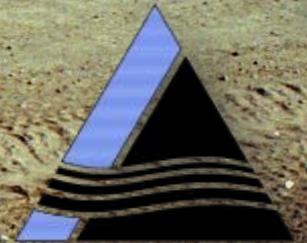


# An Introduction to Hanford's Radioactive Solid Waste Burial Grounds

Hanford Advisory Board  
Committee of the Whole  
*October 5, 2010*



*Tri-Party Agreement*

U.S. Department of Energy  
Washington State Department of Ecology  
U.S. Environmental Protection Agency



**1955**



**2004**



**1961**

*Disposal Practices  
over the Years*

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# SESSION 1: INTRODUCTION

# Tri-Party Agency Opening Comments

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- Matt McCormick, Department of Energy, Richland Operation Office Manager
- Jane Hedges, Washington State Department of Ecology, Nuclear Waste Program Manager
- Dennis Faulk, Environmental Protection Agency, Hanford Project Office Manager



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over the Years*



2004



1961

*Matt McCormick,  
DOE-RL*

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# SETTING CONTEXT FOR SW-2 OPERABLE UNIT IN THE OVERALL HANFORD CLEANUP APPROACH

# Hanford Site Cleanup Completion Framework

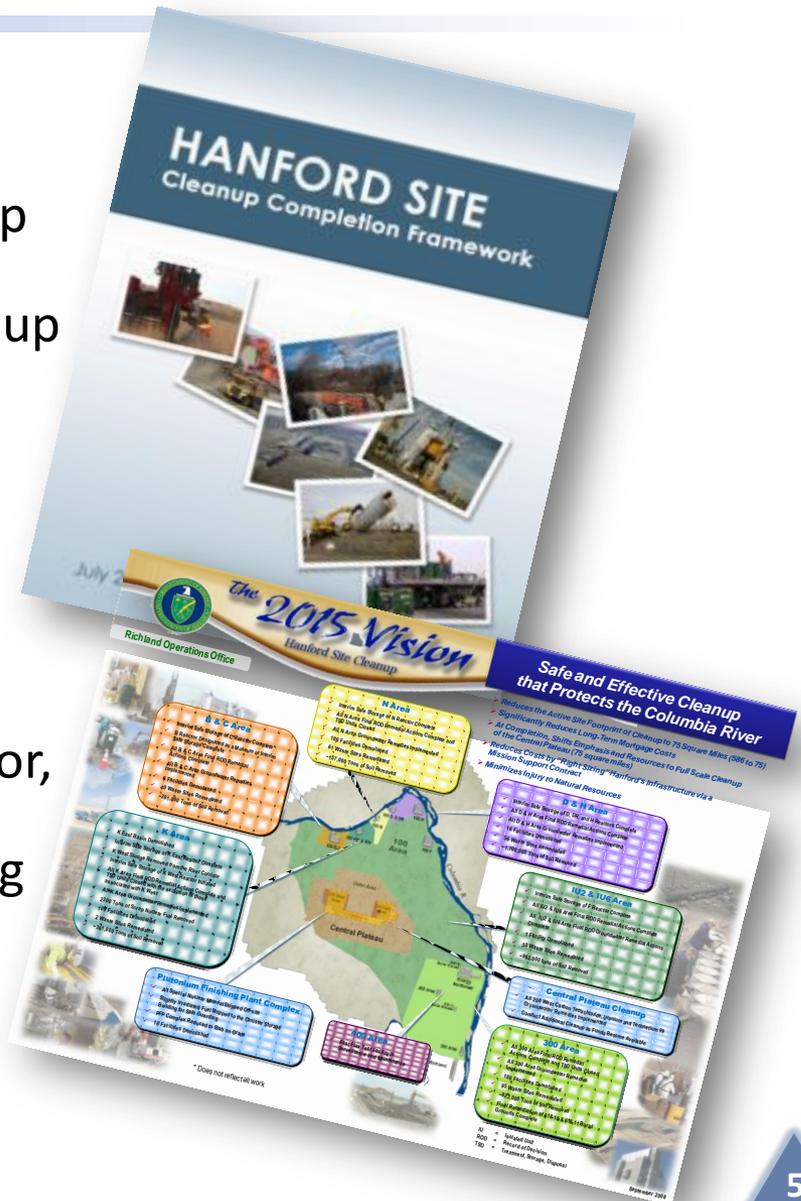
NEW

## Comprehensive Information Resource on Hanford Site Cleanup

- Provides overview of Hanford cleanup strategy
- Strives to make complexities of cleanup more understandable
- Gives context for how individual activities support cleanup completion

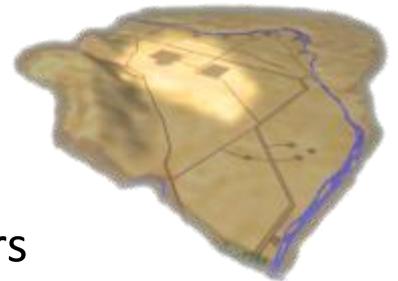
## Content

- Overarching goals for cleanup
- Relationships between three main components of cleanup: River Corridor, Central Plateau and Tank Waste
- Stages of cleanup completion building upon 2015 Vision, Central Plateau Strategy, new tank waste completion milestones
- Cleanup challenges



# Key Cleanup Challenges

- River Corridor
  - K Basin Sludge
  - Final Disposition of Surplus Production Reactors
  - Hexavalent Chromium at 100-D, 100-H and 100-K Areas
  - Strontium-90 Plume at 100-N Area
  - Uranium Plume at 300 Area
- Central Plateau
  - Number, Variety, Complexity of Cleanup Actions
  - Deep Vadose Zone Contamination
  - Long-Term Effectiveness of Engineered Surface Barriers
  - **Legacy Solid Waste Burial Grounds**
  - Tank Waste Retrieval and Treatment
  - Tank Area Closure



# Hanford Site Cleanup Completion Framework

## *Shrinking the Hanford Site Cleanup*

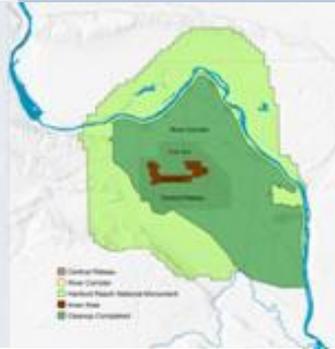
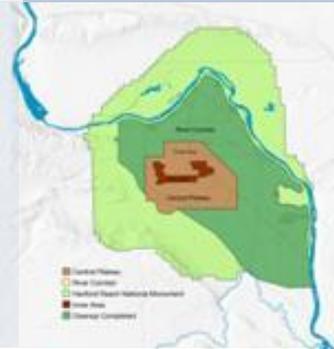
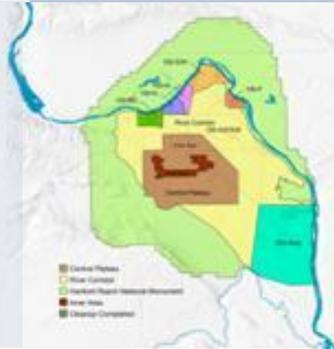
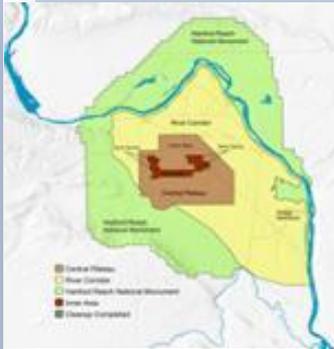
Hanford Lands  
586 sq. miles

River Corridor  
Cleanup  
Underway

Cleanup  
Footprint  
Reduced to  
75 sq. miles

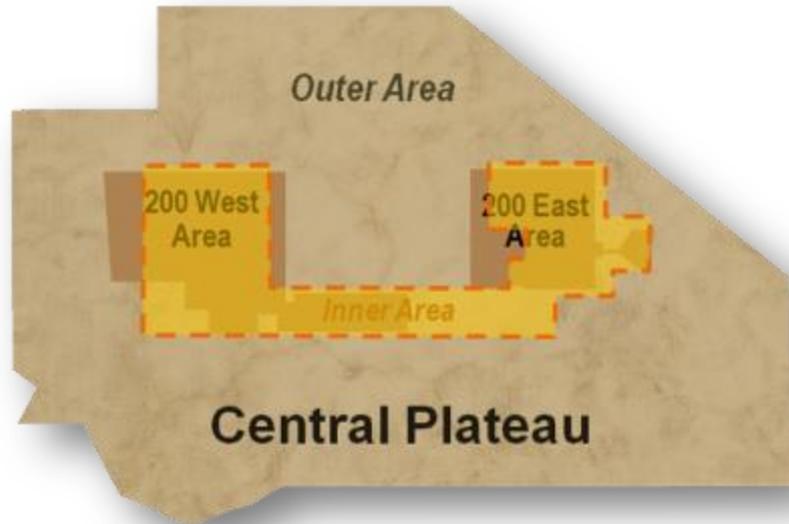
Cleanup  
Footprint  
Reduced to  
~ 10 sq. miles

Long Term  
Management  
Area less than  
10 sq. miles



**We are Here**

# Central Plateau Cleanup Approach



Minimize the area used for waste disposal and containment of residual contamination -- resulting in the smallest practical footprint

Central Plateau cleanup is focused in three areas:

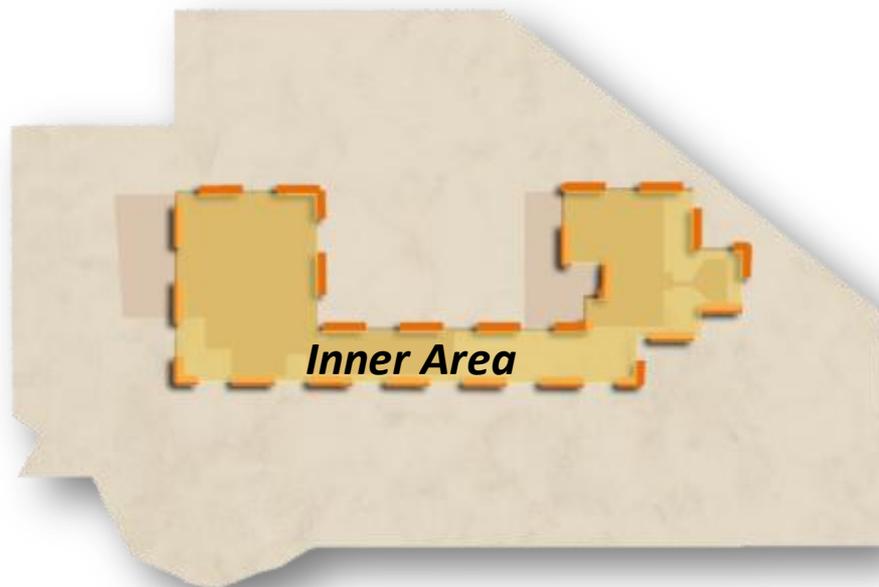
Inner Area

Outer Area

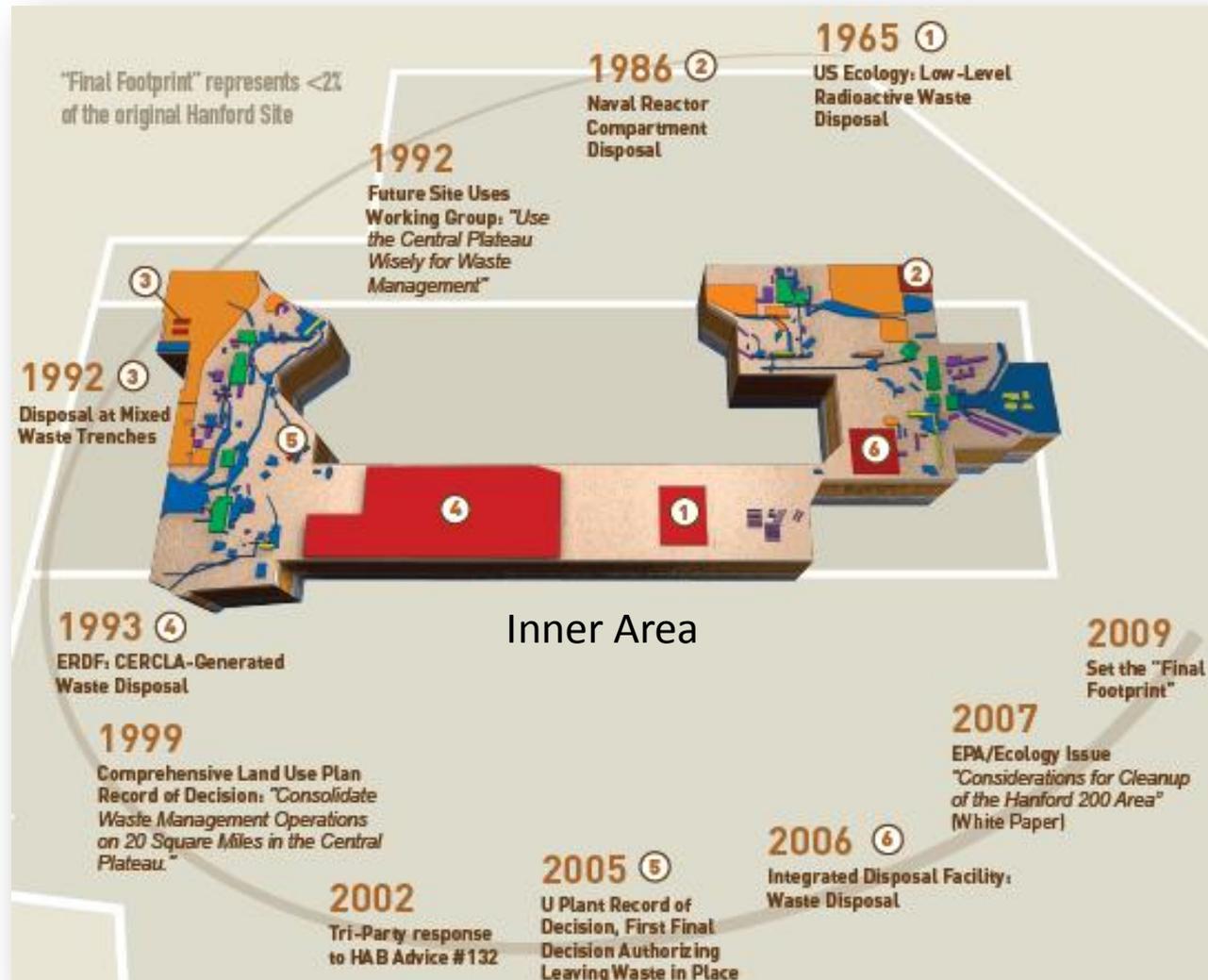
Groundwater

# Inner Area Approach

- Minimize the size of the final footprint to less than 10 square miles
- Ensure waste disposal and residual contamination is protective of human health and the environment
- Make comprehensive & consistent cleanup decisions
- Implement cleanup decisions using a geographical approach
- Monitor Inner Area to ensure cleanup remedies are protective

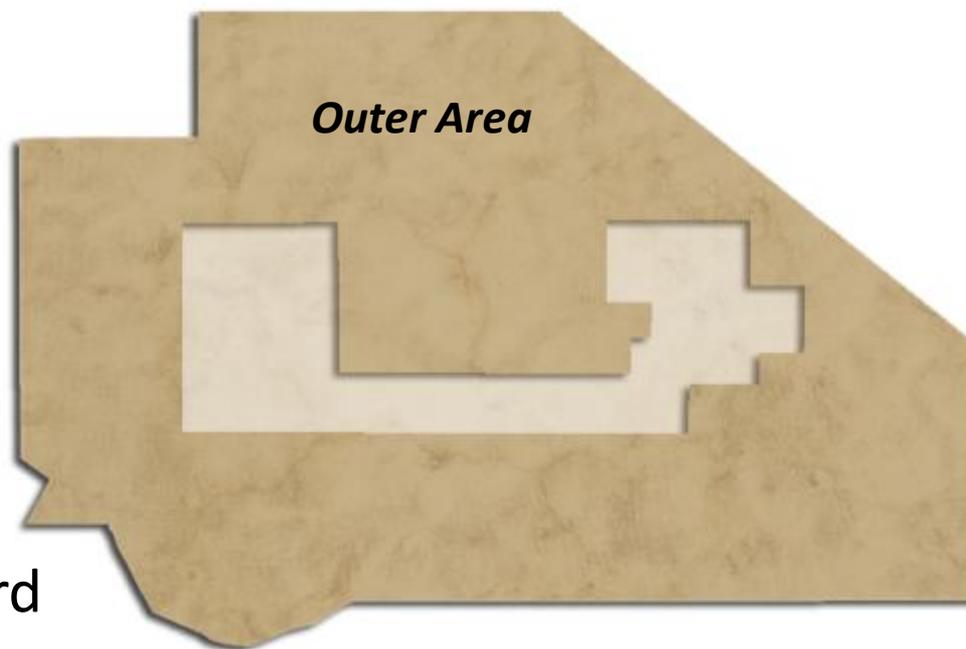


# Setting the Stage For the Final Footprint



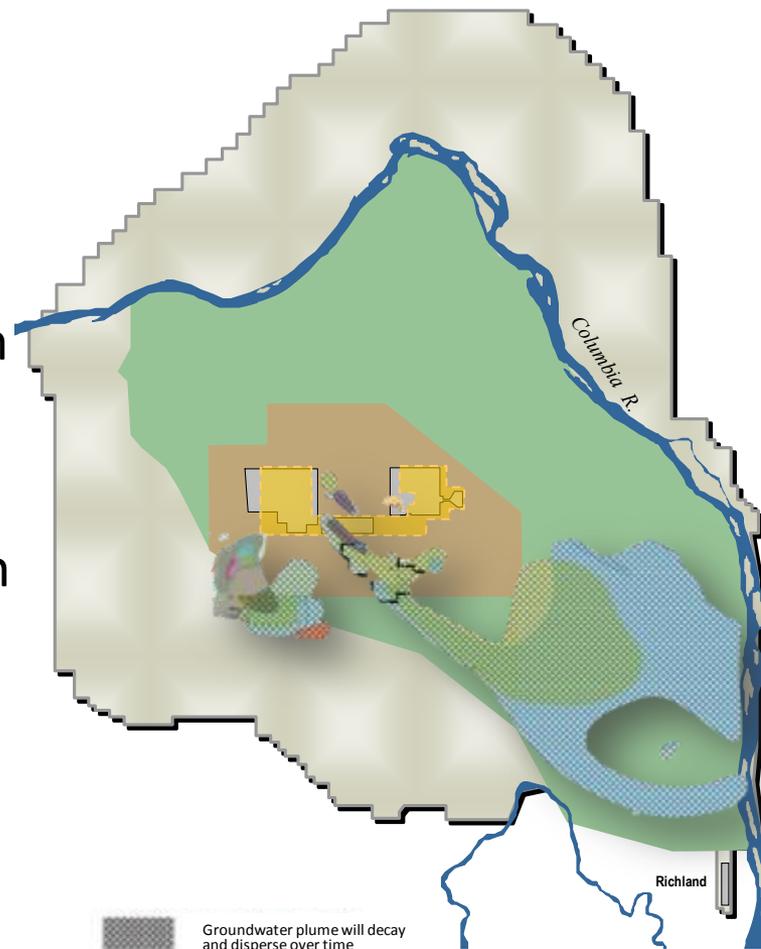
# Outer Area Approach

- Clean up waste sites comparable to the River Corridor with some exceptions
- Demolish and dispose excess facilities
- Make final cleanup decisions with one Record of Decision
- Start cleanup with interim CERCLA actions using ARRA funds



