



**Treatability Test for
Removing Technetium-99
from 200-ZP-1 Groundwater,
Hanford Site**

**Mark E. Byrnes- Fluor Hanford
(509) 373-3996**

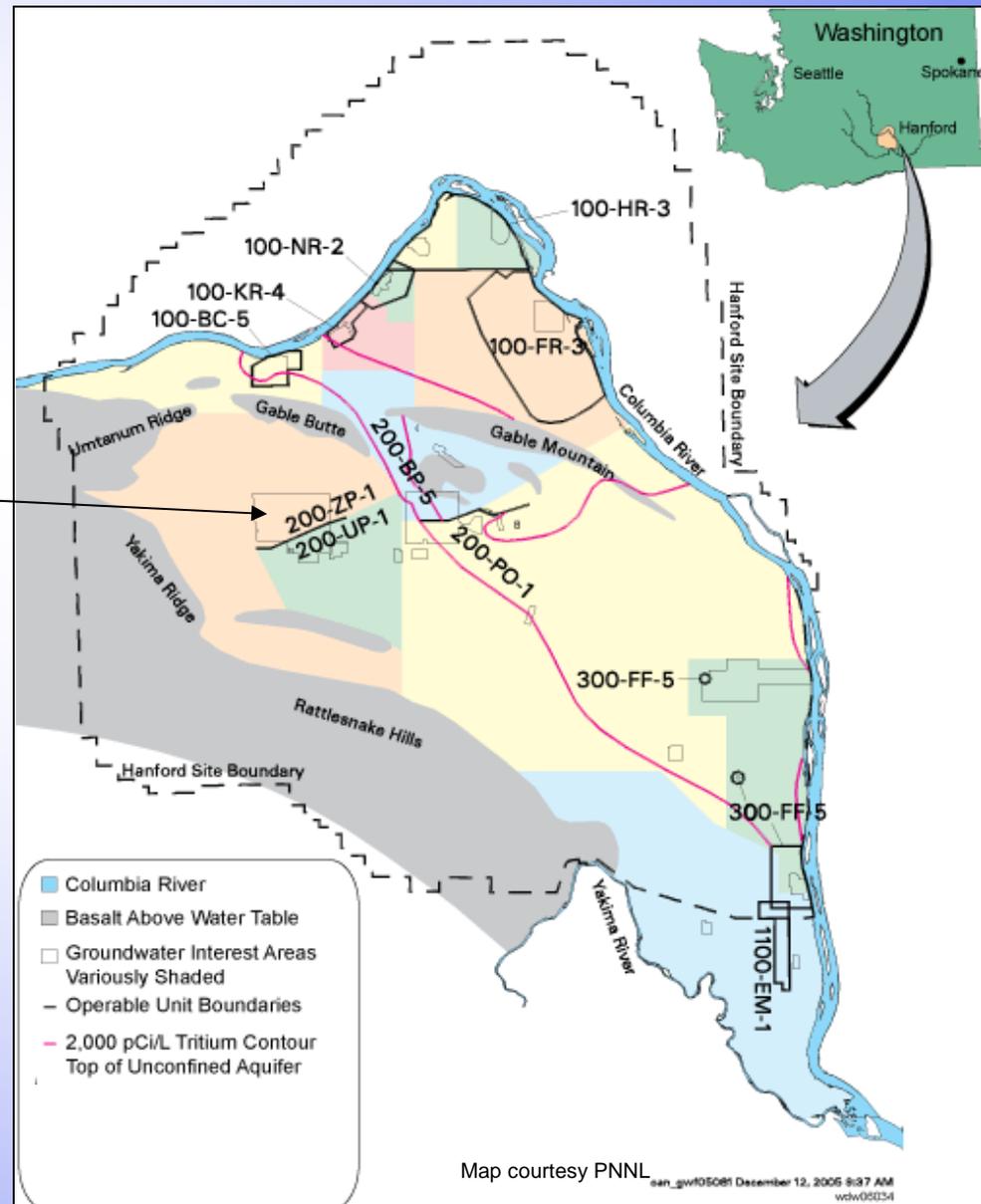
**Wanda Elliott- EQM Inc.
(509) 946-4985 ext. 26**

