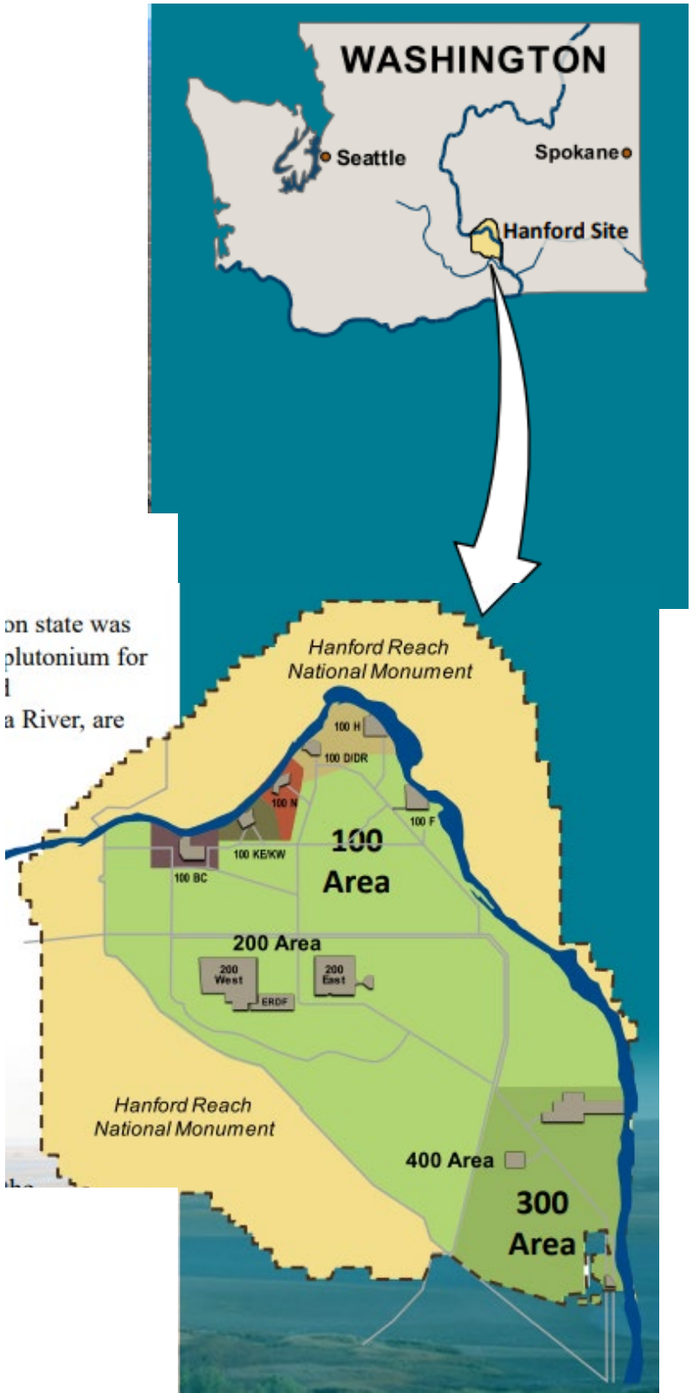
A Short History of Hanford Cleanup

Richard Raymond, Senior Consultant



1943 - 1945

The world's first full-scale plutonium production reactor

Workers completed design and construction of the world's first plutonium producing reactor (B Reactor) in 11 months. The B Reactor produced plutonium used in the Trinity Test, as well as for the atomic bomb dropped on Nagasaki, Japan. At the direction of the Atomic Energy Commission, the B Reactor was shut down on Feb. 12, 1968.

1946 - 1991

Cold War

Post-World War II tensions between the U.S. and the U.S.S.R. brought about the "Cold War" and drove continued atomic weapons production and Hanford's plutonium production mission. Additional reactors constructed next to the Columbia River allowed the U.S. to develop and stockpile nuclear weapons.

