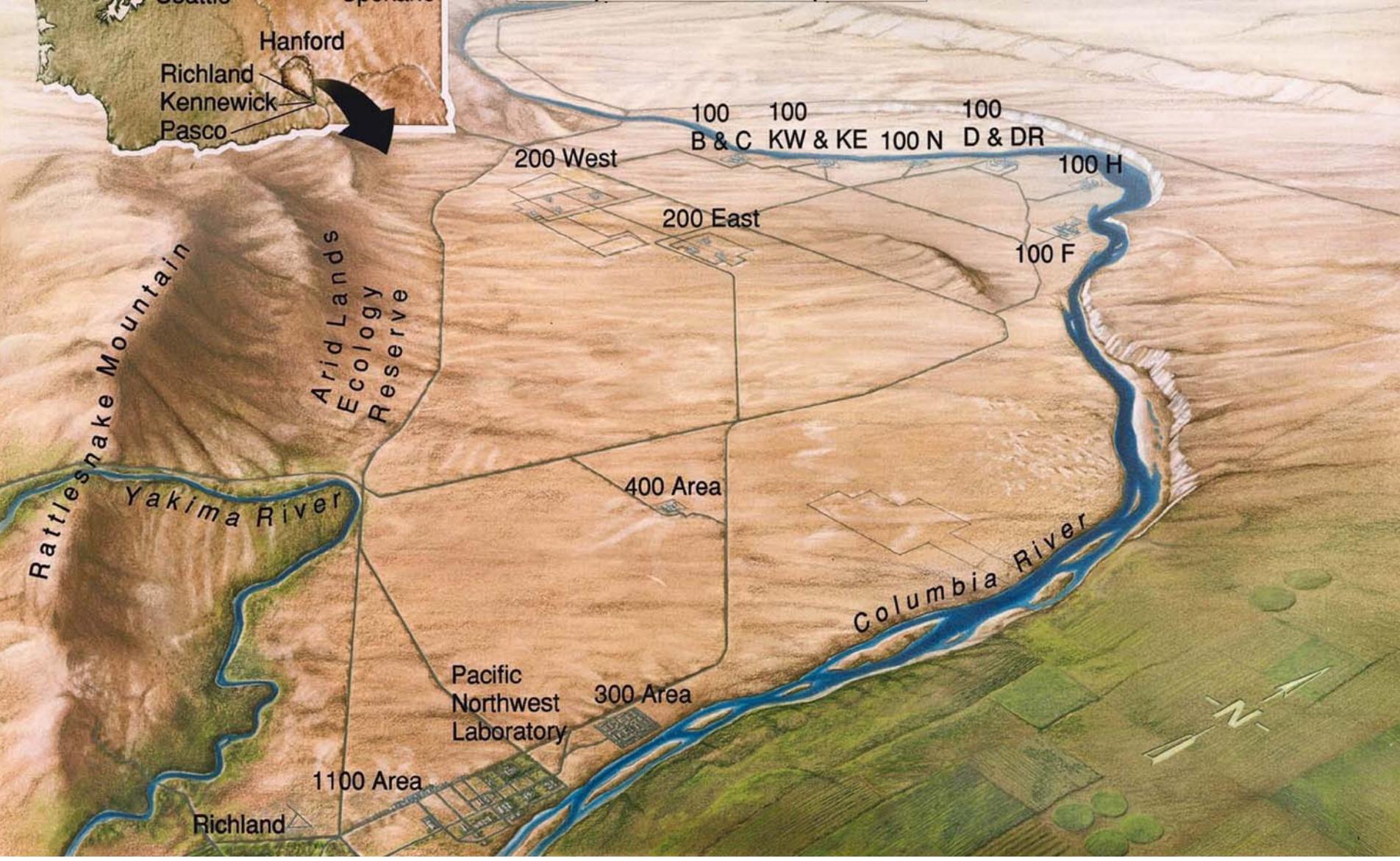
Christopher Murray, Pacific Northwest National Laboratory

