Cleanup Verification Package for the 118-F-3, Minor Construction Burial Ground

Prepared for the U.S. Department of Energy
by Washington Closure Hanford

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EXECUTIVE SUMMARY

This cleanup verification package documents completion of remedial action for the 118-F-3, Minor Construction Burial Ground waste site. The 118-F-3 site is located within the 100-FR-2 Operable Unit in the 100-F Area of the Hanford Site in southeastern Washington State. This site operated during 1952 and, prior to remediation, was as an open field covered with cobbles, with no vegetation growing on the surface. The burial ground measured approximately 55.3 m (175 ft) by 15.2 m (50 ft) by 4.5 m (15 ft) deep (DOE-RL 2001). The site received irradiated reactor parts that were removed during the conversion of the 105-F Reactor from the Liquid 3X to the Ball 3X Project safety systems. The burial ground received mostly vertical safety rod thimbles and step plugs. The site was located approximately 85 m (280 ft) southwest of the 105-F Reactor Building.

Remedial action at the 118-F-3 site began on January 31, 2006 with load out of waste material completed on May 23, 2006. Remedial activities included removal of metal and concrete debris from the burial ground along with the underlying contaminated soil. Results of the sampling, laboratory analyses, and data evaluations for the 118-F-3 site (which includes the remediation footprint, overburden [stockpiled soil], and the above-cleanup-level staging pile footprint) indicate that all remedial action objectives and goals for direct exposure, protection of groundwater, and protection of the Columbia River have been met (see Table ES-1).

The site meets cleanup standards and has been reclassified as "interim closed out" in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) and the Waste Site Reclassification Guideline TPA-MP-14 (RL-TPA-90-0001) (DOE-RL 1998). A copy of the waste site reclassification form is included as Attachment ES-1.

Table ES-1. Summary of Cleanup Verification Results for the 118-F-3 Burial Ground. (2 pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?	Ref.
Direct Exposure – Radionuclides	1. Attain 15 mrem/yr dose rate above background over 1,000 years.	1. All cumulative radionuclide activities are below the cumulative 15 mrem/yr dose rate.	Yes	d,e
Direct Exposure – Nonradionuclides	1. Attain individual COC RAGs.	1. All individual COC concentrations are below the direct exposure criteria.	Yes	d,e
Meet Nonradionuclide Risk Requirements	1. Hazard quotient of <1 for noncarcinogens.	1. The individual hazard quotient for boron is <1.	Yes	e
	2. Cumulative hazard quotient of <1 for noncarcinogens.	2. Cumulative hazard quotient calculation not required.	N/A	e
	3. Excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	3. There are no carcinogenic nonradionuclide COCs for this site.	N/A	d,e
	4. Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	4. There are no carcinogenic nonradionuclide COCs for this site.	N/A	d,e
Groundwater/ River Protection – Radionuclides	1. Attain single COC groundwater and river protection RAGs.	1. Groundwater and river RAGs for the radionuclide COCs have been attained.	Yes	d,e
	2. Attain National Primary Drinking Water Standards: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.[a]	2. RESRAD modeling predicts that residual concentrations of the detected radionuclide COCs meet the dose rate limit of 4 mrem/yr.		d
	3. Meet drinking water standards for alpha emitters: the more stringent of the 15 pCi/L MCL or 1/25th of the derived concentration guide per DOE Order 5400.5.[b]	3. There are no alpha-emitting COCs for this site.	N/A	
	4. Meet total uranium standard of 21.2 pCi/L.[c]	4. Uranium is not a COC for this site.	N/A	

Table ES-1. Summary of Cleanup Verification Results for the 118-F-3 Burial Ground. (2 pages)

Groundwater/ River Protection – Nonradionuclides	1. Attain individual nonradionuclide groundwater and river cleanup requirements.	1. Barium exceeded groundwater and/or river protection RAGs in the focused sample. However, results of the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005)[f] indicate that this constituent will not reach groundwater (and therefore, the Columbia River) within 1,000 years. Thus, the residual concentrations achieve the RAOs for groundwater and river protection.	Yes	[d]
Other supporting Information	118-F-3 cleanup verification 95% UCL calculation (Appendix C).[e] 118-F-3 cleanup verification sample location design (Appendix C).[g]			

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).

