Hanford Site Groundwater – Introduction

E_M Environmental Management

safety • performance • cleanup • closure

***The Hanford Site**, in southeastern Washington State, is part of the U.S. Department of Energy's (DOE) nuclear weapons complex. Disposal of liquid waste from the 1940s through most of the 1980s contaminated some of the soil and groundwater with radionuclides and chemicals. Environmental cleanup began in the late 1980s. To help plan, investigate, and remediate contaminated groundwater, the Site is divided into 11 groundwater operable units.*

Glossary:

Aquifer – Underground sediment or rock that is saturated with water (***groundwater***). The top of an unconfined aquifer is the ***water table***.

Plume – A volume of groundwater containing contaminants. Plumes are usually depicted as two-dimensional maps.

Pump-and-Treat – A method of remediation where contaminated water is pumped from the aquifer and treated to remove contamination. The clean water is then disposed, often by injecting it into the aquifer through another well.

Vadose zone (unsaturated zone) – The area between the land surface and the water table, where pores between sediment grains hold a mixture of air and water.

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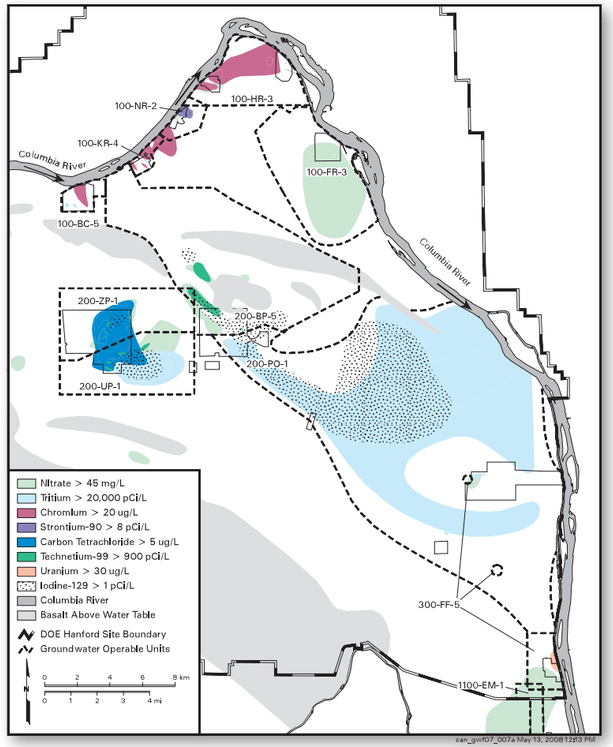
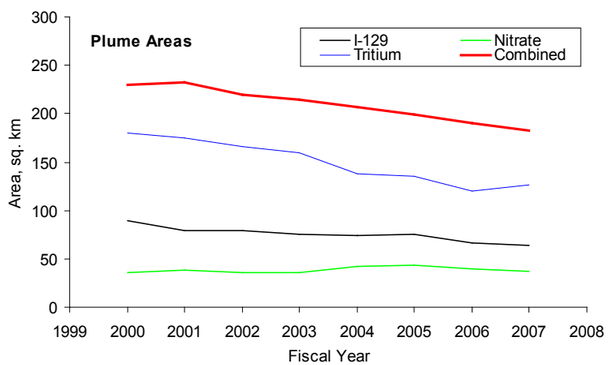
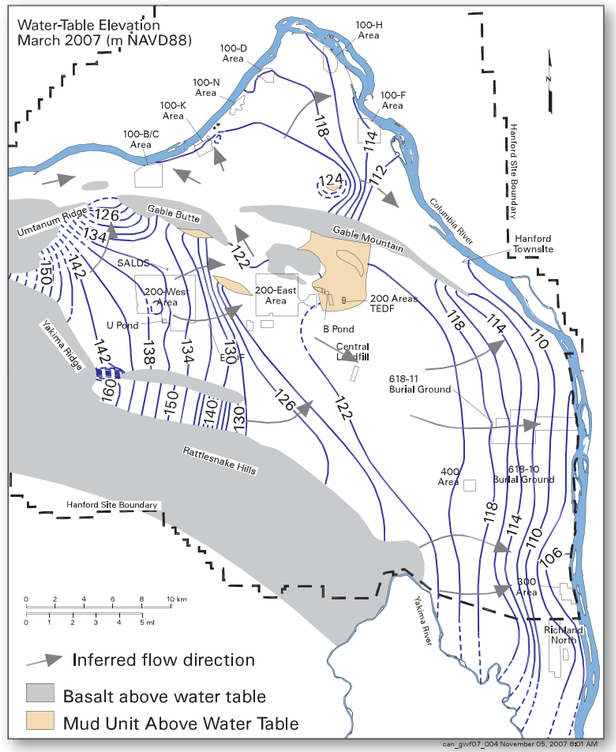
Groundwater Operable Units and Major Plumes



