DOE/RL-2007-02-VOLII-ADD5
Revision 0

# Site-Specific Field-Sampling Plans for 216-A-5 Crib and 216-S-1 & 2 Cribs, 200-PW-2/4 Operable Unit (Addendum 5)



Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

**United States Department of Energy**
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*Richland, Washington 99352*



Attached to: 0076860

DOE/RL-2007-02-VOLII-ADD5
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# Site-Specific Field-Sampling Plans for 216-A-5 Crib and 216-S-1 & 2 Cribs, 200-PW-2/4 Operable Unit

## (Addendum 5)

Date Published
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Assistant Secretary for Environmental Management

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*P.O. Box 550*
*Richland, Washington 99352*

J. D. Aardal 03/03/2008
Release Approval Date

Approved for Public Release;
Further Dissemination Unlimited

# VOLUME II ADDENDA

***(Each addendum consists of one or more site-specific field-sampling plans)***

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## FIGURES



## TABLES

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## APPROVAL PAGE

**Title:** Supplemental Remedial Investigation Work Plan for the 200 Areas Central Plateau Operable Units, Volume II, Addenda

Addendum 5 – Site-Specific Field-Sampling Plans for 216-A-5 Crib and 216-S-1&2 Cribs

**Approval:** U.S. Department of Energy, Richland Operations Office

Signature Date

U.S. Environmental Protection Agency

Signature Date

Lead Regulatory Agency:

☐ U.S. Environmental Protection Agency

☒ Washington State Department of Ecology

Signature Date

The approval signatures on this page indicate that this document has been authorized for information release to the public through appropriate channels. No other forms or signatures are required to document this information release.

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## TERMS

| | |
|---|---|
| bgs | below ground surface |
| CCU | Cold Creek unit |
| COPC | contaminant of potential concern |
| DG-S | downhole geophysics-spectral |
| DG-SC | downhole geophysics-scintillation |
| Ecology | Washington State Department of Ecology |
| ERC | electrical resistivity characterization |
| FH | Fluor Hanford, Inc. |
| GL | geologic log |
| $H_f$ | Hanford formation |
| HRR | high-resolution resistivity |
| MESC/MNA/IC | Maintain Existing Soil Cover, Monitored Natural Attenuation, Institutional Controls |
| N/A | not applicable |
| NPH | normal paraffin hydrocarbon |
| PUREX | Plutonium-Uranium Extraction (Plant or process) |
| $R_E$ | Ringold Formation, Unit E |
| REDOX | Reduction-Oxidation (Plant or process) |
| RL | U.S. Department of Energy, Richland Operations Office |
| RPP | RCRA past practice |
| SAP | sampling and analysis plan |
| TBP | tributyl phosphate |
| TD | total depth of borehole |
| WIDS | *Waste Information Data System* database |

## METRIC CONVERSION CHART

| Into Metric Units | | | Out of Metric Units | | |
|---|---|---|---|---|---|
| *If you know* | *Multiply by* | *To get* | *If you know* | *Multiply by* | *To get* |
| **Length** | | | **Length** | | |
| Inches | 25.40 | millimeters | millimeters | 0.0394 | inches |
| Inches | 2.54 | centimeters | centimeters | 0.394 | inches |
| Feet | 0.305 | meters | meters | 3.281 | feet |
| Yards | 0.914 | meters | meters | 1.094 | yards |
| miles (statute) | 1.609 | kilometers | kilometers | 0.621 | miles (statute) |
| **Area** | | | **Area** | | |
| sq. inches | 6.452 | sq. centimeters | sq. centimeters | 0.155 | sq. inches |
| sq. feet | 0.0929 | sq. meters | sq. meters | 10.764 | sq. feet |
| sq. yards | 0.836 | sq. meters | sq. meters | 1.196 | sq. yards |
| sq. miles | 2.591 | sq. kilometers | sq. kilometers | 0.386 | sq. miles |
| Acres | 0.405 | hectares | hectares | 2.471 | acres |
| **Mass (weight)** | | | **Mass (weight)** | | |
| ounces (avoir) | 28.349 | grams | grams | 0.0353 | ounces (avoir) |
| Pounds | 0.454 | kilograms | kilograms | 2.205 | pounds (avoir) |
| tons (short) | 0.907 | Ton (metric) | ton (metric) | 1.102 | tons (short) |
| **Volume** | | | **Volume** | | |
| Teaspoons | 5 | milliliters | milliliters | 0.034 | ounces (U.S., liquid) |
| Tablespoons | 15 | milliliters | liters | 2.113 | pints |
| ounces (U.S., liquid) | 29.573 | milliliters | liters | 1.057 | quarts (U.S., liquid) |
| Cups | 0.24 | liters | liters | 0.264 | gallons (U.S., liquid) |
| Pints | 0.473 | liters | cubic meters | 35.315 | cubic feet |
| quarts (U.S., liquid) | 0.946 | liters | cubic meters | 1.308 | cubic yards |
| gallons (U.S., liquid) | 3.785 | liters | | | |
| cubic feet | 0.0283 | cubic meters | | | |
| cubic yards | 0.764 | cubic meters | | | |
| **Temperature** | | | **Temperature** | | |
| Fahrenheit | (°F-32)*5/9 | Centigrade | Centigrade | (°C*9/5)+32 | Fahrenheit |
| **Radioactivity** | | | **Radioactivity** | | |
| Picocurie | 37 | millibecquerel | millibecquerel | 0.027 | picocurie |

## AD5-1.0 INTRODUCTION

Addendum 5 of Work Plan Volume II contains the site-specific field-sampling plans for the 216-A-5 Crib and 216-S-1&2 Cribs in the 200-PW-2 Operable Unit. The site-specific field-sampling plans in this addendum provide site-specific information regarding the waste sites including detailed sampling location maps, detailed sampling strategy (i.e., number and location of samples, analytes, and sampling and analytical methods), and the interpreted site conceptual models for each site. These requirements have been determined by the Tri-Parties (U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Ecology) and documented via the data quality objectives process in the data-needs priority summary tables (Volume I, Appendix C).

Volume I of the supplemental work plan includes the overarching supplemental sampling and analysis plan (SAP), which supports the remedial investigation/feasibility study process for all of the supplemental waste sites (Volume I, Appendix A). Data collected under the overarching SAP will be used to support completion of the remedial investigation/feasibility study process for the 216-A-5 and 216-S-1&2 Cribs. The overarching SAP includes the field-sampling plan, which contains investigative strategies for a range of sampling techniques; the health and safety plan; and the quality assurance project plan, which establishes quality requirements for the supplemental investigation activities. For radioactive samples, as low as reasonably achievable principles may limit the amount of sample the laboratory can process for analysis. This may result in elevated levels of detection (greater than the Required Detection Limits listed in Tables A2-1 and A2-2 of DOE/RL-2007-02, Volume I) and provide limitations on the analytical batch quality control analyses that can be completed. The overarching SAP also includes the list of contaminants of potential concern identified for each of the supplemental waste sites (Volume I, Appendix A, Table A2-3). The overarching SAP was approved by the Tri-Parties to support all supplemental waste-site sampling activities.

Together with the elements of the overarching SAP (Volume I, Appendix A), the site-specific field-sampling plans presented in this addendum complete the SAP for the 216-A-5 and 216-S-1&2 Cribs waste sites. This addendum is part of the supplemental work plan and is considered a component of that primary document under Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order.*

Activities associated with surface geophysical resistivity characterization or high-resolution resistivity (HRR) (now referred to as electrical resistivity characterization [ERC]), identified in Volume I, Appendix C, are completed and, therefore, not discussed in this addendum. ERC results will be reported in separate reports by the ERC contractor. ERC results for the area surrounding A-5 Crib are reported in hydroGeophysics, 2005, *Geophysical Results for the PUREX Plant A-4 Cribs Area.* ERC areas are not included in the figures of this addendum, as they extend beyond the waste site boundaries, but can be accessed from their corresponding reports.

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## AD5-2.0 216-A-5 CRIB SITE-SPECIFIC FIELD-SAMPLING PLAN

The following figures and tables provide the site-specific field-sampling plan for the 216-A-5 Crib.

Figure AD5-1. 216-A-5 Crib Data-Collection Locations.