[b] *Radiation Protection of the Public and the Environment* (DOE Order 5400.5).

[c] Based on the isotopic distribution of uranium in the Hanford Site background, the 30 µg/L MCL (65 *Federal Register* 76708) corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038 (BHI 2001).

[d] The Cleanup Verification Package for the 118-F-3, Minor Construction Burial Ground, CVP-2006-00008, Washington Closure Hanford, Richland, Washington.

[e] *118-F-3 Waste Site Cleanup Verification 95% UCL Calculations*, 0100F-CA-V0273, Rev. 0, Washington Closure Hanford, Richland, Washington.

[f] *BHI 2005*

[g] *118-F-3 Shallow Zone, ACL, and BCL Overburden Sampling Plan,* 0100F-CA-V0268, Rev. 0, Washington Closure Hanford, Richland, Washington.

COC = contaminant of concern
MCL = maximum contaminant level
N/A = not applicable
RAG = remedial action goal
RAO = remedial action objective
RESRAD = RESidual RADioactivity (dose model)

Attachment ES-1

Waste Site Reclassification Form

Date Submitted: November **Originator:** L. M. Dittmer **Phone:** 372-9664	**Operable Unit(s):** 100-FR-2 **Waste Site ID:** 118-F-3, Minor Construction Burial Ground **Type of Reclassification Action:** Rejected ☐ Closed Out ☐ Interim Closed Out ☒ No Action ☐	**Control Number:** 2006-059 **Lead Agency:** EPA

This form documents agreement among the parties listed below authorizing classification of the subject unit as rejected, closed out, or no action and authorizing backfill of the site, if appropriate. Final removal from the National Priorities List (NPL) of no action or closed-out sites will occur at a future date.

Description of current waste site condition:

Remedial action at this site has been performed in accordance with remedial action objectives and goals established by the U.S. Environmental Protection Agency and the Washington State Department of Ecology, in concurrence with the U.S. Department of Energy, Richland Operations Office. The selected remedial action involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility at the 200 Area of the Hanford Site, and (3) backfilling the site with clean soil to adjacent grade elevations. These excavation and disposal activities have been completed.

Basis for reclassification:

The results of verification sampling of the soils at the 118-F-3 waste site demonstrated that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also showed that residual contaminant concentrations are protective of groundwater and the Columbia River. The waste site does not have a deep zone; therefore, no institutional controls are required. The basis for reclassification is described in detail in the *Cleanup Verification Package for the 118-F-3, Minor Construction Burial Ground* (CVP-2006-00008), Washington Closure Hanford, Richland, Washington.

D. C. Smith DOE Project Manager	Signature	12/20/06 Date
N/A Ecology Project Manager	Signature	Date
R. A. Lobos EPA Project Manager	Signature	12/21/06 Date

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ACRONYMS AND ABBREVIATIONS

ACL	above cleanup level
COC	contaminant of concern
DQA	data quality assessment
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
GPERS	Global Positioning Environmental Radiological Surveyor
RAG	remedial action goal
RDR/RAWP	remedial design report/remedial action work plan
RESRAD	RESidual RADioactivity (dose assessment model)
ROD	record of decision
SAP	sampling and analysis plan
UCL	upper confidence limit
WAC	*Washington Administrative Code*

1.0 INTRODUCTION

The purpose of this cleanup verification package is to document that the 118-F-3 waste site was remediated in accordance with the Record of Decision for the *100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units, Hanford Site (100 Area Burial Grounds), Benton County, Washington* (ROD) (EPA 2000). Remedial action objectives and goals for the 118-F-3 site were established by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy, Richland Operations Office, in concurrence with the Washington State Department of Ecology. These goals and objectives are documented in the 100 Area Burial Grounds ROD (EPA 2000) and the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005). The ROD (EPA 2000) provides the U.S. Department of Energy, Richland Operations Office the authority, guidance, and objectives to conduct this remedial action.