Plume Areas



2007 Water Table

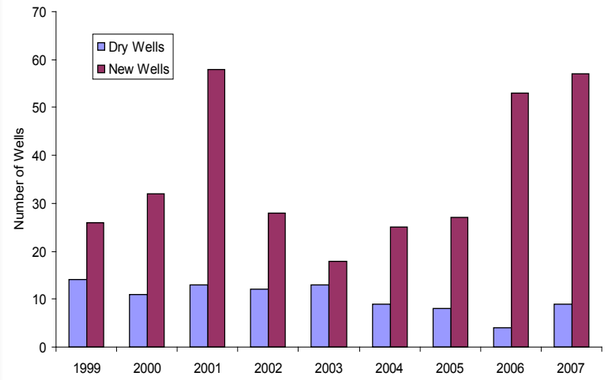


The water table has hills and valleys similar to the land surface. Groundwater flows from higher to lower water table elevations. Hanford Site groundwater flows slowly toward the Columbia River.

Contaminant Facts

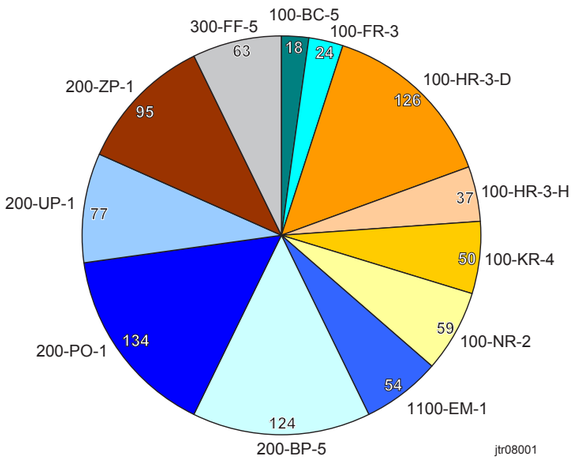
Contaminant	Primary locations	Plume Area (sq.km)	Drinking Water Standard	Remediation in place?	Comment
Carbon Tetrachloride	200-ZP-1	10.1	5 ug/L	Yes	
Chromium (hexavalent)	100-KR-4, 100-HR-3	2.2	100 ug/L	Yes	aquatic standard = 10 ug/L
Iodine-129	200-PO-1	64.4	1 pCi/L	No	half-life = 15.7 million yr
Nitrate	100-FR-3, 200-PO-1	37.3	45 mg/L	No	
Strontium-90	100-NR-2	2.3	8 pCi/L	Yes	half-life = 29 yr
Technetium-99	200-BP-5, 200-UP-1	2.3	900 pCi/L	Yes	half-life = 210,000 yr
Tritium	200-PO-1	127	20,000 pCi/L	No	half-life = 12 yr
Uranium	200-BP-5, 200-UP-1	1.4	30 ug/L	Yes	

New and Dry Wells



The water table has declined, causing some wells to go dry. DOE installed wells to replace them and to investigate or treat groundwater contamination.

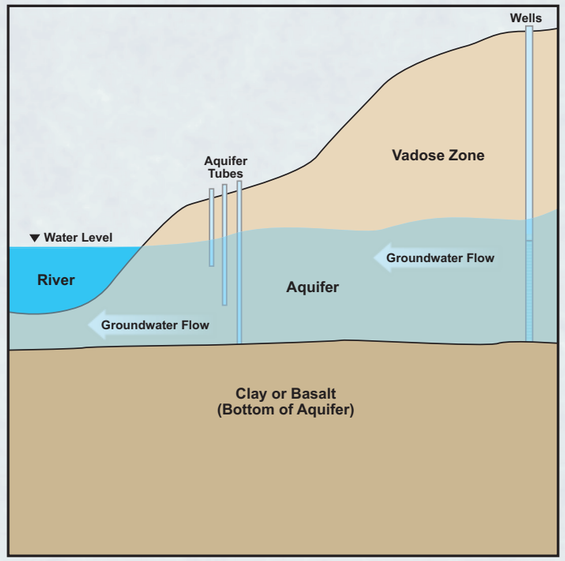
Wells Sampled FY07



In Fiscal Year 2007 Hanford scientists sampled over 860 wells and over 200 aquifer tubes. Many of the wells were sampled several times for multiple constituents, yielding over 30,000 groundwater samples.

Hanford Site Groundwater – Introduction (contd)

Scientists sample groundwater from monitoring wells. The samples are then sent to laboratories to be analyzed for chemicals or radionuclides of interest. In locations where the water table is shallow, such as near the Columbia River, workers have emplaced narrow, flexible plastic aquifer tubes to collect groundwater samples.