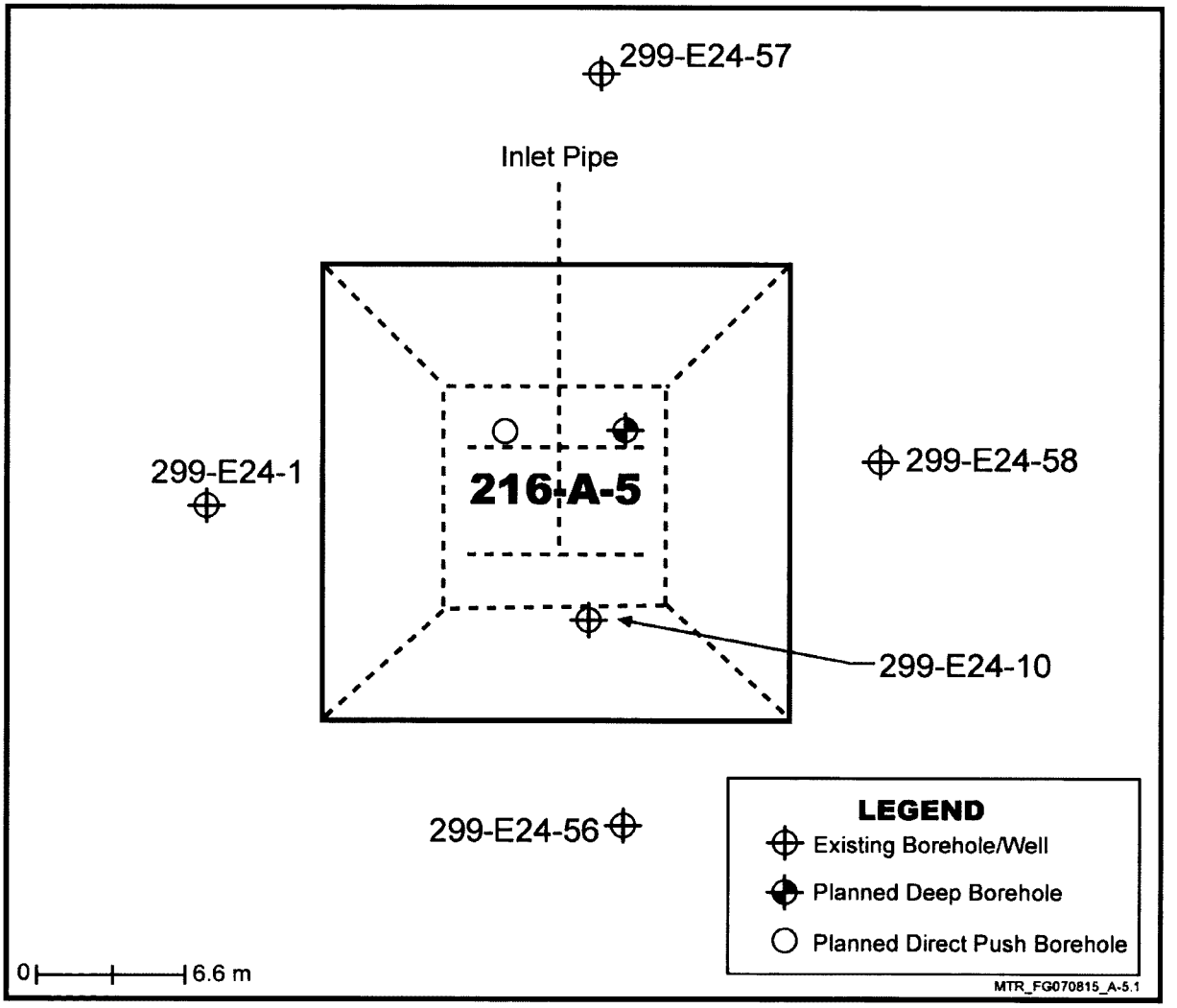
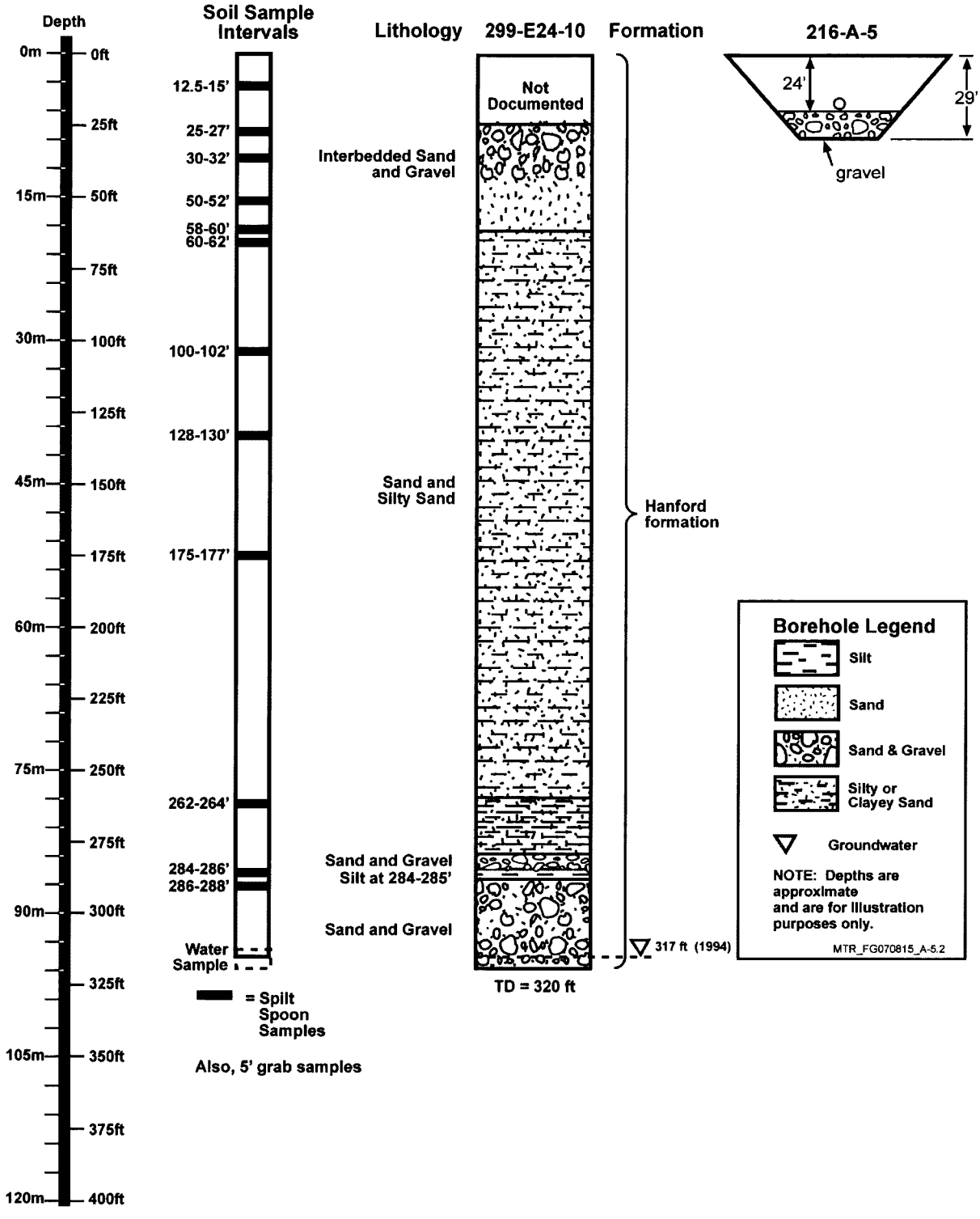


Figure AD5-2. 216-A-5 Crib Estimated Stratigraphy and Proposed Sample-Collection Intervals.




TD = total depth of borehole.

Table AD5-1. 216-A-5 Crib Sampling Plan. (3 Pages)

| Sample Collection Methodology | Sample Location | Maximum Depth of Investi-gation | Sample Interval Depth (ft bgs) [a] | Analyte List [b] | Physical Properties | |
|---|---|---|---|---|---|---|
| | | | | | Sample Interval | Parameters |
| Direct-push technology – cone penetrometer | One direct push through center of the crib. Refer to Figure AD5-2. | 60 ft | Grab sample from 60 ft bgs or bottom of push (whichever is deeper) | 200-PW-2 OU COPC analytes are presented in Volume 1, Table A2-3.<br>Analytical performance requirements are presented in Volume 1, Table A2-4 for vadose-zone porewater. | Bottom of push | Moisture content, particle size distribution |
| Vadose-zone characterization borehole – cable tool with split-spoon sediment core sampler | One deep borehole near center of crib. Refer to Figure AD5-2. | To ~5 ft below the water table (~325 ft bgs or the depth of the water table +5 ft). | Spit-spoon core samples collected at:<br>12.5-15 ft bgs<br>25-27 ft bgs<br>30-32 ft bgs<br>50-52 ft bgs<br>58-60 ft bgs<br>60-62 ft bgs<br>100-102 ft bgs<br>128-130 ft bgs<br>175-177 ft bgs<br>262-264 ft bgs<br>284-286 ft bgs<br>286-288 ft bgs | 200-PW-2 OU COPC analytes are presented in Volume 1, Table A2-3.<br>Analytical performance requirements are presented in Volume 1, Table A2-4 for vadose-zone porewater. | All split-spoon sediment core samples | pH, specific conductance, moisture content, bulk density, particle size distribution |
| | | | Collect 5-ft interval grab samples starting at 35 ft bgs (beneath interval of high rad. contamination) and continuing to TD.<br>Perform extraction analysis on selected (~15) grab samples. | COPC analytes are presented in Volume 1, Table A2-3.<br>Analytical performance requirements are presented in Volume 1, Table A2-4 for vadose-zone porewater. | 15 selected samples. Sample determination based on site-specific results, borehole and geophysical data, and radiological and health and safety info. | Moisture content, particle size distribution |