# Central Plateau Groundwater Approach

- Contain key contaminants (carbon tetrachloride, technetium-99, iodine-129, uranium) to the Central Plateau and remediate to meet drinking water standards
- Complete groundwater remediation on the Central Plateau using existing decision (200-ZP-1 Record of Decision) as a model
- Implement pump & treat systems in next few years to continue to remove and contain key contaminants
- Pursue multiple approaches to find effective long-term solutions for deep vadose zone challenges



# The Path Ahead for SW-2

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- We're early in the decision-making process
- Your input and feedback (both past and future) is greatly appreciated
- We are looking forward to continuing this discussion with you over the next several years as we arrive at a final decision



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*Disposal Practices  
over the Years*

*Jane A. Hedges  
Program Manager  
Ecology Nuclear Waste  
Program*

---

# REGULATORY HISTORY WORK PLAN REQUIRING INVESTIGATION OF HANFORD'S PAST-PRACTICE RADIOACTIVE SOLID WASTE BURIAL GROUNDS

# Tri-Party Agreement history of 200-SW-2 investigation work plan

- 1998 – new work plan milestones for 200 Area
- 2002 (June): 200-SW-2 operable unit work plan specifically identified in TPA milestone
- 2004 (Dec): DOE submits first draft work plan
- 2005 (Mar): DOE & Ecology agree to extensive re-vamp, re-submittal of work plan
- 2006 (Sep): revised TPA milestones – all 200 Area remedy proposals due 2011
- 2008 (Dec): 200-SW-2 work plan approved

# Investigation history (continued)

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- 2008 – 2010 DOE completes work plan Phase 1 “non-intrusive” investigations
- March 2010 Tri-Party Tentative Agreement
  - 200-SW-2 Phase 2 work plan due Dec. 2011
  - 200-SW-2 Proposed decision due Dec. 2016
- Today: public participation toward developing the work plan due Dec. 2011



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## SESSION 2: LANDFILL DESCRIPTIONS/ PHYSICAL SETTING

# Introduction to Session 2

---

- Overview of Hanford landfills
- Location of landfills
- Overview of waste disposal
- General description of the landfill categories
- Physical setting – design and configuration of landfills
- Overview of waste packaging



*Disposal Practices  
over the Years*

*Doug Hildebrand  
U.S. DOE - RL*

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## SESSION 3: PROCESS KNOWLEDGE

# Summary of Process Knowledge Documentation by Landfill

| Site                             | No. of Records | Waste Vol m <sup>3</sup> | Estimated Volume Covered by Records with Known Location | Estimated Volume Covered by Records with Known Waste Description |
|----------------------------------|----------------|--------------------------|---|--|
| <b>TSD Unit Landfills</b>        |                |                          |   |  |
| 218-E-10                         | 570            | 26,900                   | 5%  | 5%   |
| 218-E-12B                        | 21,570         | 65,086                   | 84%   | 60%  |
| 218-W-3A                         | 26,019         | 97,528                   | 100%  | 60%  |
| 218-W-3AE                        | 11,433         | 34,240                   | 100%  | 100%   |
| 218-W-4B                         | 4,545          | 7,213                    | 100%  | 60%  |
| 218-W-4C                         | 6,949          | 15,211                   | 100%  | 100%   |
| 218-W-5                          | 39,187         | 70,961                   | 100%  | 65%  |
| 218-W-6                          |                | no waste                 | N/A   | N/A  |
| <b>Industrial Landfills</b>      |                |                          |   |  |
| 218-E-2                          | 1              | 9,033                    | 0%  | 0%   |
| 218-E-2A                         |                | unknown                  | N/A   | N/A  |
| 218-E-5                          | 16             | 3,172                    | 0%  | 1%   |
| 218-E-5A                         | 8              | 6,173                    | 0%  | 0%   |
| 218-E-9                          |                | unknown                  | N/A   | N/A  |
| 218-W-1A                         | 114            | 13,700                   | 0%  | 2%   |
| 218-W-2A                         | 172            | 26,000                   | 1%  | 2%   |
| 218-W-11                         | 1              | 1,160                    | 0%  | 0%   |
| <b>Alpha Dry Waste Landfills</b> |                |                          |   |  |
| 218-W-1                          | 65             | 7,164                    | 0%  | 2%   |
| 218-W-2                          | 4              | 8,240                    | 0%  | 0%   |
| 218-W-3                          | 789            | 12,400                   | 16%   | 16%  |
| 218-W-4A                         | 4,914          | 16,886                   | 74%   | 74%  |
| <b>Dry Waste Landfills</b>       |                |                          |   |  |
| 218-E-1                          | 20             | 3,030                    | 0%  | 1%   |
| 218-E-12A                        | 62             | 15,400                   | 0%  | 1%   |
| <b>Construction Landfills</b>    |                |                          |   |  |
| 218-C-9                          | 723            | 7,573                    | 100%  | 100%   |
| 218-E-4                          | 1              | 1,586                    | 0%  | 0%   |
| 218-E-8                          | 4              | 2,265                    | 0%  | 0%   |

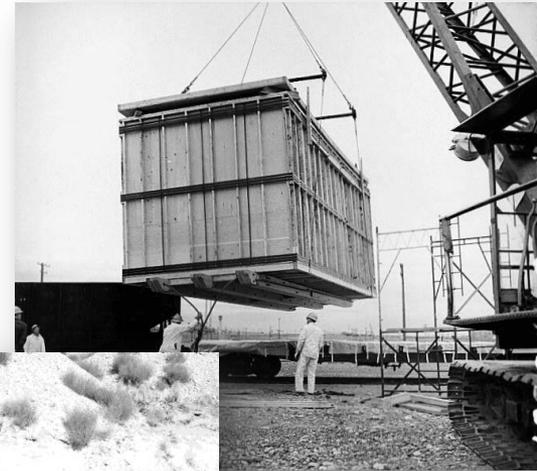
# Years of Operation

| Landfill                  | Years of Operation |                      |
|---------------------------|--------------------|----------------------|
|                           | Start              | End                  |
| <b>200-West Landfills</b> |                    |                      |
| 218-W-1                   | 1944               | 1952                 |
| 218-W-11                  | 1960               | 1960                 |
| 218-W-1A                  | 1945               | 1961                 |
| 218-W-2                   | 1953               | 1956                 |
| 218-W-2A                  | 1954               | 1985                 |
| 218-W-3                   | 1957               | 1961                 |
| 218-W-3A <sup>b</sup>     | 1970               | 1998                 |
| 218-W-3AE <sup>b</sup>    | 1981               | 2004                 |
| 218-W-4A                  | 1960               | 1968                 |
| 218-W-4B <sup>b</sup>     | 1967               | 1990                 |
| 218-W-4C <sup>b</sup>     | 1978               | 2005                 |
| 218-W-5                   | 1985               | Present <sup>f</sup> |
| 218-W-6 <sup>b</sup>      | Not Used           |                      |

| Landfill                  | Years of Operation |         |
|---------------------------|--------------------|---------|
|                           | Start              | End     |
| <b>200-East Landfills</b> |                    |         |
| 218-C-9                   | 1985               | 1989    |
| 218-E-1                   | 1945               | 1953    |
| 218-E-2                   | 1945               | 1953    |
| 218-E-2A                  | 1945               | 1950    |
| 218-E-4                   | 1955               | 1956    |
| 218-E-5                   | 1954               | 1956    |
| 218-E-5A                  | 1956               | 1961    |
| 218-E-8                   | 1958               | 1959    |
| 218-E-9                   | 1953               | 1958    |
| 218-E-10 <sup>b</sup>     | 1955               | 2000    |
| 218-E-12A                 | 1953               | 1967    |
| 218-E-12B <sup>b</sup>    | 1967               | Present |

# Waste Containers Disposed of in Landfills

- Design Considerations
- Design specification began in the mid-1960s
- Primary purpose of a fission waste container was to keep the waste in and let the heat out
- Designed for a long life to prevent release of radioactive material.
- Elements of design included:
  - Venting
  - Seals
  - Shielding
  - Shipment
  - Lifting devices
  - Labeling
- Discontinued use of cardboard boxes in 1984
- Interior void space was limited to 20% from 1985-1990, and 10% from 1990 to current time.

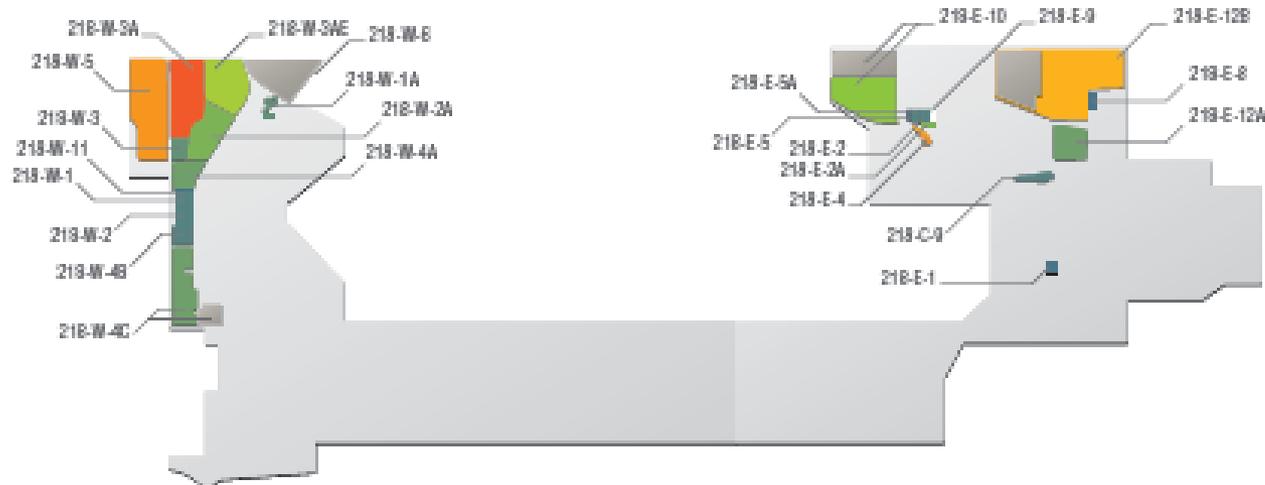


# Waste Containers Disposed of in Landfills

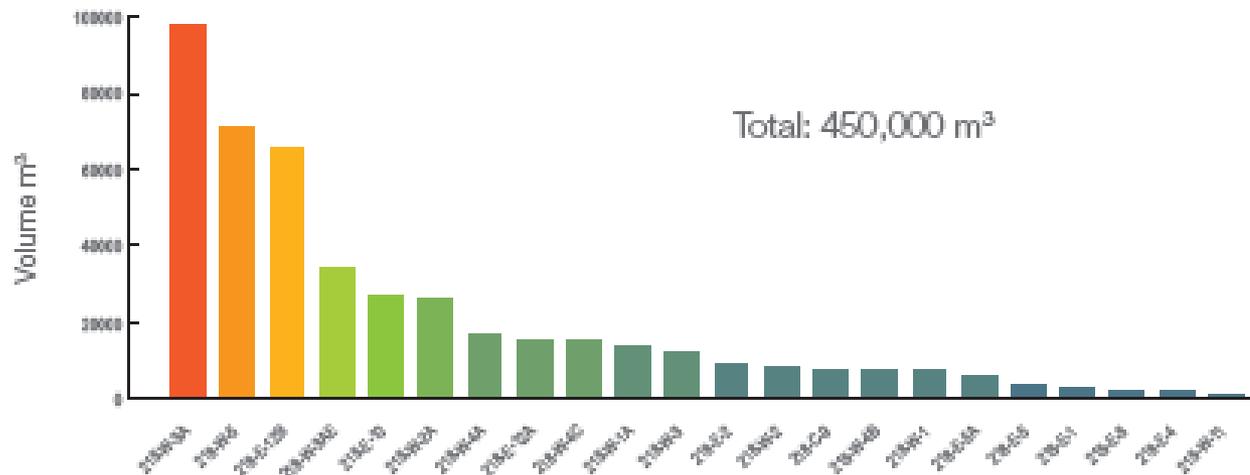
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- A wide range of disposal containers have been used:
  - Bags (Burlap, cloth, paper or plastic)
  - Boxes/cartons/cases (Concrete, wood, paper, metal, fiberboard/plastic)
  - Cylinders/casks (concrete metal)
  - Ion exchange columns
  - Drums/barrels/kegs

# Volume of Waste Buried By Landfill

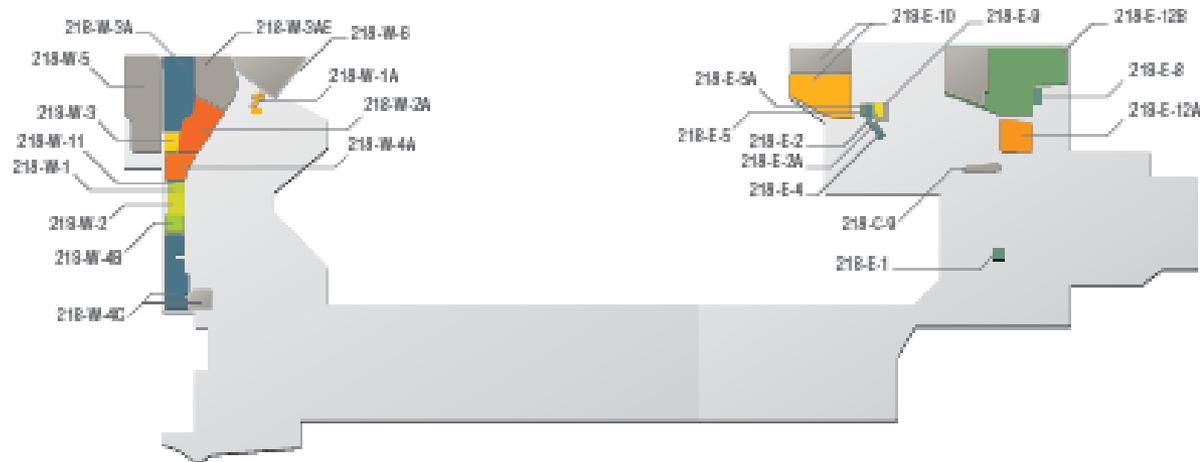


Distribution of Waste Volume in Landfills in Inner Area

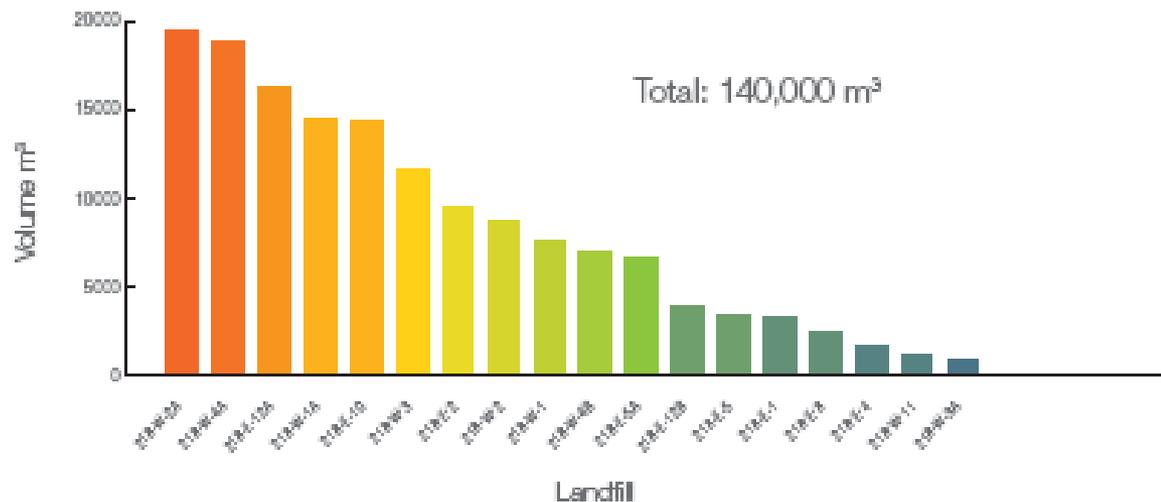


Total: 450,000 m<sup>3</sup>

# Volume of Waste Buried by Landfill Pre-1970



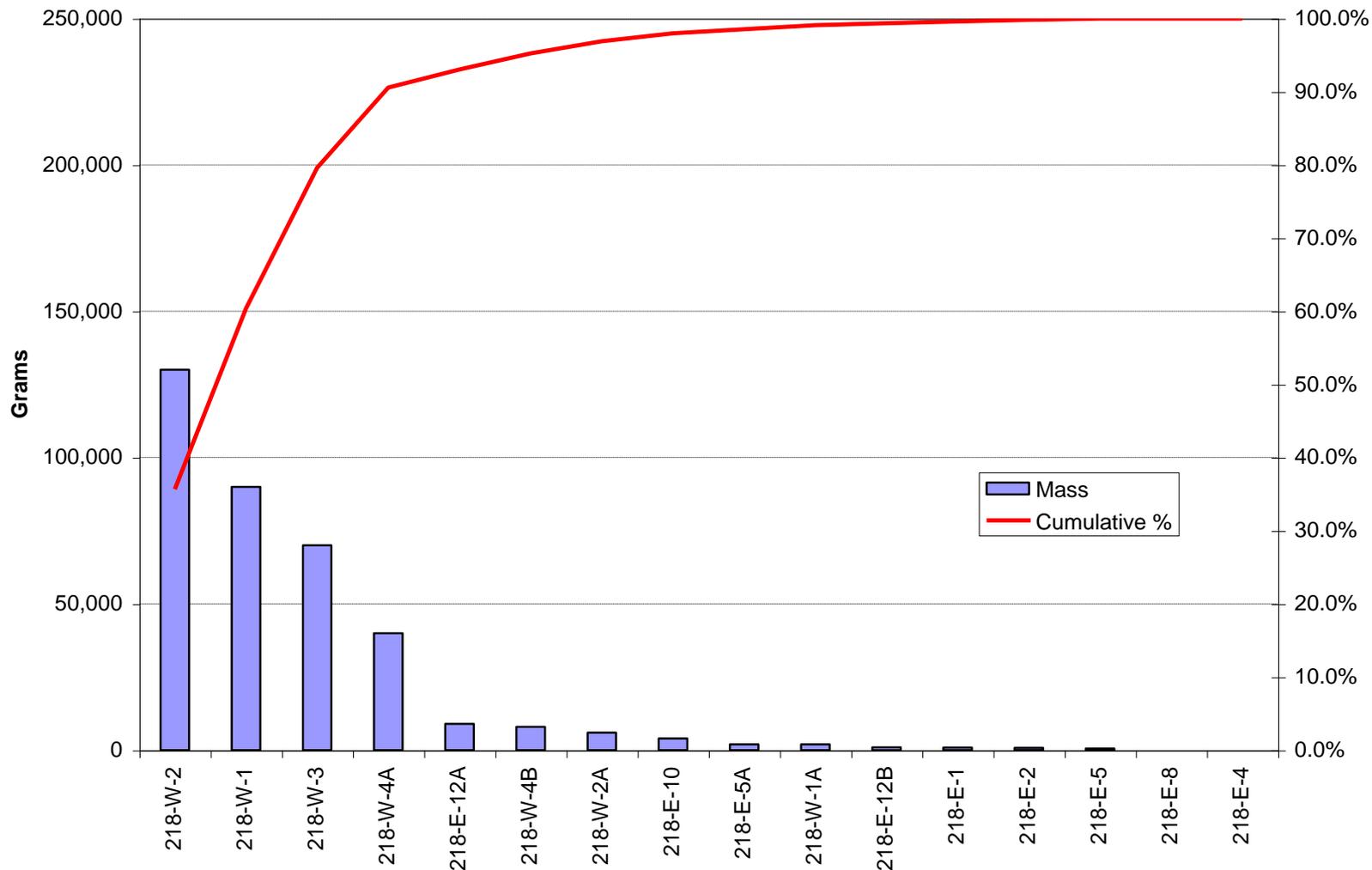
Distribution of Waste Volume in Landfills in Inner Area



# Plutonium Recovery in Pre-1970 Waste

- The economic recovery value of Plutonium (Pu) over the years was a principle DOE strategy. This reduced the volume of material actually disposed of.
- The 232-Z incinerator came on-line around 1960. Pu was recovered from the incinerated waste that ranged from a few grams to 250 g per box.
- Pending construction of the incinerator there were >150 boxes of Pu contaminated material in storage as of March 1959.
- Some boxes were “damp with organic” and acids, which caused disintegration of the boxes and created a storage/fire hazard. These boxes were sent for burial before the incinerator was constructed.