The preferred remedy specified in the ROD (EPA 2000) and conducted for the 118-F-3 site included: (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility (ERDF) at the 200 Areas of the Hanford Site, and (3) backfilling the site with clean soil from the overburden (stockpiled soil) and the100-F Area borrow pit to an average adjacent grade elevation. Excavation was driven by remedial action objectives for direct exposure, protection of groundwater, and protection of the Columbia River. For the respective points of compliance, the remedial action goals (RAGs) summarized in Table 1 were established for the radionuclide and nonradionuclide contaminants of concern (COCs). Waste site COCs were identified in the RDR/RAWP (DOE-RL 2005) and included cobalt-60 and nickel-63. Barium, boron, and strontium-90 were detected in the remaining black surface ash located at the northern end of the 118-F-3 burial ground and, as such, were added as waste site COCs. Additionally, cesium-137 was detected in the verification samples and was added as a COC. The COCs for the 118-F-3 waste site are barium, boron, cobalt-60, cesium-137, nickel-63, and strontium-90 and are provided in Table 1.

Soil cleanup levels were established in the interim action ROD based on a limited ecological risk assessment. Although not required by the ROD (EPA 2000), a screening comparison against ecological risk screening levels has been made for the site COCs, as identified in the RDR/RAWP. The highest exceedance values were observed in the focused sample collected of the black surface ash located north of the 118-F-3 waste site. Barium, boron, and selenium exceeded screening level values. However, exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Barium, boron, and selenium are below the range for generic background soil values: (barium: <70 to 3000 ppm), (boron: <20 to 150 ppm), (selenium : <0.1 to 4.0 ppm), provided in the Risk Assessment Information System (RAIS) database < http://risk.lsd.ornl.gov >. The exceedance of soil values by these constituents at the site will be evaluated in the context of additional lines of evidence for ecological effects. A baseline risk assessment for the river corridor portion of the Hanford Site began in 2004, which includes a more complete quantitative ecological risk assessment. That baseline risk assessment will be used as part of the final closeout decision for this site.

Table 1. Summary of Remedial Action Goals.[a]

COCs	Direct Exposure RAG	Groundwater Protection RAG (pCi/L)	Columbia River Protection RAG (pCi/L)
Radionuclides			
Cobalt-60	15 mrem/yr (cumulative)[b]	4 mrem/yr (cumulative)[c]	4 mrem/yr (cumulative)[c]
Cesium-137			
Nickel-63			
Strontium-90		8[d,e]	8[d,e]
COCs	**Direct Exposure RAGs (mg/kg)**	**Soil RAG for Groundwater Protection (mg/kg)**	**Soil RAG for Columbia River Protection (mg/kg)**
Nonradionuclides			
Barium	5,600[f]	132[g,h]	224[i]
Boron[j]	16,000	320	--[k]

[a] Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.

[b] Lookup values that correspond to the 15 mrem/yr dose rate are based on a generic site model and are presented in the 100 Area RDR/RAWP (DOE-RL 2005).

[c] Lookup values based on individual radionuclide 4 mrem/yr dose rate equivalent for beta and gamma emitters per National Drinking water standards as presented in the *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (DOE-RL 2001). Alpha emitters must meet drinking water standards based on the more conservative of the 15 pCi/L maximum contaminant level or 1/25th of the derived concentration guide per DOE Order 5400.5.

[d] Strontium-90 contributes to the 4 mrem/yr (cumulative) RAG for groundwater and river protection.

[e] Promulgated groundwater protection standard (40 CFR 141).

[f] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), 1996 (Method B for soils) (as presented in the 100 Area RDR/RAWP [DOE-RL 2005]). Updated oral reference dose values (as provided in IRIS) yield Method B direct exposure RAG values of 16,000 mg/kg and 120,000 mg/kg for barium.

[g] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996).

[h] Barium soil cleanup level for groundwater protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule") and WAC 173-340-720(3), 1996 (Method B for groundwater) is 112 mg/kg (as presented in the 100 Area RDR/RAWP [DOE-RL 2005]). The updated oral reference dose value (as provided in IRIS) yields a Method B groundwater cleanup criteria of 7 mg/L, as compared to the more restrictive MCL of 2 mg/L (40 CFR 141). Per WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), the most restrictive updated soil cleanup level for groundwater protection would be 200 mg/kg.

