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# EXPLANATION OF SIGNIFICANT DIFFERENCES FOR THE 300-FF-2 OPERABLE UNIT RECORD OF DECISION

May 2004

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USDOE Hanford 300 Area
300-FF-2 Operable Unit
Hanford Site
Benton County, Washington

## INTRODUCTION TO THE SITE AND STATEMENT OF PURPOSE

The U.S. Environmental Protection Agency (EPA–the lead regulatory agency), the Washington State Department of Ecology (Ecology–the support regulatory agency), and the U.S. Department of Energy (DOE–the responsible agency), hereafter referred to as the Tri-Parties, are issuing this Explanation of Significant Differences (ESD) pursuant to Section 117(c) of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) and 40 *Code of Federal Regulations* (CFR) 300.435(c)(2)(1). This ESD provides notice of a change to the uranium cleanup level identified in the *Record of Decision for the 300-FF-2 Operable Unit, Hanford Site* issued April 2001 (EPA 2001) (hereafter referred to as the 300-FF-2 Record of Decision [ROD]), and modifies the cleanup levels for eight waste sites from industrial to "unrestricted" based on a change in the reasonably anticipated future land use. The 300 Area unrestricted exposure scenario is based on the 100 Area rural residential exposure scenario.

In summary, this ESD provides notice of two changes to the 300-FF-2 ROD.

**Change 1: Modify the soil cleanup level for uranium to 267 pico curies/gram (pCi/g).** The original 300-FF-2 ROD identified a uranium soil cleanup level of 350 pCi/g, based on industrial use, but required (1) an engineering study to more accurately define the leachability and mobility of uranium in the 300 Area soils, and verify that the uranium soil cleanup level is protective of groundwater and Columbia River exposure pathways and (2) publishing of an ESD if changes to the uranium cleanup level are necessary. The engineering study was conducted during fiscal year (FY) 2000, FY 2001, and FY 2002, and resulted in the following two products:

- A report that summarized the results of the distribution coefficient ($K_d$)/leach analyses performed by the Pacific Northwest National Laboratory (PNNL)

- A report that summarized the rationale and basis for changing the uranium cleanup standard from 350 pCi/g to 267 pCi/g. The 350 pCi/g value is stated in Tables 5 and 6 of the 300-FF-2 ROD (EPA 2001).

**Change 2: Modify the soil cleanup levels for eight outlying waste sites.** The 300-FF-2 ROD concluded that the reasonably anticipated future land use would be industrial for the entire 300-FF-2 Operable Unit (OU), which was based on available land-use planning documents and was the basis for the industrial cleanup levels. Further evaluation by the Tri-Parties concluded that a change in cleanup levels would be appropriate for eight specific outlying waste sites in order to reduce the long term costs of institutional controls and allow other beneficial uses of these outlying areas. The location of these waste sites is depicted in Figure 1 and Figure 2. The revised cleanup levels are based on the 100 Area rural residential exposure scenario, commonly referred to as unrestricted, and are listed in Tables 1 and 2.

This ESD will become part of the Administrative Record for the cleanup decision for the Hanford Site. The Administrative Record is available for review at the following location:

Administrative Record
2440 Stevens Center Place, Room 1101
Richland, Washington 99352
509/376-2530

## SITE HISTORY, CONTAMINATION, AND SELECTED REMEDY

The 300-FF-2 OU is composed of 56 waste sites that fall into four general categories: (1) waste sites in the 300 Area industrial complex (40 sites), (2) outlying waste sites north and west of the 300 Area industrial complex (7 sites), (3) general content burial grounds (7 sites), and (4) transuranic-contaminated burial grounds (2 sites). The major components of the selected remedy in the 300-FF-2 ROD (EPA 2001) include the following:

- Remove contaminated soil, structures, and associated debris
- Treat these wastes, as required, to meet disposal facility requirements
- Dispose of contaminated materials at the Environmental Restoration Disposal Facility (ERDF) or other approved facilities
- Recontour and backfill excavated areas with clean material, and implement infiltration controls (e.g., revegetation)
- Maintain groundwater and ecological monitoring through the 300-FF-5 OU to ensure effectiveness of the remedial actions and to support the 300-FF-2 final ROD and 5-year remedy reviews
- Implement institutional controls to ensure that unanticipated changes in land use do not occur that could result in unacceptable exposures to residual contamination.

## BASIS FOR THE DOCUMENT

During public review of the *Proposed Plan for the 300-FF-2 Operable Unit* (DOE-RL 2000) comments were received about the technical basis for the soil cleanup level of 350 pCi/g for uranium. In 2001, the Tri-Parties approved the cleanup level in the ROD with a requirement that "a leach test/$K_d$ study will be performed prior to implementation of remedial actions to verify the soil cleanup level is protective of groundwater and river pathways." As a result, the *300 Area Uranium Leach and Adsorption Project* (PNNL 2002) was conducted by PNNL and Bechtel Hanford, Inc. (BHI) during FY 2000, FY 2001, and FY 2002. The leach study has been completed and is the basis for a change of the soil cleanup level from 350 pCi/g to 267 pCi/g

based on an industrial use. The technical basis for this change is explained in subsequent sections of this ESD. This ESD is required to change the uranium cleanup level, and is a 300-FF-2 ROD requirement.

In addition, the Tri-Parties have agreed that unrestricted use soil cleanup levels for eight waste sites would be appropriate in the 300-FF-2 OU, that are located outside the 300 Area "core industrial zone area" (see Figures 1 and 2). An ESD is necessary to change the cleanup levels for these eight specific outlying waste sites.