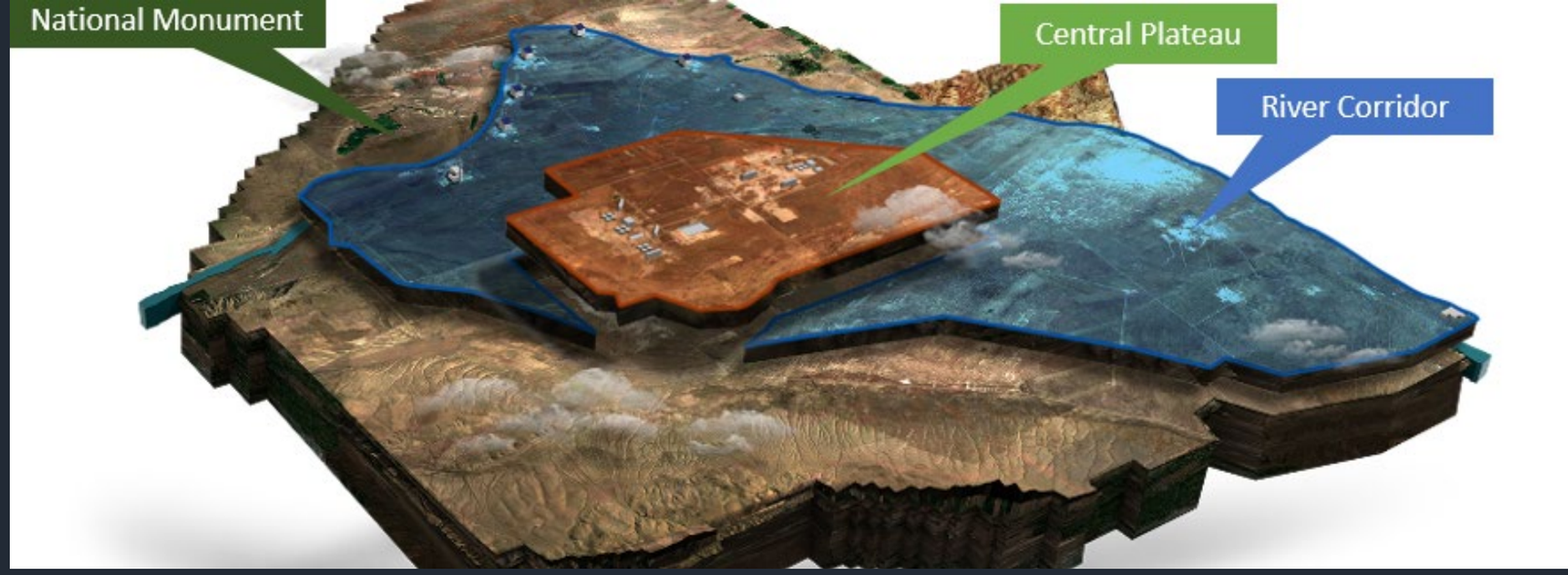
1944 - 1989

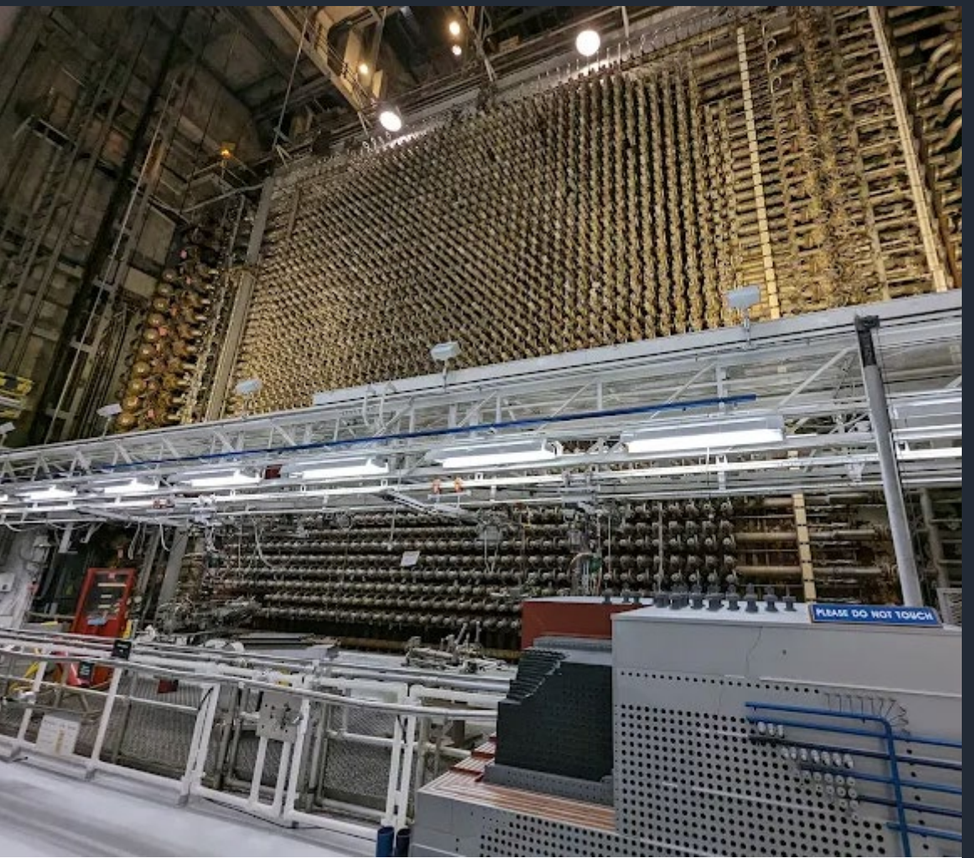
Producing Plutonium

Under careful supervision of noted scientists like Enrico Fermi, crews began the process of building production reactors at Hanford. Workers also built two massive processing facilities called "canyons," to extract plutonium from uranium "fuel rods" after removal from the reactors.

Hanford History 1943 to 1989

Production of Plutonium for Weapons





- First full-scale power reactor in the word: B Reactor 1944-1968; now part of the Manhattan Project National Historical Park
- Total of 9 production reactors including the dual-purpose N-Reactor
- Four Plutonium processing facilities, including Purex which is the process used throughout the world
- The Hanford Site produced approximately 67.4 metric tons of plutonium. This represents roughly two-thirds of the total U.S. plutonium stockpile.
- Waste from processing has resulted in 212 million liters (56 million gallons) of highly radioactive and chemically hazardous waste stored in 149 single shell and 28 double shell underground storage tanks.

Production

Resulted in hazardous solid and liquid waste

Construction of large underground waste tanks.

Cleanup

Includes waste sites, facilities, groundwater, and underground tank waste