K. Michael Thompson, Department of Energy, Richland Operations Office



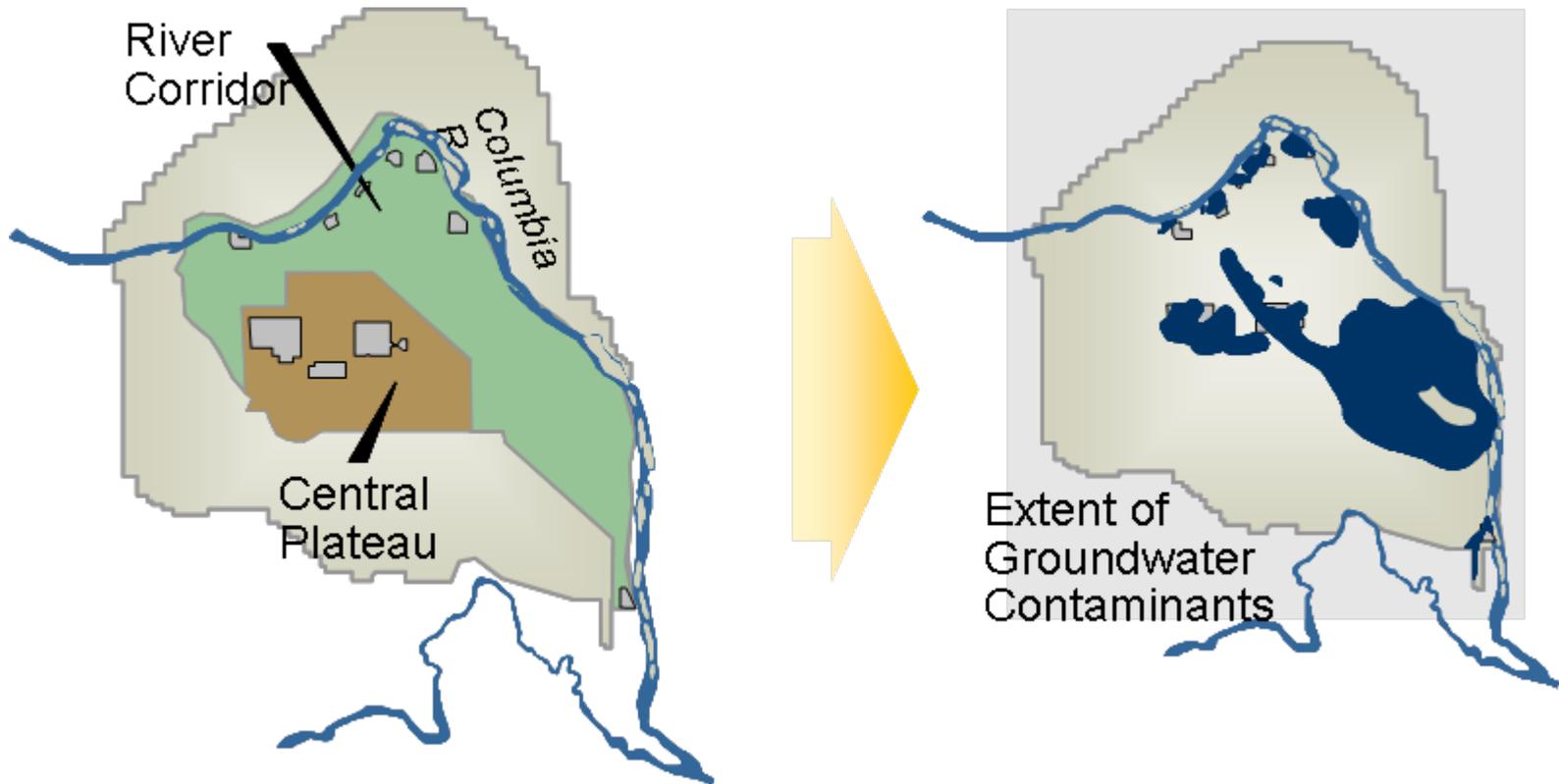
Hanford Site

1518 Square Kilometers / 586 Square Miles



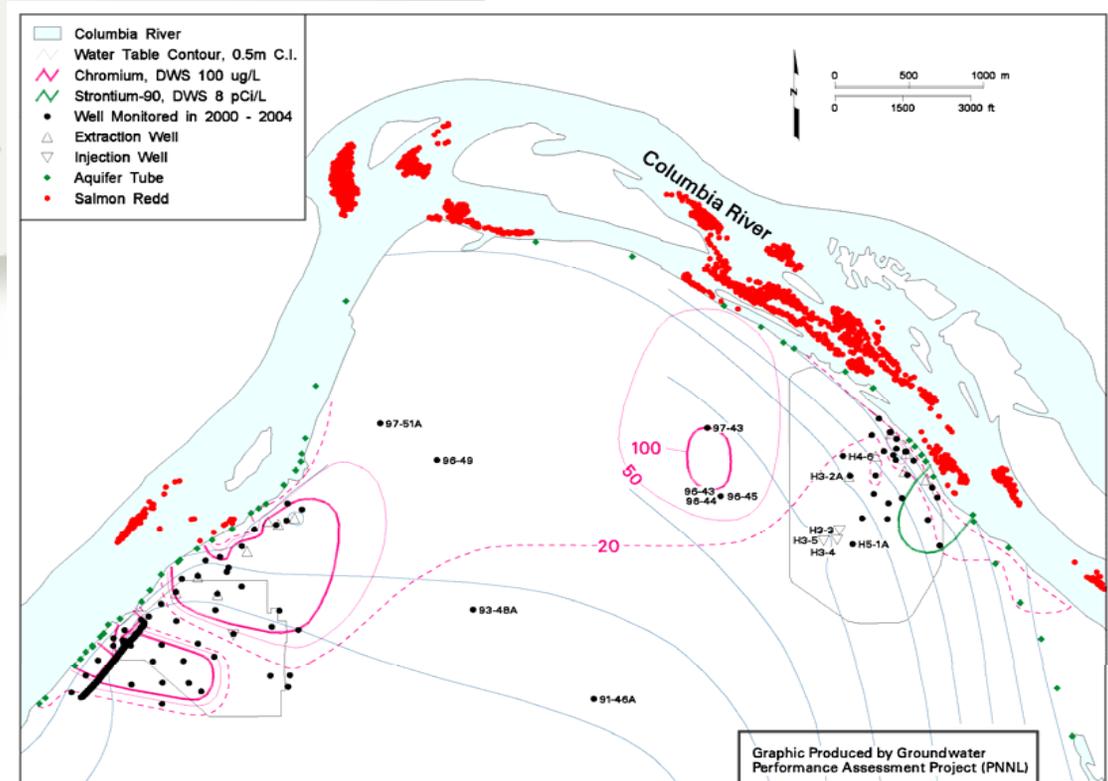
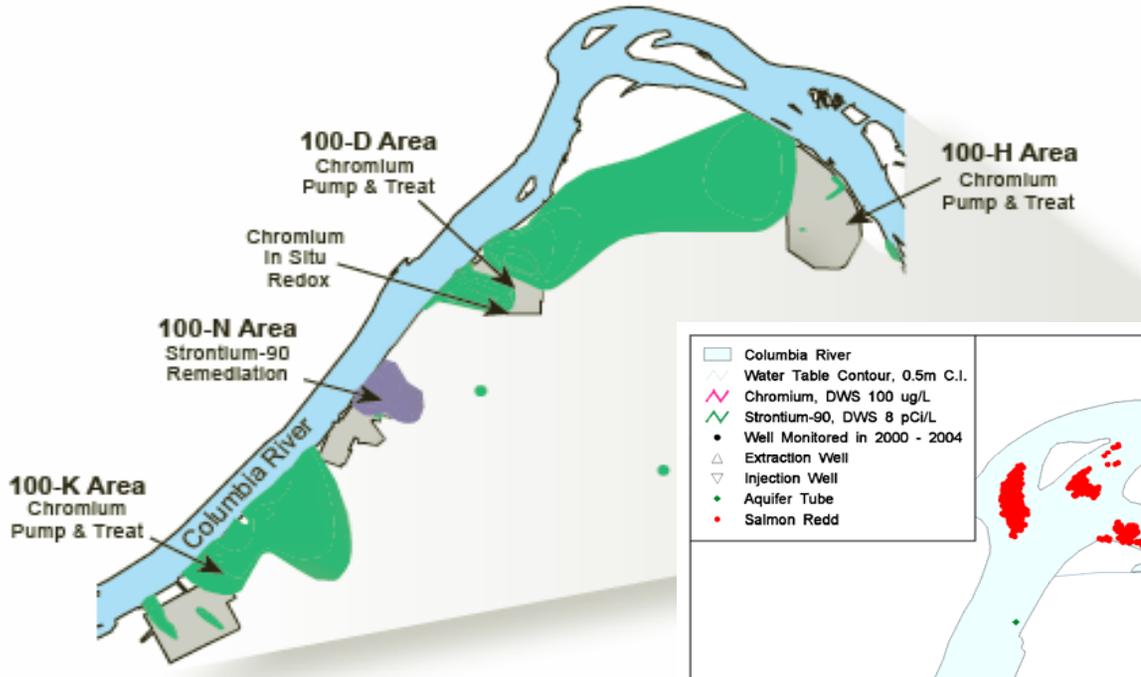
Hanford Site Groundwater Overview

Current Extent of Groundwater Contamination



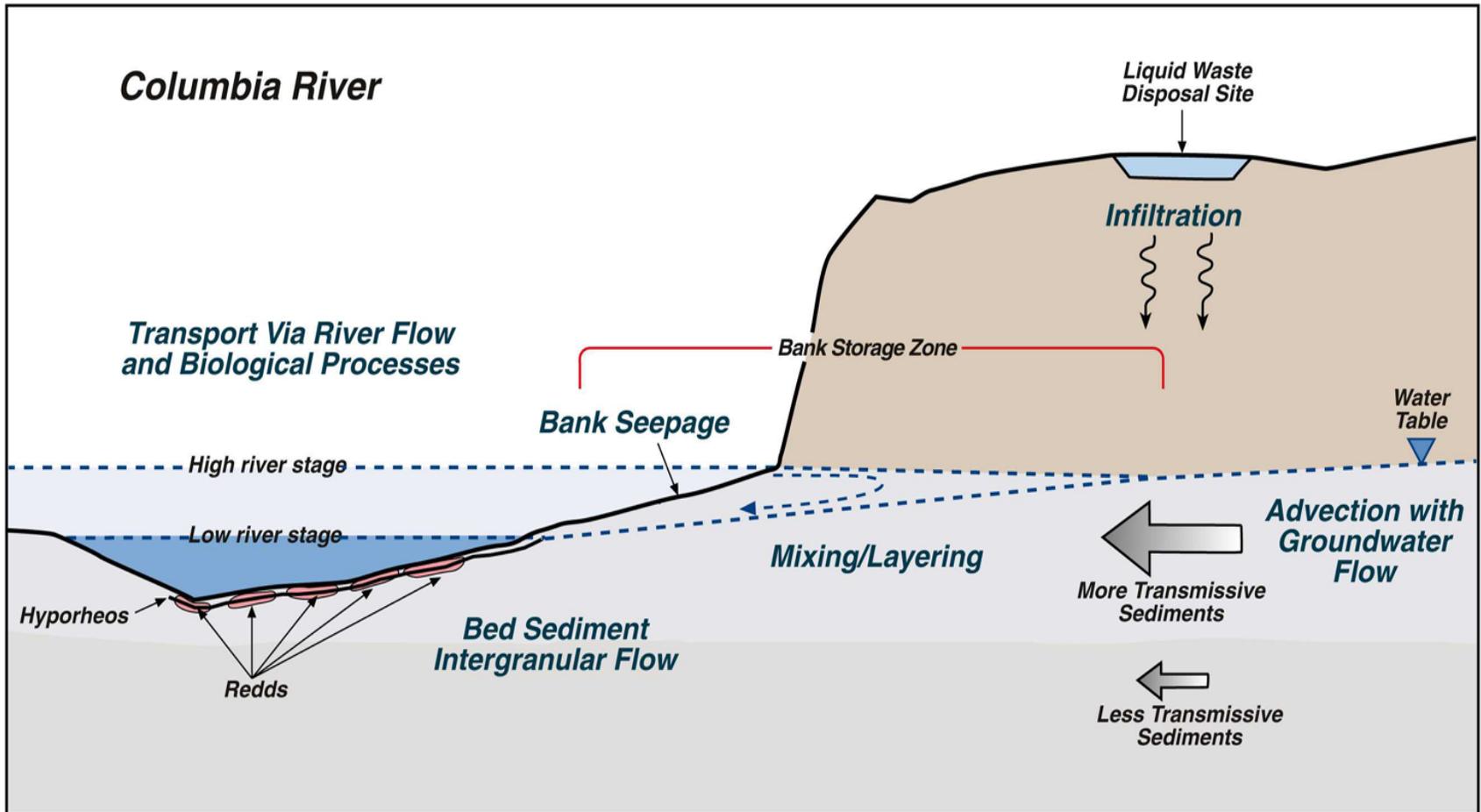
- Approximately 80 square miles of groundwater contaminated above drinking water standards
- Contaminants from 100/300 Areas and PUREX reach Columbia River