# Estimated Pu Mass in Pre-1970 Landfills



# Estimated Plutonium and Uranium Inventories, Pre-1970

| BURIAL GROUND | Plutonium, kgs | Uranium, kgs |
|---------------|----------------|--------------|
| 218-E-1       | 1              | 400          |
| 218-E-2       | 1              | 300          |
| 218-E-4       | 0              | 1            |
| 218-E-5       | 1              | 120          |
| 218-E-5A      | 1              | 120          |
| 218-E-8       | 0              | 2            |
| 218-E-10      | 4              | 800          |
| 218-E-12A     | 9              | 990          |
| 218-E-12B     | 1              | 7            |
| 218-W-1       | 94             | 700          |
| 218-W-1A      | 2              | 900          |
| 218-W-2       | 130            | 1,400        |
| 218-W-2A      | 6              | 2,000        |
| 218-W-3       | 68             | 70,000       |
| 218-W-3A      | 1              | 4,400        |
| 218-W-4A      | 35             | 400,000      |
| 218-W-4B      | 9              | 3,200        |
| Total         | 363            | 485,340      |



**1955**



**2004**



**1961**

*Disposal Practices  
over the Years*

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# SESSION 4: ENVIRONMENTAL MONITORING



1955



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*Disposal Practices  
over the Years*

*Doug Hildebrand  
U.S. DOE - RL*

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# SESSION 5: WASTE DETAILS

# Objective of Session 5

---

- Briefly discuss why we distinguish between Post-1970s waste and Pre-1970s waste.
- Provide a summary of what information has been collected on the Post-1970 and Pre-1970 landfills that are in 200-SW-2.
  - Considerable volume of knowledge has been collected on these landfills including documentation and records as well as field investigations.
- The current version of the 200-SW-2 Work Plan contains an extensive discussion of the current information.

# Overview of Landfills

| Landfill Category             | Landfill Name   | General Features   |
|-------------------------------|---|--|
| TSD- Unit Landfills (8)       | 218-E-10, 218-E-12B, 218-W-3A , 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, 218-W-6 | Included in DOEIRL-88-20, <i>Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds</i><br>Contain retrievably-stored TRU waste (M-091 Project)<br>Potential for small volumes of sorted, containerized liquids<br>Potential for areas of subsidence<br>High dose rates |
| Industrial Landfills (8)      | 218-E-2, 218-E-2A, 218-E-5, 218-E-5A, 218-E-9, 218-W-1A, 218-W-2A, 218-W-11     | Potential for subsidence<br>High internal void volume<br>Disposal of failed/obsolete equipment<br>High dose rates<br>Waste typically contained in large wooden or concrete boxes   |
| Dry Alpha Waste Landfills (4) | 218-W-1, 218-W-2, 218-W-3, 218-W-4A   | Contain ~90% of the pre-1970 alpha-contaminated low-level waste<br>Low potential for subsidence<br>Waste primarily packaged in fiberboard cartons/boxes/drums  |
| Dry Waste Landfills (2)       | 218-E-1, 218-E-12A  | Waste primarily packaged in fiberboard cartons/boxes/drums<br>Medium dose rate (up to 2,000 mR/h)<br>Low potential for subsidence<br>Primarily beta-gamma contaminated waste<br>Surface stabilized with fly ash  |
| Construction Landfills (3)    | 218-C-9, 218-E-4, 218-E-8   | Low-activity waste «100 mR/h)<br>Primarily construction/demolition debris and concrete rubble<br>Low potential for areas of subsidence   |
| Caissons (~19)                | 218-W-4A, 218-W-4B  |  |

# Years of Operation

| Landfill                  | Years of Operation |                      |
|---------------------------|--------------------|----------------------|
|                           | Start              | End                  |
| <b>200-West Landfills</b> |                    |                      |
| 218-W-1                   | 1944               | 1952                 |
| 218-W-11                  | 1960               | 1960                 |
| 218-W-1A                  | 1945               | 1961                 |
| 218-W-2                   | 1953               | 1956                 |
| 218-W-2A                  | 1954               | 1985                 |
| 218-W-3                   | 1957               | 1961                 |
| 218-W-3A <sup>b</sup>     | 1970               | 1998                 |
| 218-W-3AE <sup>b</sup>    | 1981               | 2004                 |
| 218-W-4A                  | 1960               | 1968                 |
| 218-W-4B <sup>b</sup>     | 1967               | 1990                 |
| 218-W-4C <sup>b</sup>     | 1978               | 2005                 |
| 218-W-5                   | 1985               | Present <sup>f</sup> |
| 218-W-6 <sup>b</sup>      | Not Used           |                      |

| Landfill                  | Years of Operation |         |
|---------------------------|--------------------|---------|
|                           | Start              | End     |
| <b>200-East Landfills</b> |                    |         |
| 218-C-9                   | 1985               | 1989    |
| 218-E-1                   | 1945               | 1953    |
| 218-E-2                   | 1945               | 1953    |
| 218-E-2A                  | 1945               | 1950    |
| 218-E-4                   | 1955               | 1956    |
| 218-E-5                   | 1954               | 1956    |
| 218-E-5A                  | 1956               | 1961    |
| 218-E-8                   | 1958               | 1959    |
| 218-E-9                   | 1953               | 1958    |
| 218-E-10 <sup>b</sup>     | 1955               | 2000    |
| 218-E-12A                 | 1953               | 1967    |
| 218-E-12B <sup>b</sup>    | 1967               | Present |

# Why Pre- and Post- 1970 Waste?

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- March 20, 1970 the U. S. Atomic Energy Commission (AEC) issued Immediate Action Directive regarding solid waste burial after April 30, 1970.
- Directive implemented recommendations on costing, segregation and irretrievability of waste.
- Directive calls for wastes with contamination of transuranic nuclides to be segregated, packaged and buried in a way that they can be retrieved.
- All waste before 1970 considered LLW.
- September 19, 1973 the AEC approved Radioactive Waste Management manual (Chapter 0511), defining how safe, long-term management of radioactive waste would be accomplished.
- The segregation, storage and retrieval of transuranic waste will not be part of the 200-SW-2 RI/FS remedy selection process. (M-091 Project)

# Lessons Learned on Post-1970 Landfill Excavation to Date

- Typically the more recent the material was placed, the more intact it is
- Cardboard containers: disintegrated
- Metal boxes: intact and in good shape
- Plywood containers: integrity is variable
- Plastic: intact and aids in handling
- Material ranged from small boxes to large 40-ton monoliths
- Initial assumption was to require a 10% over pack. Actual over pack applied has been 100%
- Contamination to date ranges from none to only within the immediate proximity of the container
- Early this year, a release required modification to monitoring
- Production has been less than anticipated due to weather (wind and rain) as well as excessive levels of radon

# Post-1970 Landfills

---

- Landfills in this category include the eight Treatment, Storage and Disposal Landfills
- They are included in the Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds
- Included are: 218-E-10; 218-E-12B; 218-W3A; 218-W-3AE; 218-W-4B; 218-W-4C; and 218-W5 (218-W-6 is included in this category but has not been used)

# Post-1970 TSD Unit Landfills

| Site      | No. of Records | Waste Vol m <sup>3</sup> | Estimated Volume Covered by Records with Known Locations | Estimated Volume Covered by Records with Known Waste Descriptions |
|-----------|----------------|--------------------------|--|---|
| 218-E-10  | 570            | 26,900                   | 5%   | 5%  |
| 218-E-12B | 21,570         | 65,086                   | 84%  | 60%   |
| 218-W-3A  | 26,019         | 97,528                   | 100%   | 60%   |
| 218-W-3AE | 11,433         | 34,240                   | 100%   | 100%  |
| 218-W-4B  | 4,545          | 7,213                    | 100%   | 60%   |
| 218-W-4C  | 6,949          | 15,211                   | 100%   | 100%  |
| 218-W-5   | 39,187         | 70,961                   | 100%   | 65%   |
| 218-W-6   |                | no waste                 | N/A  | N/A   |

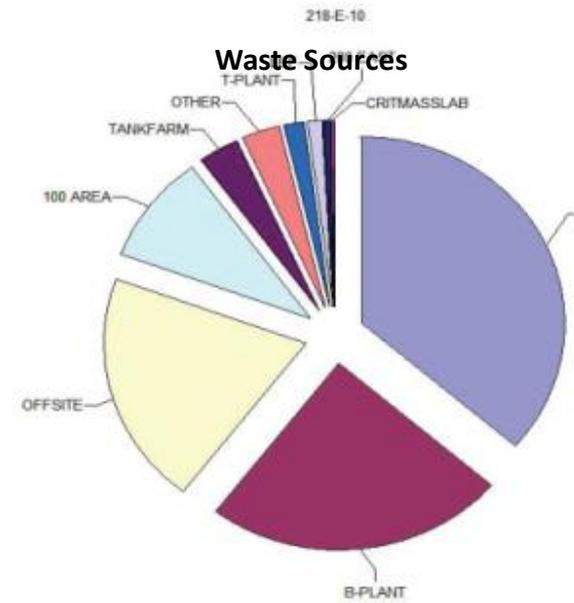
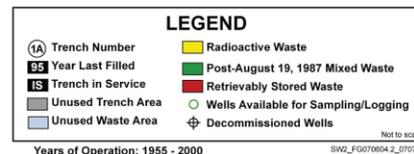
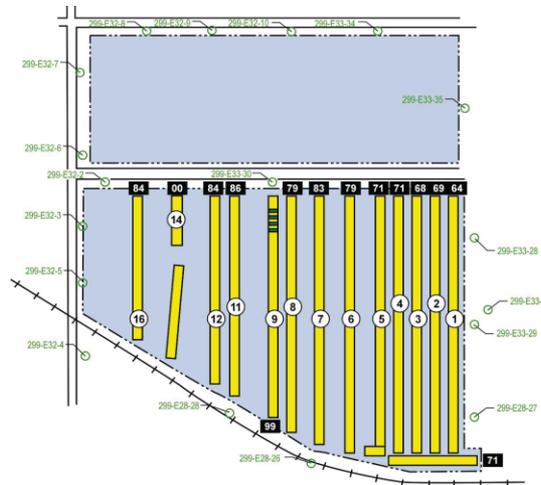
# 218-E-10, TSD-200 East

- **Dates of Waste Receipt:** 1955 to 2000
- **Area:** 22.9 ha (56.6 acres)
- **General Description:** Wastes include cover blocks, tube bundles, jumper vessels, pumps, columns, and filters. In June 1960, a partially covered burial box of PUREX tube bundles caused an airborne contamination spread (UPR-200-E- 23). In 1980, Trenches 1 through 5 were backfilled and stabilized. The section was vegetated with grasses. Surface stabilization also was completed for the eastern 10 ha (25 acres) in 1980.
- **Landfill:** Thirteen trenches running north–south and one trench running east-west. Trenches range from 264 m to 433 m (865 ft to 1,420 ft) long by 4.6 m to 5 m (15 ft to 16 ft) wide at the bottom.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 26,900 m<sup>3</sup> (35,200 yd<sup>3</sup>) of equipment/industrial wastes
  - LLW, MLLW, and unsegregated waste.
  - 4.94 kg Pu, 801 kg U. 4,700,00 Ci Beta-Gamma at burial
  - asbestos, lead, and di-n-octyl phthalate
- **Source Facilities Contributing More than 5% of Waste by Volume:** 100 Area, B-Plant (221-B/224-B), Offsite, PUREX (202-A)

# 218-E-10

## Characterization

RCRA groundwater monitoring around LLWMA 1 wells have been sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3)



Total Volume: 18654.7 m<sup>3</sup>

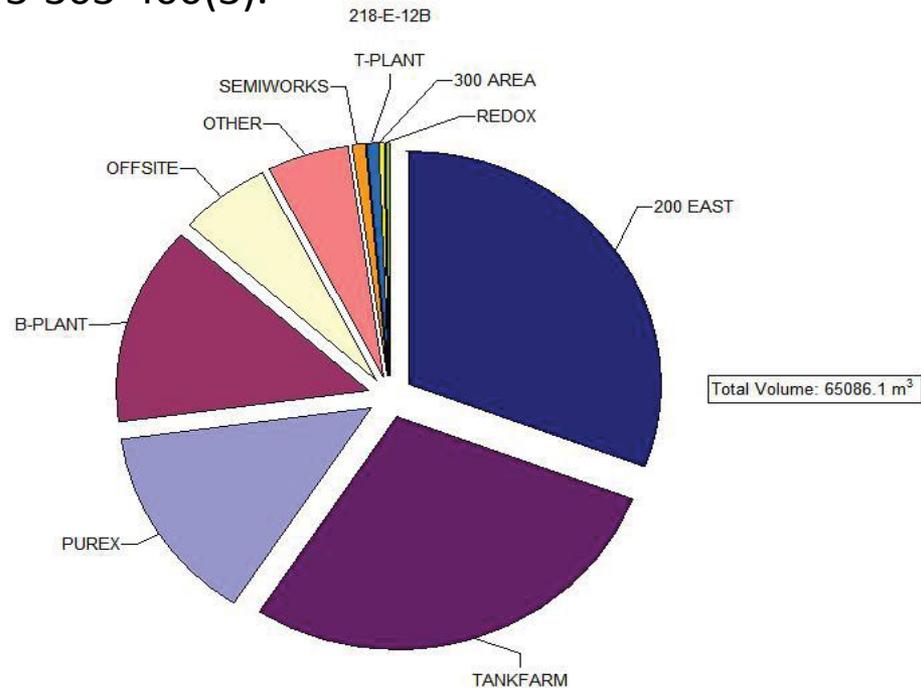
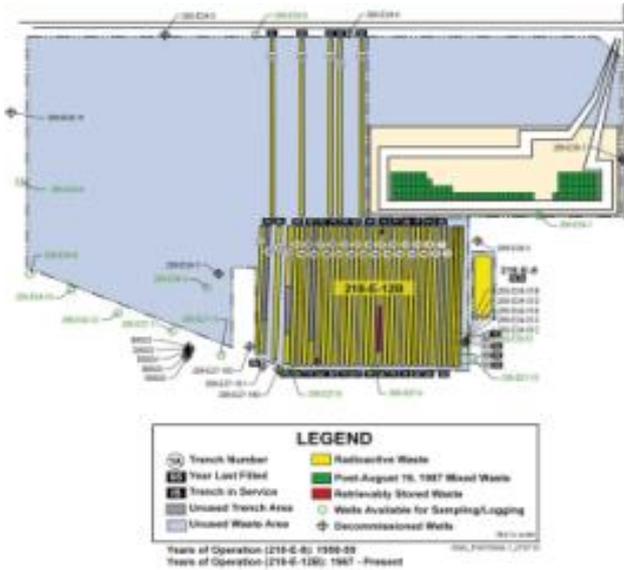
# 218-E-12B, TSD-200 East

- **Dates of Waste Receipt:** 1967 to present
- **Area:** 73.6 ha (182 acres)
- **General Description:** The southern portion of the site (Trenches 1 through 17) were interim stabilized in 1981 with clean fill. In January 2000, two contaminated tumbleweeds were removed from the site.
- **Trenches:** The landfill has the design capacity for 138 trenches running north to south -- 38 trenches are filled, 2 were partially filled, and one was excavated and never used. The remaining trenches were never excavated.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 65,600 m<sup>3</sup> (85,800 yd<sup>3</sup>) industrial wastes
  - unsegregated, low-level, and transuranic wastes
  - 1.39 kg Pu, 7.64 kg U. 183,000 Ci Beta-Gamma at burial
- **Source Facilities Contributing More than 5% of Waste by Volume:** 200 East Area, B-Plant, Offsite, PUREX, Tank Farms

# 218-E-12B

## Characterization

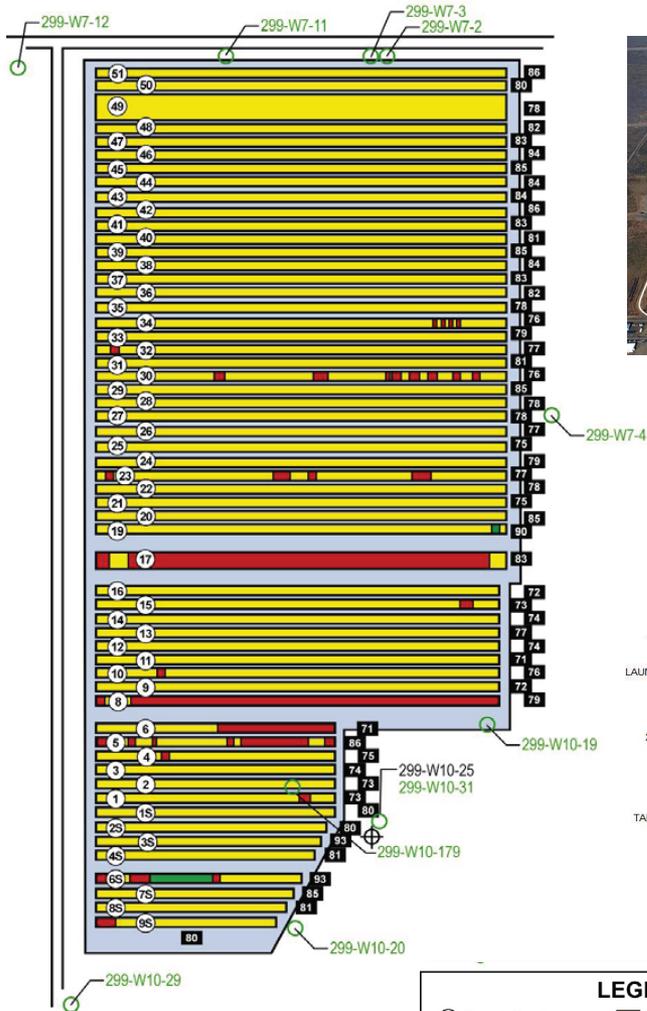
RCRA groundwater monitoring at LLWMA 2-wells have been sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3).