Demolition of the main Plutonium Production Facility.

Hanford Federal Facility Agreement and Consent Order

Tri-Party Agreement

Marked the Official Start of the Cleanup Mission (over 26 years ago)

- Formal agreement between US Department of Energy, Environmental Protection Agency, and Washington State Department of Ecology (signed May 1989)
- Legally enforceable foundation governing Hanford cleanup
- **Legal Agreement**: roles, responsibilities and authorities of the three agencies
- **Action Plan**: methods for implementing cleanup actions, enforcing milestones
- **Community Relations Plan**: stakeholder involvement/input to cleanup

Cleanup Overview

Solid Waste

- Solid waste can be everything from broken reactor equipment and tools to contaminated. The solid wastes were buried in the ground in pits or trenches.

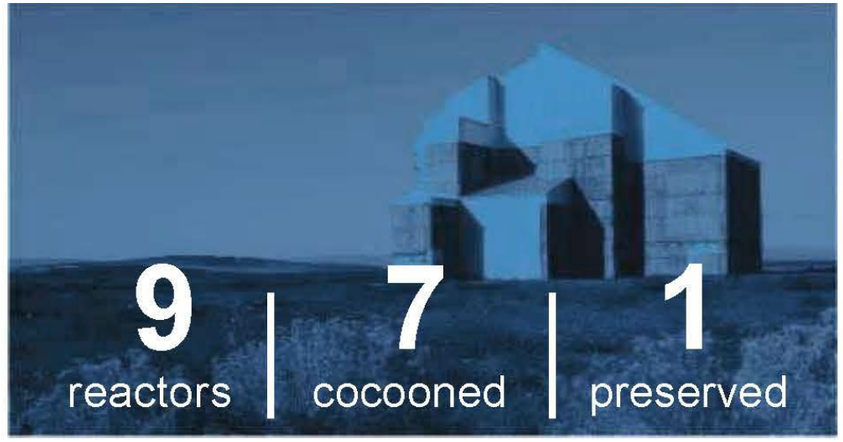
Liquid Waste

- Billions of gallons of liquid wastes were also generated during the plutonium production days. These liquid wastes were disposed of by pouring them onto the ground or into trenches or holding ponds. Liquid and semi-solid wastes from the chemical separations were put into 177 underground waste-storage tanks at Hanford, arranged in areas called tank farms.