Overview

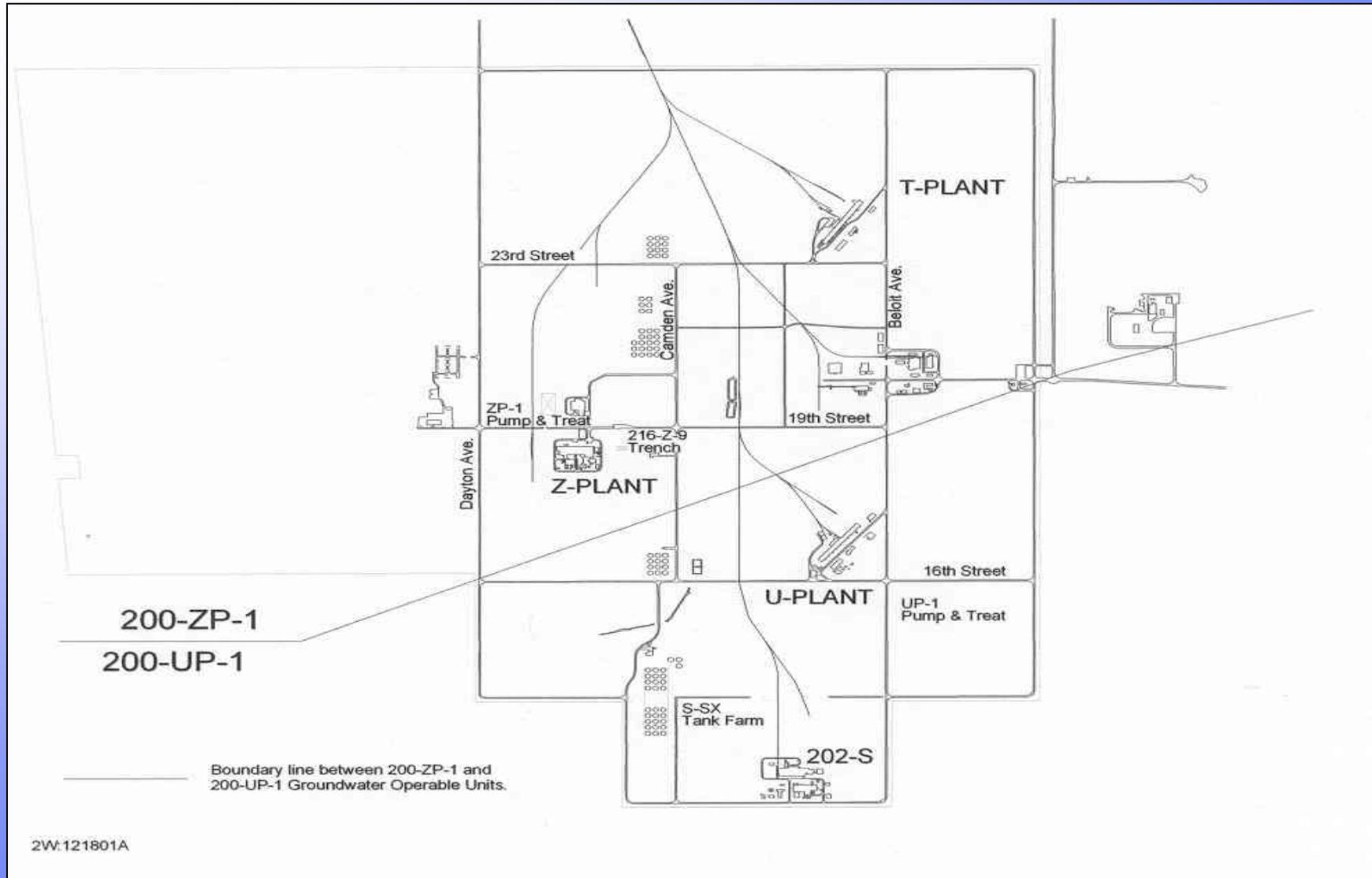
- Background:
 - Hanford Site groundwater OUs
 - 200-ZP-1 OU pump-and-treat system
- Problem: increasing Tc-99 in two 200-ZP-1 groundwater extraction wells:
 - Properties of Tc-99
 - Pertechnetate ion (TcO_4^-)
- Options for removing Tc-99:
 - Ion-exchange system developed by ORNL and UT
 - Paducah treatability test
- Proposed remediation: *ex situ* treatability test
- Treatability test assessment

Hanford Site Groundwater OUs

200-ZP-1 OU
(located in the
200 West Area)