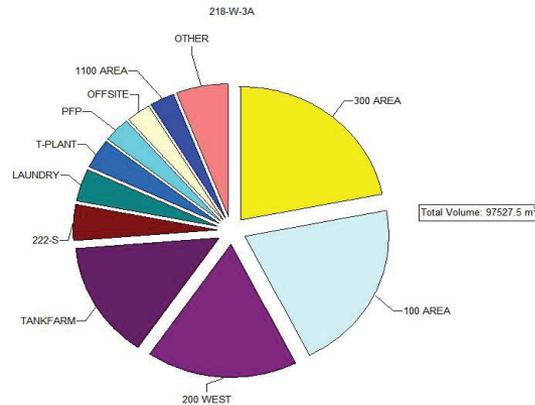
# 218-W-3A TSD

- **Dates of Waste Receipt:** 1970 to 1998
- **Area:** 21.9 ha (54.2 acres)
- **General Description:** West of the 221-T Building and north of the 218-W-3 Burial Ground, the site is located within the Low-Level Burial Ground TSD unit.
- **Trenches:** Sixty-one trenches running east to west. Four trenches have not been dug, and the 57 that have been constructed range from 127 m to 284 m (417 ft to 930 ft) in length.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 97,500 m<sup>3</sup> (127,500 yd<sup>3</sup>) dry waste and some equipment
  - TRU, TRUM, LLW, MLLW, and unsegregated wastes
  - 0.55 kg Pu, 634 kg U. 1,330,000 Ci Beta-Gamma at burial
  - 1,2,4-trimethylbenzene; acetic acid, butyl ester; acetonitrile; aliquat 336; anase; asbestos; barium; batteries; beryllium; cadmium; carbon tetrachloride; carcinogens; caustic; charcoal; chromium; coal tar; copper; cortisporin; cyclohexane; cyclohexanone; dibutyl phosphate; dibutyl-n, n-diethylcarbomyl phosphate; dioxane (1,4-diethylene dioxide); ethanol; ethanolamine; ethylene glycol; glycerin; isopropyl alcohol; kerosene; lead; lithium fluoride; mercury; methanol; naphthalene; naphthylamine tritium; n-hexane; n-hexanol; nitric acid; normal paraffins; oil; organic; phosphoric acid; polyurethane; pseudocumene; silver; silver nitrate; slaked lime; sodium; sodium hydroxide; solvents; tetrahydrofuran; toluene; tributyl phosphate; trichloroethylene; trichlorofluoromethane; trioctylphosphine oxide; uranium fluoride; xylene (mixed isomers); zinc; zirconium
- **Source Facilities Contributing More than 5% of Waste by Volume:** 100 Area, 200 West Area, 300 Area, PFP, Tank Farms

# 218-W-3A



## Waste Sources



| LEGEND               |                                      |
|----------------------|--------------------------------------|
| (1A) Trench Number   | Radioactive Waste                    |
| 95 Year Last Filled  | Post-August 19, 1987 Mixed Waste     |
| IS Trench in Service | Retrievably Stored Waste             |
| Unused Trench Area   | Wells Available for Sampling/Logging |
| Unused Waste Area    | Decommissioned Wells                 |

Not to scale  
Years of Operation: 1970 - 1998  
SW2\_F070604\_6\_070710

## Characterization

Passive soil-vapor sampling has been completed. Specific sampling locations were chosen based on detailed reviews of engineering drawings, historical documents, and waste burial record information located in the SWITS database.

Passive soil vapor samples were analyzed for the presence of 28 organic compounds identified to be contaminants of potential concern.

Two sample locations had CCl<sub>4</sub> levels greater than 100 nanograms: trench 3-S had a reading of 149 nanograms; at another location, trench 9-S had a CCl<sub>4</sub> level of 1,185.

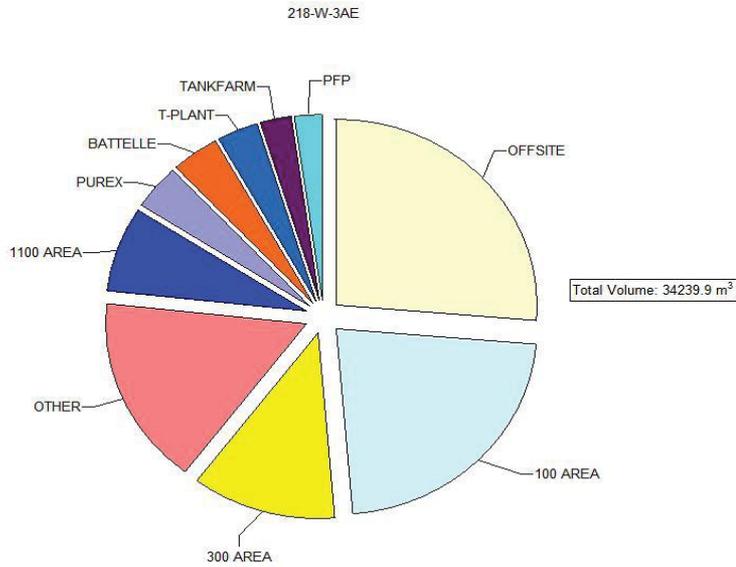
Passive soil vapor sampling was also conducted by the 200-PW-1 OU in 218-W-3A. Vent riser vapor sampling was performed on retrievably stored TRU waste trench segments; although this waste is not in the scope of this investigation, these results are included in this RI/FS work plan for completeness. Vent riser sampling in non-RSW trenches was also conducted by the 200-PW-1 OU in 218-W-3A.

RCRA groundwater monitoring in LLWMA 3-wells since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3).

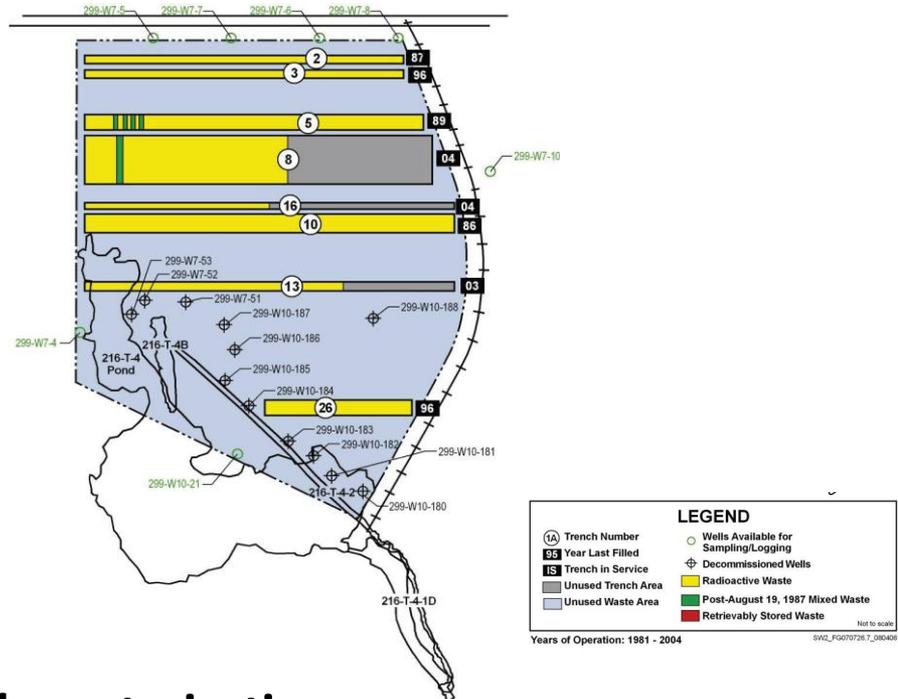
# 218-W-3AE, TSD

- **Dates of Waste Receipt:** 1981 to 2004
- **Area:** 22.9 ha (56.6 acres)
- **General Description:** The location of this site also included a portion of the 216-T-4B Pond System. The site received miscellaneous wastes including rags, paper, rubber gloves, disposable supplies, broken tools, laboratory wastes and industrial waste such as failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, decommissioned change trailers, etc. Trenches 5 and 8 contain post-1987 mixed waste.
- **Trenches:** Originally design contained 24 trenches. Re-designed to contain 12 trenches at deeper depths. Only eight of the trenches were excavated; three are only partially filled.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 34,300 m<sup>3</sup> (44,900 yd<sup>3</sup>) of miscellaneous wastes
  - TRU, LLW, and MLLW. The TRU at this site will be removed and processed; it is part of the TPA M-91 scope
  - 0.12 kg Pu, 439 kg U. 223,000 Ci Beta- Gamma at burial
  - aluminum nitrate; 2,4-dinitrotoluene; ammonium chloride; asbestos; beryllium; bis (2-ethylhexyl) phthalate; chromium; copper; dibutyl phosphate; ferric nitrate; ferrous ammonium sulfate; hydrobromic acid; lead; mercury; nickel hydroxide; nitrate; oil; polychlorinated biphenyls; potassium nitrate; silver; sodium hydroxide; sodium nitrate; sodium nitrite; sulfuric acid; tetrachloroethylene; trichloroethene; trichlorofluoromethane; zirconium
- **Source Facilities Contributing More than 5% of Waste by Volume:** 100 Area, 1100 Area (1171 Transportation & Maintenance Building), 300 Area, Offsite

# 218-W-3AE



**Waste Sources**



## Characterization

Passive soil-vapor sampling locations were chosen based on detailed reviews of engineering drawings, historical documents, and waste burial record information located in the SWITS database. Samples were analyzed for the presence of 28 organic compounds identified to be contaminants of potential concern.

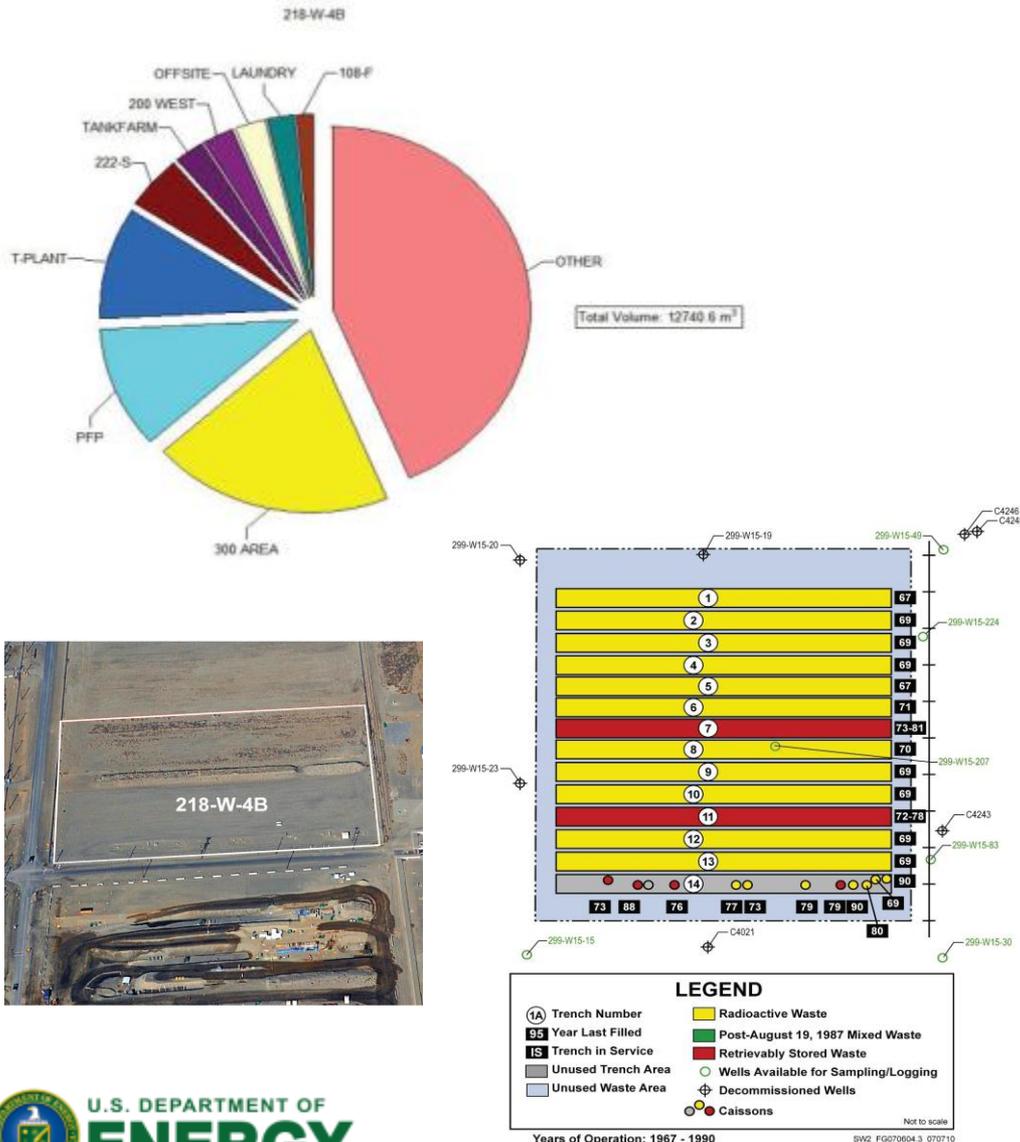
RCRA groundwater monitoring at LLWMA three wells sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3).



# 218-W-4B

- **Dates of Waste Receipt:** 1967 to 1990
- **Area:** 4.07 ha (10.1 acres)
- **General Description:** Contains debris including rags, paper, cardboard, plastic, and equipment. Trenches 7 and 11 and the alpha caissons contain TRU waste planned to be retrieved under M-91. Trenches 1 through 6 were surface stabilized and backfilled with clean soil in 1983. Trench 7 is covered with a 1.2 m (4 ft) soil mound. The remaining trenches were backfilled after use and stabilized with clean gravel in 1995. See slides 92 and 93 for more information on caissons.
- **Trenches:** The site contains 13 trenches and one row of 12 caissons (5 alpha, 6 MFP, and 1 deeper, silo-type which became plugged after receipt of two waste packages).
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 10,466 m<sup>3</sup> (13,690 yd<sup>3</sup>) of waste as of September 30, 2005
  - TRU, LLW, and unsegregated wastes
  - 8.98 kg Pu and 21.6 kg U. 406,000 Ci Beta-Gamma at burial.
  - beryllium, lead, oil, and zirconium
- **Source Facilities Contributing More than 5% of Waste by Volume:** 222-S, 300 Area, PFP, and T-Plant

# 218-W-4B



## Characterization

Passive soil-vapor sampling locations were chosen based on detailed reviews of engineering drawings, historical documents, and waste burial record information located in the Solid Waste Information and Tracking System data base. Samples were analyzed for the presence of 28 organic compounds identified to be contaminants of potential concern. One sample location had CCl4 levels greater than 100 nanograms targeted location, trench 8 had CCl4 levels in excess of 70,000 nanograms.

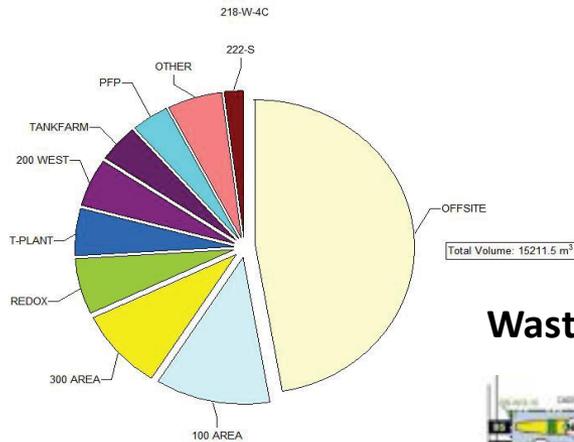
Vent riser vapor samples performed on retrievably stored TRU waste trench segments; although this waste is not in the scope of this investigation, these results are included in this RI/FS work plan for completeness.

RCRA groundwater monitoring at LLWMA 4 wells sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3).

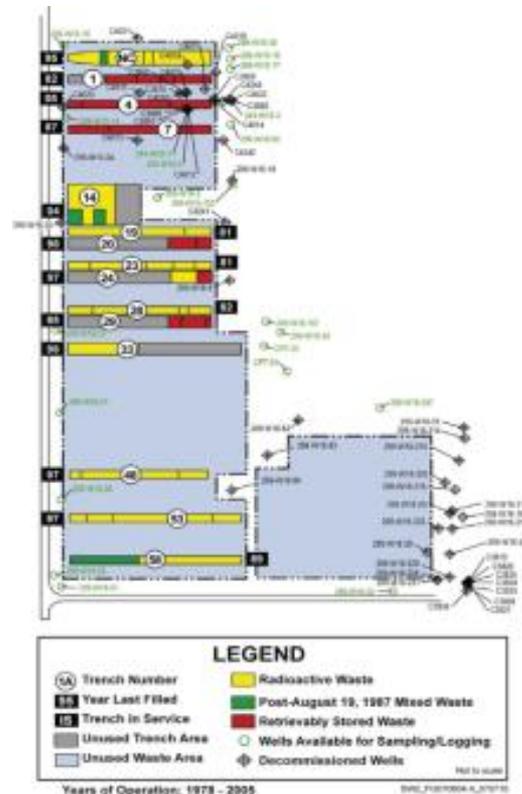
# 218-W-4C

- **Dates of Waste Receipt:** 1978 to 2005
- **Area:** 22.8 ha (56.2 acres)
- **General Description:** Divided into two parts; the section containing burial trenches to the west and an annex, (which never has been used) to the east. The Z Plant burning pit, which operated during the late 1940s and early 1950s, was reportedly excavated in the 1970s during the construction of Trench 7. Some of the TRU-containing trenches are asphalt lined. Trenches 1, 4, 7, 20, 24, and 29 contain retrievably stored, suspect TRU waste. One drum of suspect TRU was buried in what is otherwise a LLW trench in 1981; records were later examined, and the drum and trench were redefined as containing only LLW. Trenches NC, 14, and 58 contain post-1987 mixed waste.
- **Trenches:** The landfill is designed to contain up to 65 trenches. Only 14 trenches have been excavated; 6 of these are only partially filled. The landfill annex area never has been used. The trenches run east to west and range in length from 50 m to 232 m (162 ft to 760 ft).
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory (In- Scope Low-Level & Unsegregated Wastes only) 15,200 m<sup>3</sup> (19,900 yd<sup>3</sup>) of waste as of September 30, 2005. The site contains :**
  - TRU, TRUM, LLW, and MLLW
  - 0.026 kg Pu, 215 kg U. 1,100,000 Ci Beta-Gamma at burial
  - 1,2-diaminopropane; 1-butene; 2,2,4- trimethylpentane; 3,4(benz-3,6)pyrene; acetic anhydride; acetophenone; acid; chromium; coal tar; copper; cumene hydroperoxide; di-t-butyl-p-cresol; indole picrate; isopropyl iodide; lead; mercury; n,n-disalicylidene; naphthalene; 2-methyl-naphthalene; oil; paint thinner; phenol; silver; slaked lime; sodium; t-butyl hydroperoxide; uranium fluoride; vinyl chloride (chloroethylene); zirconium
- **Source Facilities Contributing More than 5% of Waste by Volume:** 100 Area, 300 Area, Offsite, PFP, REDOX

# 218-W-4C



## Waste Sources



## Characterization

Passive soil-vapor sampling locations were chosen based on detailed reviews of engineering drawings, historical documents, and waste burial record information located in the SWITS database. Samples were analyzed for the presence of 28 organic compounds identified to be contaminants of potential concern.

Vent riser vapor samples performed on retrievably stored TRU waste trench segments; although this waste is not in the scope of this investigation, these results are included in this RI/FS work plan for completeness.

Vent riser sampling was also conducted by 200-PW-1 in 218-W-4C.

RCRA groundwater monitoring at LLWMA 4 wells sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3).