## DESCRIPTION OF SIGNIFICANT DIFFERENCES

The two changes identified above are described in more detail below.

**Change 1: Modify the soil cleanup level for uranium to 267 pCi/g.**

### Background

A 300 Area uranium cleanup level of 350 pCi/g was established in the 300-FF-1 ROD (EPA 1996). This cleanup level meets the remedial action objectives (RAOs) for cumulative risk (i.e., $10^{-4}$ to $10^{-6}$ under the industrial land-use scenario) from exposure to contaminated waste soil. The value was developed by calculating a uranium residual soil concentration that would result in a radiation dose of 15 mrem/yr above background. The calculation was made with the RESidual RADioactivity (RESRAD) model using industrial land-use and 300 Area specific parameters. These parameters were agreed to by the Tri-Parties. The 350 pCi/g cleanup level for direct exposure was determined to be protective of the groundwater and the Columbia River. The RESRAD model used 300 Area specific parameters that affect groundwater contaminant concentrations. A leach test/$K_d$ study (as required by the 300-FF-2 ROD) that was initiated in FY 2000 to more accurately assess and represent the leachability and mobility of uranium in soil in the 300 Area is described below.

### Description of Study

PNNL performed controlled laboratory experiments to measure the leaching and adsorption characteristics of uranium in near-surface soil samples collected from the 300 Area of the Hanford Site. A *Data Quality Objectives Summary Report for the 300 Area Uranium Leach/$K_d$ Study* (BHI 2000), followed by the *Sampling and Analysis Plan for the 300 Area Uranium Leach/$K_d$ Study* (DOE-RL 2002a), documented the procedures used to conduct the study.

Six soil samples were collected from three locations in the 300 Area. A background soil sample was collected outside of the 300 Area to represent soil with uranium at naturally occurring background concentrations. Two soil samples were collected from areas affected by past liquid waste disposal activities in the North Process Pond, and three soil samples were collected in the vicinity of a former contaminated waste storage building (303-K). Sample locations were selected in order to obtain a range of uranium concentrations in soil for testing. Figures showing the sample locations are included in the 300 Area leach test/$K_d$ study (PNNL 2002).

PNNL conducted a wide variety of tests on the soil samples, including total uranium analyses, leach, and adsorption tests. A complete listing and discussion of the tests, including the results, are provided in the leach test/$K_d$ study (PNNL 2002).

**Analysis of Results and Revision of Conceptual Site Model**

Using the results of the PNNL column tests and groundwater batch leach tests with the conditions considered to be the most representative of in-situ field conditions, desorption $K_d$ values and adsorption $K_d$ values were calculated for five soil samples from representative 300 Area waste sites. The results of these calculations are documented in *Protection of 300 Area Groundwater from Uranium-Contaminated Soils at Remediated Sites* (BHI 2002). The calculated desorption $K_d$ values ranged from 8.9 mL/g to 11.4 mL/g, with the exception of a single anomalous high $K_d$ of 527 mL/g from one sample. The PNNL leach test/$K_d$ study (PNNL 2002) indicated that once uranium is in solution, adsorption onto soil is low with an adsorption $K_d$ value of 0 to 1.8 mL/g, which is consistent with a solubility or desorption driven system.

The most conservative $K_d$ values of 8.9 mL/g for the desorption phase of the contaminated zone, and 0 mL/g for the adsorption phase of the uncontaminated zone and saturated zone respectively, were selected to be the $K_d$ values used to assess the protectiveness of residual contamination following remediation.

A RESRAD assessment of site-specific residual uranium soil concentrations for groundwater protection was performed using new $K_d$ values (8.9 mL/g for the contaminated zone, 0 mL/g for the uncontaminated zone, and 0 mL/g for the saturated zone). In addition, the approaches developed in the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (RDR/RAWP) (DOE-RL 2002b) for cleanup verification of solid and liquid waste disposal sites were also applied. The RESRAD calculations used the applicable land-use scenario (industrial, without irrigation), soil characteristics, and hydrogeologic inputs. The model calculated the concentrations in groundwater, and then these concentrations were compared to the drinking water standard maximum contaminant level (MCL) of 30 μg/L (20.8 pCi/L) for making decisions on whether residual contamination levels are protective of groundwater. The model predicts that 267 pCi/g of uranium in soil is protective of groundwater at the drinking water MCL standard and of the Columbia River.

The RESRAD model is known to provide conservative results, and the $K_d$ values selected were the lowest observed in the PNNL leach test/$K_d$ study. This is considered to be appropriate since it provides a margin of safety in translating laboratory results to actual field conditions.

The old and the new conceptual models are shown in Figures 3 and 4.

**Changes Made as a Result of this Study**

The soil cleanup level for uranium for the 300 Area industrial waste sites will be changed from 350 pCi/g to 267 pCi/g (see Table 3). The basis for this change is RESRAD modeling to predict the residual uranium soil contamination that will not cause an exceedence of the groundwater

protection standard of 30 μg/L (uranium MCL) using the generic profile for a 300-FF-2 waste site. However, site-specific data are used in compliance with the RAOs specified in the 300-FF-2 ROD (EPA 2001), consistent with the process identified in the RDR/RAWP (DOE-RL 2002b). This soil concentration is also used to identify material that is "below cleanup levels" and can, therefore, be used as backfill or left in place within a waste site boundary.

A revision has been made to the conceptual site model (see the "Analysis of Results and Revision of Conceptual Site Model" section for a description of the old and new conceptual models), which is used to evaluate compliance with the RAOs specified in the 300-FF-2 ROD (EPA 2001) for cleanup actions to be protective of groundwater and surface water quality. The change is to use $K_d$ values and a revised conceptual site model that is representative of the observations made during the PNNL leach test/$K_d$ study (PNNL 2002).