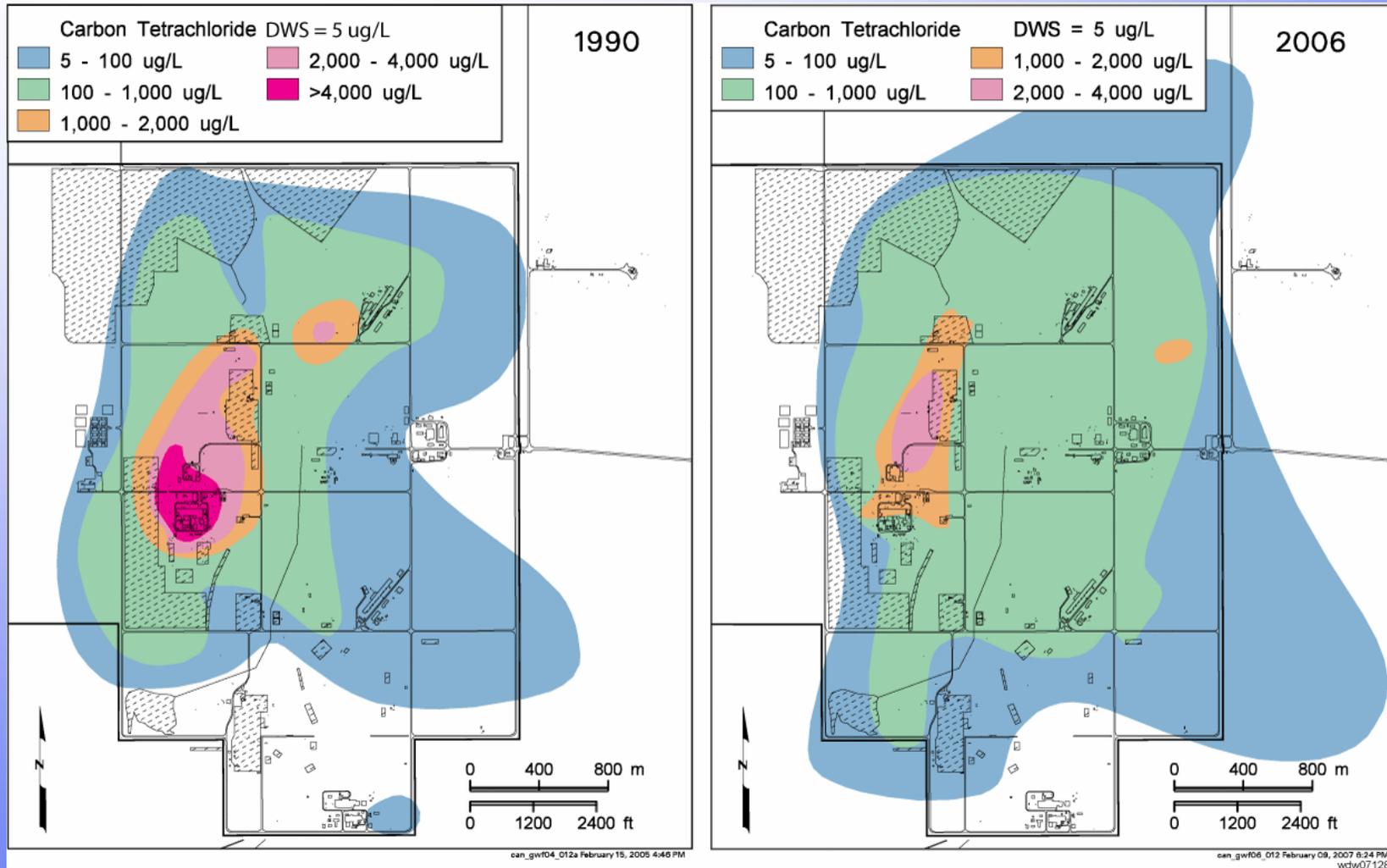
200 West Area Facilities



2W.121801A

Figure courtesy DOE/RL-2004-72

Carbon Tetrachloride Concentrations in Groundwater – 1990 and 2006



200-ZP-1 Treatment Building



Influent and Effluent Tanks



Effluent tank

Influent tank

Heater chiller unit

GAC Canisters



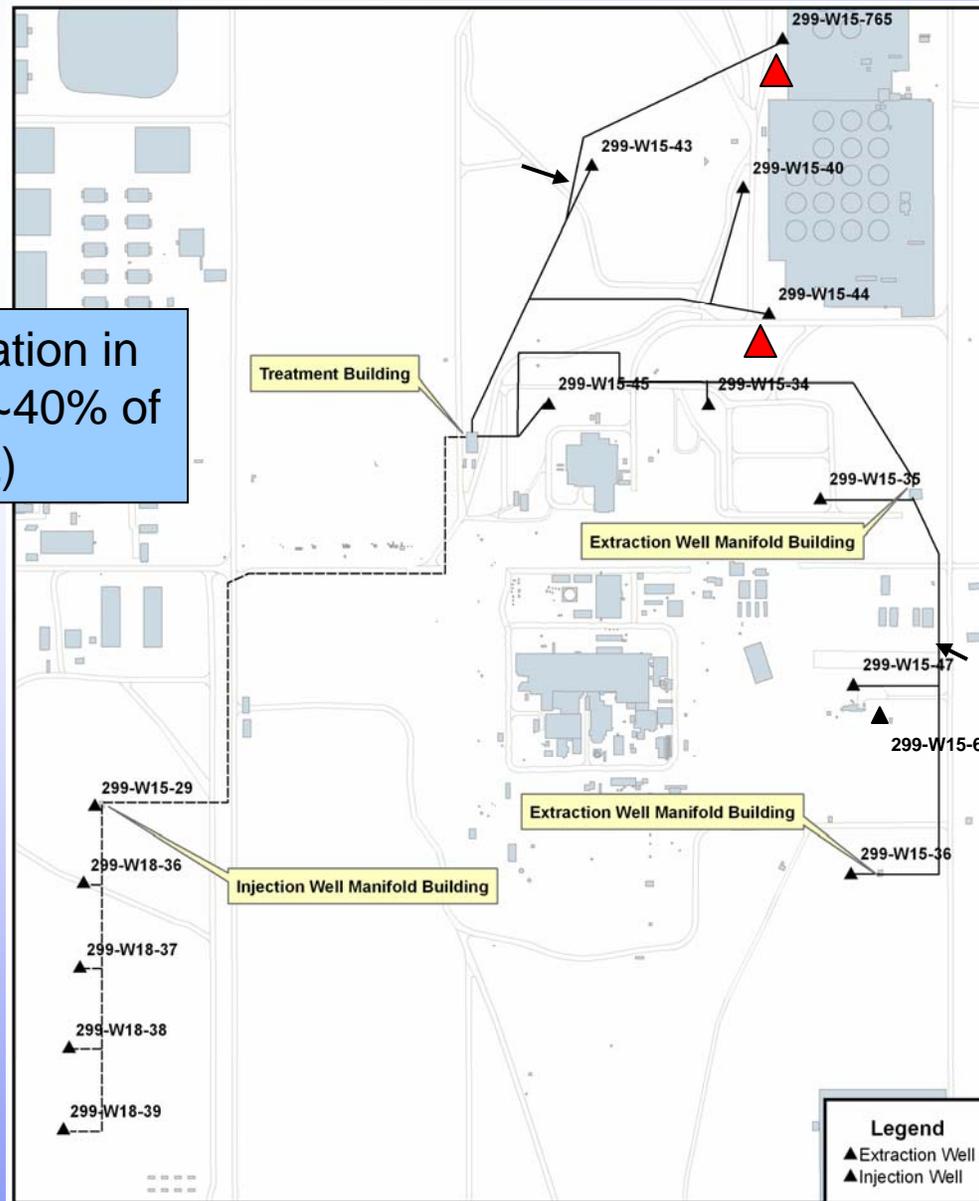
200-ZP-1 Pump-and-Treat Performance

- Estimated mass released to ground:
 - 577,000 to 922,000 kg*
- Total mass removed to date:
 - Groundwater (1994 – 2005): carbon tetrachloride:
~9,300 kg
 - Soil vapor: carbon tetrachloride: ~ 78,700 kg
(1991 – 2005)
- Total volume of water treated (1994 – 2005):
 - 2,762,269,046 L