# 218-W-5

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- **Dates of Waste Receipt:** 1985 to present
- **Area:** 38.6 ha (95.3 acres)
- **General Description:** Trenches 22 and 24 contain post- August 19, 1987 mixed waste.
- **Trenches:** Contain 18 low-level and four mixed waste trenches. Currently there are 11 inactive low-level trenches.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 71,000 m<sup>3</sup> (92,900 yd<sup>3</sup>) of total wastes as of September 30, 2005. This site contains:
    - LLW and MLLW
    - 0.17 kg Pu, 6,915 kg U. 31,400 Ci Beta- Gamma at burial
    - lead, oil, and slaked lime
- **Source Facilities Contributing More than 5% of Waste by Volume:** 100 Area, 300 Area, Offsite, PFP, Tank Farms

# 218-W-5

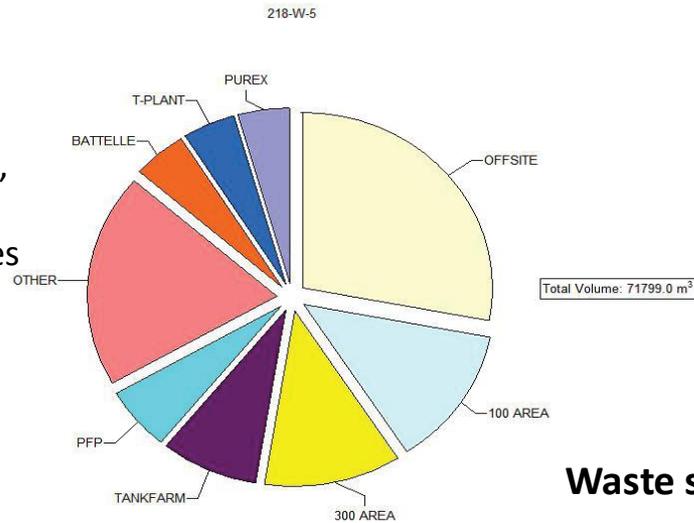
## Characterization

Passive soil-vapor sampling locations were chosen based on detailed reviews of engineering drawings, historical documents, and waste burial record information located in the SWITS database. Samples were analyzed for the presence of 28 organic compounds identified to be contaminants of potential concern.

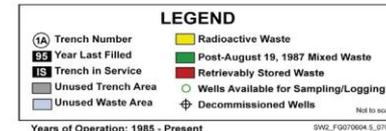
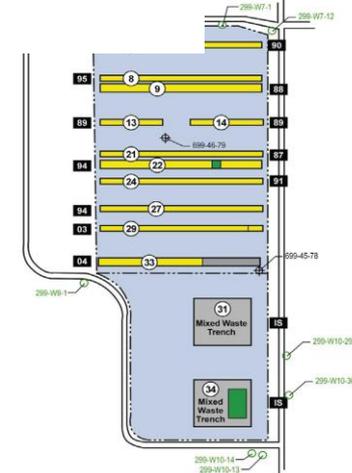
Vent riser vapor samples performed on retrievably stored TRU waste trench segments; although this waste is not in the scope of this investigation, these results are included in this RI/FS work plan for completeness.

Vent riser sampling was also conducted by 200-PW-1 in 218-W-4C.

RCRA groundwater monitoring at LLWMA 4 wells sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3).



## Waste sources



# Pre-1970 Landfills

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- The Pre-1970 landfills are categorized as:
  - Industrial Landfills
  - Dry Waste Alpha Landfills
  - Dry Waste Landfills
  - Construction Landfills

| Pre-1970 Landfills               |                |                          |  |   |
|----------------------------------|----------------|--------------------------|--|---|
| Site                             | No. of Records | Waste Vol m <sup>3</sup> | Estimated Volume Covered by Records with Known Locations | Estimated Volume Covered by Records with Known Waste Descriptions |
| <b>Industrial Landfills</b>      |                |                          |  |   |
| 218-E-2                          | 1              | 9,033                    | 0%   | 0%  |
| 218-E-2A                         |                | unknown                  | N/A  | N/A   |
| 218-E-5                          | 16             | 3,172                    | 0%   | 1%  |
| 218-E-5A                         | 8              | 6,173                    | 0%   | 0%  |
| 218-E-9                          |                | unknown                  | N/A  | N/A   |
| 218-W-1A                         | 114            | 13,700                   | 0%   | 2%  |
| 218-W-2A                         | 172            | 26,000                   | 1%   | 2%  |
| 218-W-11                         | 1              | 1,160                    | 0%   | 0%  |
| <b>Alpha Dry Waste Landfills</b> |                |                          |  |   |
| 218-W-1                          | 65             | 7,164                    | 0%   | 2%  |
| 218-W-2                          | 4              | 8,240                    | 0%   | 0%  |
| 218-W-3                          | 789            | 12,400                   | 16%  | 16%   |
| 218-W-4A                         | 4,914          | 16,886                   | 74%  | 74%   |
| <b>Dry Waste Landfills</b>       |                |                          |  |   |
| 218-E-1                          | 20             | 3,030                    | 0%   | 1%  |
| 218-E-12A                        | 62             | 15,400                   | 0%   | 1%  |
| <b>Construction Landfills</b>    |                |                          |  |   |
| 218-C-9                          | 723            | 7,573                    | 100%   | 100%  |
| 218-E-4                          | 1              | 1,586                    | 0%   | 0%  |
| 218-E-8                          | 4              | 2,265                    | 0%   | 0%  |

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# INDUSTRIAL LANDFILLS

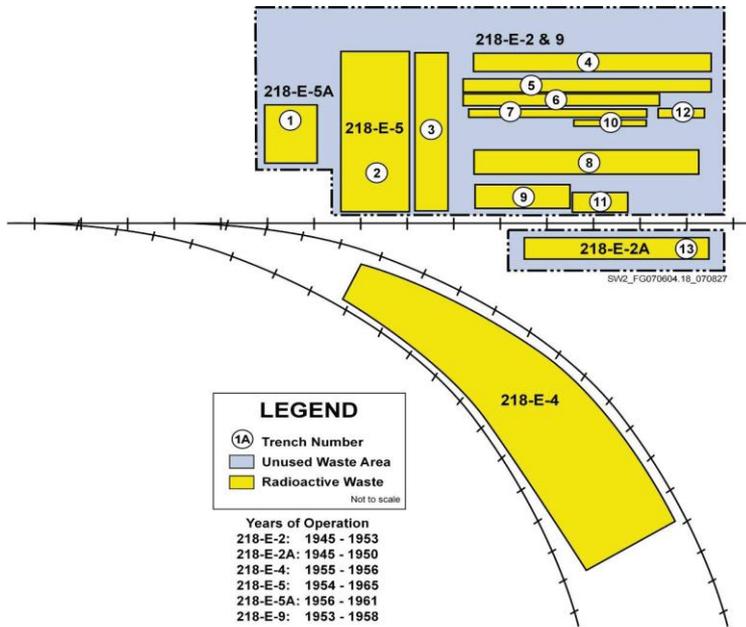
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There are eight landfills categorized as Industrial

# 218-E-2, Industrial-200 East

- **Dates of Waste Receipt:** 1945 to 1953
- **Area:** 2.05 ha (5.06 acres)
- **Historical Documentation Design and Operation:** The unit was surface stabilized in 1979 with 0.3 m (1 ft) of clean backfill material and vegetated with wheat grass. Trench lengths vary from 27 m to 142 m (90 ft to 465 ft). The site is co-located with Landfills 218-E-2A, 218-E-4, 218-E-5, 218-E-5A and 218-E-9.
- **Trenches:** Nine industrial (wide) trenches.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 9,033 m<sup>3</sup> (11,815 yd<sup>3</sup>) of industrial wastes
  - 0.8 kg Pu, 300 kg U. 25,000 Ci Beta-Gamma at burial
- **Source Facilities Contributing More than 5% of Waste by Volume:**  
200 East Area

# 218-E-2



## Characterization

September 2006 radiological soil measurements at the 218-E-2 and 218-E-5 Burial Grounds were performed in support of the 200-SW-2 OU non-intrusive characterization effort.

Eight survey locations (hot-spots) were selected for further radiological soil measurements in and around the two landfills, based on previously collected Mobile Surface Contamination Monitor data.

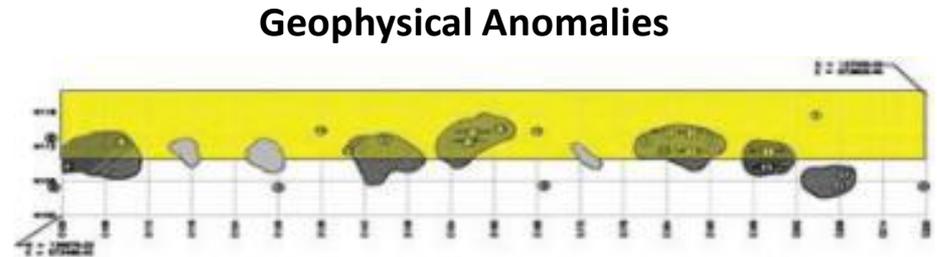
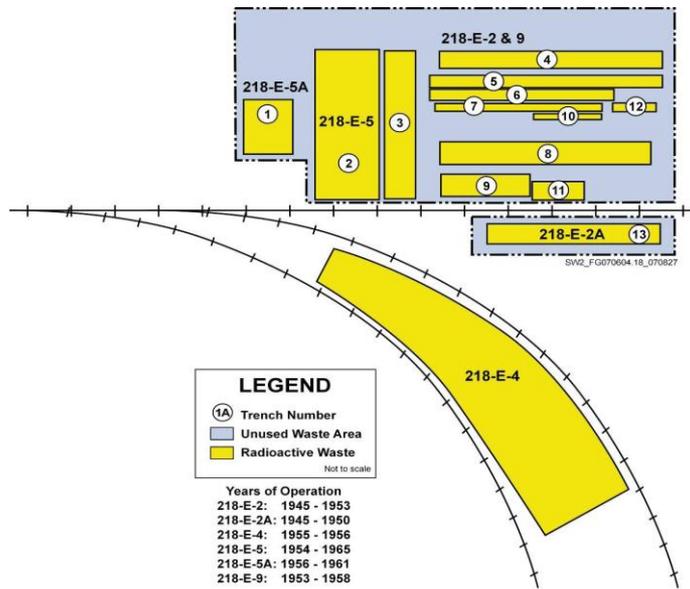
Cesium contamination appears to be close to the surface and probably not directly related to the landfill.



# 218-E-2A, Industrial-200 East

- **Dates of Waste Receipt:** 1945 to 1950
- **Area:** 0.372 ha (0.918 acres)
- **Historical Documentation Design and Operation:** The site was used as an above-ground storage site for contaminated equipment. There are no records or inventories for this site. A 1978 inspection noted a number of sinkholes. During 1979, several loads of soil were placed over the sinkholes, and the stored above-ground equipment was buried in the 218-E-10 Landfill. The site was surface stabilized with 0.3 m (1 ft) of soil, re-vegetated, and posted/marked as an underground radioactive material area in 1980 to 1981. The site is co-located with Landfills 218-E-2, 218-E-4, 218-E-5, 218-E-5A and 218-E-9.
- **Trenches:** One
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory :**
  - Nothing known about waste volume or inventories
- **Source Facilities Contributing More than 5% of Waste by Volume:** Unknown

# 218-E-2A



## Characterization

Surface geophysical surveys conducted were an expansion of the area covered in the first phase of geophysical investigations.

Results of the previous investigation appeared to show anomalies extending beyond the edge of the landfill boundary to the west. This investigation concluded no buried debris or objects are interpreted to be west of the landfill boundary.



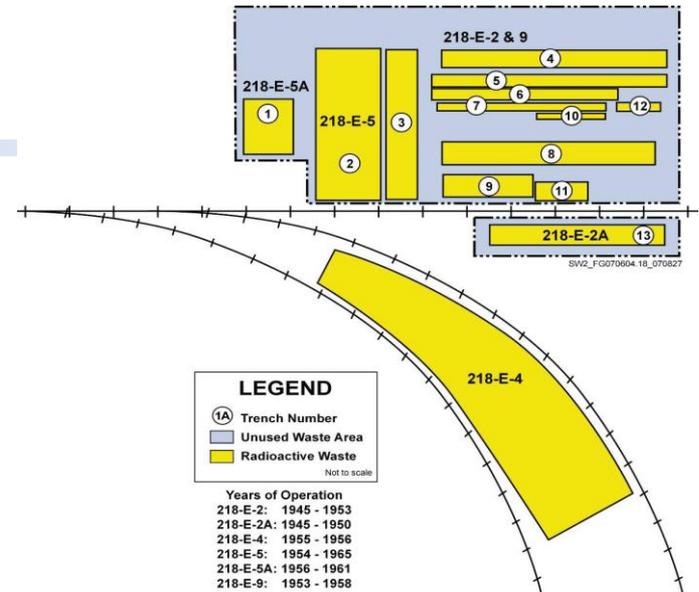
# 218-E-5, Industrial-200 East

- **Dates of Waste Receipt:** 1954 to 1956
- **Area:** 1.09 ha (2.69 acres)
- **General Description:** The westernmost trench contains railroad boxcars contaminated by uranyl nitrate hexahydrate at the north end. The burial areas were stabilized and covered with 0.3 m (1 ft) of clean soil in 1980. The site is co-located with Burial Grounds 218-E-2, 218-E-2A, 218-E-4, 218-E-5A and 218-E-9.
- **Trenches:** The site contains two areas of trenches. One area is 104 m (341 ft) long by 40 m (131 ft) wide and contains multiple narrow trenches that received industrial dry waste and small boxes. The second area is a single trench oriented north/south that is 102 m (335 ft) long by 20 m (64 ft) wide.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 3,172 m<sup>3</sup> (4,149 yd<sup>3</sup>) of miscellaneous debris
  - 0.62 kg Pu, 120 kg U, 3,500 Ci Beta-Gamma at burial
- **Source Facilities Contributing More than 5% of Waste 200 East Area:** - PUREX (202-A)

# 218-E-5



## Geophysical Anomalies



## Characterization

In September 2006 radiological soil measurements at the 218-E-2 and 218-E-5 Burial Grounds were performed in support of the 200-SW-2 OU non-intrusive characterization effort.

Eight survey locations (hot-spots) were selected for further radiological soil measurements in and around the two landfills, based on previously collected MSCM data.

Cesium contamination appears to be close to the surface and probably not directly related to the landfill.

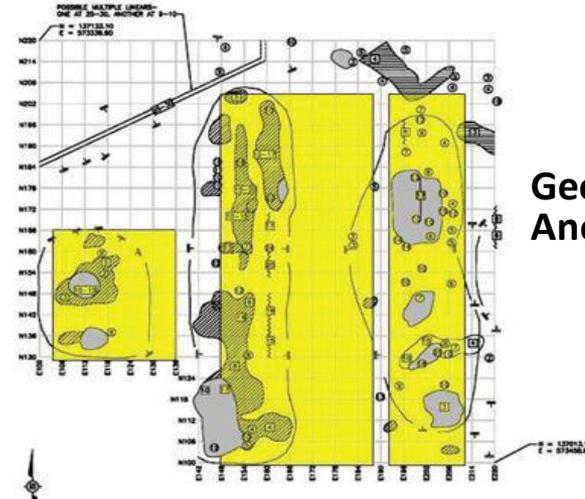
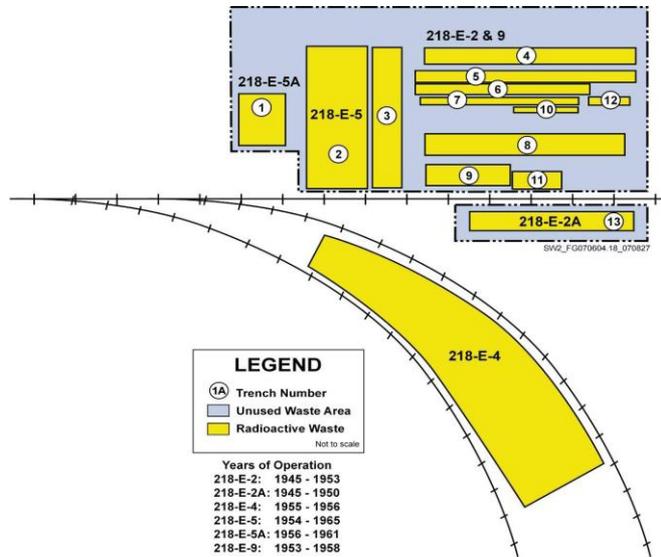
Surface geophysical surveys of 218-E-5 and 218-E-5A Burial Grounds are contiguous and were investigated as a single landfill. Two trenches are documented in 218-E-5. Trench 2 appears to be roughly 20 m to the west of its documented location. In the eastern half of the landfill, a second trench was detected that correlates well with the documented location of Trench 3 shown on Hanford Site Drawing H-2-55534.



# 218-E-5A, Industrial-200 East Waste

- **Dates of Waste Receipt** : 1956 to 1961
- **Area**: 1.42 ha (3.51 acres)
- **General Description**: Literature indicates that the site contains wooden boxes of spent PUREX equipment. The trench was backfilled in 1961. The site was stabilized in 1980, covered with 1 ft of clean backfill, and re-vegetated. The site is co-located with Burial Grounds 218-E-2, 218-E-2A, 218-E-4, 218-E-5, and 218-E-9.
- **Trenches**: Probably one large pit.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory**:
  - 6,173 m<sup>3</sup> (8,740 yd<sup>3</sup>) of PUREX failed equipment
  - 1.38 kg Pu, 120 kg U. 16,500 Ci Beta-Gamma at burial
- **Source Facilities Contributing More than 5% of Waste by Volume**:  
200 East Area – PUREX (202-A)

# 218-E-5A



**Geophysical Anomalies**



## Characterization

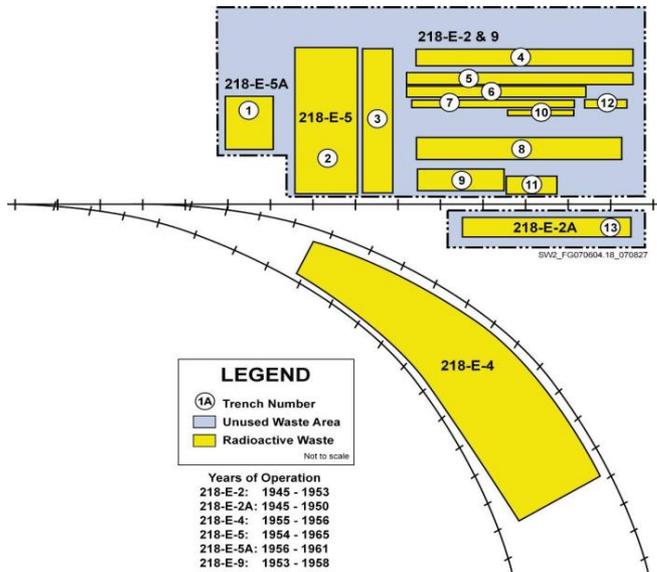
Surface geophysical surveys for the 218-E-5 and 218-E-5A Burial Grounds are contiguous and were investigated as a single landfill.

Data indicates that there is one trench in the 218-E-5A Burial Ground; an oblong-shape trench or pit containing a significant amount of metallic debris or objects.