**Assessment of Impacts**

The impact of this change from 350 pCi/g to 267 pCi/g on the estimated cost of the remedy is expected to be insignificant, for these eight waste sites, due to the similarity in cleanup levels. In addition, although not required, an assessment of the 300-FF-1 waste sites that were previously remediated was performed to identify impacts to groundwater/river protectiveness predictions based on the revised uranium cleanup level of 267 pCi/g. The results of this testing is documented in the October 2003 Unit Managers' Meeting Minutes for the 300 Area (EPA et al. 2003) (see BHI Calculation No. 0300X-CA-V0033). Results of the assessment indicate that all previously remediated 300-FF-1 waste sites, which required a 350 pCi/g uranium cleanup level, can be demonstrated to be protective of groundwater and the river at the 267 pCi/g cleanup level without further action.

**<u>Change 2:</u> Modify the soil cleanup levels for eight outlying waste sites.**

The 300-FF-2 ROD requires that waste sites be remediated to industrial cleanup levels as well as be protective of ecological receptors, groundwater, and river water quality. The basis for this requirement is the Tri-Parties' assessment of the reasonably anticipated future land use for the areas where these waste sites are located. Since issuing the 300-FF-2 ROD, the Tri-Parties have evaluated the additional cleanup necessary to achieve unrestricted cleanup levels for waste sites outside the "core industrial zone". Based on the evaluation, the soil cleanup levels for the eight outlying waste sites changed from industrial to unrestricted. The eight sites are 618-7 Burial Ground, 300 Vitrification Test Site, 618-13 Burial Ground, 600-47 Dumping Area, 316-4 Crib, 600-63 Lysimeter Facility, 600-259 Lysimeter Facility, and 618-10 Burial Ground (Figures 1 and 2). Twenty-six other waste sites were also evaluated but dismissed due to their proximity to either the industrialized core zone of the 300 Area or the Energy Northwest Complex. Therefore, the Tri-Parties believe that the reasonable anticipated future land use remains industrial for these 26 waste sites, which is consistent with various 300 Area RODs.

The 300-FF-2 ROD identifies institutional control requirements. As a result of changing cleanup levels for the eight waste sites from industrial to unrestricted, one of the institutional controls requirements will no longer apply to these eight sites. This requirement is listed in the 300-FF-2 ROD section titled, "Institutional Controls Required After Cleanup Is Complete." Specifically,

institutional control number 1, listed on page 57 of the 300-FF-2 ROD would not apply to these eight waste sites.

**Unrestricted Land-Use Scenario**

The 300 Area unrestricted land-use scenario is identical to the existing 100 Area unrestricted land-use scenario, which is represented by an individual in a rural residential setting. The exposure pathways considered in estimating dose from radionuclides in soil are inhalation; soil ingestion; ingestion of crops, meat, fish, drinking water, and milk; and external gamma exposure. This individual is conservatively assumed to spend 80% of his/her lifetime onsite. It is assumed that drinking water and irrigation water are obtained from groundwater, as impacted by the waste site.

Cleanup levels for chemicals or nonradionuclides in the 300 Area unrestricted land-use scenario are based on *Washington Administrative Code* (WAC) 173-340-740(3), January 1996, which assumes that the exposure pathway for residual contamination will be from ingestion of contaminated soil. Soil cleanup levels are calculated using the equations provided by WAC 173-340-740(3) for carcinogens and for noncarcinogens. For both carcinogens and noncarcinogens, the calculations assume that a resident with an average body weight 16 kg (35 lb) over the period of exposure ingests soil at a rate of 200 mg/day (73 g/yr [2.6 oz/yr]), with a frequency of contact of 100% and a gastrointestinal absorption rate of 100%. For carcinogens, the calculation is based on achieving a lifetime cancer risk goal of 1 in 1,000,000 ($1 \times 10^{-6}$) for an exposure duration of 6 years and a lifetime of 75 years. For noncarcinogens, the calculation is based on achieving a hazard quotient of 1.

The key assumptions in the 300 Area unrestricted land-use scenario that affect the groundwater protection determination are irrigation at agronomic rates (76 cm/yr [30 in./yr]), surface vegetation resulting in an evapotranspiration coefficient of 91%, and the change in the exposure pathway to include drinking water ingestion. Based on the unrestricted land-use scenario described above, the cleanup levels to be used for the eight waste sites are listed in Tables 1 and 2.

**Assessment of Impacts**

The total estimated cost of remediating the eight waste sites to the unrestricted cleanup levels is approximately $65 million, which is an increase of approximately $750,000 from the industrial cleanup endpoint (the original cost of remediating the eight waste sites to industrial levels is approximately $64.25 million). This represents an approximate 1% increase in the total estimated cost of remediating the eight waste sites. Incremental costs due to changing from industrial to unrestricted are primarily associated with the removal of additional volume of contaminated soil. Using unrestricted cleanup levels for the eight waste sites will likely reduce the long term costs of institutional controls and allow other potential beneficial uses of these outlying sites.

## SUPPORT AGENCY COMMENTS

Ecology concurs with the proposed action. Ecology wishes, however, to note the following expectations with respect to 300 Area cleanup.

Ecology notes that the *USDOE Hanford Site First Five Year Review Report* (EPA 2001) is relevant to the proposed action. The five year review required an assessment of "whether or not contaminant plumes are attenuating and, if they are not, an assessment of active remedial measures must be presented to EPA." Nearly three years have elapsed since that finding, and neither assessment has been started. Ecology expects that DOE will initiate a focused feasibility study for groundwater alternatives within the next 90 days from EPA and Ecology signature of this ESD, and expects that DOE will complete the study on a priority basis.