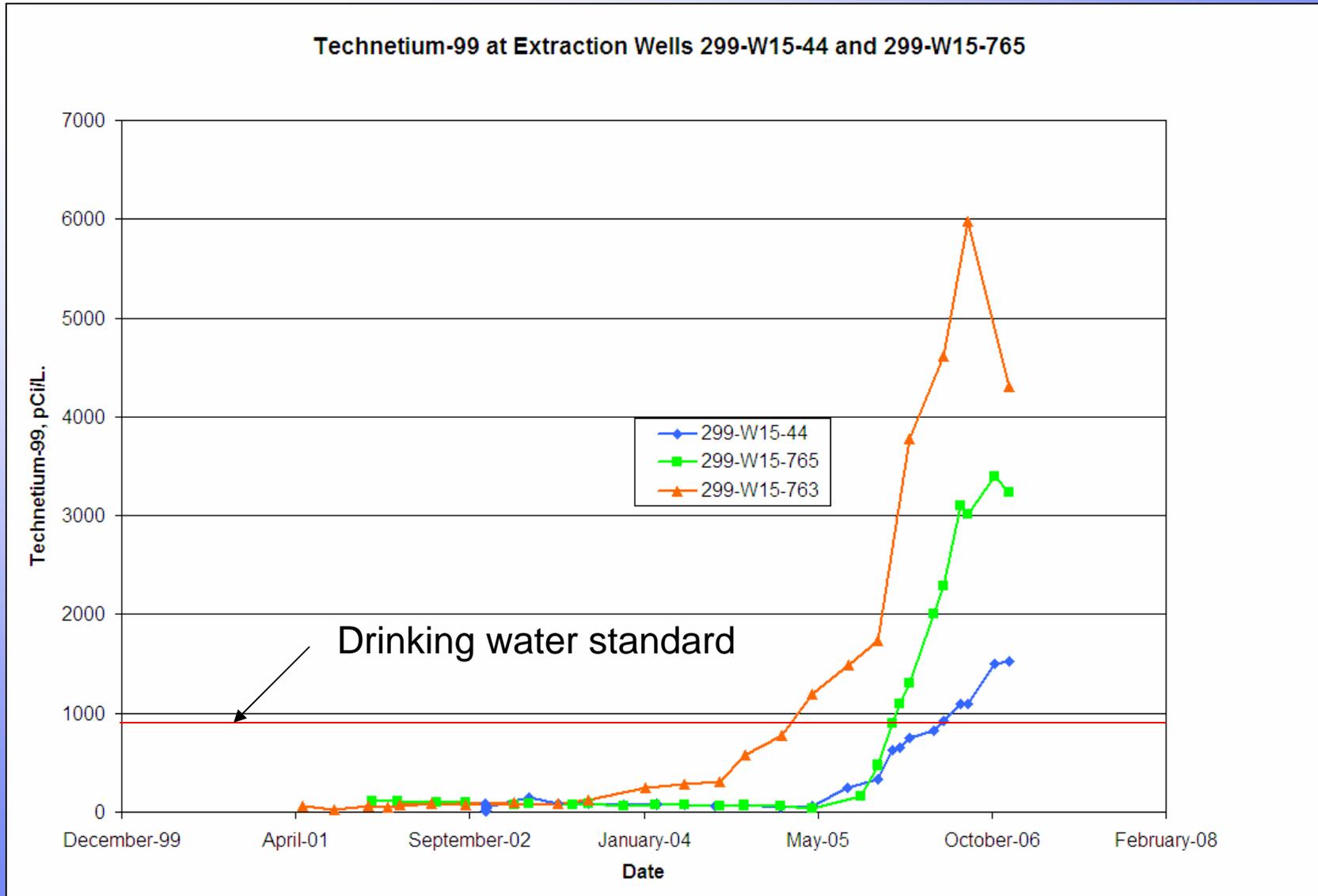
*From DOE-RL, 2006, *Fiscal Year 2005 Annual Summary Report for 200-UP-1 and 200-ZP-1 Pump-and-Treat Operations*, DOE/RL-2005-91, Rev. 0.