Table AD5-1. 216-A-5 Crib Sampling Plan. (3 Pages)

| Sample Collection Methodology | Sample Location | Maximum Depth of Investi-gation | Sample Interval Depth (ft bgs) [a] | Analyte List [b] | Physical Properties | |
|---|---|---|---|---|---|---|
| | | | | | Sample Interval | Parameters |
| One water sample collected from top of aquifer in bottom of characterization borehole [c] | Bottom of deep borehole located center of crib. | 325 ft bgs or TD | 1 groundwater sample near the water table at TD | 200-PO-1 OU COPC analytes for groundwater are presented in DOE/RL-2007-31, Table A3-2. | N/A | N/A |
| Number of split-spoon samples [d] | 12 | N/A | N/A | N/A | N/A | N/A |
| Approximate number of field quality-control samples [e] | 2 | N/A | N/A | N/A | N/A | N/A |
| Approximate number of sediment grab samples collected | 59 | N/A | N/A | N/A | N/A | N/A |
| Total number of soil samples (split-spoon and grab samples) initially analyzed [d] | 27 | N/A | N/A | N/A | N/A | N/A |
| Approximate number of groundwater samples analyzed | 1 | N/A | N/A | N/A | N/A | N/A |
| **Non-Sample Data Collection Methodology** | **Sample Location** | **Maximum Depth of Investi-gation** | **Sample Interval Depth (ft bgs) [a]** | **Analyte List [b]** | **Physical Properties** | |
| | | | | | **Sample Interval** | **Parameters** |
| Two dedicated downhole electrodes | In deep borehole | Mid-vadose depth in lower Hanford Interval. | One probe each at ~180 and ~285 ft bgs | N/A | N/A | N/A |

Table AD5-1. 216-A-5 Crib Sampling Plan. (3 Pages)

| Sample Collection Methodology | Sample Location | Maximum Depth of Investi-gation | Sample Interval Depth (ft bgs) [a] | Analyte List [b] | Physical Properties | |
|---|---|---|---|---|---|---|
| | | | | | Sample Interval | Parameters |
| Downhole high-resolution spectral gamma and neutron moisture geophysical logging | Log the direct-push borehole and the deep borehole | To TD | Surface to TD in each borehole | Evaluate for manmade gamma-emitting radioisotopes and anomalous vadose-zone moisture. | N/A | N/A |

[a]Actual sampling depths may vary depending on the amount of backfill/overburden used in interim stabilization at the waste site, field-screening results, and varying subsurface conditions.
[b]See Volume 1, Appendix A, Tables A2-1, A2-2, A2-3, A2-5, and A3-2 for detection limits and other analytical parameters.
[c]One groundwater sample will be collected in support of the 200-PO-1 Groundwater Operable Unit and analyzed for OU specific COPCs.
[d]Total number of soil samples analyzed includes 12 split-spoon samples and 15 grab samples. Determination of which subset of grab samples to analyze will be based on the new push and borehole geologic and geophysical log data, and health and safety and radiological screening info.
[e]One duplicate and one equipment blank.

DOE/RL-2007-31, *Remedial Investigation/Feasibility Study Work Plan for the 200-PO-1 Groundwater Operable Unit.*

bgs = below ground surface.
COPC = contaminant of potential concern.
N/A = not applicable.
OU = operable unit.
TD = total depth of borehole.

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Figure AD5-3. 216-A-5 Crib Conceptual Model and Data Summary.

**200-PW-2 Operable Unit**
**Waste Type: Process Effluent**

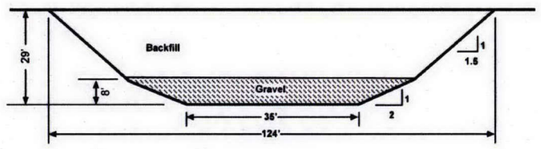
# 216-A-5 Crib

**PUREX Zone**

## History

This crib received acidic process condensate from the 202-A Building from December 1955 through November 1961. After 1961, the crib was used as a back-up waste site for the 216-A-10 Crib. The 216-A-5 Crib received additional waste in October 1966. In November 1983, the site was surface stabilized when the PUREX exclusion area fences were installed. The site was deactivated by valving out the effluent piping to the unit and rerouting the effluent to the 216-A-10 Crib. (WIDS)

**CONSTRUCTION:** The unit consists of a 20 cm (8-in.) vitrified clay pipe placed horizontally, 7.3 m (24 ft) below grade and two 10.7 m (35 ft) lengths of 20 cm (8-in.) vitrified clay pipe placed perpendicular to the first pipe, forming an "H" pattern. The site is backfilled with approximately 2.4 m (8 ft) of coarse rock fill with a volume of 595 m³ (21,000 ft³). The side slope from the surface to 7.3 m (24 ft) deep is 1:1.5 and from 7.3 m (24 ft) to the bottom, 2:1. (WIDS)




**WASTE VOLUME:** 1,630,000,000 L (WIDS)

**DURATION:** 1955 to 1966 (WIDS)

**ESTIMATED DISCHARGED INVENTORY (RPP-26744):**

| | |
|---|---|
| U-Total | 198.2 kg |
| H-3 | 17,080 Ci |
| Tc-99 | 0.3065 Ci |
| Pu-239 | 32.59 Ci |
| Pu-240 | 6.553 Ci |
| NO3 | 1,071,000 kg |
| Cs-137 | 11.61 Ci |

**REFERENCES/BIBLIOGRAPHY:**

DOE/RL-2000-60
DOE/RL-2004-25
DOE/RL-2004-85
RHO-CD-673
RPP-26744
WIDS general summary reports.

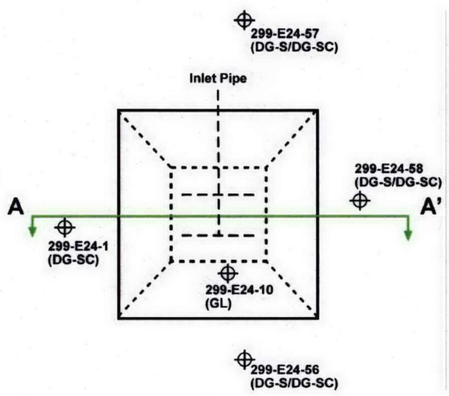
bgs = below ground surface.
PUREX = Plutonium-Uranium Extraction (Plant or process).
WIDS = *Waste Information Data System* database.

## Basis of Knowledge (Data Types)

- Process History
- Downhole Geophysics – Spectral (DG-S)
- Downhole Geophysics – Scintillation (DG-SC)
- Geologic Logs (GL)

## Site Plan View

**(not to scale)**




**Legend**

⊕ = Existing borehole (data type).

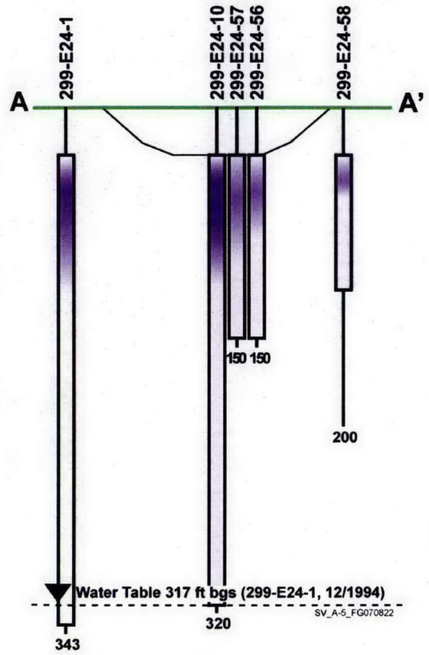
▼ = Groundwater surface.

## Characterization Summary

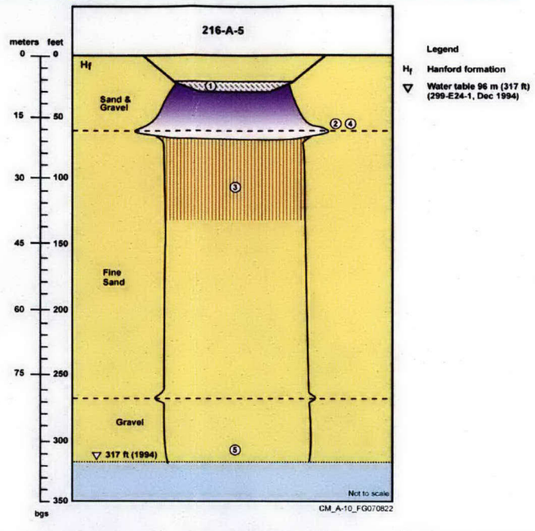
Characterization of the 216-A-5 Crib was performed under DOE/RL-2004-25. The 216-A-5 Crib is an analogous site assigned to the 216-A-10 Crib. Four older existing boreholes surrounding the crib were geophysically logged. Presently, the maximum detected concentration of Cs-137 is 314 pCi/g at 17.7 m (58 ft) bgs.

## Site Section View

**(not to scale)**




## Conceptual Contaminant Distribution Model




1. Acidic process condensate wastes were discharged to the 216-A-5 Crib between 1955 and 1961. The crib received a total volume of 1.63 x $10^9$ L (4.3 x $10^8$ gal) of wastewater. The effluent contained uranium, Cs-137, Eu-154, plutonium, tritium, Am-241, I-129, and nitric acid.
2. Effluent and contaminants were released to the environment from a buried vitrified clay pipe approximately 7.3 m (24 ft) bgs within a gravel-filled drain field that extended to approximately 8.8 m (29 ft) bgs. The wetting front and contaminants moved vertically down beneath the crib. Moderate lateral spreading existed as evidenced by residual Cs-137 contamination detected in boreholes surrounding the crib at a depth of approximately 17.7 m (58 ft) bgs.
3. The zone of greatest contamination is detected at well 299-E24-10, located in the center of the crib, to a depth of approximately 29 m (95 ft). Contaminants that are immobile, such as Cs-137, sorb to soils near the bottom of the crib. Cesium-137 concentrations are highest (314 pCi/g) at 17.7 m (58 ft) bgs. Contaminants that are moderately mobile, such as Eu-154 and Co-60, were present deeper in the vadose zone at low concentrations, but have decayed to near the detection level. The most mobile contaminants, such as nitrate, moved with the moisture front and probably are present throughout the vadose zone.
4. If additional lateral spreading occurred within the vadose zone, it is likely to be constrained by the contact between the overlying Hanford coarse sand and gravel and the finer grained silty sand sediments beneath.
5. Wastewater and mobile contaminants likely impacted groundwater because the effluent volume discharged to the soil column (1,630,000 m³ [57,562,594 ft³]) is greater than the soil pore volume (2,347m³[82,883 ft³]).