- Much of the waste currently stored in underground tanks will ultimately be transformed into a stable, glass-like product in a process called vitrification at the Waste Treatment and Immobilization Plant. The molten, glass-like material will be poured into steel cylinders. Ultimately, cylinders containing the most hazardous vitrified waste will be taken to a national repository for permanent burial. The cylinders with less hazardous waste will be sent for disposal at Hanford's on-site Integrated Disposal Facility.

Facilities

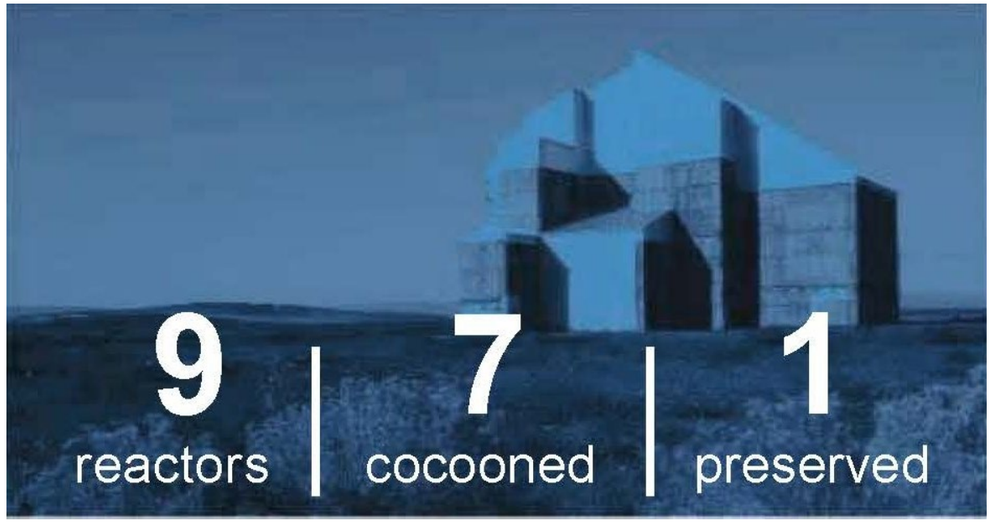
- Reactor buildings, support facilities and auxiliary structures must also be cleaned up.



HANFORD CLEANUP by the NUMBERS #s

Sept. 12, 2025

Status of Reactor Decommissioning at Hanford



- Between 1943 and 1963, **Nine** plutonium-production reactors were constructed along the Columbia River
- **Seven** reactors have been placed in Interim Safe Storage (ISS or “cocooning”) condition
- The **105 K West Reactor** is currently undergoing decommissioning and is also going to be placed into ISS.
- The remaining reactor, the **105-B Reactor** — the world’s first, full-scale nuclear reactor — has been designated a National Historic Landmark, part of the National Park system, and will be preserved.

K East Reactor in 2020.

K East Reactor in October 2022, after Interim Safe Storage.

N Reactor in 2005.