# 218-E-9, Industrial-200 East Regulated Equipment Storage

- **Dates of Waste Receipt:** 1953 to 1958
- **Area:** 0.572 ha (1.41 acres)
- **General Description:** Used as an aboveground storage site for fission product equipment that became contaminated in the Uranium Recovery Process operations at tank farms. It is not certain that it ever was used as a landfill. The site is co-located with Burial Grounds 218-E-2, 218-E-2A, 218-E-4, 218-E-5, and 218-E-5A and stabilized in 1980. The site was re-stabilized in 1991 when contaminated vegetation was found.
- **Trenches:** The site consists of an unknown number of trenches. Some overlap with trenches in 218-E-2.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - Equipment
  - Nothing is known about waste volume or contaminant inventory
- **Source Facilities Contributing More than 5% of Waste by Volume:** Unknown – believed to be uranium-recovery process operations at tank farms

# 218-E-9



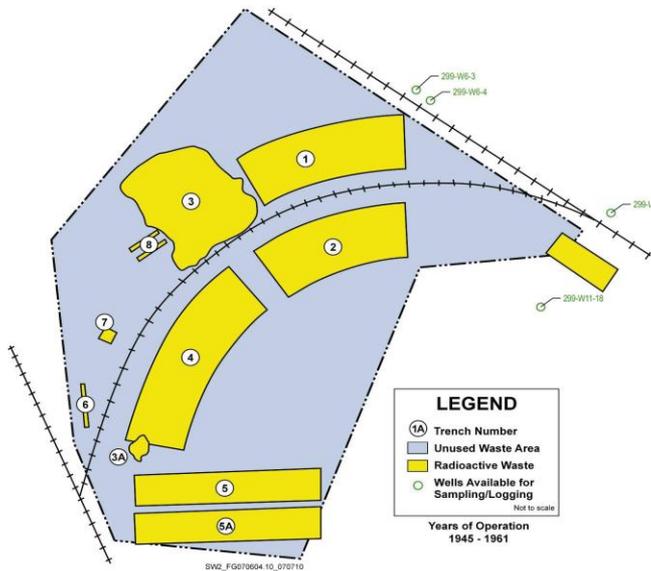
Historical document(s) indicate that 218-E-9 is located as shown in the aerial photo but that there is uncertainty in its actual location (which is more likely to be the area east of trench 11)



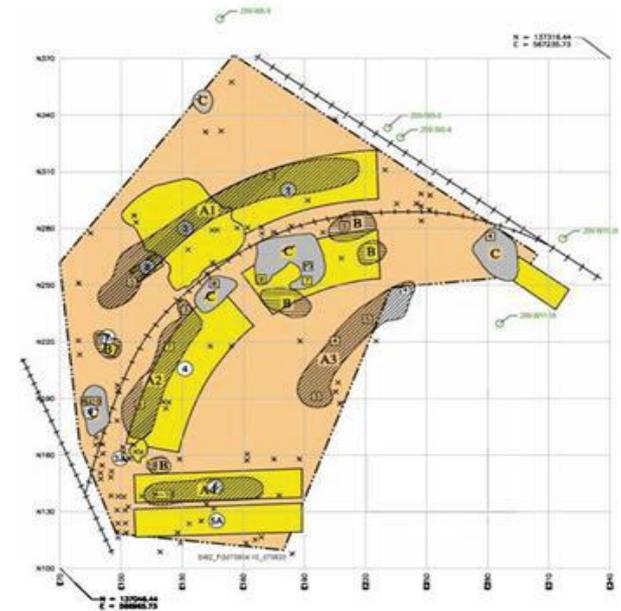
# 218-W-1A, Industrial 200 West

- **Dates of Waste Receipt:** 1945 to 1961
- **Area:** 4.86 ha (12.0 acres)
- **General Description:** The site is the first landfill in the 200 West Area to receive large, contaminated equipment. Most of the equipment was disposed in wooden boxes that eventually rotted and settled, creating sinkholes. The sinkholes were filled in 1975 with 1.8 m (6-ft) thick concrete cell blocks and clean fill. Radiological surveys are performed annually.
- **Trenches:** The site contains approximately ten burial areas. The areas include typical trenches and “burial holes.” The exact locations of the holes are not known.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory :**
  - 13,700 m<sup>3</sup> (17,900 yd<sup>3</sup>) equipment and industrial wastes
  - 2.0 kg Pu, 900 kg U. 48,000 Ci Beta- Gamma at burial
- **Source Facilities Contributing More than 5% of Waste by Volume:** 200 West Area

# 218-W-1A



## Geophysical Anomalies



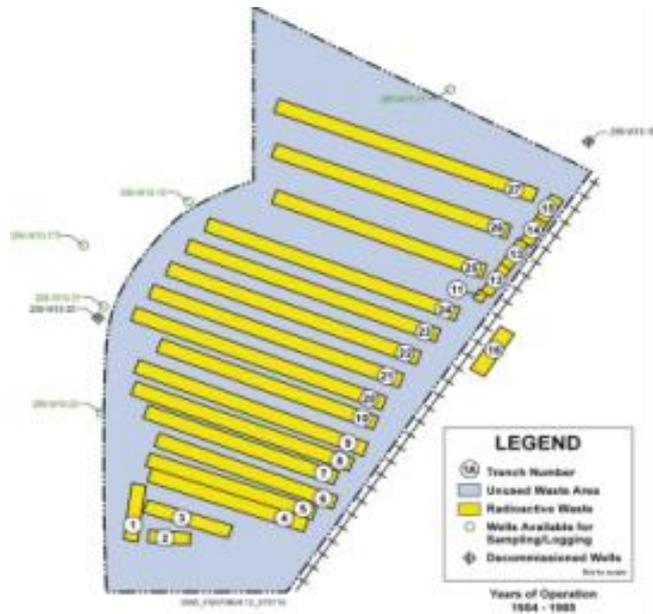
## Characterization

Surface geophysical surveys indicate the landfill contains a large number of small, scattered shallow anomalies that confound the interpretation of distinct burial trenches in the GPR data. For this reason, concentrations of buried debris are inferred primarily from EMI and magnetic data.

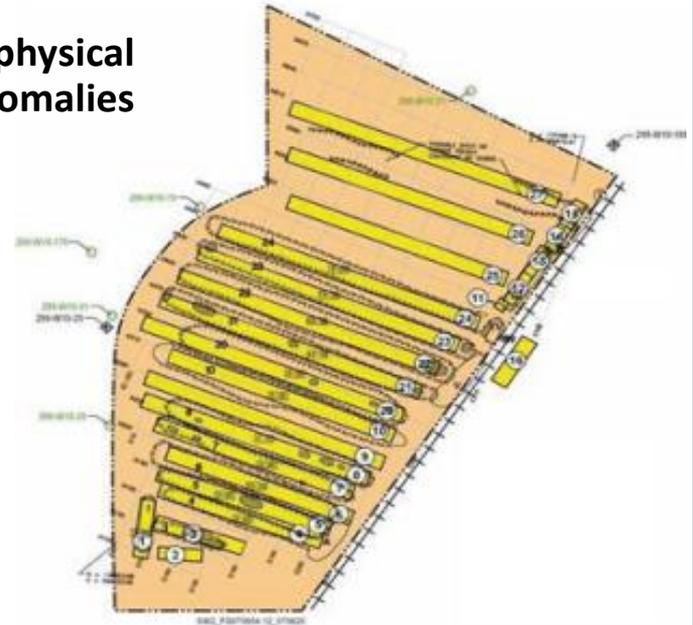
# 218-W-2A, Industrial

- **Dates of Waste Receipt:** 1954 to 1985
- **Area:** 16.5 ha (40.7 acres)
- **General Description:** Includes tanks, concrete blocks, facility wastes, process equipment, contaminated soil scraped from the 216-T-4-1 Pond (Trench 27), REDOX centrifuges, jumpers, pumps, filters, and miscellaneous cell equipment and wastes. Trench 21 contains a plutonium glovebox. In January 1959, a contamination spread occurred when a burial box containing REDOX jumpers collapsed during backfill operations (UPR-200-W-53). The site was backfilled and surface stabilized in 1980. However, the site remained active until 1985 because of two unused trenches and the cell block burial sites. An undocumented burial box was discovered in June 1983 while extending an active trench. The site was re-stabilized with clean fill and gravel in 2001.
- **Trenches:** The site is an industrial burial area with 19 trenches; 17 run east to west and 2 run north to south.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 25,100 m<sup>3</sup> (32,800 yd<sup>3</sup>) equipment and industrial wastes
  - LLW
  - 6.38 kg Pu, 2,690 kg U. 247,000 Ci Beta- Gamma at burial
- **Source Facilities Contributing More than 5% of Waste by Volume:** 200 Area facilities including T-Pond soil, REDOX, B Plant, and 234-5Z

# 218-W-2A



## Geophysical Anomalies



## Characterization

Surface geophysical survey data indicates that there are burial trenches at most of the locations shown for trenches on Hanford Site Drawing H-2-32095. Most of the debris or objects in the trenches have a ferrous metal content; some have a significant ferrous content.

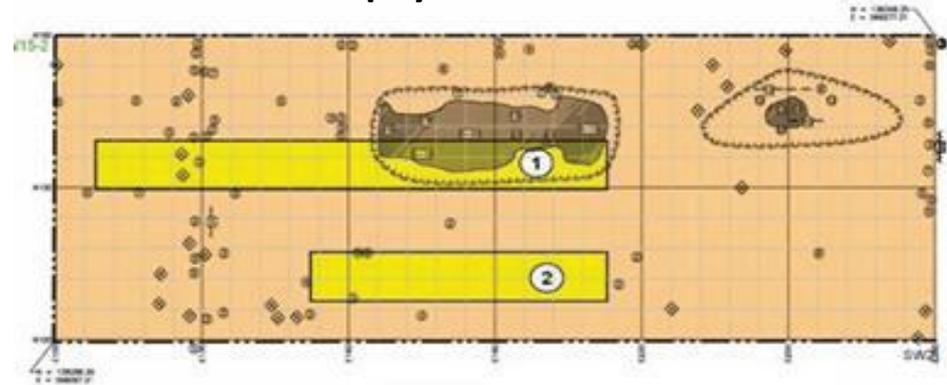
# 218-W-11

- **Dates of Waste Receipt:** 1960
- **Area:** 1.43 ha (3.53 acres)
- **General Description:** Before stabilization in 1983, a portion of the landfill was used for above-ground storage of contaminated equipment. The waste is low-level contaminated equipment. A surface radiological survey is performed annually.
- **Trenches:** Two burial trenches 77 m (258 ft) and 46 m (150 ft) long. Sources conflict as to whether the southernmost of the two trenches ever was excavated and filled. Geophysics data collected in 2006 (D&D-30708) suggest that the trench does not exist.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 1,160 m<sup>3</sup> (1,520 yd<sup>3</sup>) miscellaneous solid debris
  - No plutonium, uranium, or beta-gamma inventories are reported for this site
- **Source Facilities Contributing More than 5% of Waste by Volume:** Tank Farms – Uranium Recovery Process and Sr/Cs Recovery Operations

# 218-W-11



## Geophysical Anomalies



## Characterization

Surface geophysical survey data indicates that the investigation area contains two concentrations of buried debris or objects. One trench and one “pit” make up the 218-W-11 Burial Ground. The trench location correlates very well with the trench documented in Hanford Site Drawing H-2-31268.

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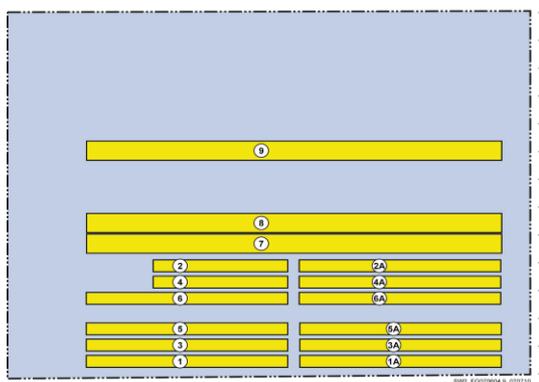
# **DRY WASTE ALPHA LANDFILLS**

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# 218-W-1, Dry Waste Alpha-200 West

- **Dates of Waste Receipt:** 1944 to 1952
- **Area:** 3.32 ha (8.19 acres)
- **General Description:** “V” trenches typically used to dispose of small contaminated articles such as paper, filters, and small pieces of equipment. Flat-bottom trenches contain large pieces of contaminated equipment and wooden, metal, and concrete burial boxes. Trenches backfilled, and site stabilized in 1983. A surface radiological survey performed annually.
- **Trenches:** Contains 15 trenches running east to west. Twelve trenches are “V” shaped 2.4 m (8 ft) deep and 5 m (16 ft) wide at ground level. The other three trenches are flat-bottomed at 2.7 m (9 ft) deep and 7.3 m (24 ft) wide at the surface.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 7,164 m<sup>3</sup> (9,370 yd<sup>3</sup>) dry waste. The site contains
  - 94 kg Pu, 700 kg U. 200 Ci Beta-Gamma at burial

# 218-W-1



**LEGEND**

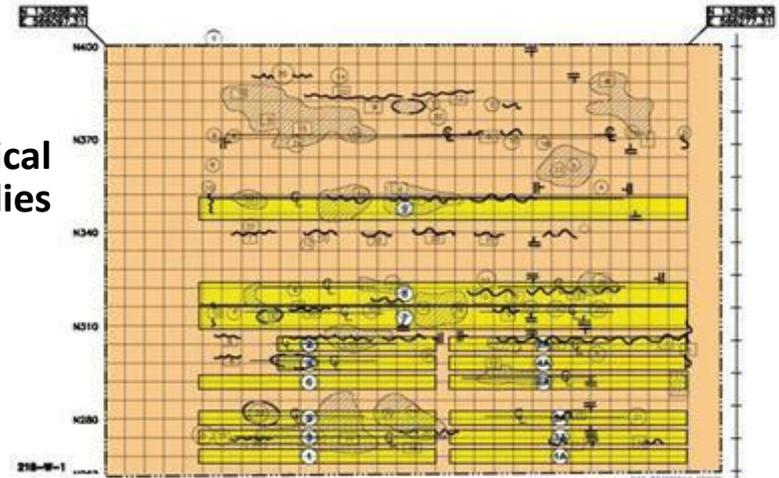
- 1A Trench Number
- Unused Waste Area
- Radioactive Waste

Not to scale

Years of Operation  
1944 - 1952



## Geophysical Anomalies



## Characterization

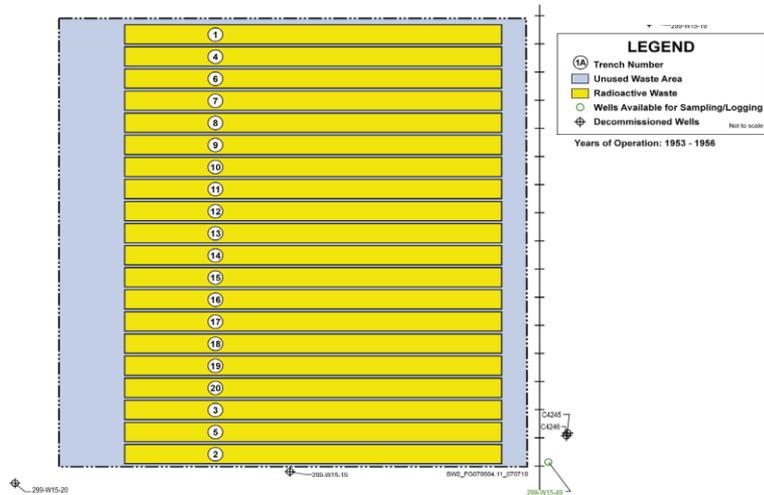
Geophysical data for 218-W-1 indicates pockets of debris in each of the identified trenches. Discrete concentrations of metallic waste were identified in most of the trenches.

Three east-west-oriented trenches were identified that are not shown on Hanford Site Drawing H-2-75149. They are north of the northernmost trench shown on the drawing (Trench 9) and south of the 218-W-11 Burial Ground.

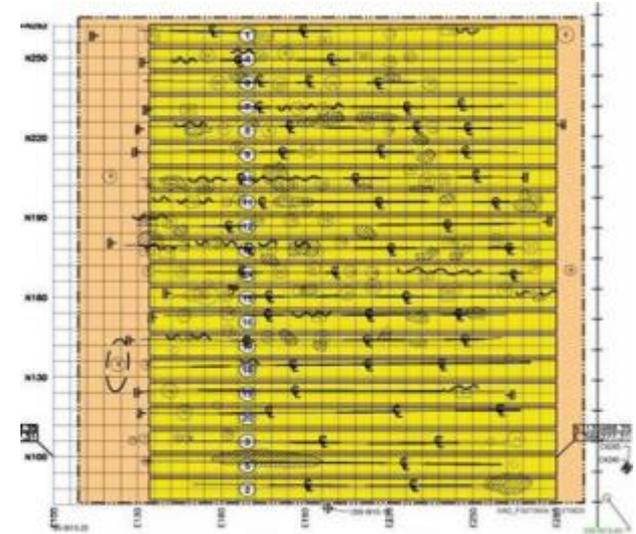
# 218-W-2, Dry Waste Alpha-200 West

- **Dates of Waste Receipt:** 1953 to 1956
- **Area:** 3.45 ha (8.51 acres)
- **General Description:** Before backfilling, waste observed to be within 46 cm (18 in.) of the ground surfaces. Sinkholes filled in 1974. The site was surface stabilized in 1983 with a minimum of 0.6 m (2 ft) of clean fill and vegetated. A surface radiological survey performed annually.
- **Trenches:** The site is a landfill that contains 20 trenches running east to west.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 8,240 m<sup>3</sup> (10,778 yd<sup>3</sup>) dry waste
  - 126 kg Pu, 1400 kg U. 500 Ci Beta-Gamma at burial
- **Source Facilities Contributing More than 5% of Waste by Volume:**  
200 West Area

# 218-W-2



## Geophysical Anomalies



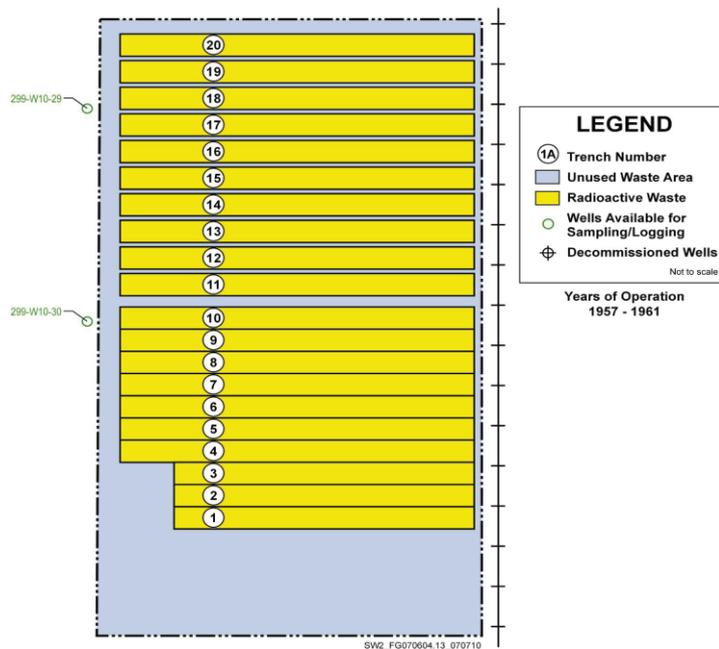
## Characterization

Surface geophysical surveys indicate that all 20 of the trenches in 218-W-2 were clearly evident in the geophysical data. The geophysical data indicates that pockets/zones of debris are located and mapped in each of the identified trenches.