Increasing Tc-99 Concentrations

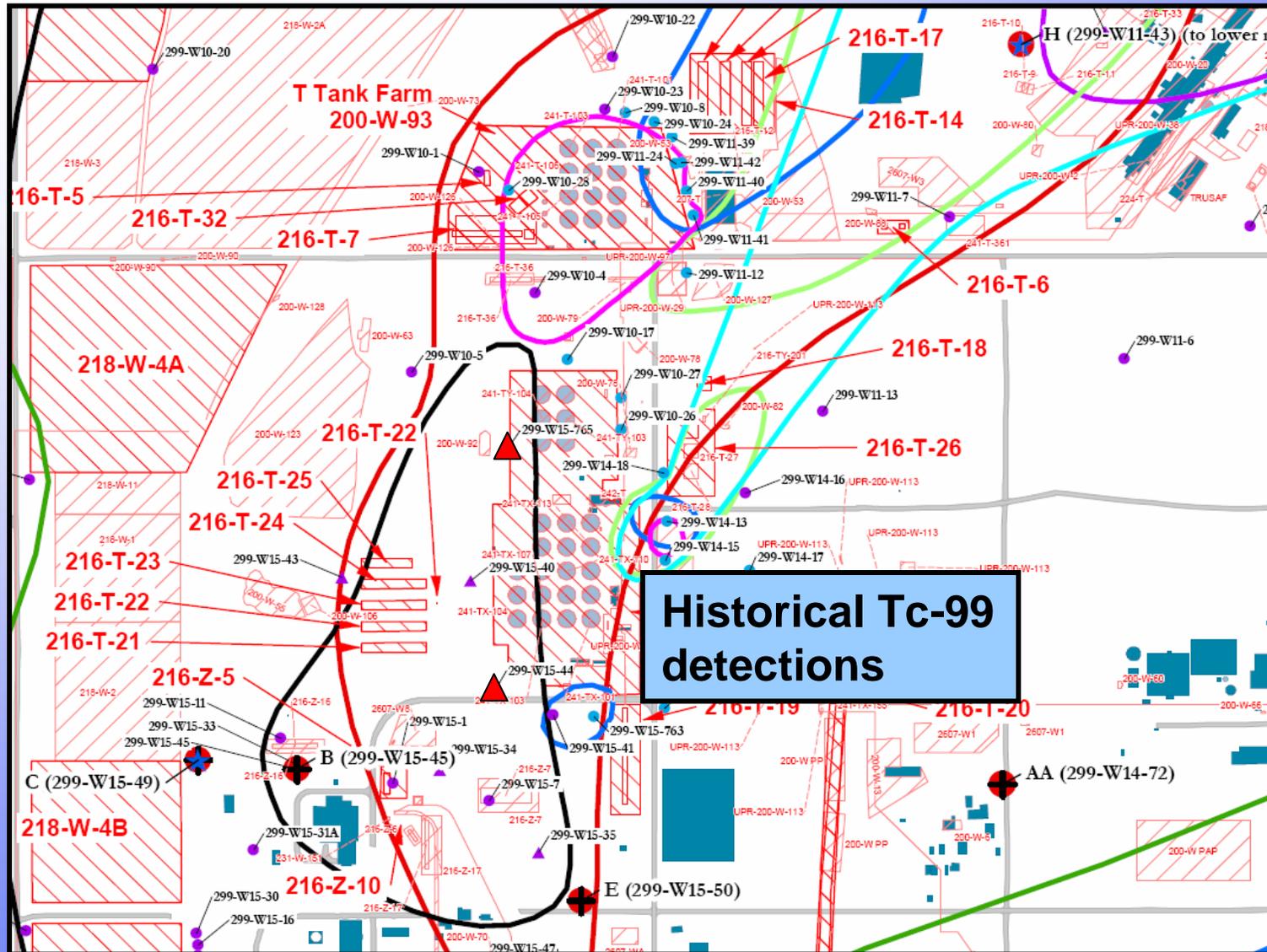
Tc-99 concentration in combined flow ~40% of MCL (900 pCi/L)



Increasing Tc-99 Concentrations



Historical Tc-99 Detections in Groundwater



Tc-99

- Man-made radioactive element:
 - Product of the fission process
- Half-life = 214,000 years
- $K_d = 0.0 \text{ mL/g}$
- In oxygenated groundwater, Tc-99 is in the compound pertechnetate (TcO_4^-):
 - Does not readily sorb onto sediments that are low in organic content
 - Is highly soluble and mobile in aqueous environments

Reasons to Remove Tc-99 from 200-ZP-1 Groundwater

- Current treatment system does not remove Tc-99; only removes volatile organics
- Composited concentrations of Tc-99 from all 10 extraction wells currently exceed 40% of drinking water MCL
 - Treated water cannot be reinjected if 900 pCi/L drinking water MCL is exceeded
- It can plate out on the inside metal surfaces of treatment system, causing safety hazards
- It has a long half-life (214,000 years)
- It is highly mobile in aqueous environments

Tc-99 Remediation

- Ion-exchange technology:
 - Resin (Purolite® A-530E) developed by ORNL and UT
 - Selective for Tc-99
 - Efficient at removing Tc-99 in field studies