100 Area Hexavalent Chromium

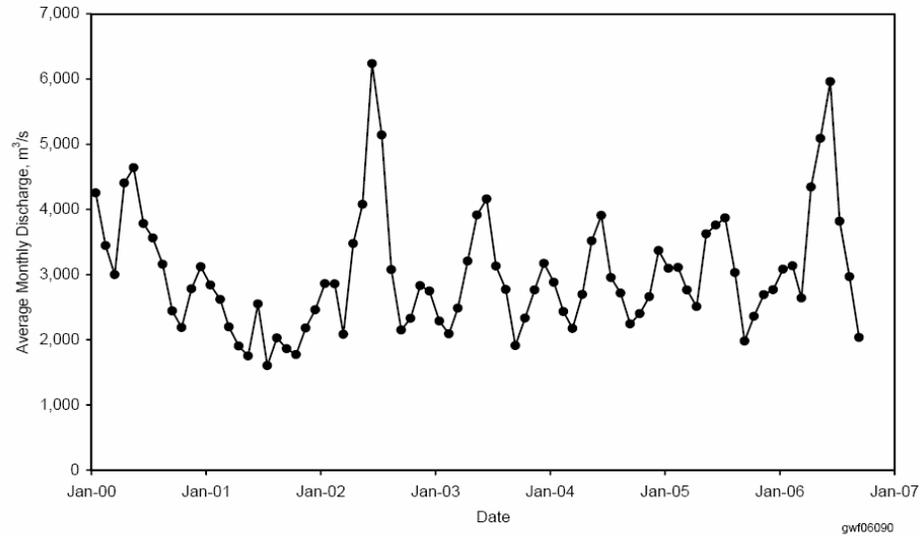


Graphic Produced by Groundwater Performance Assessment Project (PNNL)