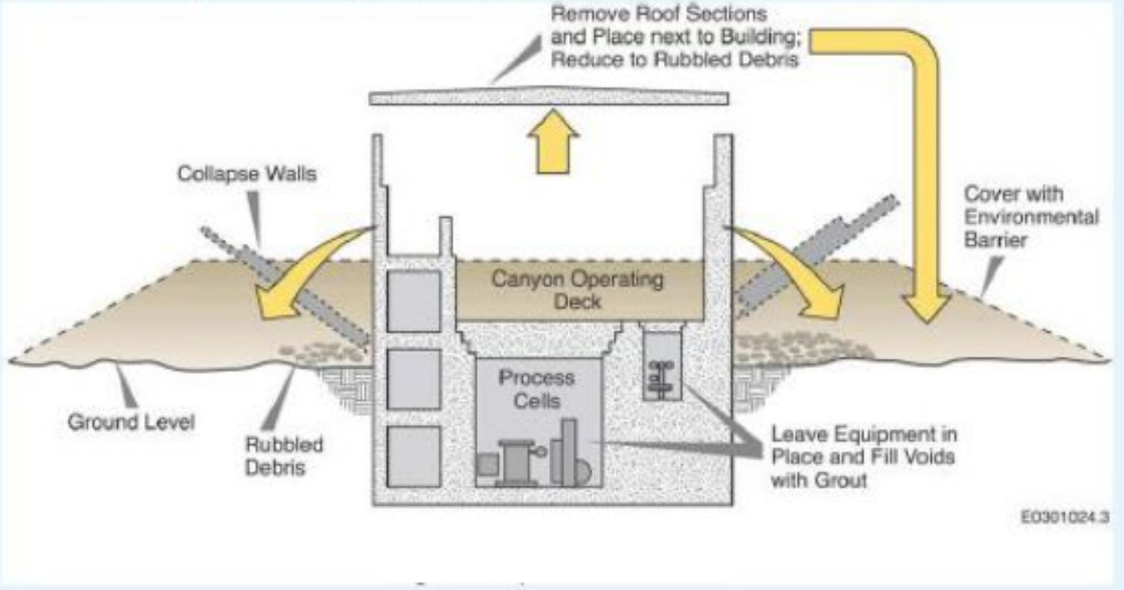
N Reactor in 2015, after Interim Safe Storage.

Nuclear Facility D&D Options

Cocoon or In-Situ Disposition (ISD)

Partial D&D Hanford "C" Reactor Cocoon

Partial D&D Hanford "U" Canyon In-Situ Disposition (ISD) Option



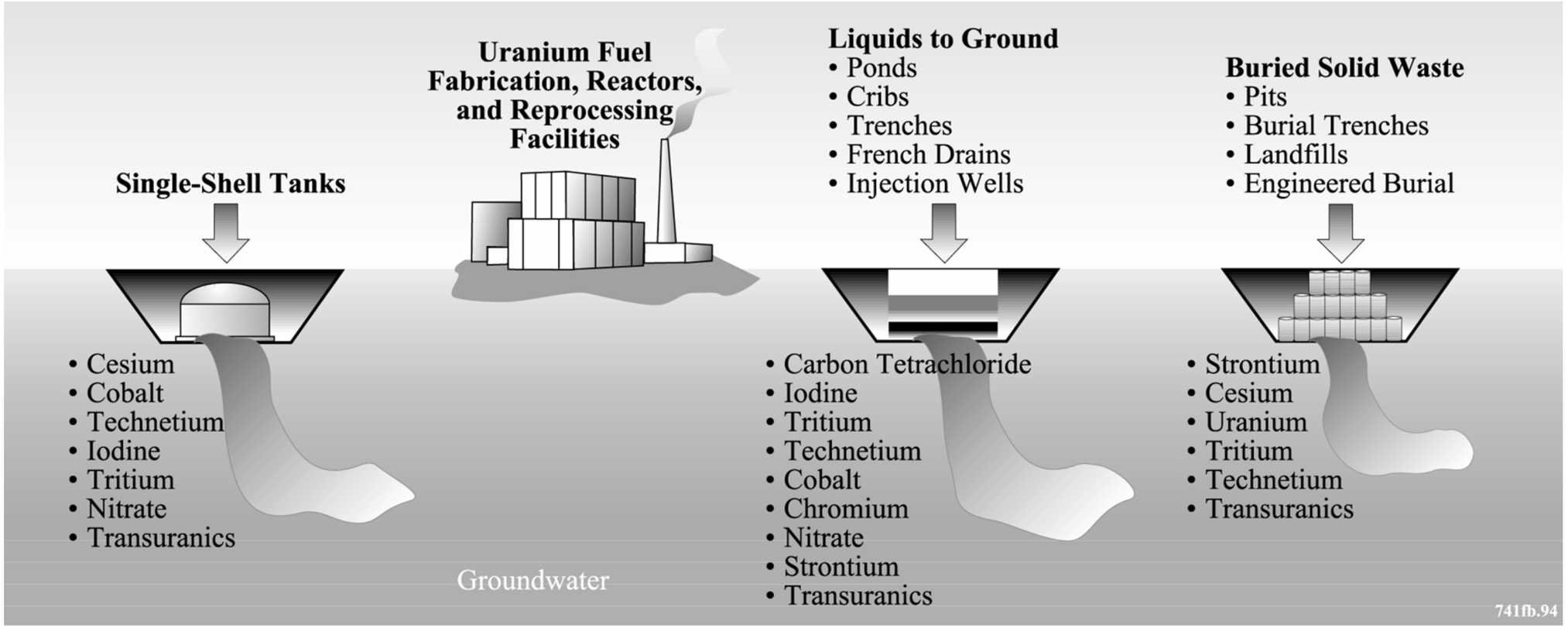
- **EIS for 8 large surplus production reactors**
  - Graphite-moderated design
- **Record of Decision**
  - Interim safe storage for up to 75 years
  - Reduce footprint to biological shield