Table AD5-2. Data Needs Priority Summary – Model Group 2 – 216-A-5 Crib (200-PW-2/4) (RL/FH) (RPP) (Ecology). (2 Pages)

**Background**

| | |
|---|---|
| Site Identification | 216-A-5 |
| Site Location | 200 East Area, PUREX Zone, south of PUREX |
| Type of Site | Crib |
| Operating History | The crib is marked and posted with Underground Radioactive Material signs. The crib received acidic process condensate from the 202-A Building from December 1955 through November 1961. After 1961, the crib was used as a back-up waste site for the 216-A-10 Crib. The 216-A-5 Crib received additional waste in October 1966.<br>The unit consists of a 20 cm (8-in.) vitrified clay pipe placed horizontally, 7.3 m (24 ft) below grade and two 10.7 m (35-ft) lengths of 20 cm (8-in.) vitrified clay pipe placed perpendicular to the first pipe, forming an "H" pattern. The site is backfilled with approximately 2.4 m (8 ft) of coarse rock fill with a volume of 595 $m^3$ (21,000 $ft^3$). The side slope from the surface to 7.3 m (24 ft) deep is 1:1.5 and from 7.3 m (24 ft) to the bottom, 2:1. In November 1983, the site was surface stabilized when the PUREX exclusion area fences were installed. The site was deactivated by valving out the effluent piping to the unit and rerouting the effluent to the 216-A-10 Crib (*Waste Information Data System* database).<br>Site received approximately 1.63 billion L (430 million gal) of acidic process condensate containing nitric acid, uranium, and other fission products. The waste inventory at time of discharge included total uranium (263 kg), total plutonium (965 g), Cs-137 (25 Ci), strontium (90 Ci), and nitrate (1 million kg). (These inventory values differ from those given in the table below because of different sources. The text values are from the *Waste Information Data System* database and the table values are from RPP-26744.)<br>Site Inventory Model 216-A-5 Crib inventory (some constituents of interest highlighted) (RPP-26744) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Na (kg)<br>1.665E+04 | Al (kg)<br>0.000E+00 | Fe (kg)<br>1.847E+03 | Cr (kg)<br>0.000E+00 | Bi (kg)<br>0.000E+00 | La (kg)<br>0.000E+00 | Hg (kg)<br>0.000E+00 | Zr (kg)<br>0.000E+00 | Pb (kg)<br>0.000E+00 |
| Ni (kg)<br>0.000E+00 | Ag (kg)<br>0.000E+00 | Mn (kg)<br>0.000E+00 | Ca (kg)<br>0.000E+00 | K (kg)<br>0.000E+00 | **NO3 (kg)**<br>**1.071E+06** | NO2 (kg)<br>0.000E+00 | CO3 (kg)<br>0.000E+00 | PO4 (kg)<br>0.000E+00 |
| SO4 (kg)<br>9.210E+03 | Si (kg)<br>0.000E+00 | F (kg)<br>0.000E+00 | Cl (kg)<br>1.649E+05 | CCl4 (kg)<br>0.000E+00 | Butanol (kg)<br>0.000E+00 | TBP (kg)<br>0.000E+00 | NPH (kg)<br>0.000E+00 | NH3 (kg)<br>0.000E+00 |
| Fe(CN)6 (kg)<br>0.000E+00 | **H-3 (Ci)**<br>**1.708E+04** | C-14 (Ci)<br>9.979E-03 | Ni-59 (Ci)<br>2.502E-03 | Ni-63 (Ci)<br>2.328E-01 | Co-60 (Ci)<br>5.038E-02 | Se-79 (Ci)<br>9.770E-04 | Sr-90 (Ci)<br>3.033E+01 | Y-90 (Ci)<br>3.034E+01 |
| Zr-93 (Ci)<br>5.823E-02 | Nb-93m (Ci)<br>4.839E-02 | **Tc-99 (Ci)**<br>**3.065E-01** | Ru-106 (Ci)<br>1.551E-08 | Cd-113m (Ci)<br>5.151E-02 | Sb-125 (Ci)<br>7.625E-03 | Sn-126 (Ci)<br>4.040E-03 | I-129 (Ci)<br>9.632E-01 | Cs-134 (Ci)<br>2.918E-06 |
| Cs-137 (Ci)<br>1.161E+01 | Ba-137m (Ci)<br>1.096E+01 | Sm-151 (Ci)<br>2.999E+01 | Eu-152 (Ci)<br>4.479E-03 | Eu-154 (Ci)<br>3.329E-01 | Eu-155 (Ci)<br>1.521E-01 | Ra-226 (Ci)<br>6.047E-05 | Ra-228 (Ci)<br>3.728E-10 | Ac-227 (Ci)<br>2.696E-04 |
| Pa-231 (Ci)<br>3.840E-04 | Th-229 (Ci)<br>1.003E-06 | Th-232 (Ci)<br>3.843E-10 | U-232 (Ci)<br>4.421E-06 | U-233 (Ci)<br>3.105E-05 | U-234 (Ci)<br>6.454E-02 | U-235 (Ci)<br>2.761E-03 | U-236 (Ci)<br>1.425E-03 | U-238 (Ci)<br>6.616E-02 |
| **U-Total (kg)**<br>**1.982E+02** | Np-237 (Ci)<br>1.312E+00 | Pu-238 (Ci)<br>8.079E-01 | **Pu-239 (Ci)**<br>**3.259E+01** | **Pu-240 (Ci)**<br>**6.553E+00** | Pu-241 (Ci)<br>2.881E+01 | Pu-242 (Ci)<br>2.055E-04 | Am-241 (Ci)<br>4.301E+01 | Am-243 (Ci)<br>1.979E-02 |
| Cm-242 (Ci)<br>2.364E-01 | Cm-243 (Ci)<br>4.635E-03 | Cm-244 (Ci)<br>1.227E-01 | | | | | | |

| | |
|---|---|
| Vicinity Waste Sites | 216-A-10 Crib; 216-A-15 French Drain; 216-A-36A Crib; B 216-A-31 Crib |
| Current Status | Analogous site; assigned to 216-A-10 Crib; evaluated in 200-PW-2/4 feasibility study (DOE/RL-2004-85) ; capping identified as preferred alternative in feasibility study |

**Potential Remedial Alternatives**

| X for viable alternatives | **No Action** | **MESA/MNA/IC** | **Removal/Disposal** | **Barrier** | **Partial Removal/Barrier** | **In Situ Treatment** | **Other** |
|---|---|---|---|---|---|---|---|
| | No. Contamination present above levels of concern. | X | No. Contamination starts at 35 ft deep, beyond viable excavation depth. | X | No. Contamination starts at 35 ft deep, beyond viable excavation depth. | No. Contamination starts at 35 ft deep and may extend beyond viable treatment depth | |

Table AD5-2. Data Needs Priority Summary – Model Group 2 – 216-A-5 Crib (200-PW-2/4) (RL/FH) (RPP) (Ecology). (2 Pages)