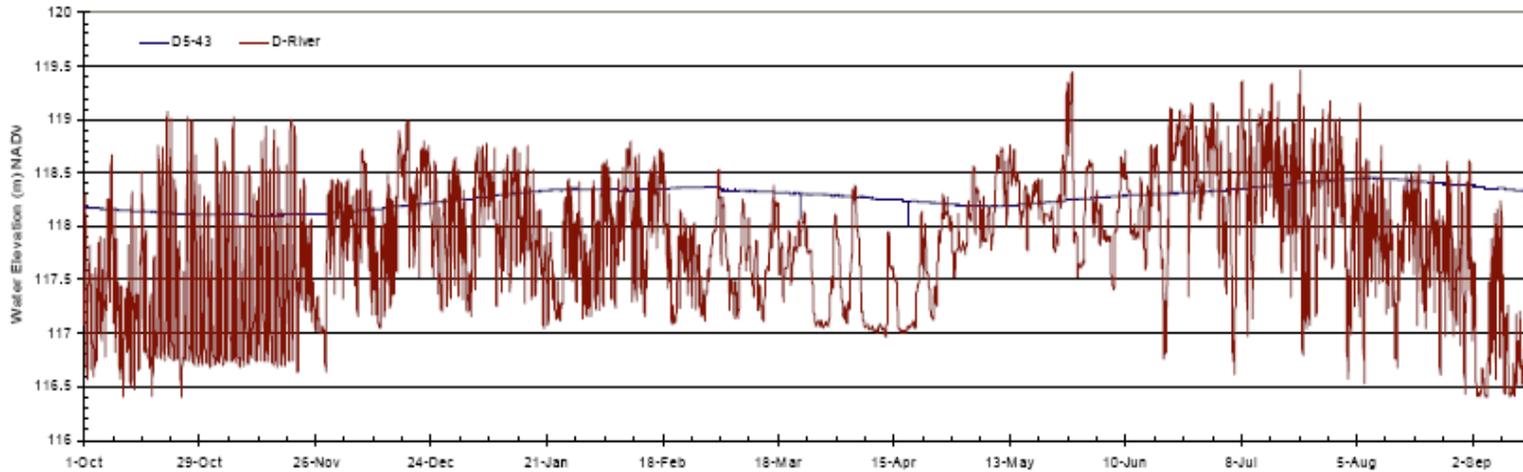
The Aquifer and the Columbia River



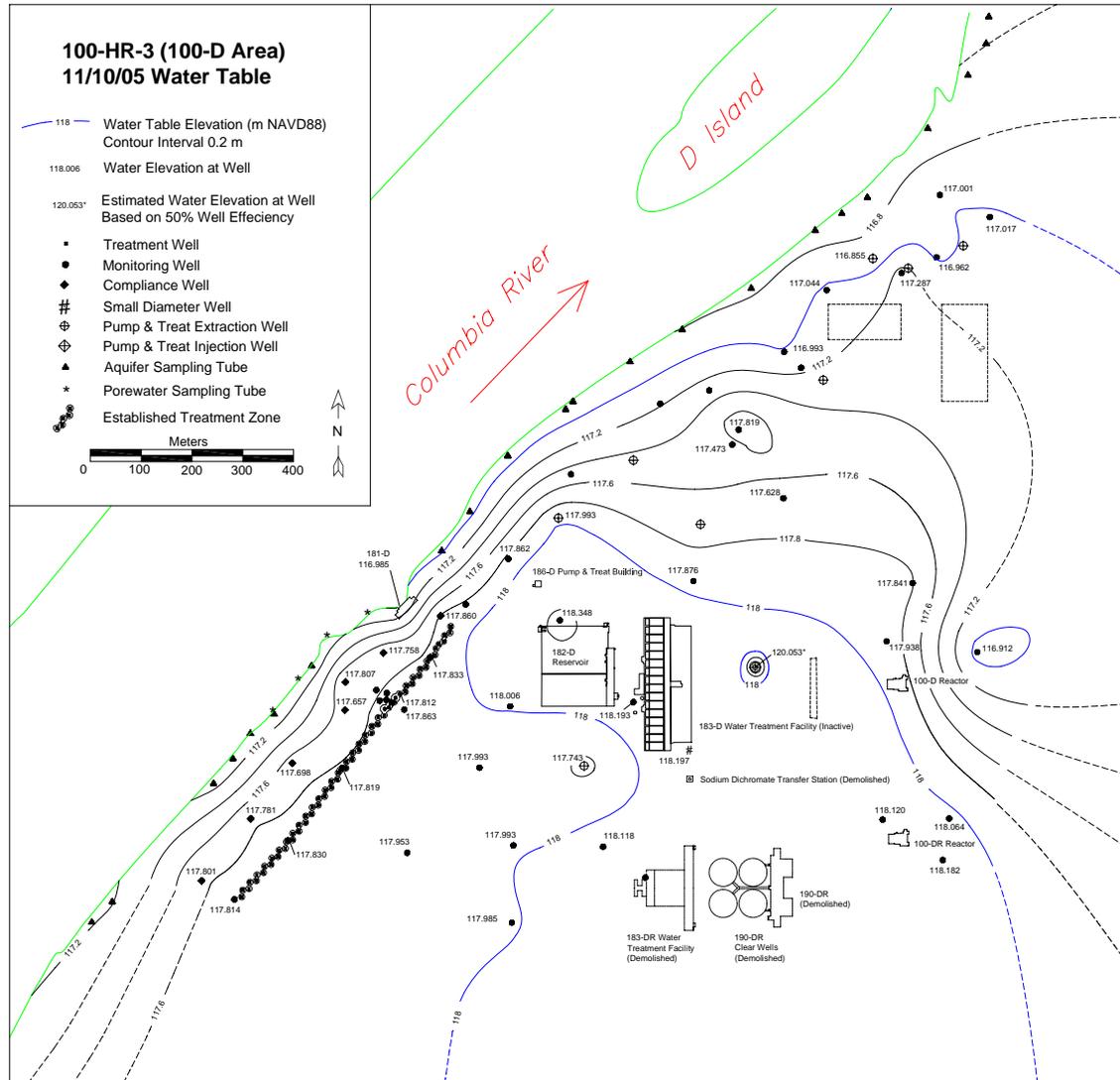
Seasonal Variations in River Flow



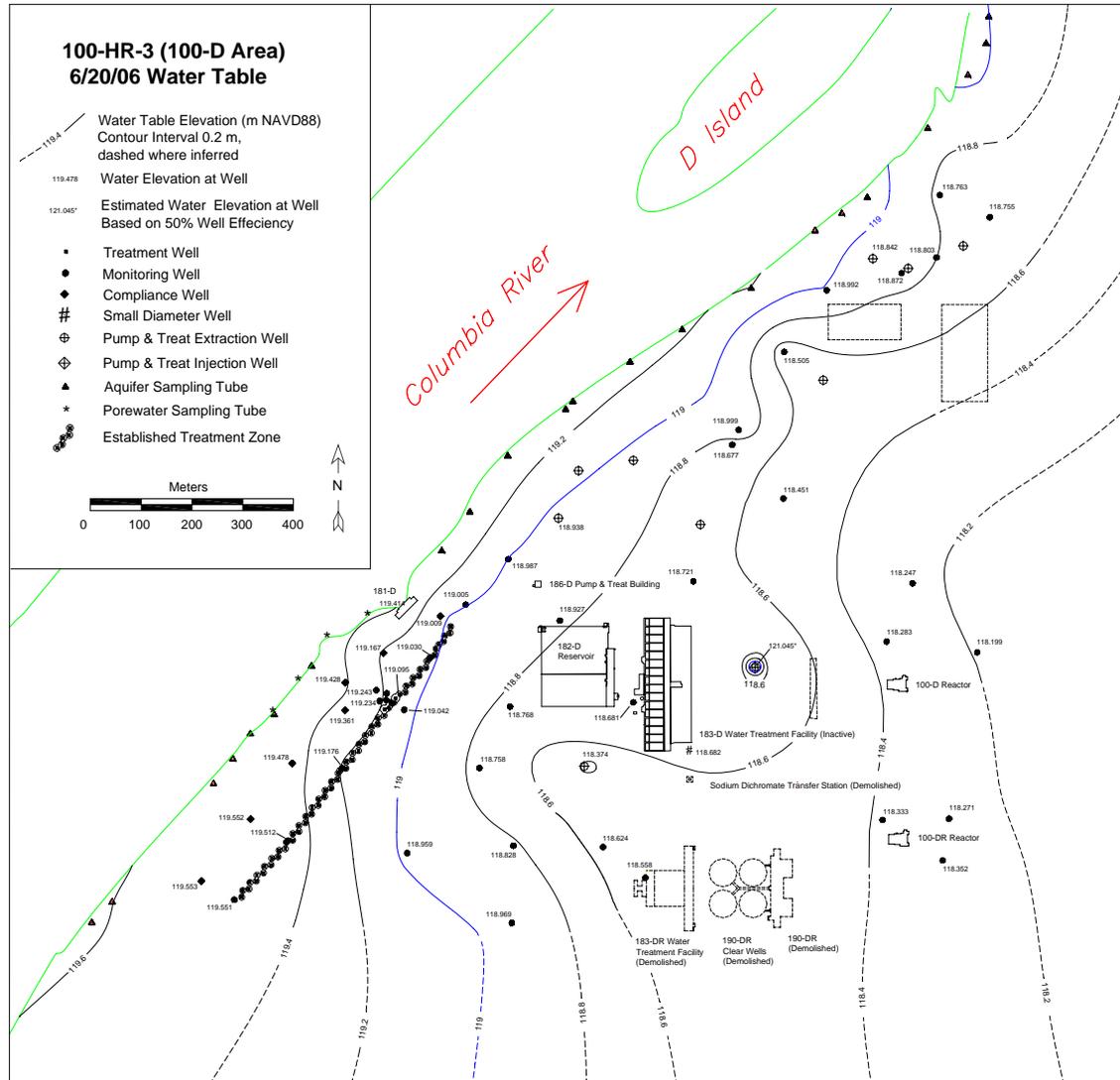
Hydrographs for Well 199-D5-43 and Columbia River; Fiscal Year 2005