Hanford Groundwater Contamination and Treatment Strategies: Pump and Treat (P&T)

This will be the topic of our next session:

A case study on Hanford 200 West P&T remedy

Examples of Disposal Methods and Origin of Contaminants in Soil and Groundwater

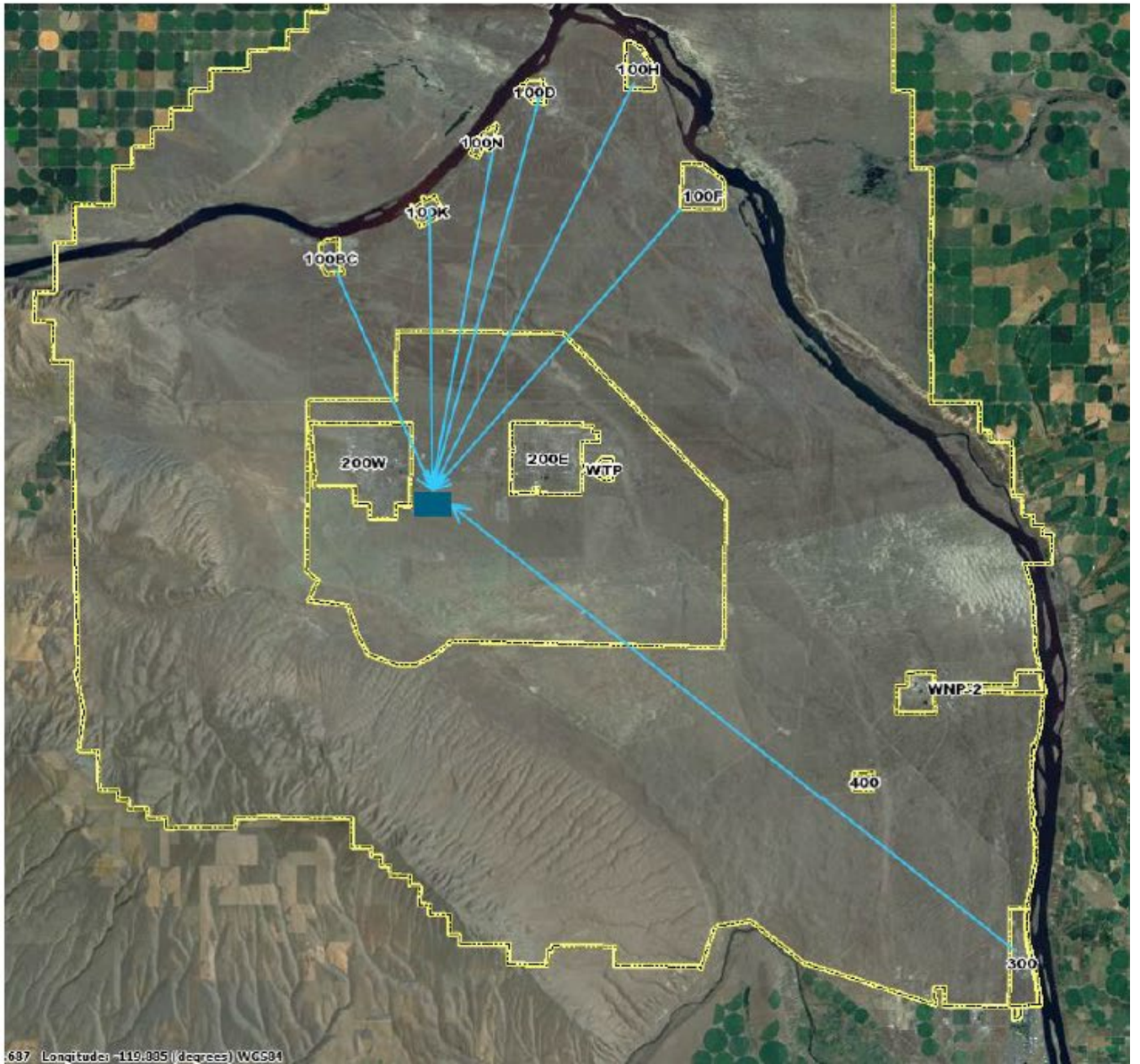


- Groundwater contamination resulted from a combination of intentional and unintentional releases (e.g., single-shell tank leaks)
- Early disposal practices sought to use the thick unsaturated zone above the groundwater table to capture contaminants
- Early assumptions about subsurface contaminant migration turned out to be false

Hanford Solid Waste Cleanup

Dedicated Disposal Facility Enables Hanford Cleanup and Visible Progress

- Future Site Uses Work Group (1992): "Use the Central Plateau Wisely for Waste Management" – Broad public consensus recognized the necessity for a dedicated waste disposal facility.
- ERDF built in 1995 supported a "bias for action" and allowed real, visible progress to occur.
- Today, ERDF holds more nearly 9 million m^3 of contaminated material and occupies 44 Ha.



E1101016_Cells.jpg

Environmental Restoration Disposal Facility

- At 1,000 ft by 500 ft by 70 ft deep, the super cells are twice the size of the earlier cells.
- Three million cubic yards of soil were excavated for super cells 9 and 10.
- Each cell is constructed with a bottom liner consisting of multiple layers of plastic, other impermeable materials, and a system to collect and remove liquids as they drain through the waste materials.
- A permanent cap will be placed on the facility after it is closed to prevent any water, plant, or animal intrusions.

ERDF Operations

- On average, 100 containers per day (peak 850/d) —each weighing 20 tons (~10 cubic meters) —arrive at the site for disposal.
- Containers have a disposability liner and reusable cover.
- Demolition debris and soils are mixed and compacted to ensure integrity of final cap.
- Areas are set up for containerized waste, large items, and items needing to be macro-encapsulated in the cell.

Expansion of ERDF in progress