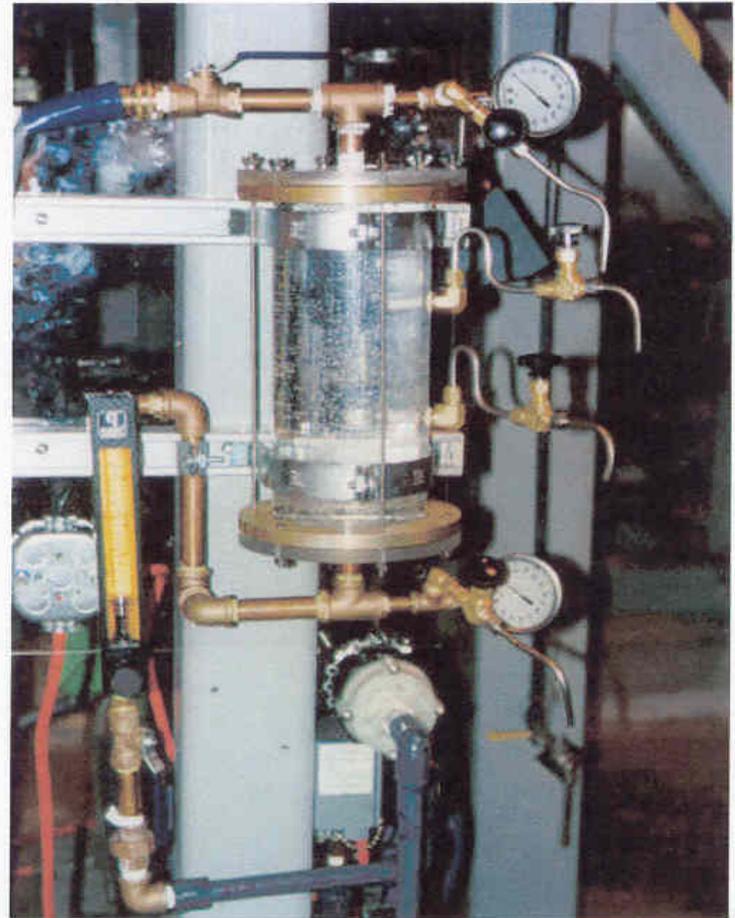
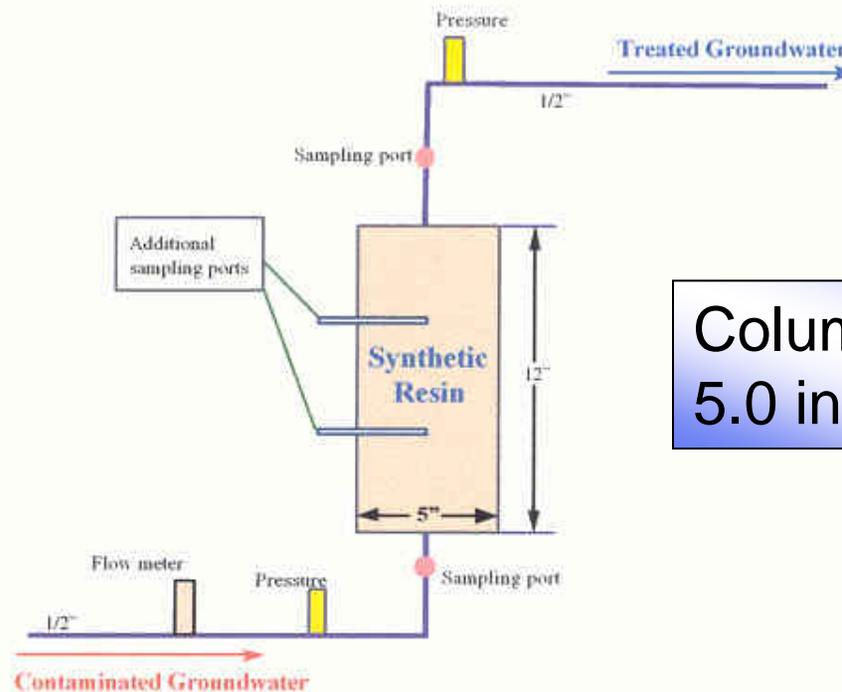


Photo courtesy ORNL

ORNL Test – Purolite[®] A-530E Resin

Field Demonstration for TcO_4^- Treatment
Paducah Gaseous Diffusion Plant site, Kentucky (FY 99).



Column size:
5.0 in. x 12.0 in.

Figure 1. Column Setup.