[i] Barium soil cleanup level for river protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), a DAF of 2, and WAC 173-340-720(3), 1996 (Method B for groundwater) is 224 mg/kg (as presented in the 100 Area RDR/RAWP [DOE-RL 2005]). No surface water bioconcentration factor is available for barium and no ambient water quality criteria exists separate from the previous drinking water standard; therefore, no WAC 173-340-730(3), 1996 (Method B for surface waters) value can be determined.

[j] No Hanford Site-specific or Washington State background value available.

[k] No cleanup level is available from the Ecology Cleanup Levels and Risk Calculations database (Ecology 2005), and no bioconcentration factor or AWQC values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).

AWQC = ambient water quality criteria
CFR = *Code of Federal Regulations*
COC = contaminant of concern
DAF = dilution attenuation factor
IRIS = Integrated Risk Information System
MCL = maximum contaminant level
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = remedial design report/remedial action work plan
WAC = *Washington Administrative Code*

2.0 SITE DESCRIPTION AND SUPPORTING INFORMATION

The 118-F-3 site is located in the 100-FR-2 Operable Unit of the 100-F Area at the Hanford Site. The site is located approximately 85 m (280 ft) southwest of the 105-F Reactor Building (Figure 1). This site operated during 1952 and, prior to remediation, was an open field covered with cobbles, with no vegetation growing on the surface. The southern half of the burial ground ran in a north-south direction, whereas the northern portion of the burial ground angled toward the east. The burial ground measured approximately 55.3 m (181 ft) by 15.2 m (50 ft) by 4.5 m (15 ft) deep (DOE-RL 2001). The site received irradiated reactor parts that were removed during the conversion of the 105-F Reactor from the Liquid 3X to the Ball 3X Project safety systems. The burial ground received mostly vertical safety rod thimbles and step plugs. Prior to remediation, the dose rate at the surface of the burial ground was less than 1 millirad/hr (DOE-RL 2001).

3.0 REMEDIAL ACTION FIELD ACTIVITIES

3.1 EXCAVATION AND DISPOSAL

Remedial action at the 118-F-3 site began on January 31, 2006 with load out of waste material completed on May 23, 2006. Excavation of the site involved removing metal and concrete debris including piping, sheet metal, an empty tank structure, a large heat-transfer tower, thimbles, and step plugs. No asbestos-containing material was identified during waste excavation. At the conclusion of excavation activities, the remediation footprint was approximately 3.5 m (12 ft) below ground surface and the elevation at the bottom of the excavation was 121.5 m (400 ft) above sea level. An estimated 4,060 metric tons (4,476 U.S. tons) of material from the site was disposed of at ERDF. In addition, approximately 1,400 cubic meters (49,441 cubic feet) of clean overburden material was excavated from the 118-F-3 waste site and stockpiled for potential reuse as backfill. All contaminated materials removed from the 118-F-3 waste site were disposed of at ERDF. Pre- and post-remediation topographic maps are shown in Figures 2 and 3, respectively. Photographs of the remediation activities are provided in Figures 4 through 6.

Figure 1. Hanford Site Map and 118-F-3 Site Plan.