The five year review report also found that "In addition, groundwater monitoring and soil site investigation/remediation are not being coordinated in the 300 Area" (EPA 2001). The proposed action proposes cleanup levels that are protective of groundwater, but does not include remedial measures for groundwater. This continuing division between source control and groundwater remediation is allowable under Ecology's regulations for site cleanup, which are applicable or relevant and appropriate requirements (ARARs) for the proposed action. Ecology notes, however, that this division does not support selection of a final cleanup action. Ecology notes that DOE will have to complete a baseline risk assessment that addresses all contaminants and all pathways, to support selection of a final cleanup action.

## STATUTORY DETERMINATIONS

This remedy, as modified by this ESD through changing the soil cleanup level of uranium, and changing cleanup levels for eight waste sites from industrial to unrestricted, satisfies CERCLA, Section 121. The interim remedy selected in the 300-FF-2 ROD (EPA 2001) remains protective of human health and the environment, complies with federal and state requirements identified in the 300-FF-2 ROD that are applicable or relevant and appropriate to remedial actions, is cost effective, and uses permanent solutions and alternative treatment technologies to the maximum extent practicable.

The response action selected by the 300-FF-2 interim action ROD, as modified by this ESD, is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Such a release, or threat of release, may present an imminent and substantial endangerment to public health, welfare, or the environment.

## PUBLIC PARTICIPATION

The public participation requirements set out in the "National Oil and Hazardous Substances Pollution Contingency Plan," Section 300.435(c)(2)(i) (40 CFR 300), are met through issuance of this ESD and through notification to the public through the *Hanford Update* publication, or other processes described in the *Hanford Site Tri-Party Agreement Community Relations Plan.*