| **Data Evaluation and Gaps Analysis** | | | |
|---|---|---|---|
| **Data** | **Knowns** | **Data Uncertainties** | **Are supplemental data required to support decision making?** |
| Borehole sampling at 299-E24-1 (320 ft)<br>5 geophysical logs at:<br>299-E24-56 (150 ft), spectral, 2005<br>299-E24-57 (150 ft), spectral 2005<br>299-E24-58 (200 ft), spectral, 2005<br>299-E24-1 (dated 1963, 1970, and 1975) and 299-E24-10 (dated 1987) also have historic scintillation profiles | *Soil Samples:*<br>299-E24-1; located 3 m (10 ft) west of 216-A-5 Crib<br>Samples collected in 1966 from well 299-E24-1 show Cs-137 concentrations of 4,400 pCi/g at 10.7 m (35 ft) decreasing to 100 pCi/g at 19.8 m (65 ft); near detection limit of 10 pCi/g throughout most of the remaining soil column.<br>Strontium-90 was below the detection limit of 32 pCi/g.<br>*Geophysical Logging*<br>299-E24-56; located 4 m (13 ft) south of 216-A-5 Crib<br>Cesium-137 was detected in a zone from 17.3 to 18.0 m (57 to 59 ft) with a maximum concentration of 8 pCi/g. Europium-154 and Co-60 also were detected in this zone at concentrations less than 1.0 pCi/g. Moisture in the well is variable; elevated moisture appears to be associated with zone of contamination.<br>299-E24-57; located 8 m (26 ft) north of 216-A-5 Crib<br>Similar to 299-E24-56, Cs-137 was detected in a zone from 16.8 to 19.8 m (55 to 65 ft) at a maximum concentration of 314 pCi/g at 17.7 m (58 ft). Europium-154 also was detected in this zone with a maximum concentration of 2 pCi/g at 19.2 m (63 ft).<br>Elevated gamma activity observed at 129 ft coincides with an elevated moisture zone measured at 39.8 m (130.5 ft).<br>299-E24-58; located 4 m (13 ft) east of 216-A-5 Crib<br>Cesium-137 was detected in a zone from 17.7 to 18.3 m (58 to 60 ft) and at 19.8 m (65 ft). The maximum concentration of 3 pCi/g was observed at 18.0 (59 ft).<br>Europium-154 was detected sporadically near the method detection limit of 0.2 pCi/g.<br>Elevated moisture was seen at 48.8 and 53.3 m (160 and 175 ft). | Site-specific data from the crib<br>Nature of elevated conductivity plume identified through HRR surveys | Yes. Because of the uncertainties identified at the 216-A-4 Crib and the potential contribution by the 216-A-5 Crib to the apparent elevated conductivity plume on the western side of the south of PUREX area, supplemental data could help provide a better understanding of deep-zone contaminants and their potential to impact groundwater. These data also would support validation of the HRR results and development of a conceptual site model south of PUREX to support all the feasibility study efforts in this area. |
| HRR | Data collected south of PUREX indicate a plume beneath the crib to 82 ft bgs. The plume combines with a second plume from the 216-A-4 Crib near 118 ft bgs to form one large plume. | | |
| Additional Notes:<br>References/Bibliography:<br>• DOE/RL-2000-60, *Uranium-Rich/General Process Condensate and Process Waste Group Operable Units RI/FS Work Plan and RCRA TSD Unit Sampling Plan; Includes 200-PW-2 and 200-PW-4 Operable Units.*<br>• DOE/RL-2004-25, *Remedial Investigation Report for the 200-PW-2 Uranium-Rich Process Waste Group and 200-PW-4 General Process Condensate Group Operable Units.*<br>• DOE/RL-2004-85, *Feasibility Study for the 200-PW-2 Uranium-Rich Process Waste Group and the 200-PW-4 General Process Condensate Group Operable Units.*<br>• RHO-CD-673, *Handbook 200 Areas Waste Sites.*<br>• RPP-26744, *Hanford Soil Inventory Model, Rev. 1.*<br>• *Waste Information Data System* database. | | | |
| Proposed Activities and Path Forward:<br>• Install one shallow drive point and one deep borehole at 216-A-5 Crib to better understand results of HRR data and to support evaluation of protection of groundwater evaluations in feasibility studies; supports development of a conceptual site model south of PUREX. | | | |

bgs = below ground surface.
Ecology = Washington State Department of Ecology.
FH = Fluor Hanford, Inc.
HRR = high-resolution resistivity.
MESC/MNA/IC = Maintain Existing Soil Cover, Monitored Natural Attenuation, Institutional Controls.
NPH = normal paraffin hydrocarbon.
PUREX = Plutonium-Uranium Extraction (Plant or process).
RL = U.S. Department of Energy, Richland Operations Office.
RPP = RCRA past practice.
TBP = tributyl phosphate.

## AD5-3.0 216-S-1&2 CRIBS SITE-SPECIFIC FIELD-SAMPLING PLAN

The following figures and tables provide the site-specific field-sampling plan for the 216-S-1&2 Cribs located in the 200 West Area east of Single-Shell Tank Waste Management Area S-SX.

Figure AD5-4. 216-S-1&2 Cribs Data-Collection Locations.

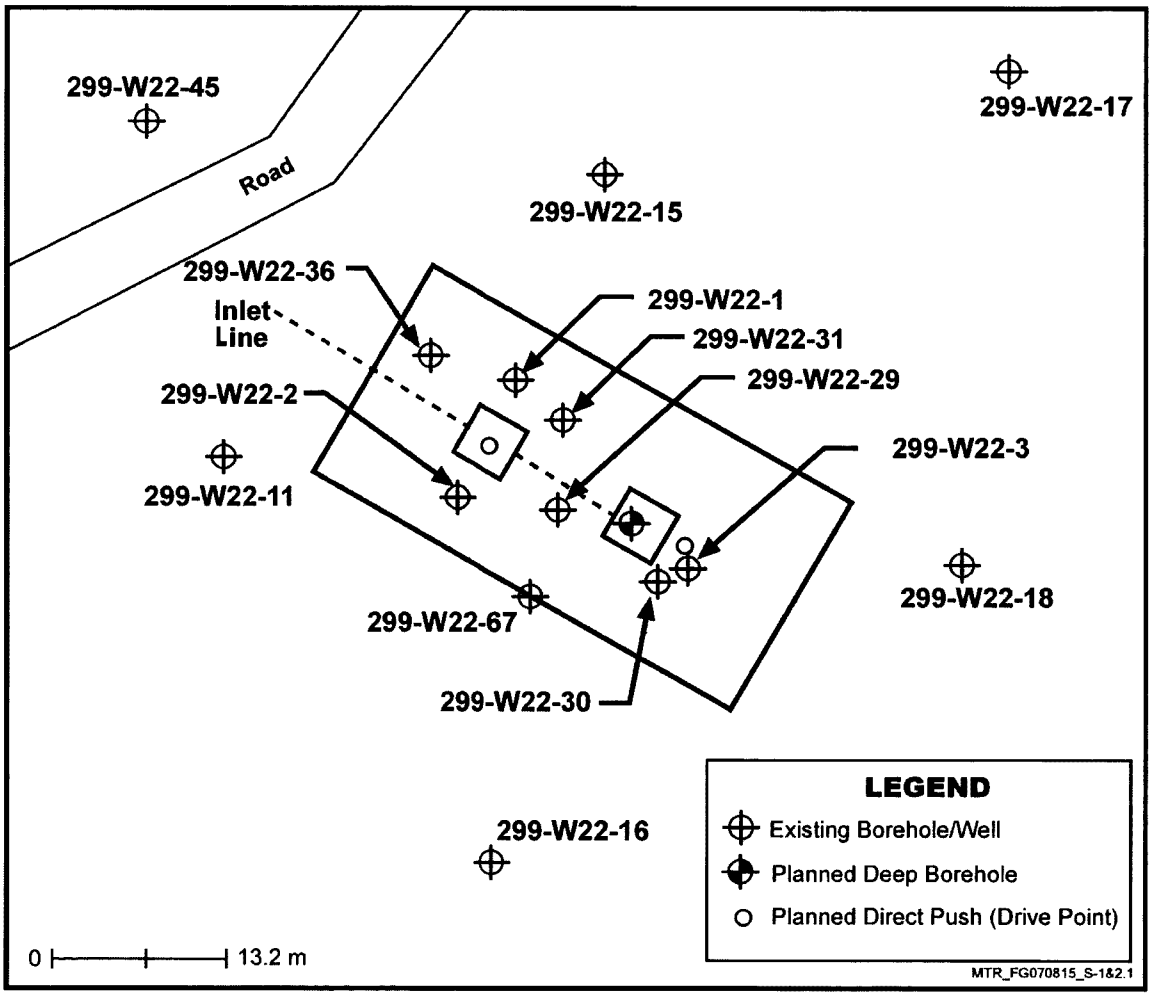
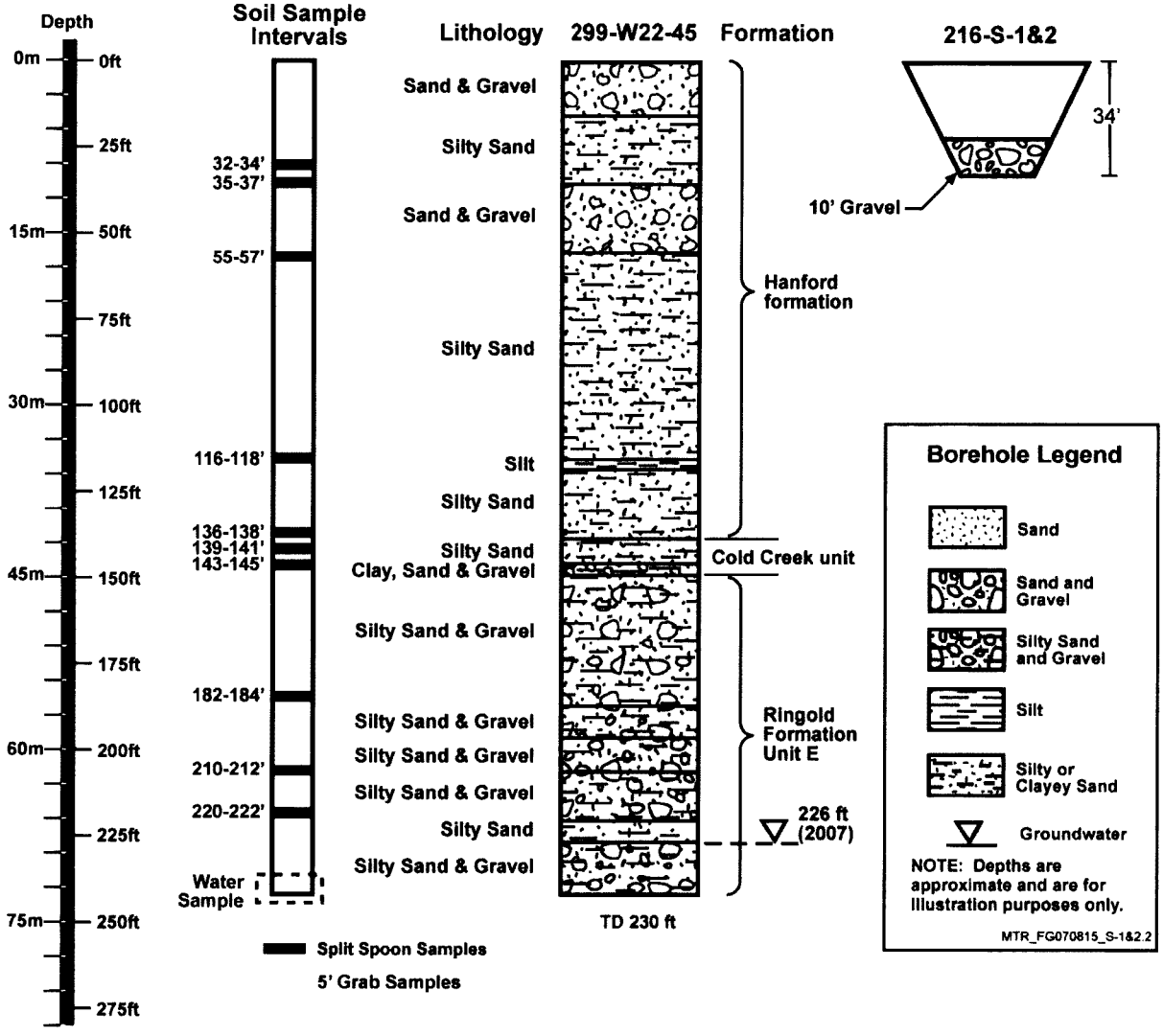