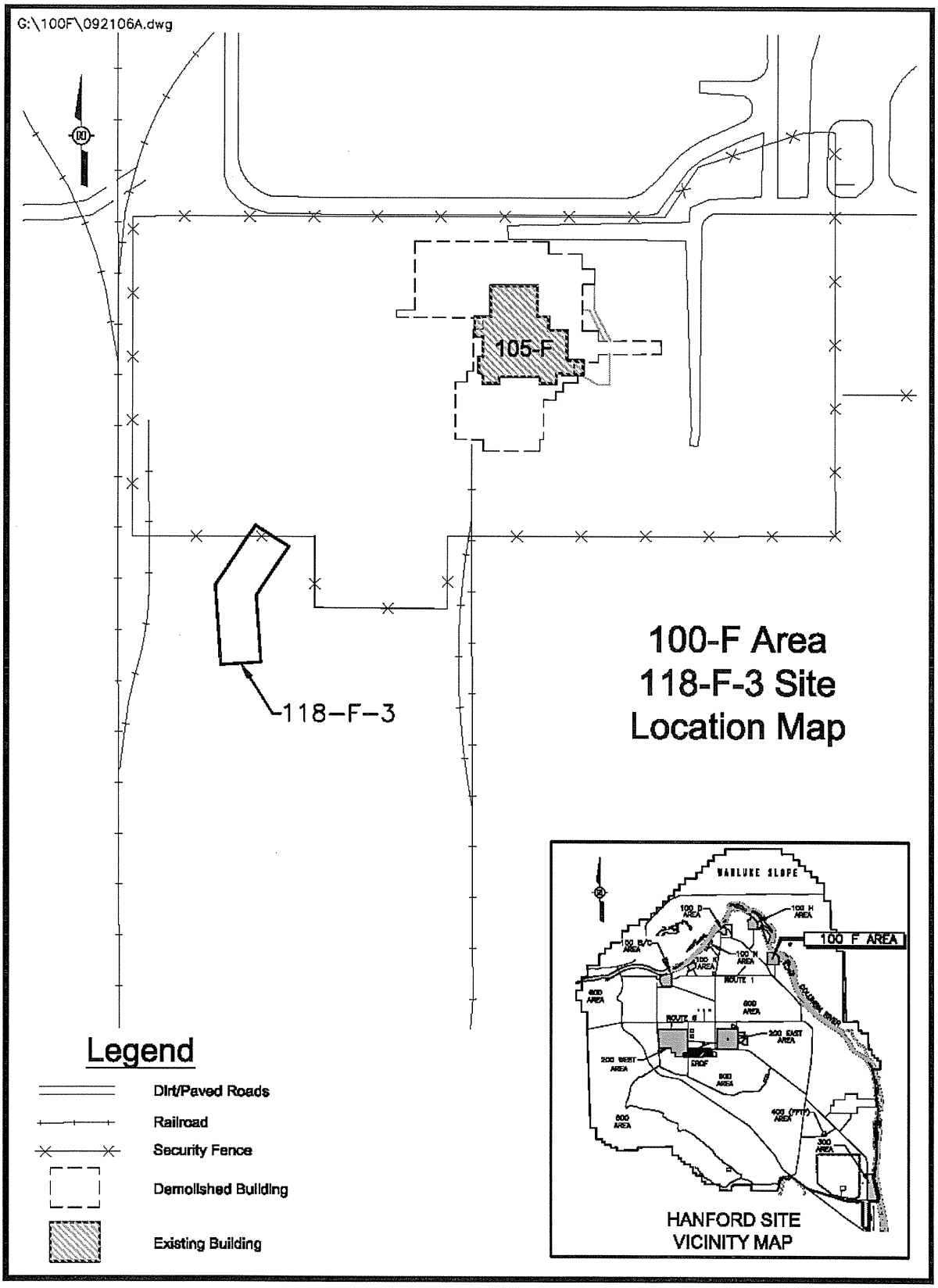


Figure 2. 118-F-3 Pre-Remediation Topographic Map.