Groundwater Changes Through a Year



Groundwater Changes Through a Year



100-D Area Operations in 1956



100-D Area in 2001

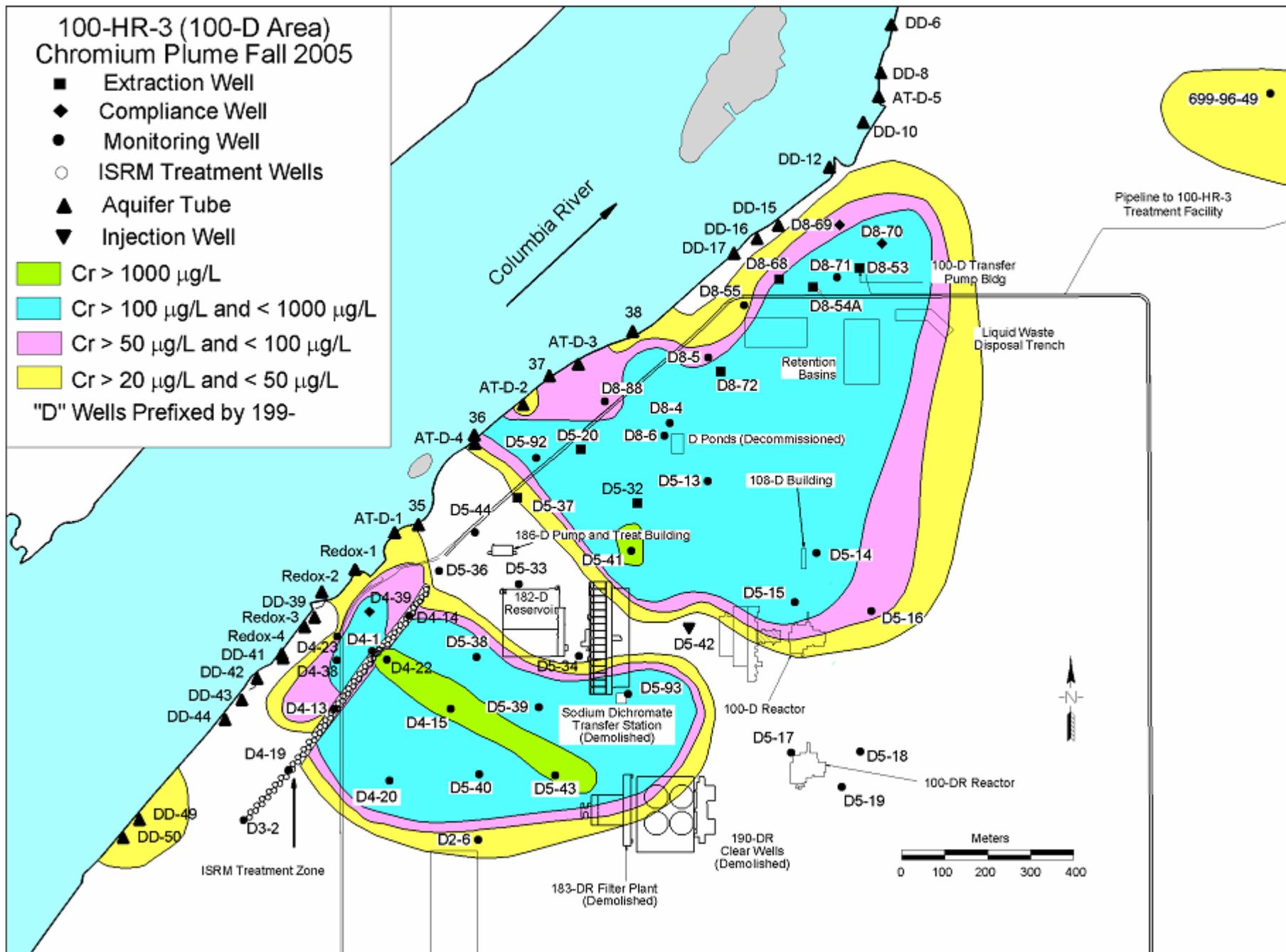


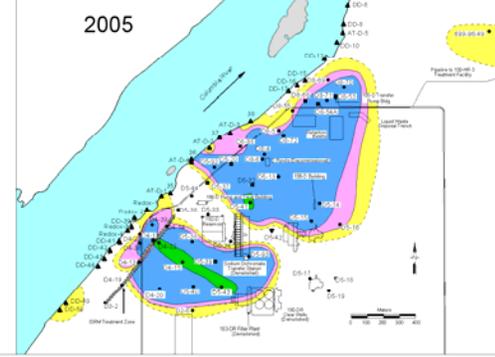
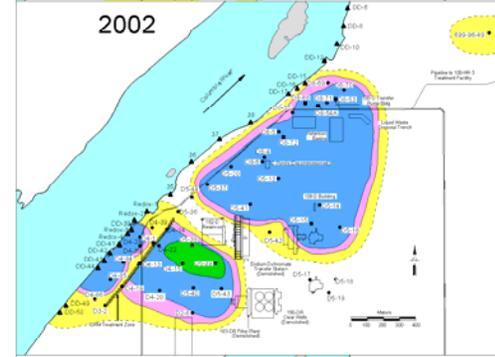
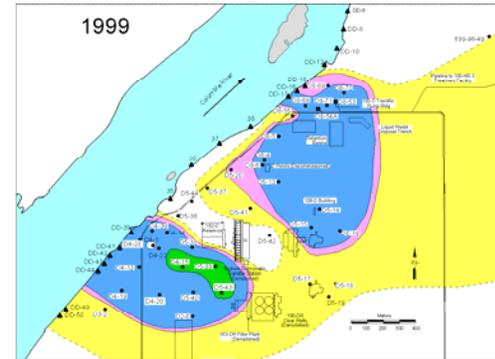
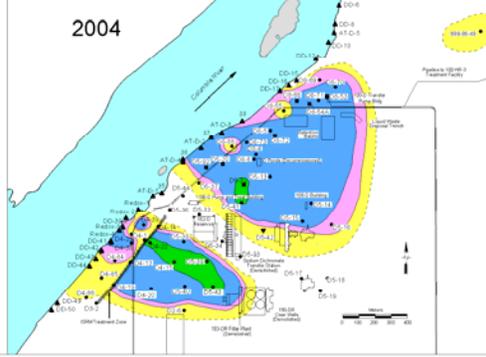
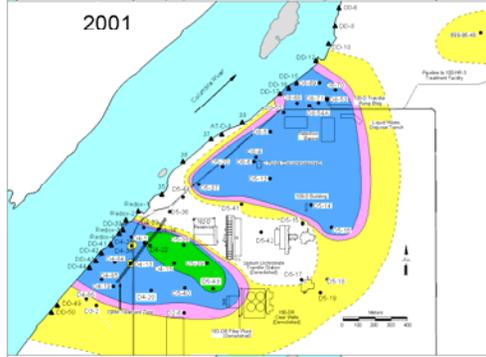
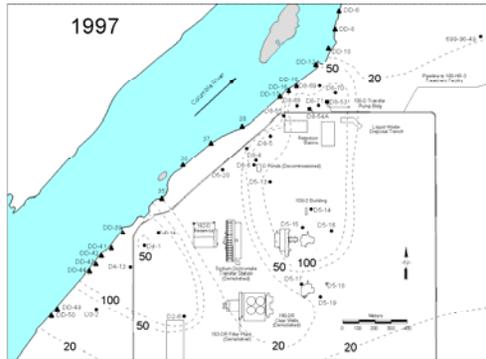
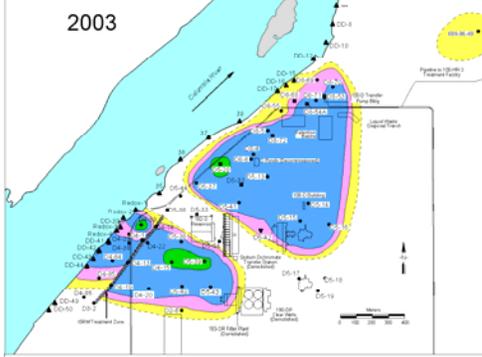
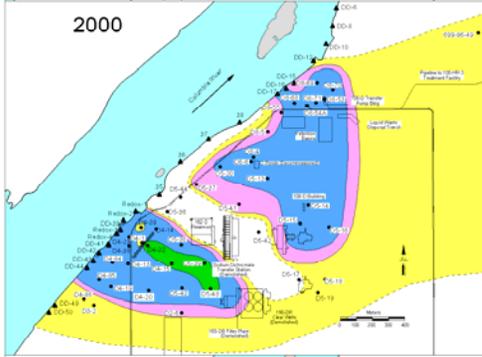
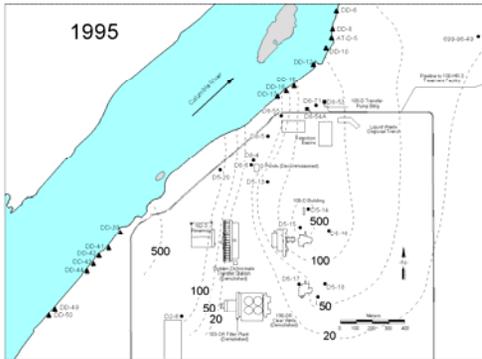
100-HR-3 (100-D Area) Chromium Plume Fall 2005

- Extraction Well
- ◆ Compliance Well
- Monitoring Well
- ISRM Treatment Wells
- ▲ Aquifer Tube
- ▼ Injection Well

- Cr > 1000 µg/L
- Cr > 100 µg/L and < 1000 µg/L
- Cr > 50 µg/L and < 100 µg/L
- Cr > 20 µg/L and < 50 µg/L