Figure AD5-5. 216-S-1&2 Cribs Estimated Stratigraphy and Proposed Sample-Collection Intervals.




TD = total depth of borehole.

Table AD5-3. 216-S-1&2 Cribs Sampling Plan. (2 Pages)

| Sample Collection Methodology | Sample Location | Maximum Depth of Investi-gation | Sample Interval Depth (ft bgs) [a] | Analyte List [b] | Physical Properties | |
|---|---|---|---|---|---|---|
| | | | | | Sample Interval | Parameters |
| Direct-push technology boreholes | 2 direct pushes – one in center of western crib and one east near well 299-W22-3. Refer to Figure AD5-5. | 60 ft | One sample from 60 ft or bottom of each push (whichever is deeper) | 200-PW-2 COPC analytes are presented in Volume 1, Table A2-3. Table A2-4 presents analytical performance requirements for vadose-zone sediment samples and extracted porewater. | Bottom of push | Moisture content, particle size distribution |
| Vadose-zone characterization borehole – cable tool with split-spoon sediment core sampler | One deep borehole near center of 216-S-2 Crib. Refer to Figure AD5-5. | To 5 ft below water table (~230 ft bgs) | Split-spoon core samples collected at: 32-34 ft bgs 35-37 ft bgs 55-57 ft bgs 116-118 ft bgs 136-138 ft bgs 139-141 ft bgs 143-145 ft bgs 182-184 ft bgs 210-212 ft bgs 220-222 ft bgs | 200-PW-2 OU COPC analytes are presented in Volume 1, Table A2-3. Analytical performance requirements are presented in Volume 1, Table A2-4 for vadose-zone porewater. | All split-spoon sediment core samples | pH, specific conductance, moisture content, bulk density, particle size distribution |
| | | | Collect 5-ft interval grab samples starting at 35 ft bgs and continuing to TD. Perform extraction analysis on selected (~15) grab samples. | COPC analytes are presented in Volume 1, Table A2-3. Analytical performance requirements are presented in Volume 1, Table A2-4 for vadose-zone porewater. | 15 selected samples. Sample determination based on site-specific results, borehole and geophysical data, and radiological and health and safety info. | Moisture content, particle size distribution |

Table AD5-3. 216-S-1&2 Cribs Sampling Plan. (2 Pages)

| Sample Collection Methodology | Sample Location | Maximum Depth of Investi-gation | Sample Interval Depth (ft bgs) [a] | Analyte List [b] | Physical Properties | |
|---|---|---|---|---|---|---|
| | | | | | Sample Interval | Parameters |
| One water sample collected from top of aquifer in deep drilled borehole | Near center of 216-S-2 Crib in deep borehole | 230 ft bgs or total borehole depth. | One groundwater sample collected at the water table or TD | COPC analytes and other required analytes are presented in Volume 1, Tables A2-3 and A2-4. | N/A | N/A |
| Number of split-spoon samples [c] | 10 | N/A | N/A | N/A | N/A | N/A |
| Approximate number of field quality control samples [d] | 2 | N/A | N/A | N/A | N/A | N/A |
| Approximate number of sediment grab samples collected | 40 | N/A | N/A | N/A | N/A | N/A |
| Total number of soil samples initially analyzed (splitspoon and grab samples) [c] | 25 | N/A | N/A | N/A | N/A | N/A |
| Groundwater samples analyzed | 1 | N/A | N/A | N/A | N/A | N/A |
| **Non-Sample Data Collection Methodology** | **Sample Location** | **Maximum Depth of Investi-gation** | **Sample Interval Depth (ft bgs) [a]** | **Analyte List [b]** | **Physical Properties** | |
| | | | | | **Sample Interval** | **Parameters** |
| Downhole high-resolution spectral gamma and neutron moisture geophysical logging | Log the direct-push boreholes and the deep borehole | To TD of each borehole | Surface to TD in each push hole and one deep-characterizatio n borehole | Evaluate for manmade gamma-emitting radioisotopes and anomalous vadose-zone moisture. | N/A | N/A |

[a] Actual sampling depths may vary depending on the amount of backfill/overburden used in interim stabilization at the waste site, field-screening results, and varying subsurface conditions.

[b] See Volume 1, Appendix A, Tables A2-1, A2-2, A2-3, A2-5, and A3-2 for detection limits and other analytical parameters.

[c] Total number of soil samples analyzed includes 10 split-spoon samples and 15 grab samples. Determination of which subset of grab samples to analyze will be based on push and borehole geologic and geophysical log data, and health and safety and radiological screening info.

[d] One duplicate and one equipment blank.

bgs = below ground surface.
COPC = contaminant of potential concern.
N/A = not applicable.
OU = operable unit.
TD = total depth of borehole.

Figure AD5-6. 216-S-1&2 Cribs Conceptual Model and Data Summary.

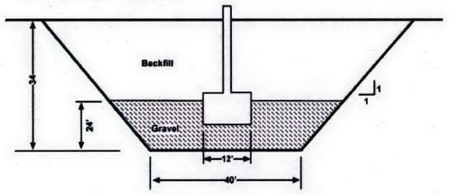
**200-PW-2 Operable Unit**
**Waste Type: Process Effluent**

# 216-S-1&2 Cribs & UPR-200-W-36 Unplanned Release

**REDOX Zone**

## History

This site consists of two open-bottomed crib boxes made of timbers. The cribs are connected in series where overflow from Crib Box S-1 flows into Crib Box S-2 via an underground pipe. The boxes were set in a gravel-lined trench and backfilled. This unit was used as a subsurface liquid distribution system that received cell drainage and process condensate from the REDOX facility. The waste had a pH of 2.1. The waste was discharged to the cribs in batches. Each batch was approximately 19,000 L (5,019 gal). An average of 10 batches was discharged each day. The associated structure is the 202-S Building and the 216-S-7 Crib. The site was deactivated in January 1956 when acid waste corroded monitoring well casings (299-W22-3) and penetrated sediments near the water table. This release is now called UPR-200-W-36. (WIDS)
**CONSTRUCTION:** 12.2 by 27.4 m (40 by 90 ft) (each individual crib is 1.1 m$^2$ [12 ft$^2$]). Depth of crib is 10.4 m (34 ft). Side slope is 1:1.




**WASTE VOLUME:** 160,000,000 L (WIDS)

**DURATION:** 1952 to 1956 (WIDS)

**ESTIMATED DISCHARGED INVENTORY (RPP-26744):**

| | |
|---|---|
| Cs-137 | 827.4 Ci |
| U-Total | 2,220 kg |
| H-3 | 2,542 Ci |
| Tc-99 | 2.601 Ci |
| Pu-239 | 72.84 Ci |
| Pu-240 | 14.14 Ci |
| NO3 | 210,900 kg |
| Sr-90 | 958.6 Ci |

**REFERENCES/BIBLIOGRAPHY:**

DOE/RL-2000-38
DOE/RL-2002-42
DOE/RL-2003-64
RPP-26744
WIDS general summary reports.

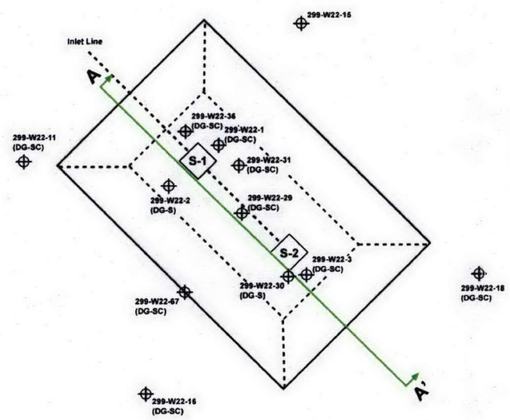
bgs = below ground surface.
REDOX = Reduction Oxidation (Plant or process).
WIDS = *Waste Information Data System* database.