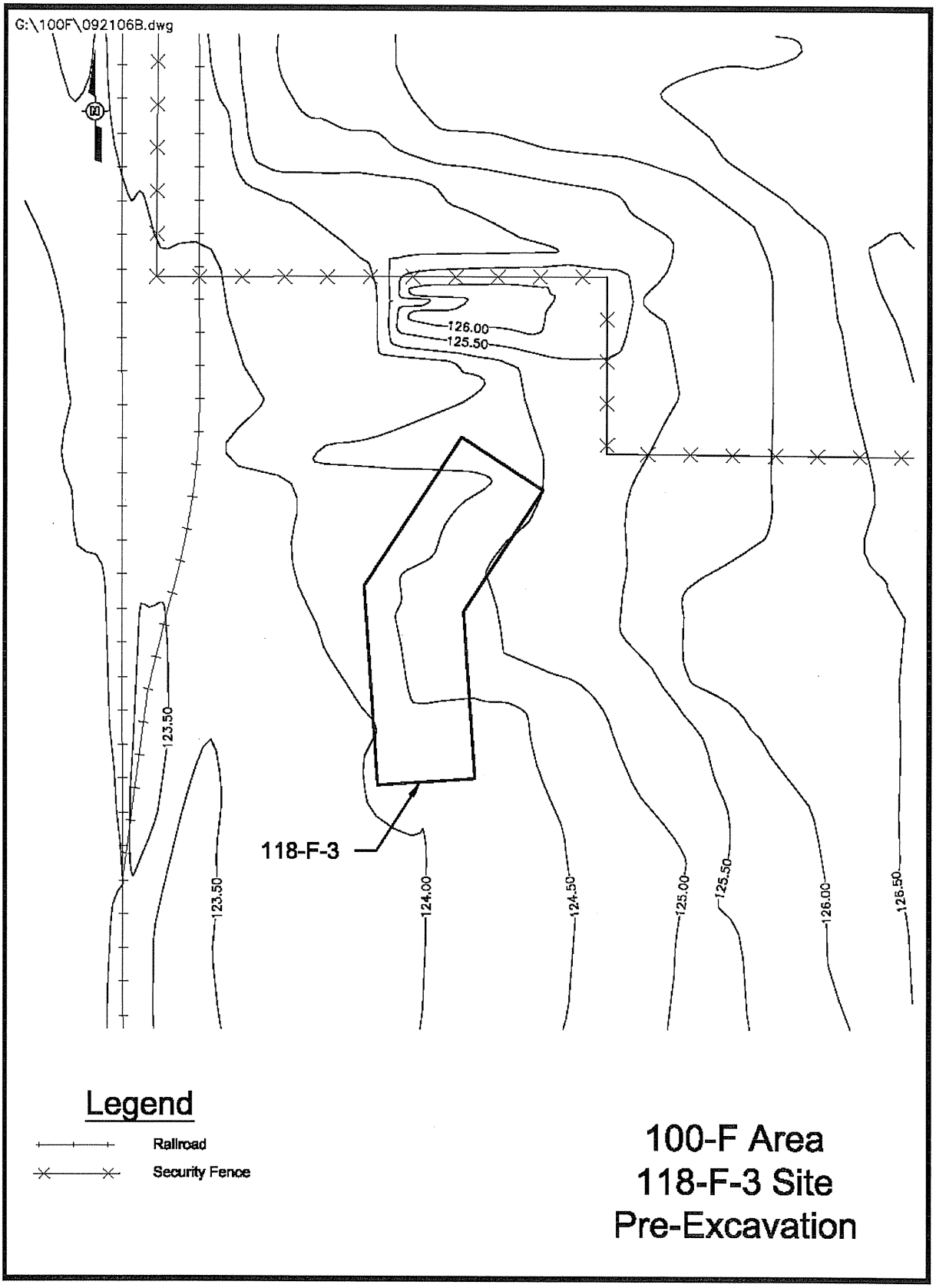


Figure 3. 118-F-3 Post-Remediation Topographic Map Showing Black Surface Ash and Focused Sample Location.