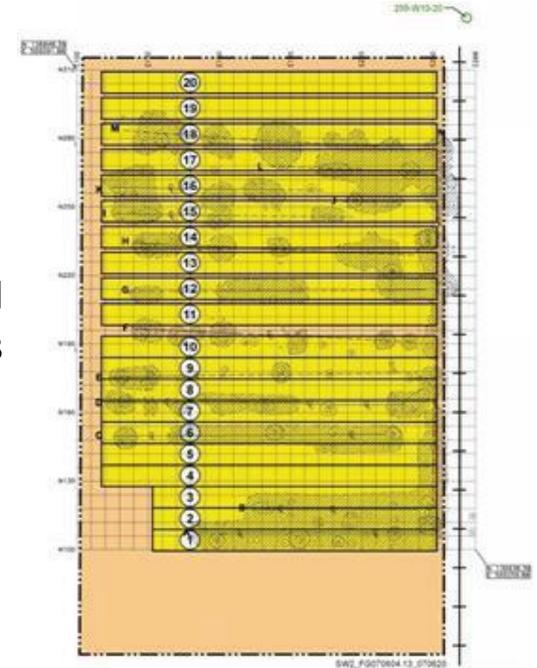
# 218-W-3, Dry Waste Alpha

- **Dates of Waste Receipt:** 1957 to 1961
- **Area:** 3.97 ha (9.81 acres)
- **General Description:** Received miscellaneous unsegregated wastes including drums of depleted uranium, a 1951 pickup truck, and other items, mainly in cardboard boxes. The site is backfilled and was surface stabilized in 1983. A surface radiological survey is performed annually.
- **Trenches:** Although drawings (H-2-32095, Sheet 1, Rev. 11) indicate that the site consists of 20 east-west trenches that range from 122 m to 145 m (400 ft to 475 ft) long with unknown widths, geophysical data collected in 2006 (D&D-30708) and unpublished 1960s logbook evidence show both east-west and north-south trenches that are different in location and differently numbered.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 12,400 m<sup>3</sup> (16,220 yd<sup>3</sup>) mostly dry wastes buried with some equipment
  - 68 kg Pu, 70,000 kg U. 900 Ci Beta-Gamma at burial
- **Source Facilities Contributing More than 5% of Waste by Volume:** PFP

# 218-W-3



## Geophysical Anomalies



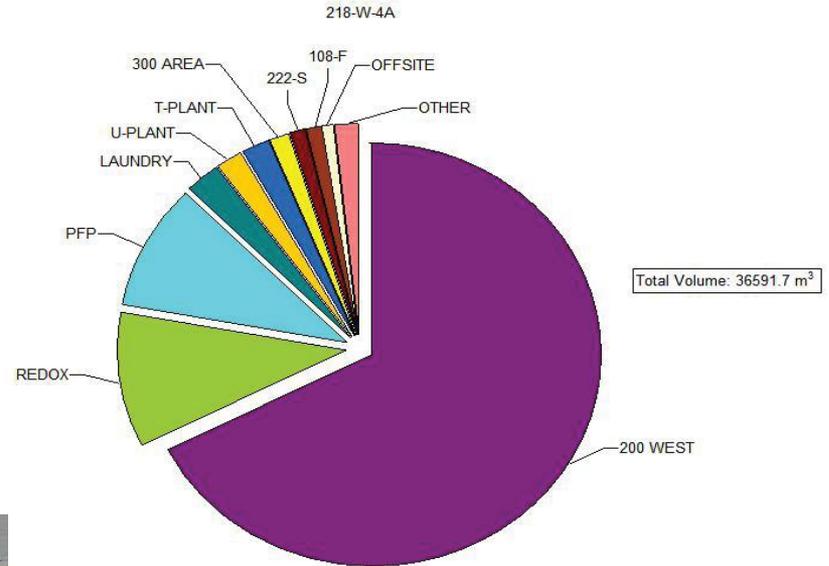
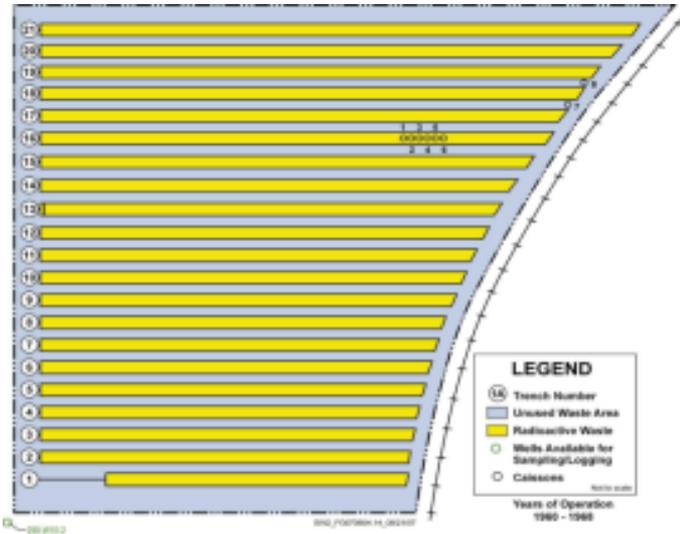
## Characterization

Geophysical data indicates that there are approximately 14 East-West oriented trenches containing varying amounts of metallic debris. Other than the two southernmost trenches, the interpreted trench locations do not correlate with the locations shown in drawings.

# 218-W-4A

- **Dates of Waste Receipt:** 1960 to 1968
- **Area:** 7.29 ha (18.0 acres)
- **General Description:** The vertical pipe units were installed near the east end of Trench 16. Each consists of two 55-gal drums welded together with the ends removed except the bottom of the lower drums; they were placed 4.6 m (15 ft) below grade surface. After each drop containing waste, dirt was shoveled into the well to shield the gamma radiation. Two vertical pipe units as deep as 15 m (48 ft) may be located near the east end of Trench 18. No information has been found on their contents. Drawing H-2-32487 shows details of many individual burials. Unplanned releases to this site (Table B-2) include a fire in the landfill (UPR-200-W-16), spotty contamination release (UPR-200-W-26), a burial box collapse (UPR-200-W-53), and a release of previously buried waste (UPR-200-W-72). The site was stabilized in 1983.
- **Trenches:** The site contains 21 trenches oriented east to west and six to eight vertical pipe units or drywells. In addition there is a special burial trench at the east end of Trench 11 containing a REDOX column. All trenches are 9 m (30 ft) wide, with 12.2 m (40 ft) between trench centerlines. They range in length from 153 m to 305 m (500 ft to 1000 ft).
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 16,700 m<sup>3</sup> (21,800 yd<sup>3</sup>) dry wastes and some equipment.
  - 35.4 kg Pu, 394,000 kg U. 3,820 Ci Beta-Gamma at burial
- **Source Facilities Contributing More than 5% of Waste by Volume:** 200 West Area, PFP, REDOX

# 218-W-4A



## Characterization

Surface geophysical surveys indicate five trenches were identified in the southern part of 218-W-4A during the geophysical investigation of 218-W-11 in June 2006.

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# DRY WASTE LANDFILLS

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# 218-E-1, Dry Waste-200 East

- **Dates of Waste Receipt:** 1945 to 1953

- **Area:** 0.961 ha (2.37 acres)

- **Historical Documentation Design and Operation:**

In 1974, areas with surface depressions were filled to grade with cinders from the 284-E Powerhouse and topped with gravel. In October 1978, an area of previously buried waste was uncovered at the south end of a trench. The contamination was reburied and covered with clean soil. The entire landfill was surface stabilized with 46 cm (18 in.) of clean soil and vegetated with wheat grass.

- **Trenches:** 15 north-to-south trenches 61 m (200 ft) long, ranging from 5 m to 6 m (16 ft to 20 ft) wide

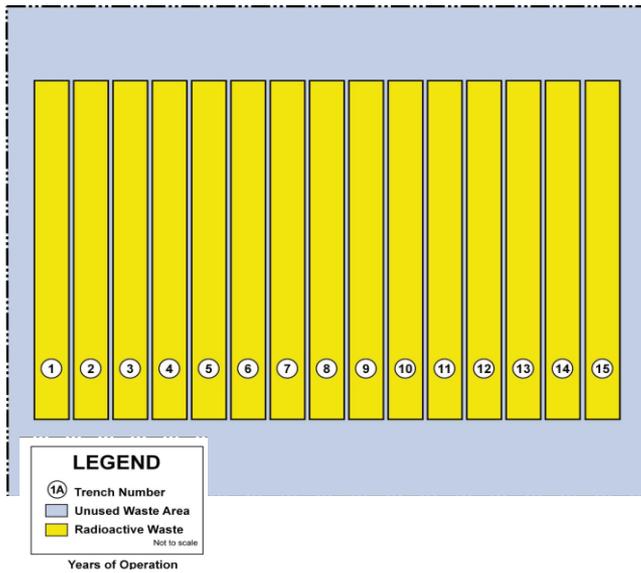
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**

- 3,030 m<sup>3</sup> (2,317 yd<sup>3</sup>) dry waste

- 0.9 kg Pu, 400 kg U. 100 Ci of Beta-Gamma at burial

- **Source Facilities Contributing More than 5% of Waste by Volume:**  
200 East Area – believed to be mainly B-Plant wastes

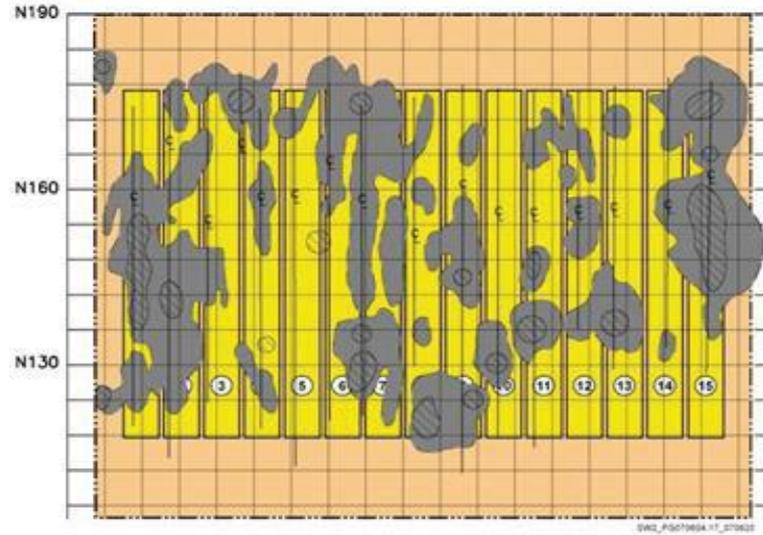
# 218-E-1



## Characterization

Geophysical data indicates that 218-E-1 contains 15 trenches with variable amounts of metallic material contained in each.

The buried material does not appear to be continuous throughout the entire length of most trenches.

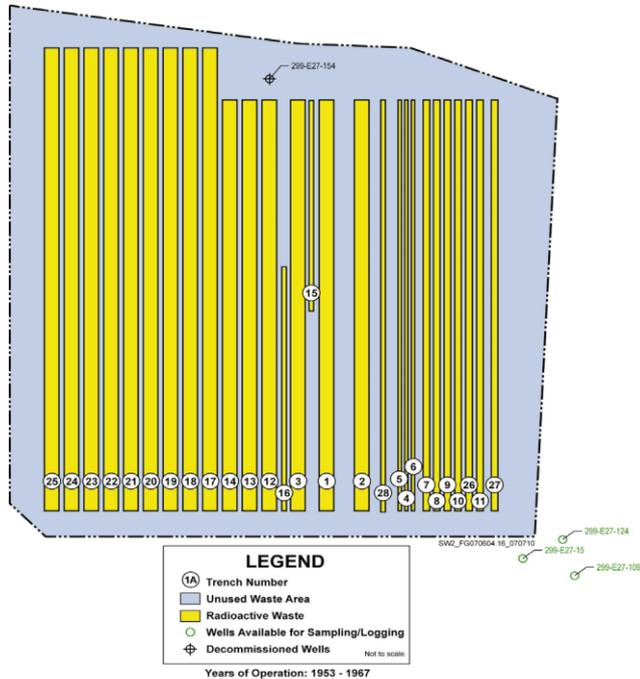


Geophysical Anomalies

# 218-E-12A, Dry Waste-200 East

- **Dates of Waste Receipt:** 1953 to 1967
- **Area 12.1 ha (30.0 acres)**
- **General Description:** The site received cardboard boxes and plastic bags of radioactive waste. Trenches 4 through 11, 15, 16, and 26 through 28 contain acid-soaked material. The specific contents of Trench 28 are not listed. A waste inventory logbook documents burials of tank farm dip tubes, an impact wrench, contaminated cable, jumpers, animal carcasses from 108-F, and an off-site shipment of depleted uranium. The trenches were backfilled, and stabilization occurred in 1979 and 1980. The site was stabilized again in 1994 with 46 cm to 61 cm (19.8 in. to 24 in.) of clean fill.
- **Trenches:** 28 burial trenches
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 15,300 m<sup>3</sup> (20,000 yd<sup>3</sup>) of dry waste
  - 8.9 kg Pu, 995 kg U. 890 Ci Beta-Gamma at burial
- **Source Facilities Contributing More than 5% of Waste by Volume:**  
200 East Area

# 218-E-12A

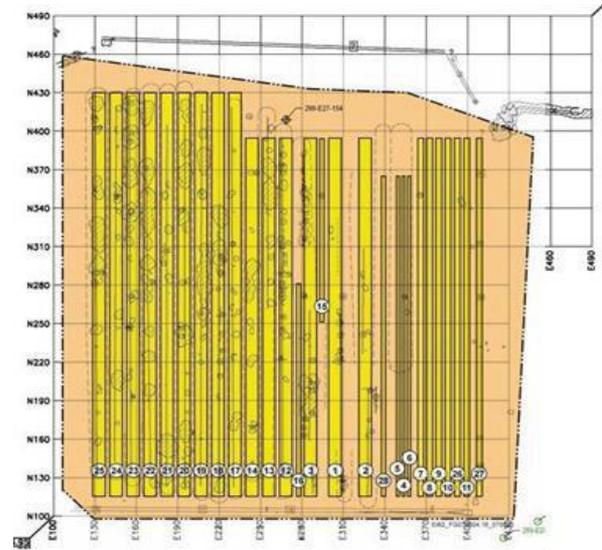


## Geophysical Anomalies

## Characterization

Surface geophysical surveys in all of the dry waste trenches identified concentrations of metallic waste. Because of the depth of burial of the debris in trenches and the marginally favorable soil conditions, it is assumed that there is more debris in the trenches than was detected in the data.

All of the acid trenches are documented as being in the eastern half of the landfill where the soil conditions are least favorable to GPR.



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# CONSTRUCTION LANDFILLS

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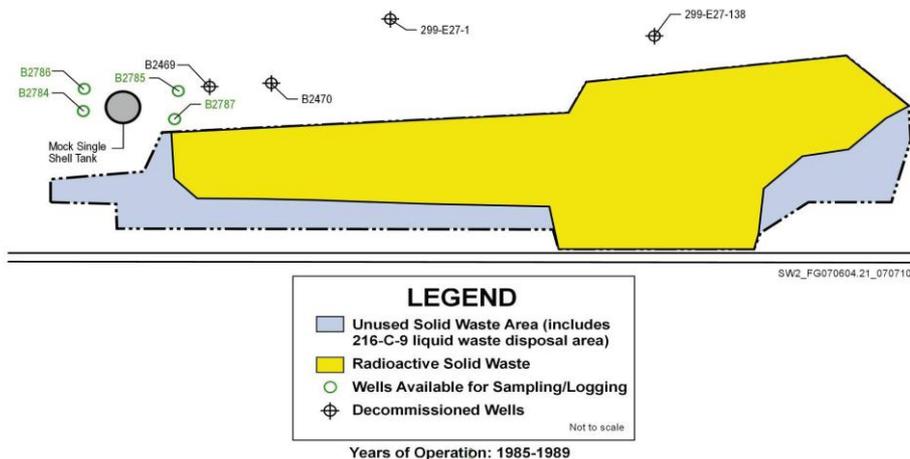
# 218-C-9, Dry Waste

- **Dates of Waste Receipt:** Solid waste burial 1985 to 1989
- **Area:** 1.81 ha (4.46 acres)
- **Historical Documentation Design and Operation:** Site of the dried 216-C-9 Pond. The dried pond was covered with a layer of washed gravel, and material from the deactivation and demolition material of the Hot Semiworks Plant was disposed of. The entire site has been backfilled and surface stabilized. Debris at the site consists of radiologically-contaminated concrete rubble, large equipment, roofing material, metal scrap, and other Hot Semiworks Plant demolition wastes. Contaminated soil from UN-216-E-37 and UN-216-E-39 also was placed in the pit. A routine radiological survey is performed annually.
- **Trenches:** One large pit
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 7,580 m<sup>3</sup> (9,920 yd<sup>3</sup>) of miscellaneous solid debris and soil
  - LLW only
  - no Pu, and less than a milligram of U. 43 Ci of Beta-Gamma at burial
- **Source Facilities Contributing More than 5% of Waste by Volume:** Hot Semiworks (201-C) demolition

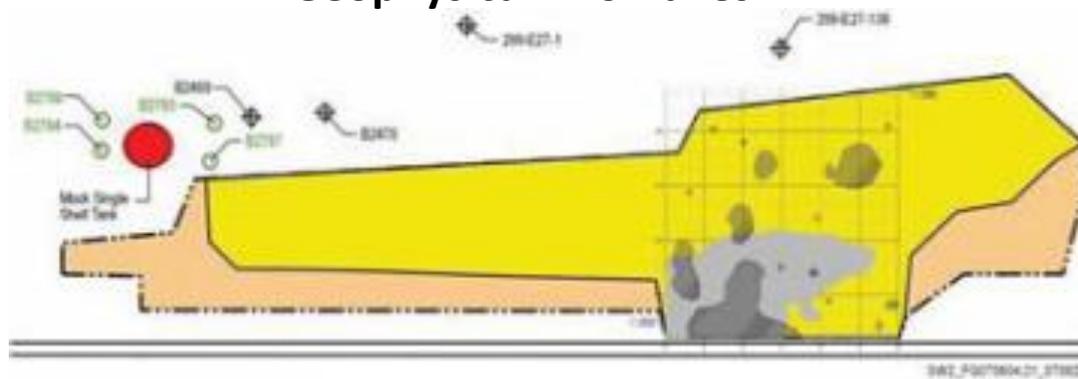
# Characterization 218-C-9

## Characterization

Geophysical data indicates this landfill does not contain large, continuous concentrations of buried objects or debris in well-defined trenches or pits.