**Figure 1. 300 Area Waste Site Groups Identified for Unrestricted Use Cleanup.**

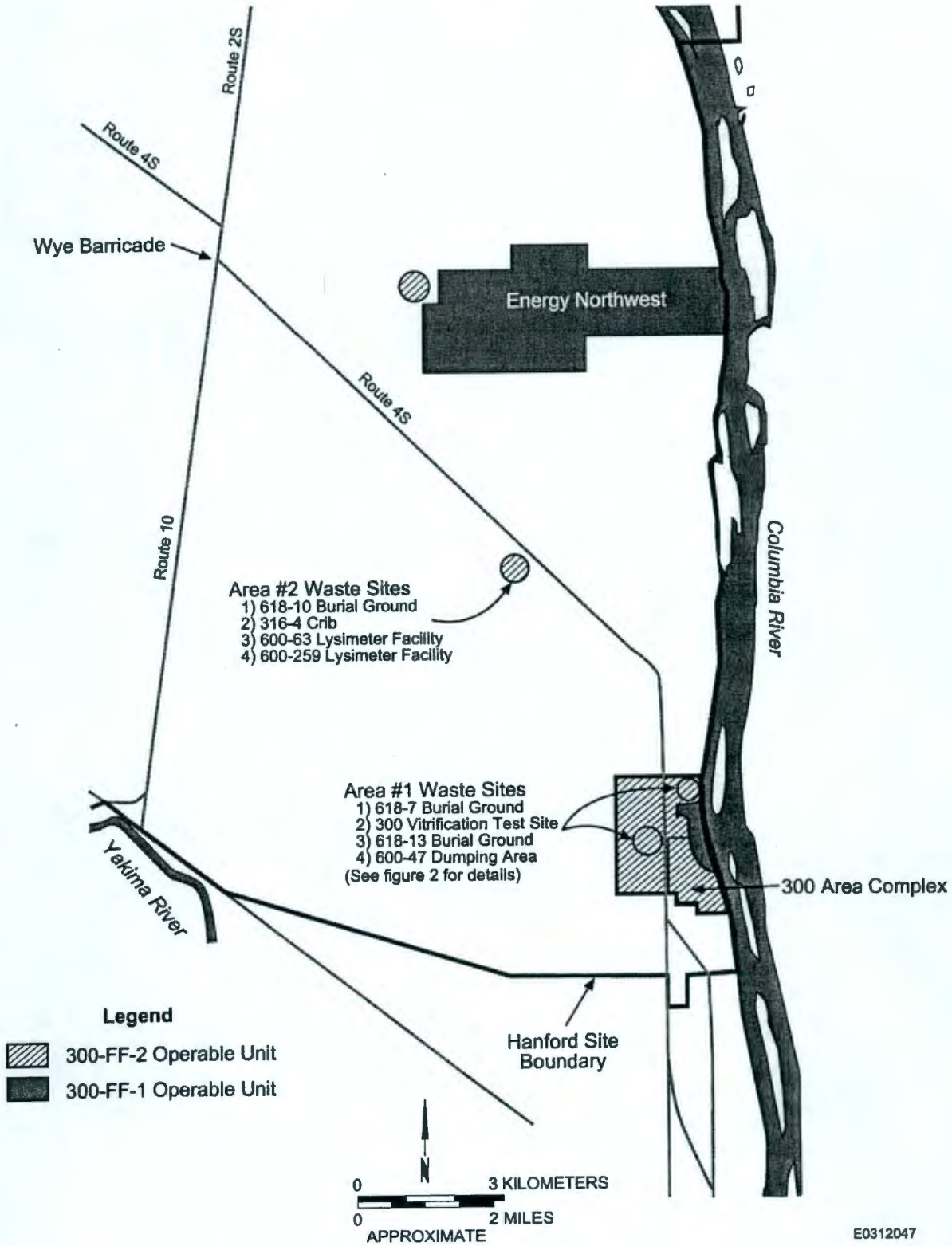
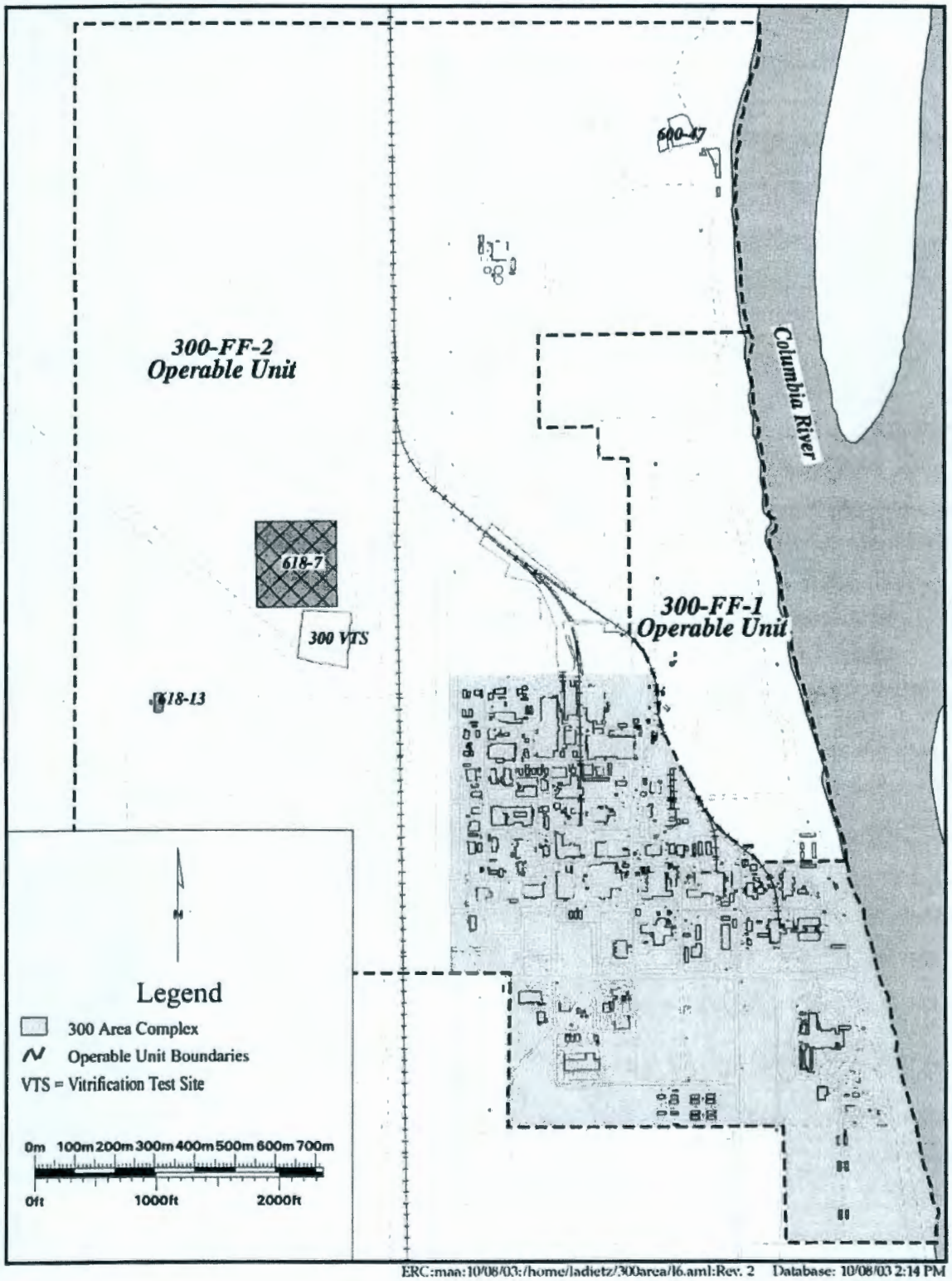


**Figure 2. Detail of Area 1 Waste Sites Identified for Unrestricted Use Cleanup.**

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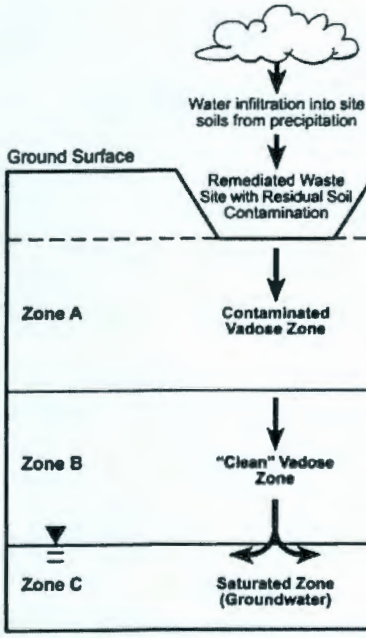
## Figure 3. Solid Waste Uranium Groundwater Protection Assessment Model.