Diagram courtesy ORNL

Ion-Exchange Resin



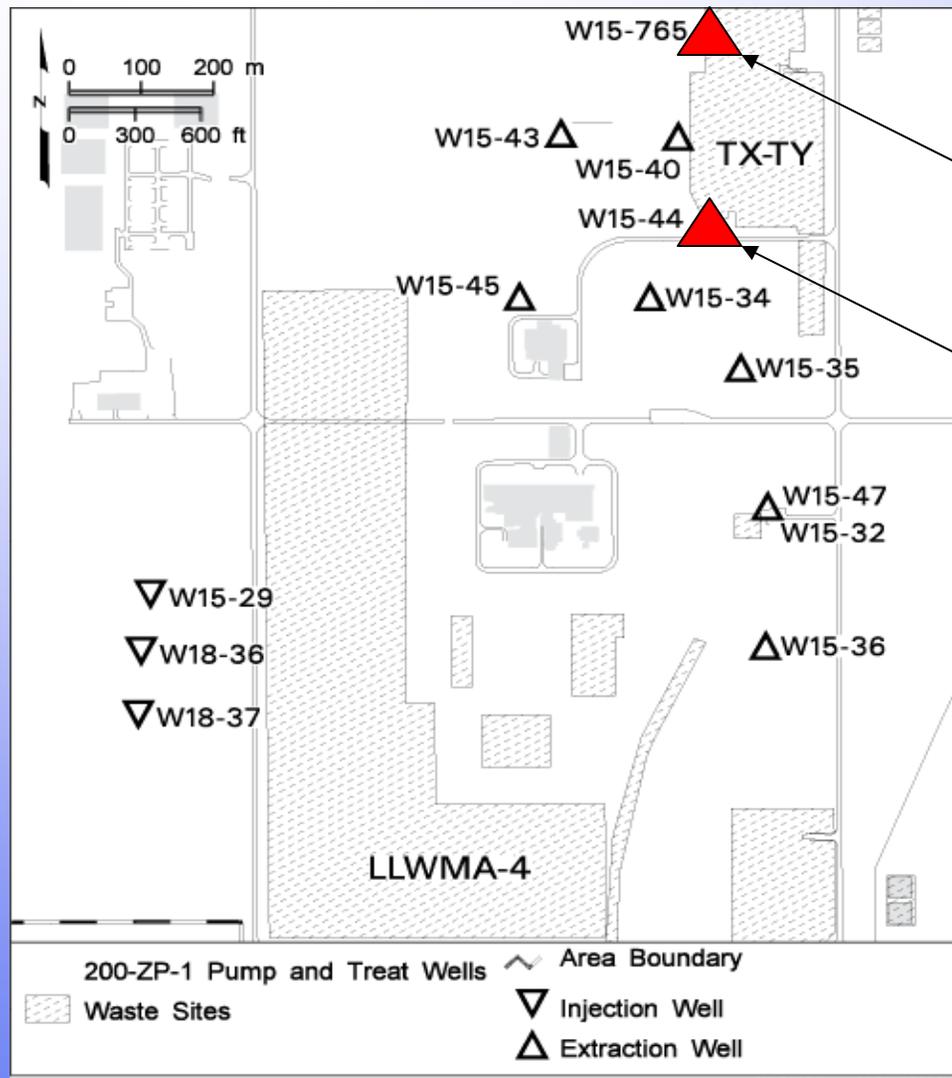
- Sphere-like beads that adsorb ions of opposite charge
- Fabricated from an organic polymer substrate

How Efficient is the Purolite® A-530E Resin?

Paducah treatability test for pertechnetate removal:

- Treated 840,000 gal in 8 months
- Activity of treated water ~7,000 pCi/L
- Flow rate of 2.5 gpm
- Residence time of ~27 seconds
- Breakthrough occurred at ~6 months
- Removal to below MCL

Proposed *Ex Situ* Purolite® A-530E Resin Treatability Test



Extraction wells
299-W15-765
and 299-W15-44
chosen for
treatability testing

Purolite[®] A-530E Resin Treatment Skid, Well 299-W15-44



Purolite[®] A-530E Resin Treatment Skid, Well 299-W15-765



200-ZP-1 OU Purolite® Resin Treatability Test

- Small column:
 - Sized to achieve resin breakthrough in ~2 months
 - Tc-99 at 1,500 pCi/L
- Large column:
 - Sized to achieve resin breakthrough in ~4 months
 - Tc-99 at 3,400 pCi/L

Primary Objectives of Treatability Test

- Is the resin efficient at removing TcO_4^- from groundwater?
 - What is the capacity of the resin?
 - What is the activity of Tc-99/resin cm^3 ?
- What is the breakthrough time?
 - How many bed volumes of water pass through before breakthrough?
 - Breakthrough occurs when the effluent is ~50% of the influent
- Verify selectivity for technetium over other contaminants
- Do competing anions reduce resin efficiency for technetium uptake?
- Determine operational parameters that will allow for full-scale design

Questions?

- Acknowledgements:
 - Dr. Scott Petersen – FH
 - Jason Modrell – MSE
 - Jim Jewett – EQM
 - Mitzi Miller – EQM
 - FH
 - Landau and Associates
 - MSE
 - EQM