## Basis of Knowledge (Data Types)

- Process History
- Downhole Geophysics - Spectral (DG-S)
- Downhole Geophysics – Scintillation (DG-SC)

## Site Plan View

**(not to scale)**




**Legend**

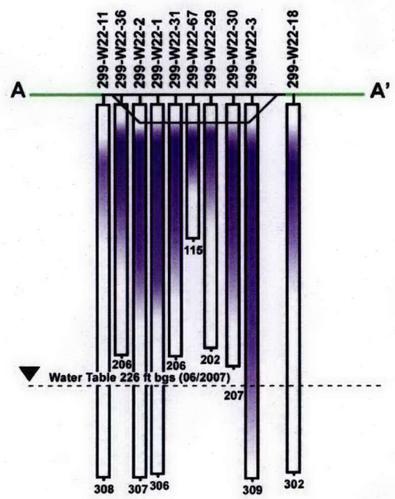
⊕ = Existing Borehole (data type)
▼ = Groundwater Surface

## Characterization Summary

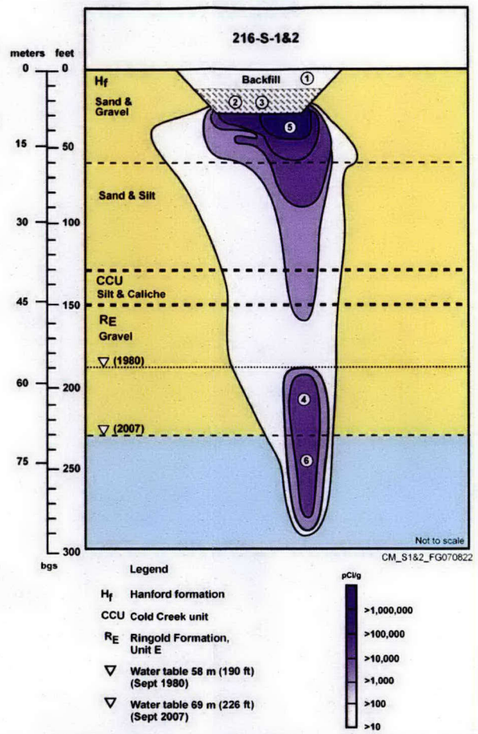
Characterization of the 216-S-1&2 Cribs was performed under DOE/RL-2003-64. Two boreholes were installed and geophysically logged. The maximum contamination detected was 0.2 pCi/g near the minimum detection level. Thirteen scintillation wells monitor the cribs before about 2005. The 216-S-1&2 Cribs also were characterized in 1982. Cesium-137 concentrations up to 100 pCi/g were found through the vadose zone to the water table. Cesium-137 concentrations >1,000,000 pCi/g were found beneath the crib to 20 m depth. Cesium-137 and Sr-90 were found in the aquifer beneath the cribs. Strontium-90 is found in the aquifer today.

## Site Section View

**(not to scale)**




## Conceptual Contaminant Distribution Model




1. The 216-S-1&2 Cribs operated between January 1952 and January 1956 and received 160,000,000 L (4.2 x 10$^7$ gal) of waste with a pH of 2.1. This waste received significant inventories of Cs-137, Sr-90, Pu-239, Pu-240, tritium, uranium, and nitrate.
2. Effluent was discharged in 19,000 L (5,019 gal) batches at an average of 10 batches/day.
3. Effluent was discharged to a 3 m (9.8 ft) thick gravel backfill at the bottom of the crib trench and at about 7.4 m (24.3 ft) depth.
4. Between January and June 1955, the casing in monitoring well 299-W22-3 failed, allowing an unknown volume of highly contaminated waste to flow directly to groundwater. The well was filled with sand in August 1955.
5. Vadose-zone contamination (Cs-137) extends through the vadose zone to ground water at concentrations > 1000 pCi/g. Cesium-137 concentrations >1,000,000 pCi/g exist directly beneath the bottom of the 216-S-1 Crib but extend to about 10 m (32.8 ft) below the bottom of the 216-S-2 Crib.
6. Gross beta and Sr-90 were found in groundwater beneath the cribs in early 1957. Strontium-90 concentrations remained above the drinking water standard (8 pCi/L) in well 299-W22-10 in fiscal year 2006.

Table AD5-4. Data Needs Priority Summary – Model Group 4 – 216-S-1&2 Cribs (200-PW-2/4) (RL/FH) (RPP) (Ecology) and UPR-200-W-36 Unplanned Release (Model Group 2) (200-PW-2/4) (RL/FH) (RPP) (Ecology). (3 Pages)

**Background**

| | |
|---|---|
| Site Identification | 216-S-1&2 Cribs and UPR-200-W-36 Unplanned Release |
| Site Location | 200 West; REDOX Zone |
| Type of Site | Crib & Unplanned Release (failed well) |

**Operating History**

**216-S-1&2 Cribs and UPR-200-W-36:** The site consists of two open-bottomed crib boxes made of timbers. The cribs are connected in series where overflow from Crib Box S-1 flows into Crib Box S-2 via an underground pipe. The boxes were set in a gravel-lined trench and backfilled. This unit was used as a subsurface liquid distribution system that received cell drainage and process condensate from the REDOX facility. The waste had a pH of 2.1. The waste was discharged to the cribs in batches. Each batch was approximately 19,000 L (5019 gal). An average of 10 batches was discharged each day.

When the crib was abandoned, it had received approximately 750,000 Ci of mixed fission products. The inventory discharged to the cribs includes total uranium (2.25E3 kg), total plutonium (1.2E3 g), Cs-137 (1.4E3 Ci), Sr-90 (1.25E3 Ci), and nitrates (60,000 kg). (These inventory values differ from those given in the table below because of different sources. The text values are from the *Waste Information Data System* database and the table values are from RPP-26744.) The estimated effluent volume is 160,000 $m^3$.

The associated structure is the 202-S Building and the 216-S-7 Crib. The site was deactivated in January 1956 when acid waste corroded monitoring well casings (299-W22-3). The casing for well 299-W22-3 near the 216-S-1&2 Cribs failed, allowing an unknown volume of highly contaminated waste to flow directly into the groundwater. After the discovery was confirmed, the well was immediately sealed off by backfilling with local sand and gravel. This unplanned release is now designated UPR-200-W-36. The pipeline to the cribs was capped at the 241-S-151 Diversion Box and the effluent was rerouted to the 216-S-7 Crib. The site operated from January 1952 to January 1956.

The cribs are located within a common radiologically posted area. The surface is free of vegetation. The area is marked and posted with Underground Radioactive Material and Cave-in Potential signs. There is an additional, small posted Underground Radioactive Material area adjacent to the south side of the cribs and the 299-W22-11 well. The Dyncorp Integrated Soil, Vegetation and Animal Control group has stated that growing, contaminated weeds were found inside this area in September 2000. The contaminated weeds were removed and disposed of properly.

Site Inventory Model 216-S-1&2 Cribs (some constituents of interest highlighted) (RPP-26744)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Na (kg) | Al (kg) | Fe (kg) | Cr (kg) | Bi (kg) | La (kg) | Hg (kg) | Zr (kg) | Pb (kg) |
| 9.778E+03 | 2.708E+03 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Ni (kg) | Ag (kg) | Mn (kg) | Ca (kg) | K (kg) | **NO3 (kg)** | NO2 (kg) | CO3 (kg) | PO4 (kg) |
| 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | **2.109E+05** | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| SO4 (kg) | Si (kg) | F (kg) | Cl (kg) | CCl4 (kg) | Butanol (kg) | TBP (kg) | NPH (kg) | NH3 (kg) |
| 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Fe(CN)6 (kg) | **H-3 (Ci)** | C-14 (Ci) | Ni-59 (Ci) | Ni-63 (Ci) | Co-60 (Ci) | Se-79 (Ci) | **Sr-90 (Ci)** | Y-90 (Ci) |
| 0.000E+00 | **2.542E+03** | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.021E-02 | 4.537E-02 | **9.586E+02** | 9.583E+02 |
| Zr-93 (Ci) | Nb-93m (Ci) | **Tc-99 (Ci)** | Ru-106 (Ci) | Cd-113m (Ci) | Sb-125 (Ci) | Sn-126 (Ci) | I-129 (Ci) | Cs-134 (Ci) |
| 5.869E-01 | 0.000E+00 | **2.601E+00** | 2.084E-11 | 8.791E-05 | 1.241E-17 | 0.000E+00 | 1.358E-01 | 1.370E-04 |
| **Cs-137 (Ci)** | Ba-137m (Ci) | Sm-151 (Ci) | Eu-152 (Ci) | Eu-154 (Ci) | Eu-155 (Ci) | Ra-226 (Ci) | Ra-228 (Ci) | Ac-227 (Ci) |
| **8.274E+02** | 7.826E+02 | 1.242E+02 | 2.181E-02 | 2.836E+00 | 2.171E-04 | 1.521E-05 | 8.553E-11 | 6.533E-05 |
| Pa-231 (Ci) | Th-229 (Ci) | Th-232 (Ci) | U-232 (Ci) | U-233 (Ci) | U-234 (Ci) | U-235 (Ci) | U-236 (Ci) | U-238 (Ci) |
| 9.691E-05 | 3.210E-07 | 9.192E-11 | 2.943E-05 | 1.449E-04 | 7.238E-01 | 3.115E-02 | 1.497E-02 | 7.412E-01 |
| **U-Total (kg)** | Np-237 (Ci) | Pu-238 (Ci) | **Pu-239 (Ci)** | **Pu-240 (Ci)** | Pu-241 (Ci) | Pu-242 (Ci) | Am-241 (Ci) | Am-243 (Ci) |
| **2.220E+03** | 5.141E-01 | 1.383E+00 | **7.284E+01** | **1.414E+01** | 4.917E+01 | 4.298E-04 | 2.445E+01 | 8.930E-03 |
| Cm-242 (Ci) | Cm-243 (Ci) | Cm-244 (Ci) | | | | | | |
| 1.491E-02 | 2.669E-04 | 6.588E-03 | | | | | | |

| | |
|---|---|
| Vicinity Waste Sites | The cribs are located east of 241-SX Tank Farm, and southeast of the 241-S-151 Diversion Box. |
| Current Status | Analogous site; assigned to the 216-S-7 Crib; evaluated in feasibility study (DOE/RL-2004-85); capping identified in the feasibility study as preferred alternative |