**Assumptions in the Uranium Groundwater Protection Assessment Model for Solid Waste Sites[a]**

| | Soil Concentration | New Kd Value | Previous Kd Value | Fate and Transport Mechanisms |
|---|---|---|---|---|
| Remediated Waste Site with Residual Soil Contamination | - | - | | The model begins at the bottom of the remediated waste site. |
| Zone A: Contaminated Vadose Zone | 95% UCL | 8.9 | 2 | Uranium is leached, or desorbed, from soil by infiltration water. |
| Zone B: "Clean" Vadose Zone | "Clean" | 0 | 2 | Uranium travels with infiltration water. Using zero conservatively assumes that no active adsorption is occurring. |
| Zone C: Saturated Zone (Groundwater) | N/A | 0 | 2 | Uranium in infiltration water mixes with groundwater. |

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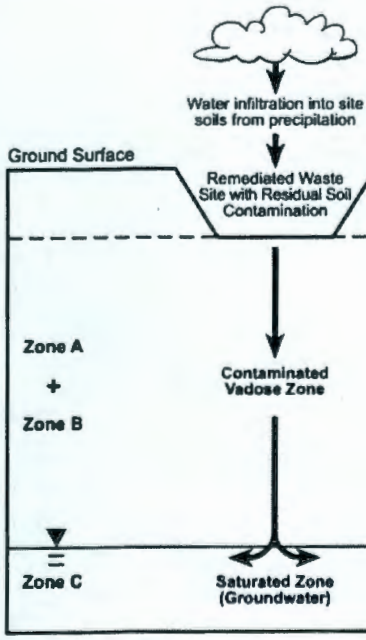
[a] In the groundwater protection assessment model for solid waste sites, an assumption is made that the upper 50% of the vadose zone beneath the excavated waste site (Zone A) is assumed to be contaminated (i.e., as a result of leaching) and the lower 50% (Zone B) is assumed to be clean. The concentration used for Zone A is the 95% Upper Confidence Limit (UCL) of the mean of cleanup verification samples collected from the bottom of the remediated site.

N/A - Not applicable

## Figure 4. Liquid Waste Uranium Groundwater Protection Assessment Model.




**Assumptions in the Uranium Groundwater Protection Assessment Model for Liquid Waste Disposal Sites[a]**

| | Soil Concentration | New Kd Value | Previous Kd Value | Fate and Transport Mechanisms |
|---|---|---|---|---|
| Remediated Waste Site with Residual Soil Contamination | - | - | | The model begins at the bottom of the remediated waste site. |
| Zone A + Zone B: Contaminated Vadose Zone | 95% UCL | 8.9 | 2 | The entire vadose zone (Zone A + Zone B) contains uniform residual uranium contamination. As the infiltration water moves downward through the contaminated zone, uranium is leached or desorbed from the soil and carried with the water. |
| Zone C: Saturated Zone (Groundwater) | N/A | 0 | 2 | Infiltration water with uranium moves into the saturated zone and mixes with groundwater. |

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[a] In the groundwater protection assessment model for liquid waste sites, the entire vadose zone (Zone A + Zone B) contains uniform residual contamination. The concentration used for the contaminated vadose zone is the 95% Upper Confidence Level (UCL) of the mean of cleanup verification samples collected from the bottom of the remediated site.

N/A - Not applicable

**Table 1. Unrestricted Use Cleanup Levels for the Eight Waste Sites in the 300-FF-2 Operable Unit - Chemical Constituents. (2 Pages)**

| Constituent | Soil Cleanup Level for Direct Contact[a] (mg/kg) | Soil Cleanup Level for Groundwater Protection[b] (mg/kg) | Soil Cleanup Level for River Protection[c] (mg/kg) | Selected Soil Cleanup Level[d] (mg/kg) |
|---|---|---|---|---|
| Acetone | 8,000 | 80 | 160 | 80 |
| Benzene | 18.2 | 0.0795 | 0.24 | 0.0795 |
| Carbon tetrachloride | 7.69 | 0.0337 | 0.05 | 0.0337 |
| Chloroform | 164 | 0.717 | 1.14 | 0.717 |
| Ethylene glycol | 160,000 | 3,200 | 6,400 | 3,200 |
| Methanol | 40,000 | 400 | 800 | 400 |
| Methyl ethyl ketone | 48,000 | 480 | 960 | 480 |
| Methyl isobutyl ketone | 6,400 | 64 | 128 | 64 |
| Polychlorinated biphenyls | 0.5 | NA[e] | NA[e] | 0.5 |
| Petroleum hydrocarbons | NA[f] | 200 | 400 | 200 |
| Tetrachloroethylene | 19.6 | 0.0858 | 0.16 | 0.0858 |
| Toluene | 16,000 | 100 | 200 | 100 |
| 1,1,1-trichloroethane | 72,000 | 20 | 40 | 20 |
| Trichloroethylene | 90.9 | 0.398 | 0.54 | 0.398 |
| Xylene | 160,000 | 1,000 | 2,000 | 1,000 |
| Aluminum | NA[f] | 11,800 | 11,800 | 11,800 |
| Antimony | 32 | NA[e] | NA[e] | 32 |
| Arsenic | 20[g] | NA[e] | NA[e] | 20 |
| Barium | 1,600 | NA[e] | NA[e] | 1,600 |
| Beryllium | 10.4[h] | NA[e] | NA[e] | 10.4 |
| Cadmium | 13.9[h] | NA[e] | NA[e] | 13.9 |
| Chromium (III) | 120,000 | NA[e] | NA[e] | 120,000 |
| Chromium (VI) | 2.1[h] | 8 | 2 | 2 |
| Copper | 2,960 | NA[e] | NA[e] | 2,960 |
| Lead | 353[i] | NA[e,j] | NA[e,j] | 353 |
| Manganese | 11,200 | NA[e] | NA[e] | 11,200 |
| Nickel | 1,600 | NA[e] | NA[e] | 1,600 |
| Strontium | 48,000 | NA[e] | NA[e] | 48,000 |
| Tin | 48,000 | NA[e] | NA[e] | 48,000 |
| Uranium | 81[k] | 53[k] | 106 | 53[k] |
| Vanadium | 560 | NA[e] | NA[e] | 560 |