"D" Wells Prefixed by 199-





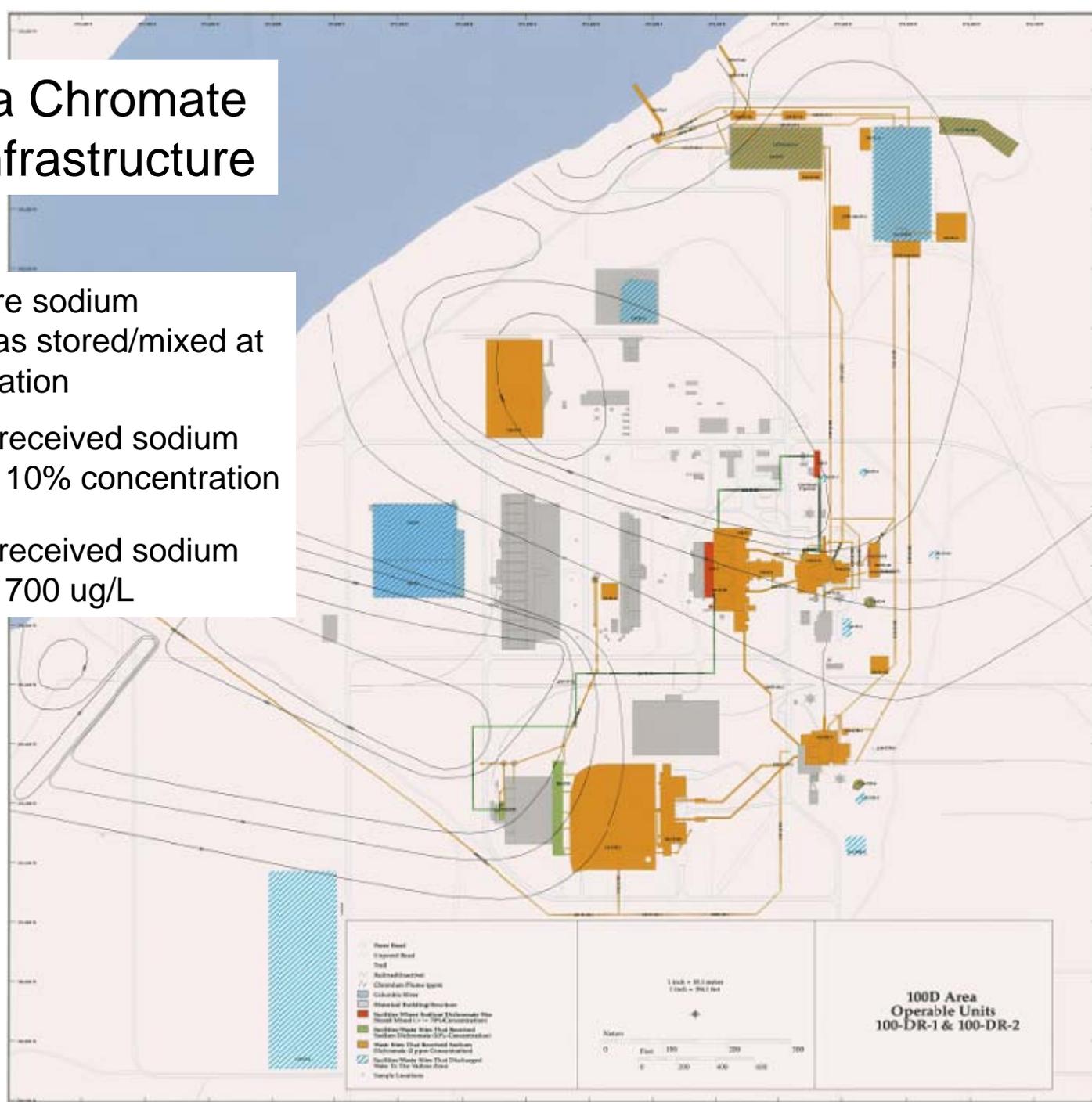
- Extraction Well
- ▼ Injection Well
- Monitoring Well
- ▲ Aquifer Tube

- Chromium > 1000 µg/L
- Chromium > 100 µg/L and < 1000 µg/L
- Chromium > 50 µg/L and < 100 µg/L
- Chromium > 20 µg/L and < 50 µg/L
- Chromium < 20 µg/L

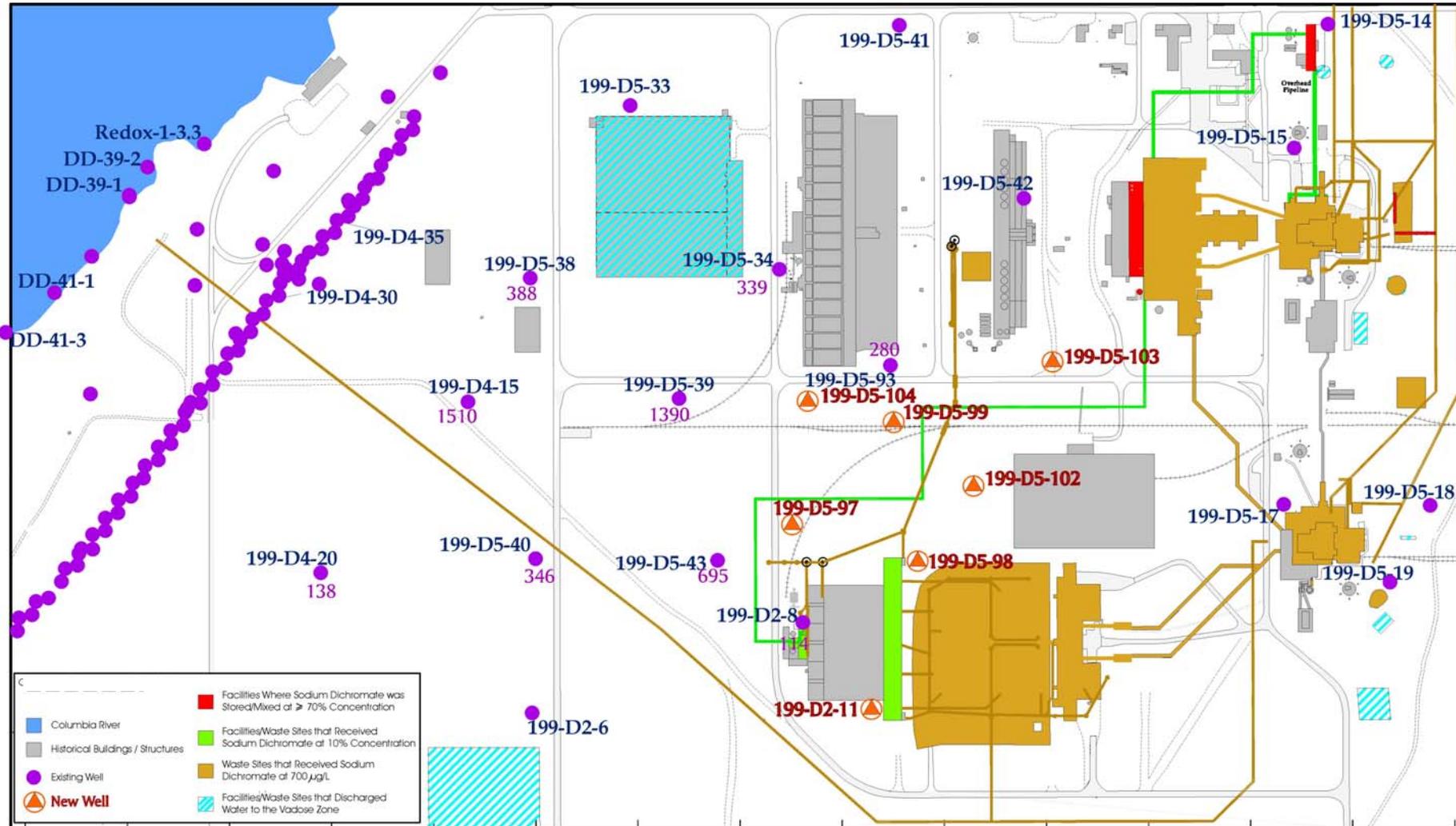
**100-HR-3 (100-D Area)
Chromium Plume
Fall 1995 to 2005**

100-D Area Chromate Handling Infrastructure

-  Facilities where sodium dichromate was stored/mixed at 70% concentration
-  Facilities that received sodium dichromate at 10% concentration
-  Facilities that received sodium dichromate at 700 ug/L



Map of 100-D Area Today



Refine Location of the Chromium Source

Problem: Groundwater data show that there is a continuing source of chromium feeding the ISRM plume.