For more information see the annual groundwater monitoring report:
http://www.hanford.gov/cp/gpp/library/gwrep07/html/start07.htm

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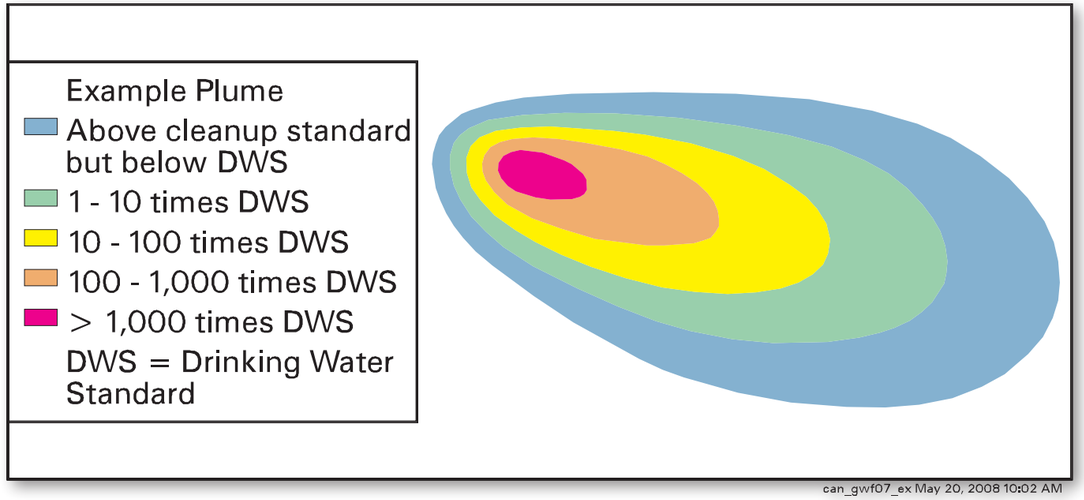
Results of groundwater monitoring are reported as concentrations of a contaminant in water, most commonly

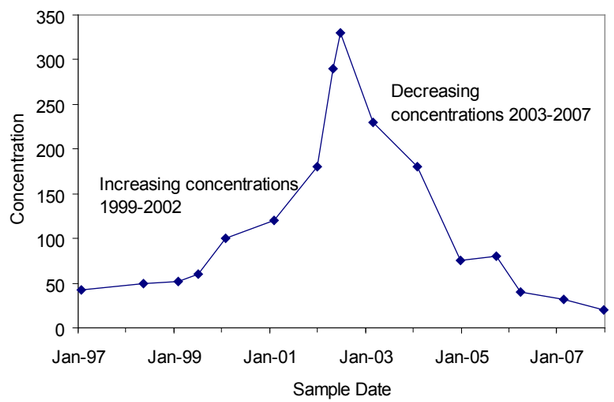
- milligrams per liter (mg/L) – one one-thousandth of a gram per liter
- micrograms per liter (µg/L or ug/L) – one one-millionth of a gram per liter
- picoCuries per liter (pCi/L) – one one-trillionth of a Curie per liter. A Curie is a unit of measure for radionuclides.

Contaminant concentrations are commonly illustrated on a ***trend plot*** to show how they change with time. Concentrations can rise and fall for many reasons, including (a) removal of contaminant sources; (b) groundwater cleanup; (c) movement of a plume; (d) movement of contamination from the vadose zone into the aquifer; (e) changing direction of groundwater flow; (f) radioactive decay; (g) dispersion.

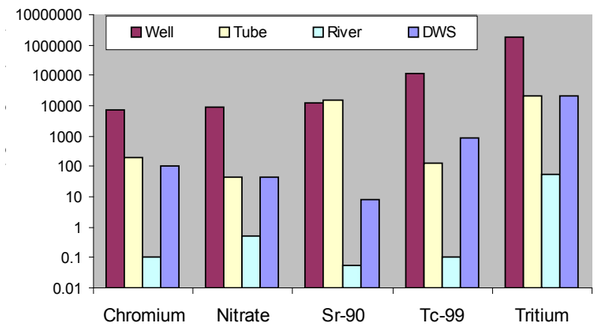


Plume maps show how contaminants are distributed in groundwater. Because the number and depth of the wells is limited, scientists must interpret the data to give their best estimate of plumes contours. At Hanford, most of the wells monitor depths near the water table. The information sheets that follow use a consistent series of colors to show relative concentrations. The maps include the locations of wells for which trend plots are provided.

Example Trend Plot



Maximum Concentrations



This chart shows contaminant concentrations in groundwater (well), at the shoreline (aquifer tube) and in Columbia River water, compared to drinking water standards.

Hanford's groundwater flows into the Columbia River at about 2.5 cubic meters per second, which is only 0.07% of the average river flow (3,400 cubic meters per second). Contaminants are detected in river water at concentrations much lower than drinking water standards.