**Table 1. Unrestricted Use Cleanup Levels for the Eight Waste Sites in the 300-FF-2 Operable Unit - Chemical Constituents. (2 Pages)**

| Constituent | Soil Cleanup Level for Direct Contact[a] (mg/kg) | Soil Cleanup Level for Groundwater Protection[b] (mg/kg) | Soil Cleanup Level for River Protection[c] (mg/kg) | Selected Soil Cleanup Level[d] (mg/kg) |
|---|---|---|---|---|
| Zinc | 24,000 | NA[e] | NA[e] | 24,000 |
| Chloride | NA[f] | 25,000 | 46,000 | 25,000 |
| Fluoride | 4,800 | 104.7 | 109.4 | 104.7 |
| Nitrate (as N) | 8,000 | 1,000 | 2,000 | 1,000 |
| Nitrite | 8,000 | 100 | 200 | 100 |
| Sulfate | NA[f] | 25,000 | 50,000 | 25,000 |
| Sulfide | NA[f] | NA[f] | 0.4 | 0.4 |

NOTE: Shaded areas represent the pathway driver for the selected cleanup level. Changes to the cleanup levels based on site-specific information (e.g., size of the waste site, presence of multiple contaminants) may be required. (Waste Sites 618-7, 300 Vitirification Test Site, 618-13, 600-47, 316-4, 600-63, 600-259, and 618-10)

[a]Direct contact values represent soil concentrations that are protective of human receptors from direct contact with contaminated waste/soil. Cleanup levels for unrestricted soil apply to the top 4.6 m (15 ft) as listed in WAC 173-340-740(3).

[b]Groundwater protection values represent soil concentrations that will be protective of groundwater. Values are equal to 100 times the groundwater cleanup standard (WAC 173-340-740), unless otherwise noted.

[c]River protection values represent soil concentrations that will not cause applicable river cleanup levels to be exceeded as contaminants migrate through the soil column to groundwater, and from groundwater to the river. Listed values are equal to 100 times the applicable river cleanup standard multiplied by a dilution attenuation factor of 2, unless otherwise noted.

[d]Listed values apply to the top 4.6 m (15 ft) and represent the most restrictive cleanup level derived from evaluation of the direct exposure, groundwater, and river pathways. Below 4.6 m (15 ft), alternate cleanup levels may be required to meet the RAOs based on the actual soil profile encountered during remediation.

[e]NA = Not applicable. The RESRAD model predicts the constituent will not reach groundwater within 1,000 years based on a generic site profile (4.6-m [15-ft] contaminated zone and 6-m [19.6-ft] uncontaminated zone).

[f]NA = Not applicable. No published cleanup standard identified for constituent and pathway.

[g] Measured as total chromium.

[h]Cleanup limit based on the inhalation exposure pathway per WAC 173-340-750(4)(b)(ii)(a) or (b).

[i] A WAC 173-340-750(3) carcinogenic cleanup limit based on the inhalation exposure pathway. Calculation is presented in the *Calculation of Hexavalent Chromium Carcinogenic Risk Calculation Brief* (BHI 2000).

[j]Anomalous lead concentrations will be assessed at the time of waste site closeout to verify protection of groundwater and river pathways.

[k]Based on the calculated isotopic distribution of uranium in the 300 Area and a groundwater protective cleanup level of 37 pCi/g for total uranium, the corresponding uranium concentration is 53 mg/kg. For direct exposure, the activity concentration corresponding to 15 mrem/yr of 56 pCi/g corresponds to a uranium concentration of 81 mg/kg.

EPA = U.S. Environmental Protection Agency
RAO = remedial action objective
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

## Table 2. Unrestricted Use Cleanup Levels for the Eight Waste Sites in the 300-FF-2 Operable Unit - Radionuclides.

| Constituent | Soil Cleanup Level for Direct Exposure[a] (pCi/g) | Soil Cleanup Level for Groundwater Protection[b] (pCi/g) | Soil Cleanup Level for River Protection[c] (pCi/g) | Selected Soil Cleanup Level [d] (pCi/g) |
|---|---|---|---|---|
| Americium-241 | 32.1 | NA[e] | NA[e] | 32.1 |
| Cesium-137 | 6.2 | NA[e] | NA[e] | 6.2 |
| Cobalt-60 | 1.4 | NA[e] | NA[e] | 1.4 |
| Europium-152 | 3.3 | NA[e] | NA[e] | 3.3 |
| Europium-154 | 3.0 | NA[e] | NA[e] | 3.0 |
| Europium-155 | 125 | NA[e] | NA[e] | 125 |
| Plutonium-238 | 38.8 | NA[e] | NA[e] | 38.8 |
| Plutonium-239/240 | 35.1 | NA[e] | NA[e] | 35.1 |
| Radium-226 | 1.0 | NA[e] | NA[e] | 1.0 |
| Ruthenium-106 | 17.2 | NA[e] | NA[e] | 17.2 |
| Strontium-90 | 4.5 | NA[e] | NA[e] | 4.5 |
| Technetium-99 | 34.7 | 33 | 66 | 33 |
| Thorium-232 | 1.0 | NA[e] | NA[e] | 1.0 |
| Tritium (H-3) | 711 | 30,530 | 61,060 | 711 |
| Uranium (Total) | 56[f] | 37[g] | 74 | 37[g] |