Solution: Refine the source location. No indirect (e.g., geophysical) methods are able to do this, so physical samples must be obtained.

Approach:

- Drill approximately 7 boreholes near the expected source
- Collect and analyze vadose zone samples for chromate
- Monitor **chromium concentrations** and **groundwater levels** in the wells for 6 months
- Evaluate the data using geostatistics to refine the source location.

Systems Approach to Chromium Cleanup

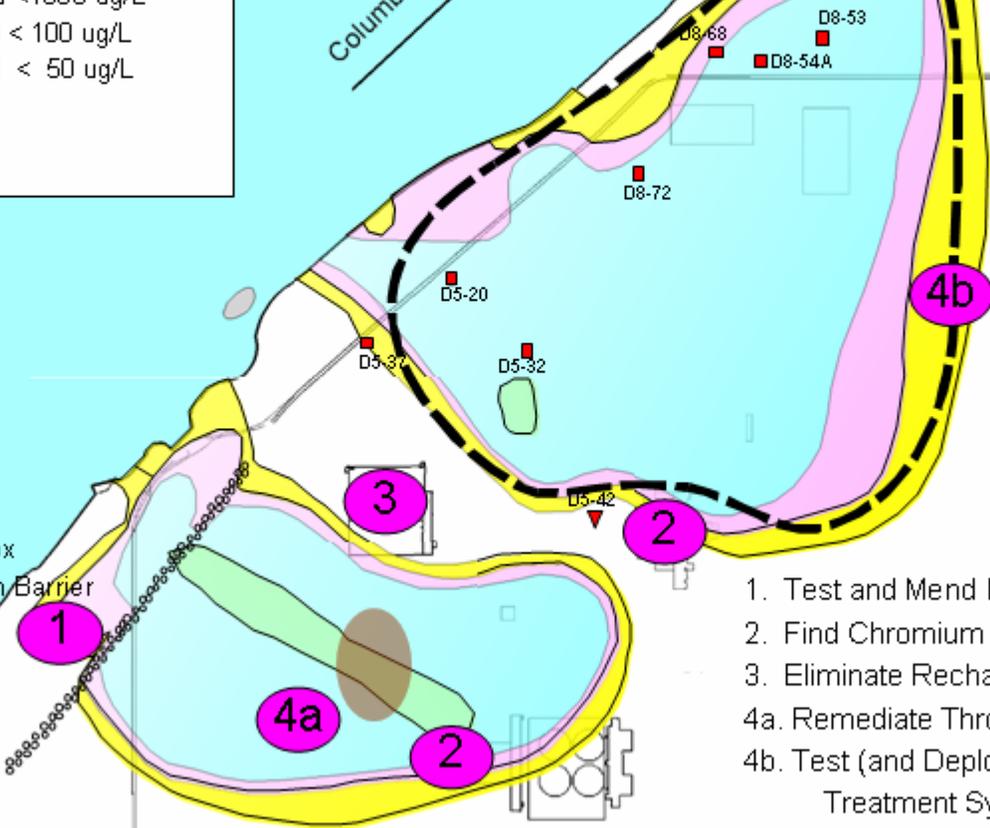
100-HR-3 (100-D Area)
Chromium Plume Fall 2005

- Extraction Well
- ▼ Injection Well

- Cr > 1000 ug/L
- Cr > 100 ug/l and <1000 ug/L
- Cr > 50 ug/L and < 100 ug/L
- Cr > 20 ug/L and < 50 ug/L