Table AD5-4. Data Needs Priority Summary – Model Group 4 – 216-S-1&2 Cribs (200-PW-2/4) (RL/FH) (RPP) (Ecology) and UPR-200-W-36 Unplanned Release (Model Group 2) (200-PW-2/4) (RL/FH) (RPP) (Ecology). (3 Pages)

| **Potential Remedial Alternatives** | | | | | | | |
|---|---|---|---|---|---|---|---|
| X for viable alternatives | **No Action** | **MESC/MNA/IC** | **Removal/Disposal** | **Barrier** | **Partial Removal/Barrier** | **In Situ Treatment** | **Other** |
| | No. Contamination is at significant concentrations. | X | No. Cribs are constructed below the reasonable removal depth. | X | No. Cribs are constructed below the reasonable removal depth. | No. Contaminants are below reasonable treatment depth | |

| **Data Evaluation and Gaps Analysis** | | | |
|---|---|---|---|
| **Data** | **Knowns** | **Data Uncertainties** | **Are supplemental data required to support decision making?** |
| Shallow boreholes from RHO-ST-39<br><br>299-W22-47 (349 ft), spectral, 2004 | Cs-137 – The cesium activity is generally located within a 10 m (32.8 ft) zone beneath the crib bottoms (10 to 20 m [32.8 to 65.6 ft] from the surface) (RHO-ST-39). Recent logs indicate that the Cs-137 was detected at a few sporadic locations in borehole W22-04, with values typically around the minimum detection limit of around 0.2 pCi/g. (NOTE: This well is ~100 m to the east of the cribs.) The elevated levels directly beneath the waste site pose potential worker risk concerns should direct exposure be realized. | None | Yes. A large inventory of mobile contaminants was discharged to these cribs. An assessment of the extent of deeper contaminants is needed to support protection of groundwater evaluation. HRR will give an indication of the presence of a conductivity plume that likely will be associated with the nitrate and other mobile constituents. A follow-on data quality objectives process to evaluate the need for further characterization needs based on the results of the HRR will be conducted as needed.<br><br>The inventory of plutonium discharged to these cribs may result in concentrations above 100 nCi/g. This is an uncertainty that can influence the evaluation of alternatives. Determining the extent of the plutonium contamination will support a better evaluation of protectiveness, disposal options, and costs. Two direct pushes and one borehole to water table are proposed to evaluate the extent of plutonium at these cribs. |
| | Sr-90 – Historically, this constituent was widespread beneath the cribs, with limited knowledge regarding distribution within the saturated zone. Strontium was detected in the water table, widespread beneath the cribs (RHO-ST-39); however, this is attributed to the UPR-200-W-36 well casing failure. | None | |
| | Uranium – Limited characterization information exists regarding uranium at this waste site. However, this waste site can be compared to the 216-B-7A&B Cribs in that the uranium mass is an order of magnitude higher at 216-S-1&2 (1.8E2 vs. 2.2E3) and the volume discharged at these cribs is four times greater (43,600 vs. 160,000 $m^3$). Given this, one can approximate that the uranium mass would have traveled further (greater than 50 ft) at similar concentrations when compared to the 216-B-7A&B Cribs. It still is assumed that the mass of contamination would be within the top 50 ft, but residuals remain below this elevation. | Uncertainties related to the extent of contamination associated with uranium in this area | |
| | Nitrate – Limited characterization information exists regarding nitrate at this waste site. However, this waste site can be compared to the 216-B-7A&B Cribs in that the nitrate mass is one order of magnitude less than these cribs (2.7 million kg at 216-B-7A&B vs. 210,900 kg at 216-S-1&2) and the volume discharged at these cribs is four times greater (43,600 vs. 160,000 $m^3$). Given this, one can approximate that the nitrate also would be throughout the soil column, but at a much less concentration.<br><br>299-W22-47<br><br>No anomalous gamma activity was observed suggesting no significant manmade radionuclides migrated laterally to this location. | Uncertainties related to the extent of contamination associated with nitrate in this area | |

Table AD5-4. Data Needs Priority Summary – Model Group 4 – 216-S-1&2 Cribs (200-PW-2/4) (RL/FH) (RPP) (Ecology) and UPR-200-W-36 Unplanned Release (Model Group 2) (200-PW-2/4) (RL/FH) (RPP) (Ecology). (3 Pages)

Additional Notes:

References/Bibliography:

- DOE/RL-2000-38, *200-TW-1 Scavenged Waste Group Operable Unit and 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan*
- DOE/RL-2002-42, *Remedial Investigation Report for the 200-TW-1 and 200-TW-2 Operable Units (Includes the 200-PW-5 Operable Unit)*
- DOE/RL-2003-64, *Feasibility Study for the 200-TW-1 Scavenged Waste Group, the 200-TW-2 Tank Waste Group, and the 200-PW-5 Fission-Product Rich Waste Group Operable Units*
- DOE/RL-2004-85, *Feasibility Study for the 200-PW-2 Uranium-Rich Process Waste Group and the 200-PW-4 General Process Condensate Group Operable Units*
- HW-60115, *Exploratory Field Study of a Ground Waste Disposal Facility*
- Logs
- RHO-ST-39, *216-S-1 and S-2 Mixed Fission Product Crib Characterization Study*
- RPP-26744, *Hanford Soil Inventory Model, Rev. 1*
- *Waste Information Data System* database.

Proposed Activities and Path Forward:

- Conduct ERC surveys within the entire area to evaluate potential impacts associated with substantial volumes of nitrate, uranium, and tritium that were discharged.
- Conduct geophysical logging of 299-W22-67 (for spectral gamma and moisture), located immediately adjacent to cribs, to augment existing understanding of contaminant distribution.
- Evaluate any remaining data gaps following ERC results that would be needed to support decision making.
- Install two direct pushes to evaluate the extent of plutonium at the cribs and one deep borehole.

Ecology = Washington State Department of Ecology.
ERC = electrical resistivity characterization.
FH = Fluor Hanford, Inc.
HRR = high-resolution resistivity.
MESC/MNA/IC = Maintain Existing Soil Cover, Monitored Natural Attenuation, Institutional Controls.
NPH = normal paraffin hydrocarbon.
REDOX = Reduction Oxidation (Plant or process).
RL = U.S. Department of Energy, Richland Operations Office.
RPP = RCRA past practice.
TBP = tributyl phosphate.

## AD5-4.0 REFERENCES

DOE/RL-2000-38, 2001, *200-TW-1 Scavenged Waste Group Operable Unit and 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan,* Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2000-60, 2004, *Uranium-Rich/General Process Condensate and Process Waste Group Operable Units RI/FS Work Plan and RCRA TSD Unit Sampling Plan; Includes 200-PW-2 and 200-PW-4 Operable Units*, Rev. 1, Reissue, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2002-42, 2003, *Remedial Investigation Report for the 200-TW-1 and 200-TW-2 Operable Units (Includes the 200-PW-5 Operable Unit)*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2003-64, 2004, *Feasibility Study for the 200-TW-1 Scavenged Waste Group, the 200-TW-2 Tank Waste Group, and the 200-PW-5 Fission-Product Rich Waste Group Operable Units*, Draft A Re-issue, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2004-25, 2004, *Remedial Investigation Report for the 200-PW-2 Uranium-Rich Process Waste Group and 200-PW-4 General Process Condensate Group Operable Units*, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2004-85, 2006, *Feasibility Study for the 200-PW-2 Uranium-Rich Process Waste Group and the 200-PW-4 General Process Condensate Group Operable Units*, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2007-31, 2007, *Remedial Investigation/Feasibility Study Work Plan for the 200-PO-1 Groundwater Operable Unit,* U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington, as amended.

HW-60115, 1959, *Exploratory Field Study of a Ground Waste Disposal Facility*, General Electric Company, Richland, Washington.

hydroGeophysics, 2005, *Geophysical Results for the PUREX Plant A-4 Cribs Area*, hydroGeophysics, Inc., Tucson, Arizona.

RHO-CD-673, 1979, *Handbook 200 Areas Waste Sites*, 3 vols., Rockwell Hanford Operations, Richland, Washington.

RHO-ST-39, 1982, *216-S-1 and S-2 Mixed Fission Product Crib Characterization Study*, Rev. 0, Rockwell Hanford Operations, Richland, Washington.

RPP-26744, 2005, *Hanford Soil Inventory Model, Rev. 1*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

*Waste Information Data System* Report, Hanford Site database.

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