NOTE: Shaded areas represent the pathway driver for the selected cleanup level. Changes to the cleanup levels based on site-specific information (e.g., size of the waste site, nature and extent of contamination in the soil column, presence of multiple contaminants) may be required. (Waste Sites 618-7, 300 Vitirification Test Site, 618-13, 600-47, 316-4, 600-63, 600-259, and 618-10)

[a]Direct exposure values represent soil activities for individual radionuclides that would meet the RAO for cumulative risk (i.e., $10^{-4}$ to $10^{-6}$ risk under an unrestricted land-use scenario) from exposure to contaminated waste/soil. As operational guidance, the Tri-Parties have interpreted compliance with this requirement to mean that the total dose of all radionuclides shall not exceed 15 mrem/year above Hanford Site background for 1000 years following the remediation for the individual who receives a reasonable maximum exposure (RME). Values will be lower for multiple radionuclides to achieve the same risk endpoint. Listed values are calculated by RESRAD and apply to the top 4.6 m (15 ft).

[b]Groundwater protection values represent soil concentrations that will be protective of groundwater. Listed values are calculated by RESRAD based on the applicable groundwater cleanup standard.

[c]River protection values represent soil concentrations that will not cause applicable river cleanup levels to be exceeded as contaminants migrate through the soil column to groundwater, and from groundwater to the river. Listed values are calculated by RESRAD based on the applicable river cleanup standard.

[d]Listed values apply to the top 4.6 m (15 ft) and represent the most restrictive cleanup level derived from evaluation of the direct exposure, groundwater, and river pathways. Below 4.6 m (15 ft), alternate cleanup levels may be required to meet the RAOs based on the actual soil profile encountered during remedial action.

[e]NA = Not applicable. The RESRAD model predicts that the constituent will not reach groundwater within 1,000 years based on a generic site profile (4.6-m [15-ft] contaminated zone and 6-m [19.6-ft] uncontaminated zone).

[f]Listed value is equal to a 15 mrem/yr dose (approximately $10^{-4}$ to $10^{-6}$ excess cancer risk) based on the isotopic distribution of uranium-234, uranium-235, and uranium-238 in the 300 Area.

[g]Value calculated using RESRAD based on the generic site model with a length parallel to groundwater of 100 m, and $K_d$ values of 8.9 mL/g for the contaminated zone and 0 mL/g for the saturated zone (Figure 3). The irrigation component of the exposure scenario is the primary reason why this value is lower than the groundwater protection value identified in Table 3. The soil concentrations in both tables are protective of the groundwater at the MCL, given the generic site profile and the exposure scenario assumptions.

EPA = U.S. Environmental Protection Agency
$K_d$ = distribution coefficient
MCL = maximum contaminant level
RAO = remedial action objective
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

**Table 3. Soil Cleanup Level for Uranium.**

| Constituent | Direct Exposure[a] (pCi/g) | Groundwater Protection[b] (pCi/g) | River Protection[c] (pCi/g) | Selected Cleanup Level[d] (pCi/g) |
|---|---|---|---|---|
| Uranium (Total) | 350[e] | 267[f] | 267[f] | 267[f] |

NOTE: In applying the new uranium cleanup level, an assessment based on the development of additional site-specific parameters (e.g., site-specific $K_d$/leach tests) will be performed to evaluate groundwater protection. If the additional site-specific assessment indicates that the groundwater protection standard will not be met, further cleanup and/or appropriate remedy selection change may be required.

[a] Direct exposure values represent soil activities for individual radionuclides that would meet the remedial action objective for cumulative risk (i.e., $10^{-4}$ to $10^{-6}$ risk under an industrial scenario) from exposure to contaminated waste/soil. As operational guidance, the Tri-Parties have interpreted compliance with this requirement to mean that the total dose of all radionuclides shall not exceed 15 mrem/year above Hanford Site background for 1000 years following the remediation for the individual who receives a reasonable maximum exposure (RME). Values will be lower for multiple radionuclides to achieve the same risk endpoint. Listed values are calculated by RESRAD and apply to the top 4.6 m (15 ft).

[b] Groundwater protection values represent soil concentrations that will be protective of groundwater at the MCL.

[c] River protection values represent soil concentrations that will not cause applicable river cleanup standards to be exceeded as contaminants migrate through the soil column to groundwater, and from groundwater to the river. Listed values are calculated by RESRAD based on the applicable river cleanup standard.

[d] Listed values apply to the top 4.6 m (15 ft) and represent the most restrictive cleanup level derived from evaluation of the direct exposure, groundwater, and river pathways. Below 4.6 m (15 ft), alternate cleanup levels may be required to meet the remedial action objectives based on verification of the generic site profile during remedial actions.

[e] Listed value is equal to a 15 mrem/yr dose based on the isotopic distribution of uranium-234, uranium-235, and uranium-238 in the 300 Area.

[f] Listed value is the soil cleanup level that is based on the technical evaluation provided in *Protection of 300 Area Groundwater from Uranium-Contaminated Soils at Remediated Sites* (BHI 2002).

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*Signature sheet for the Explanation of Significant Differences to the Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington, between the United States Department of Energy and the United States Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.*

Mike Gearheard
Director, Office of Environmental Cleanup
United States Environmental Protection Agency Region 10

4-19-04
Date

*Signature sheet for the Explanation of Significant Differences to the Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington, between the United States Department of Energy and the United States Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.*

Keith Klein
Manager, Richland Operations Office
U.S. Department of Energy

5/6/04
Date

*Signature sheet for the Explanation of Significant Differences to the Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington, between the United States Department of Energy and the United States Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.*

Mike Wilson
Program Manager, Nuclear Waste Program
Washington State Department of Ecology

5/5/04
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