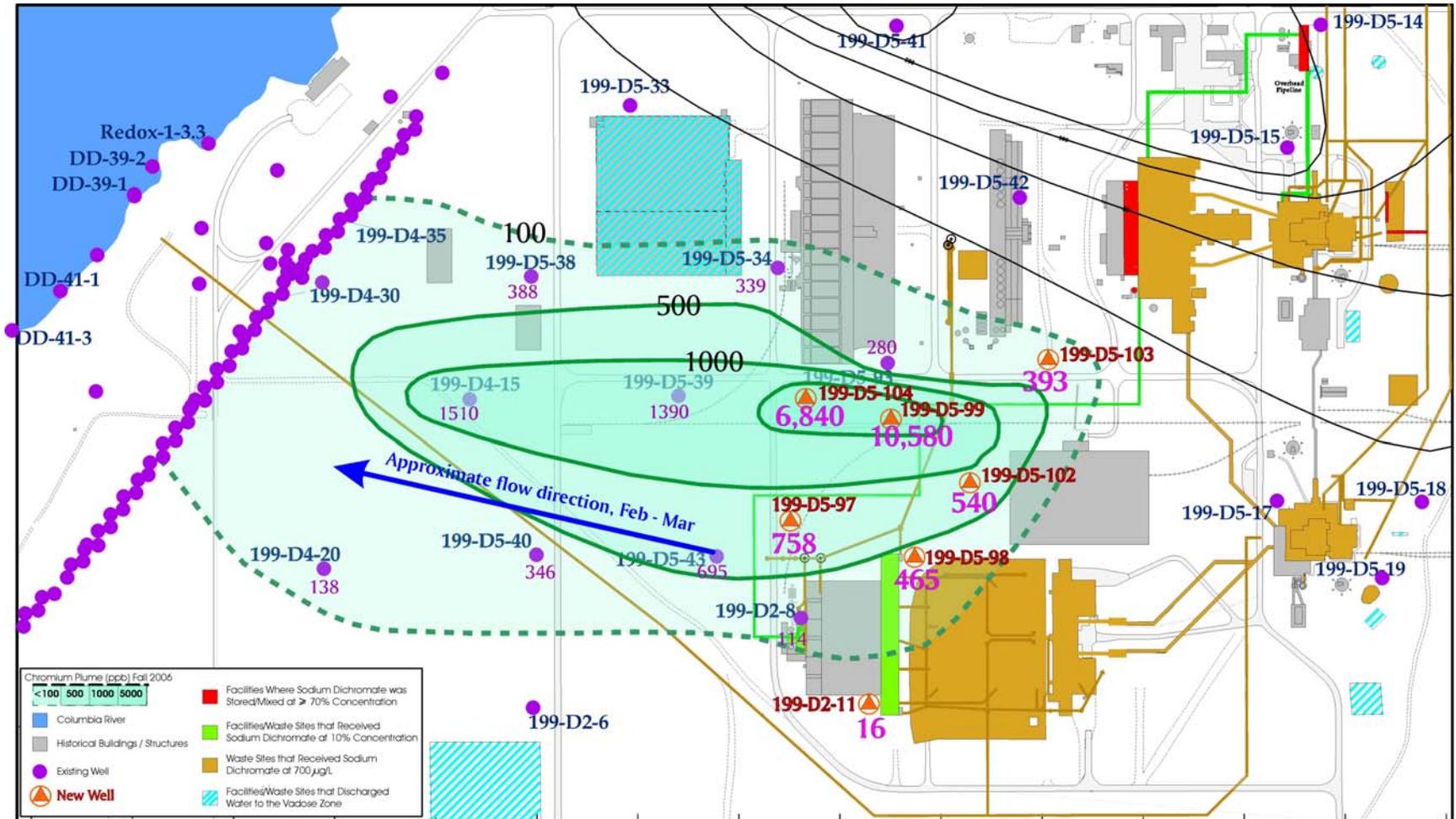
Columbia River

In Situ Redox Manipulation Barrier



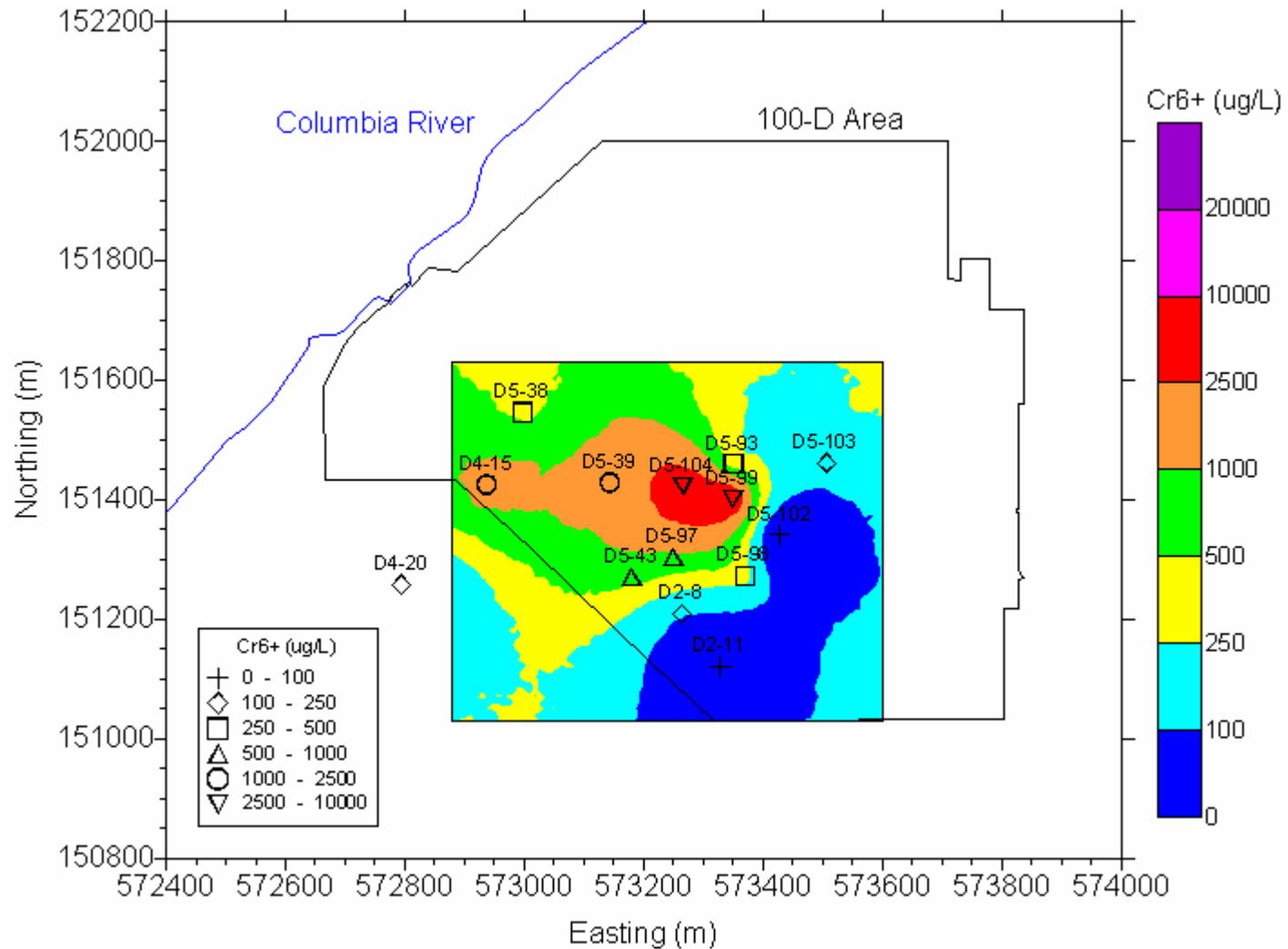
1. Test and Mend ISRM Barrier
2. Find Chromium Source
3. Eliminate Recharge
- 4a. Remediate Through Biostimulation
- 4b. Test (and Deploy) Electrocoagulation Treatment System

Initial Results from the Chromate Source Investigation Project

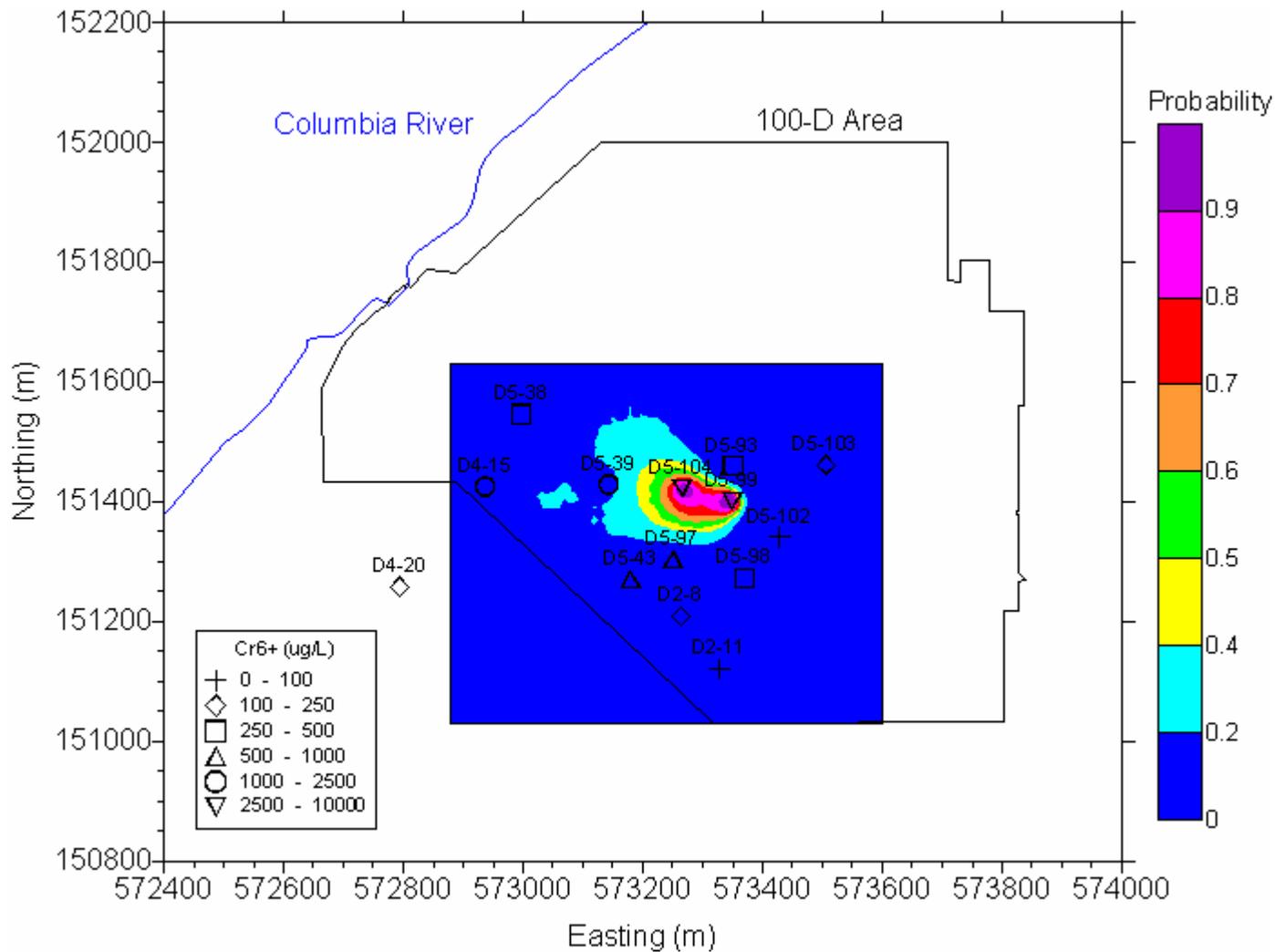


Hexavalent chromium values in parts per billion (ug/L)

Geostatistical Realization, Median Simulated Value Based on 1,000 Simulations



Geostatistical Realization, Probability of Exceeding 2,500 ug/L Based on 1,000 Simulations



Future Work

- Continue bi-weekly monitoring for hexavalent chromium through September 2007
- Continue collecting automated groundwater level measurements
- Evaluate the data set using geostatistics to refine the source location
- Drill several more wells in both the southwest and the northwest plumes to further refine the chromium source
- Evaluate technologies to remediate the source in situ