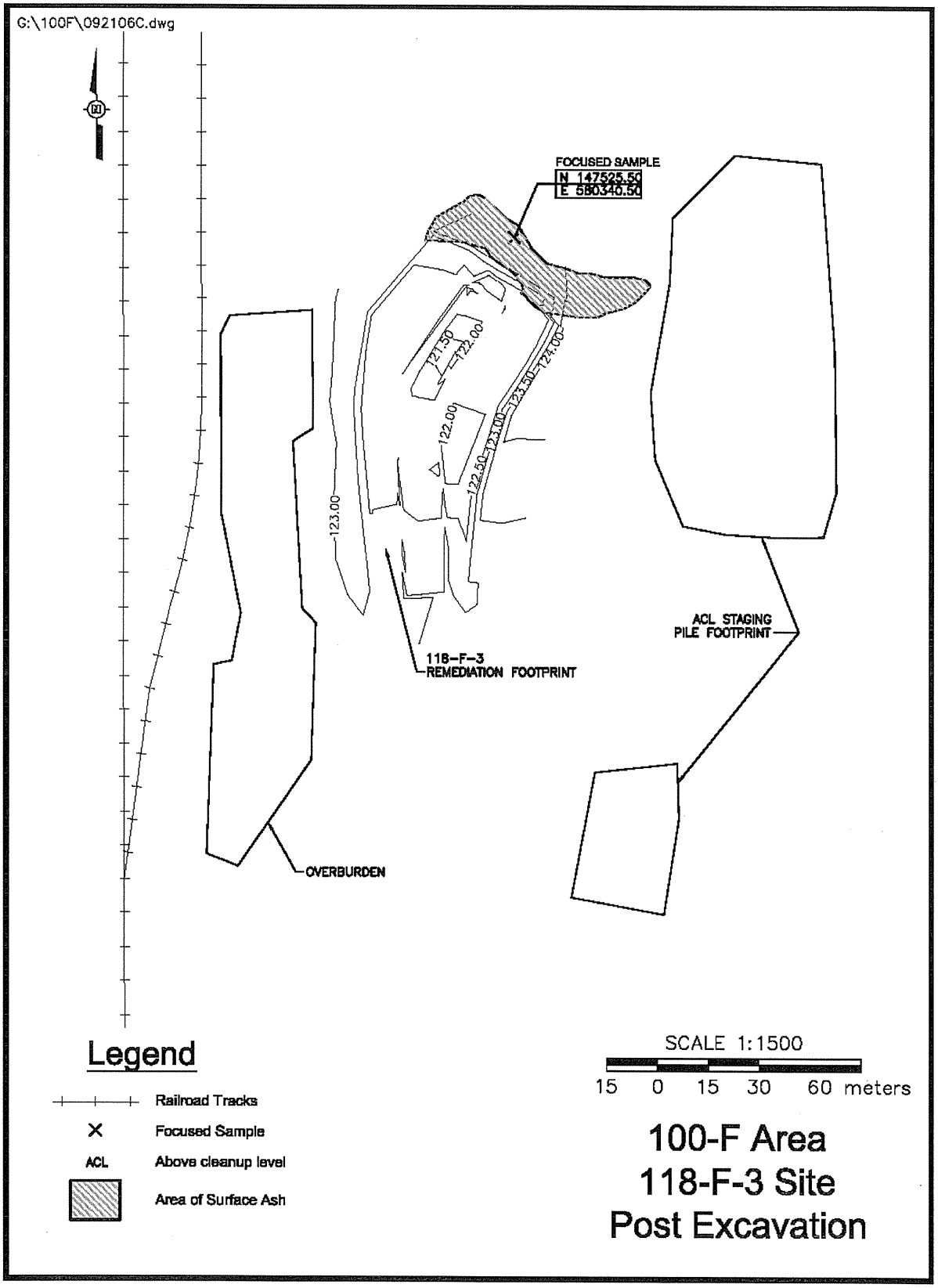


Figure 4. Photograph of 118-F-3 Burial Ground Remediation Debris.

Figure 5. Photograph of 118-F-3 Burial Ground Remediation Debris.

Figure 6. Photograph of 118-F-3 Remediation Footprint.

3.2 FIELD SCREENING

In-process characterization samples were analyzed for the COCs identified in the *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2001) along with a wide range of metals, semi-volatile organic compounds, gamma energy emitting isotopes, gross alpha, and gross beta. In addition, samples were collected from an area containing a black surface ash located at the northern end of the 118-F-3 excavation. Strontium-90 and barium were detected at levels above soil background concentrations in the black surface ash and boron exceeded the ecological screening criteria. Based on the surface ash sample results, all verification samples were analyzed for strontium-90, barium, and boron in addition to the listed waste site COCs.

Radiological field screening was conducted during the site remedial action effort to provide an initial assessment of the attainment of radiological cleanup levels. Field screening at the site included using a Global Positioning Environmental Radiological Surveyor (GPERS) to quickly assess the presence and level of contamination. The radiological survey, conducted May 3, 2006, detected areas of residual radiological contamination that required additional site excavation (Figure 7). The "hot spot" areas were further excavated and an activated metal wire was located and removed along with the underlying soil. A second GPERS survey was performed on May 15, 2006 in order to demonstrate that the subsequent remediation efforts had removed the residual radiological contamination and that no further remediation was required at the site (Figure 8). The second GPERS survey detected an area of elevated radiation levels in the southern portion of the burial ground (Figure 8). Additional hand held surveys were performed over the area and no elevated radionuclides were detected. Therefore, no further excavation was required in this area prior to collection of the verification samples.