Workers are in the progress of construction on a new disposal cell at the Environmental Restoration Disposal Facility (ERDF). The construction of the 11th cell – called a “super cell” because it is twice the size of the facility’s original cells – will add about 2.8 million cubic yards of disposal capacity to support ongoing Hanford cleanup projects through calendar year 2040

Tank Waste Remediation

From 1944 to 1989, Hanford generated radioactive and chemical byproducts of processing. To store this waste the site built thick, reinforced concrete tanks lined inside with carbon steel and buried under several feet of soil. The tanks held up to a million gallons each, and when production stopped at the end of the Cold War, 56 million gallons (212 million liters) of waste was in 177 of the large tanks.

Photos from inside tank AX-101 before and after retrieval.

By June 2024, workers had removed about 346,000 gallons of radiological and chemical waste from AX-101, completing retrieval of the Hanford Site's second tank farm, or group of underground storage tanks.

The tank is now empty of radiological and chemical waste. This reduces the hazard to the workers, the community and the environment.

Hanford, College Students Collaborate on Tank Waste Measuring Device

Workers recently used a new tool developed by Washington State University students and Hanford engineers that uses radar to measure the depth of waste in underground tanks at the Hanford Site.

Progress and Future Plans

Crews at the Hanford Site’s Waste Treatment and Immobilization Plant (WTP) recently brought the second of two 300-ton melters up to the operating temperature of 2,100 degrees Fahrenheit AND have recently received Low-Activity Waste from Tank Farms.

The achievement represents significant progress toward immobilizing millions of gallons of radioactive and chemical waste from large underground tanks.

Direct-Feed Low-Activity Waste Progress: Tank Waste Treatment

Two 300-ton melters will vitrify, or immobilize in glass, tank waste during treatment.

Direct-Feed Low-Activity Waste Progress: Tank Waste Treatment

This year (2025), Hanford started making chemically correct non-radioactive test glass.

Questions?