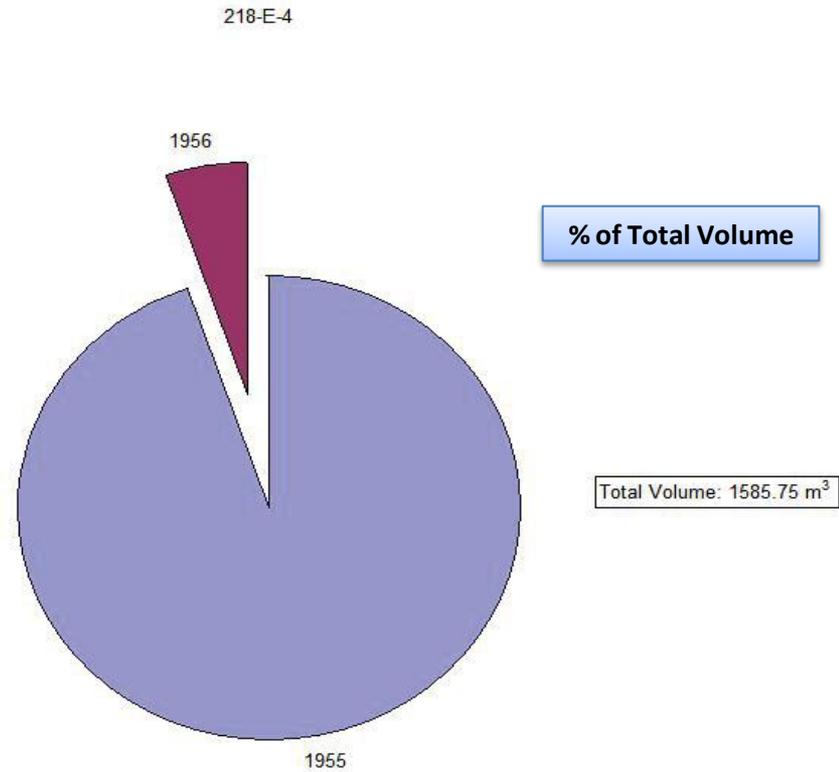
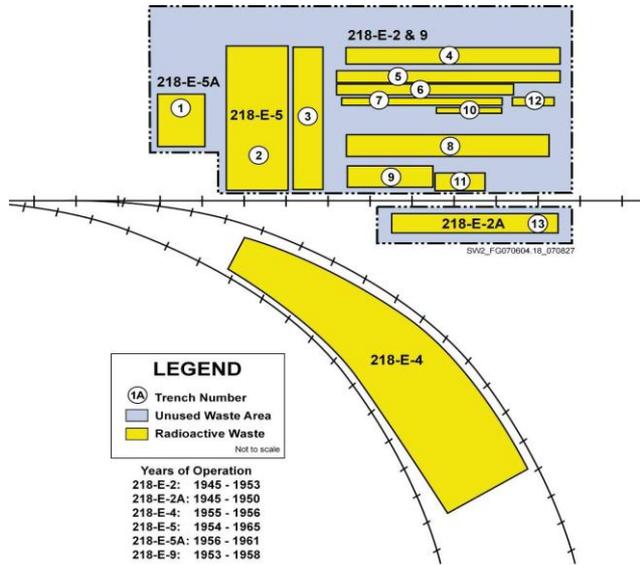
## Geophysical Anomalies



# 218-E-4, Construction

- OU & Category 200-SW-2, past practice
- **Dates of Waste Receipt:** 1955 to 1956
- **Area:** 1.38 ha (3.41 acres)
- **General Description:** The site received repair and construction waste from the 221-B modifications. In June 1960, UPR-200-E-23 occurred and contaminated the area to a maximum reading of 1 rad/h. The site was surface stabilized in 1980 and is posted as Underground Radioactive Material. A radioactive survey is performed annually. The site is co-located with Landfills 218-E-2, 218-E-2A, 218-E-5, 218-E-5A, and 218-E-9.
- **Trenches:** The exact number of trenches remains unknown. It is believed that 2 trenches run parallel to the railroad tracks.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 1,586 m<sup>3</sup> (2,074 yd<sup>3</sup>) of mainly construction debris
  - .01 kg Pu, 1 kg U
  - 10 Ci Beta-Gamma at burial
- **Source Facilities Contributing More than 5% of Waste by Volume:** 200 East Area –(B-Plant [221-B]construction and modification

# 218-E-4



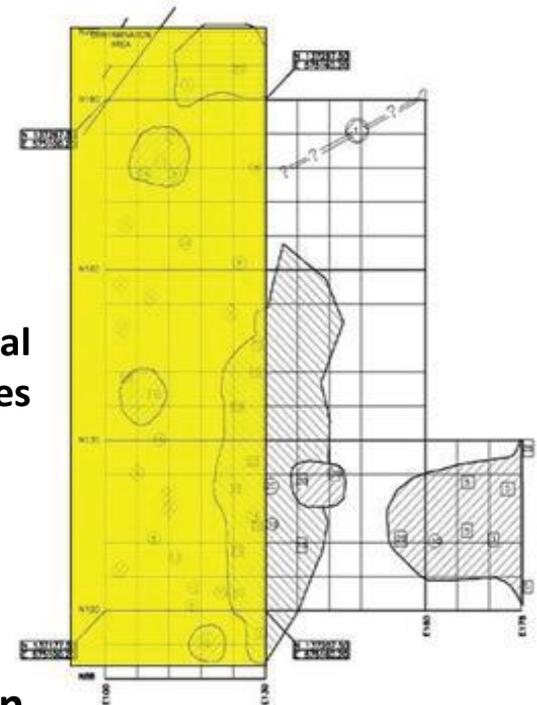
# 218-E-8, Construction-200 East

- **Dates of Waste Receipt:** 1958 to 1959
- **Area:** 0.444 ha (1.10 acres)
- **General Description:** In 1979, contaminated tumbleweed fragments were found that had blown in and accumulated inside the site and along the west boundary. The trenches were backfilled, and the site was surface stabilized in 1980. An annual radiological survey is performed. Debris included construction and repair wastes from 293-A Building and the PUREX crane addition.
- **Trenches:** Consists of an unknown number of trenches.
- **Waste Volume, Pu/U Inventory, and Contaminant Inventory:**
  - 2,265 m<sup>3</sup> (2,963 yd<sup>3</sup>) miscellaneous solid construction debris
  - 0.02 kg Pu, 2 kg U. 10 Ci Beta-Gamma at burial
- **Source Facilities Contributing More than 5% of Waste by Volume:**  
200 East Area - PUREX (202-A and 293-A)

# 218-E-8



## Geophysical Anomalies



## Characterization

Surface geophysical surveys of most of the landfill shows a scattering of anomalies of variable concentrations. A significant pit of buried debris, not fully characterized by this investigation, was located approximately 60 m east of the landfill.

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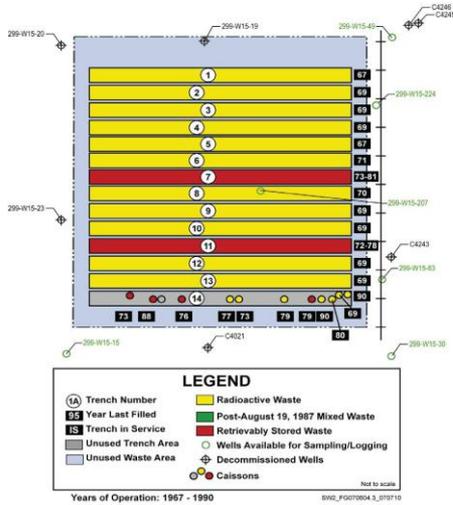
# CAISSONS

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# Caissons

- Vertical Pipe Units in 218-W-4A Burial Ground
  - 21 dry waste trenches oriented east to west
  - Six or eight vertical pipe unit style caissons
  - Group of six vertical pipe units installed near the east end of Trench 16 (five 55-gal drums welded together, lids and bottoms removed, and installed 4.6 m (15 ft) below ground surface)
  - Two deeper vertical pipe caissons may be located between the eastern end of Trenches 17, 18, and 19 and buried to depths of 16 m (48 ft)
- Caissons in 218-W-4B Burial Ground
  - 12 caissons used for disposal of alpha and Mixed Fission Products containing waste
  - Five caissons (alpha caissons) planned for TRU waste and considered out of scope for 200-SW-2
  - From 1970 to 1988, retrievably stored TRU waste placed in four of the five caissons. Caisson Alpha #5 has never been used. These caissons are ~2.7 to 3 m (8.75 to 10 ft) in diameter, 3 m (10 ft) high concrete and steel covered vaults with steel lifting lugs and a 0.9 m (3 ft) diameter access chute, and weigh ~11,800 kg (26,000 lb).
  - Six general (dry waste or MFP) caissons containing LLW were filled from 1968 to 1979. These caissons are 2.4 m (8 ft) in diameter and 3.1 m (10 ft) high. Two of these caissons were constructed the same way as the alpha caissons, except with corrugated metal instead of steel and concrete for the upright cylinder. Last shipment of caisson waste in 218-W-4B was deposited into MFP Caisson #6 in 1990.
  - One caisson is noted as a United Nuclear Industries (UNI) below grade silo-type caisson used for high-activity N Reactor waste. This caisson is 3 m (10 ft) in diameter and 9 m (30 ft) tall with corrugated pipe containers placed on a concrete foundation with a top concrete shielding slab. It has a 1.1 m (3.5 ft) diameter access chute. Waste is placed beneath a concrete slab 4.6 m (15 ft) below grade. The chute of this caisson became plugged shortly after it began receiving waste and was taken out of service.

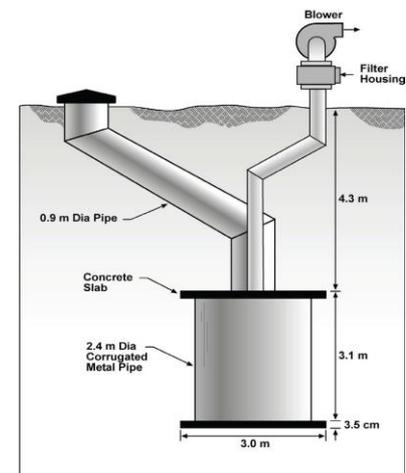
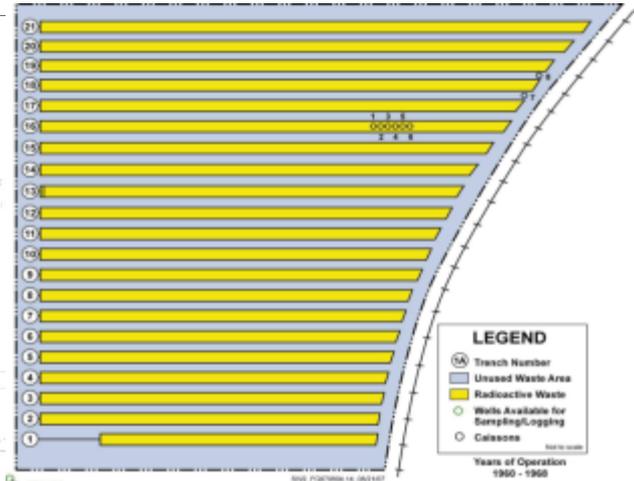
# Caissons



218-W-4B



218-W-4B





*Disposal Practices  
over the Years*

*Nick Ceto  
U.S. DOE - RL*



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# SESSION 6: REGULATORY PROCESS

# RCRA/CERCLA Process

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- Tri-Parties have reached a Tentative Agreement for new TPA Milestones that include 200-SW-2 OU. 200-SW-2 will continue as a stand alone Operable Unit for the purpose of investigation and remedy selection.
  - M-015-93A: Submit revised RFI/CMS/RI/FS<sup>1</sup> Work Plan for the 200-SW-2 OU to Ecology by 12/31/2011
  - M-015-93B: Submit RFI/CMS /RI/FS Report and Proposed Corrective Action Decision (PCAD) / Proposed Plan (PP) to Ecology by 12/13/2016
- Decision documents to select the 200-SW-2 landfill remedy(ies) are to be completed following the public review of the PP and PCAD.
- These will require integration of both RCRA and CERCLA requirements.

<sup>1</sup> RFI/CMS/RI/FS – RCRA Facility Investigation/Corrective Measures Study/Remedial Investigation/Feasibility Study.

# Revising the 200-SW-2 Work Plan

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- First step in decision document development is to revise the 200-SW-2 Work Plan.
- Objectives of the RFI/CMS/RI/FS Report for 200-SW-2 are:
  - Determine the nature and extent of contamination from releases and potential for future releases from the landfills.
  - Identify and evaluate candidate technologies that may be applicable in addressing potential releases.
  - Determine appropriate alternatives to address any known or potential releases.
  - Conduct a comparative analysis of the alternatives using the CERCLA remedy evaluation criteria.
- Work Plan will guide the development of the RFI/CMS/RI/FS Report.

# 200-SW-2 RFI/CMS/RI/FS

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- Objectives of the RFI/CMS/RI/FS Report for 200-SW-2 are:
  - Determine the nature and extent of contamination from releases and potential for future releases from the landfills.
  - Identify and evaluate candidate technologies that may be applicable in addressing potential releases.
  - Determine appropriate alternatives to address any known or potential releases.
  - Conduct a comparative analysis of the alternatives using the CERCLA remedy evaluation criteria.

# Characterization Strategy

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Building on current knowledge from field investigations and historic records review

- Post-1970 landfills generally well documented
- Historical records are extensive, 147,000 records
- Geophysical surveys:
  - Confirmed presences and depth to waste, trench boundaries.
  - Helped to confirm location of metal materials
  - Confirmed locations of trenches
- Radiation surveys beneficial in locating high dose surface contamination
- Passive surface soil vapor, 477 samples assisted in the identifying of location where there may be buried organic contamination
- Inspection of unused TSDs did not identify any waste disposal had occurred.
- Groundwater monitoring results do not indicate that the Low-Level Burial Grounds have contributed to the groundwater contamination

Develop data needs for remediation alternatives development and evaluation based upon current knowledge

# Alternatives Development

- Challenges in Remediation Alternatives Development:
  - The 200-SW-2 landfills since 1999 have been operating under a disposal authorization issued under DOE Order 435.1 and are considered permanent radioactive solid waste disposal sites and are operated and maintained in a manner consistent with this designation.
  - Select Hanford landfills are known to contain materials that are contaminated with long-live radionuclides.
  - The Hanford landfills contain low-level and mixed low-level waste<sup>1</sup>.
    - The non-radiological waste as appropriate is regulated under Ecology's Corrective Action authority.
    - The radiological waste is regulated under DOE's authority.
    - Releases from radioactive and hazardous waste is regulated under CERCLA.
  - Existing data do not indicate there has been a release from the landfills.

<sup>1</sup> The Post-1970 landfills that contain waste that is retrievably stored are outside the scope of 200-SW-2.

Memorandum from **J.J. Fiore and M.W. Frei, DOE Washington, D.C.** to **R.T. French, DOE/Office of River Protection**, and **K.A. Kline, DOE Richland Operations Office**, dated October 25, 1999, *Disposal Authorization Statement for the Hanford Site Low-Level Waste Disposal Facilities*.

# Potential Remediation Alternatives

- No Action alternative.
- Minimize the need for long-term management (RTD) – Unrestricted use at landfill sites.
  - Excavation, treatment (as necessary) and disposal of waste in ERDF landfill and/or off-site with institutional controls (ICs)
  - Excavation, treatment (as necessary) and disposal of waste from sections of individual landfills in ERDF landfill and/or off-site with ICs (targeted RTD)
- Treatment as a primary component – Restricted use at landfill sites with ICs.
  - In-situ treatment (e.g., in-situ vitrification or grouting) of portions of individual landfills
- Containment to prevent potential exposure – Restricted use at landfill sites with ICs.
  - Capping of individual landfills with ICs
- Some combination of the above

# Characteristics of Landfills To Consider in Remedy Selection

(from EPA guidance on presumptive remedies for landfills)

- Key factors identified by EPA<sup>1</sup> in determining if containment as a remedy should be applied to a military landfill include:
  - the size of the landfill (Is it >0.4 ha [>1 acre]?);
  - volume of the landfill (Is it >76,000 m<sup>3</sup> [ >100,000 yd<sup>3</sup>]?)
  - type of landfill contents (Is it mixed heterogeneous waste?);
  - future land use of the area; and
  - the presence, proportion, and distribution of wastes.

<sup>1</sup> EPA Directive No. 9355.0-67FS. EPA/540/F-96/020 Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills. December 1996.

# Remedy Selection Process

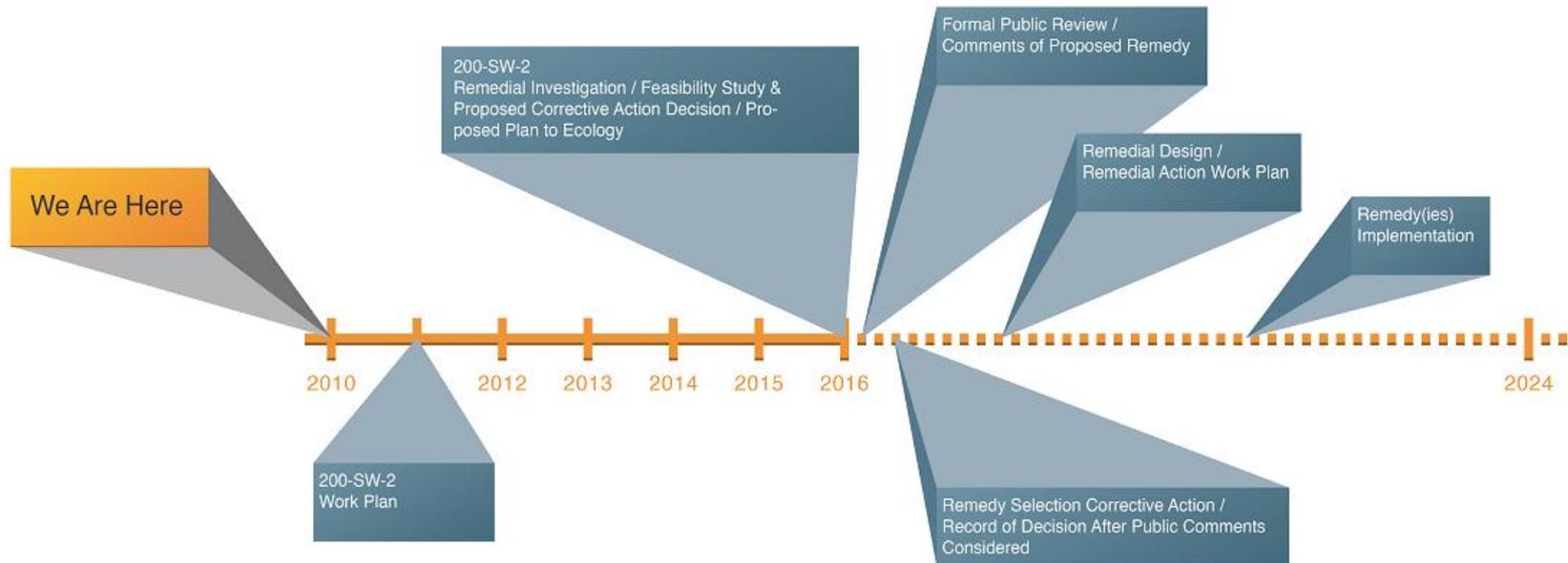
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- Remedy(ies) are defined in PCAD/PP and provided to the public for comment
- Public comment will occur on combined PCAD and CERCLA Proposed Plan
  - Public meetings will be single/joint meetings
  - Single responsiveness summary for public comments
- Corrective Action Decision is made by the State (Ecology)<sup>1</sup>.
- CERCLA ROD is the federal decision (DOE and EPA approve ROD, Ecology concurs)
- Remedial Design/Remedial Action Work Plan

<sup>1</sup> State Dangerous Waste Regulations and the Model Toxics Control Act do not include cleanup standards for radionuclides

# We are Early in the RCRA/CERCLA Decision Process

Timeline for 200-SW-2 Remedy Selection





1955



2004



1961

*Disposal Practices  
over the Years*

*Deborah Singleton  
Washington State  
Department of Ecology*

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# SESSION 6: REGULATORY PROCESS

# Regulation of the Radioactive Solid Waste Landfills

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- Tri-Party Agreement commitment
- CERCLA
- RCRA/CERCLA Integration

# Regulation of Radioactive Solid Waste Landfills

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- Complete the Following Commitments:
  - Revision of Work Plan
    - Due December 31, 2011
  - Complete RI/FS Process
    - Due December 31, 2016

# Regulation of “active” and “inactive” landfills

## Active Landfills

- Trench 31 and 34
- Trench 94
- Never Used

## Inactive Landfills

- Received dangerous/radioactive waste after 1987
- Did not receive dangerous/radioactive waste after 1987

# Washington laws & regulations

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- Washington Hazardous Waste Management Act
  - Administrative Code (WAC) 173-303
  - Operation of units that treat, store or dispose (**TSD**) of dangerous wastes
  - Closure of TSDs
  - Corrective Action