Figure 7. GPERS Radiological Survey Gamma Track Map of the 118-F-3 Remediation Footprint (May 5, 2006).

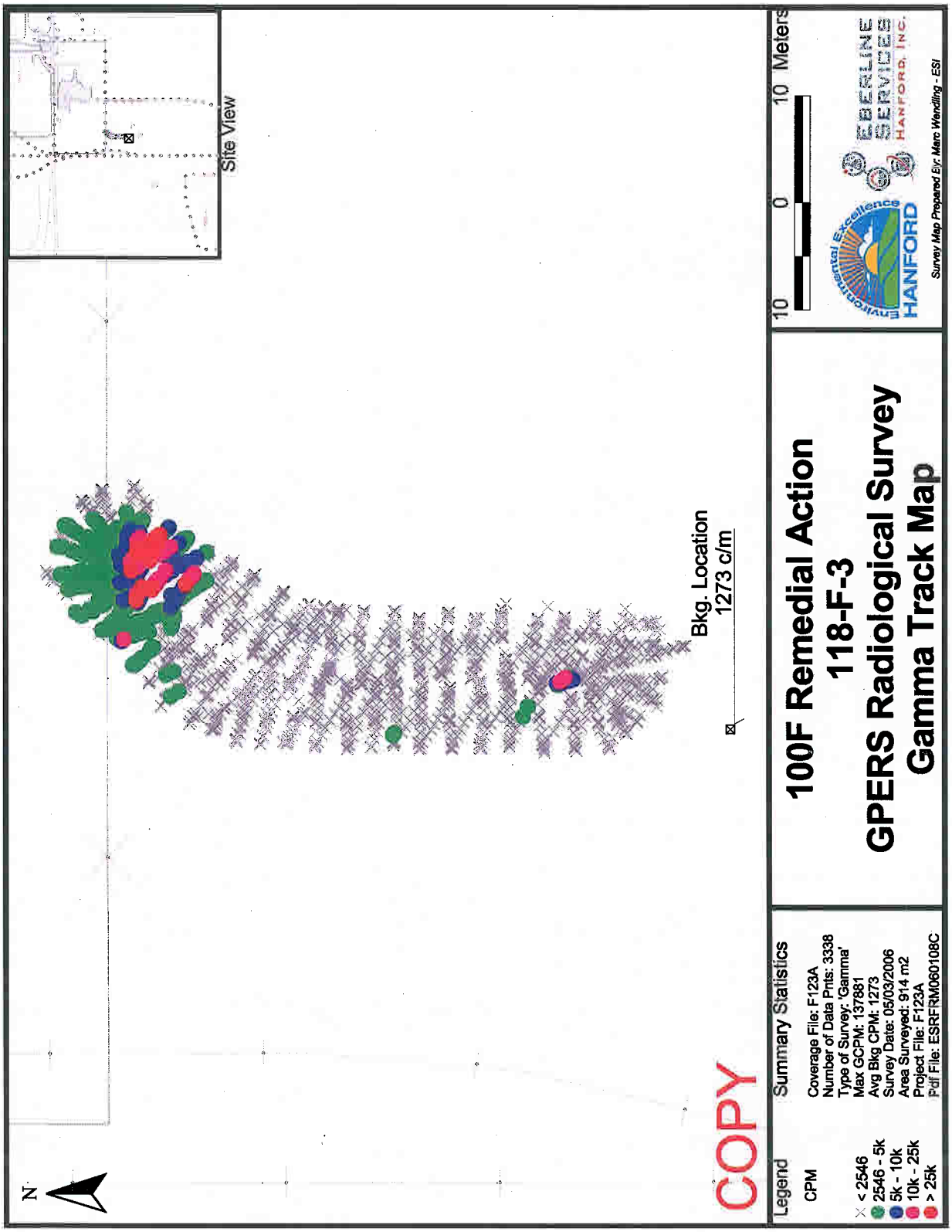
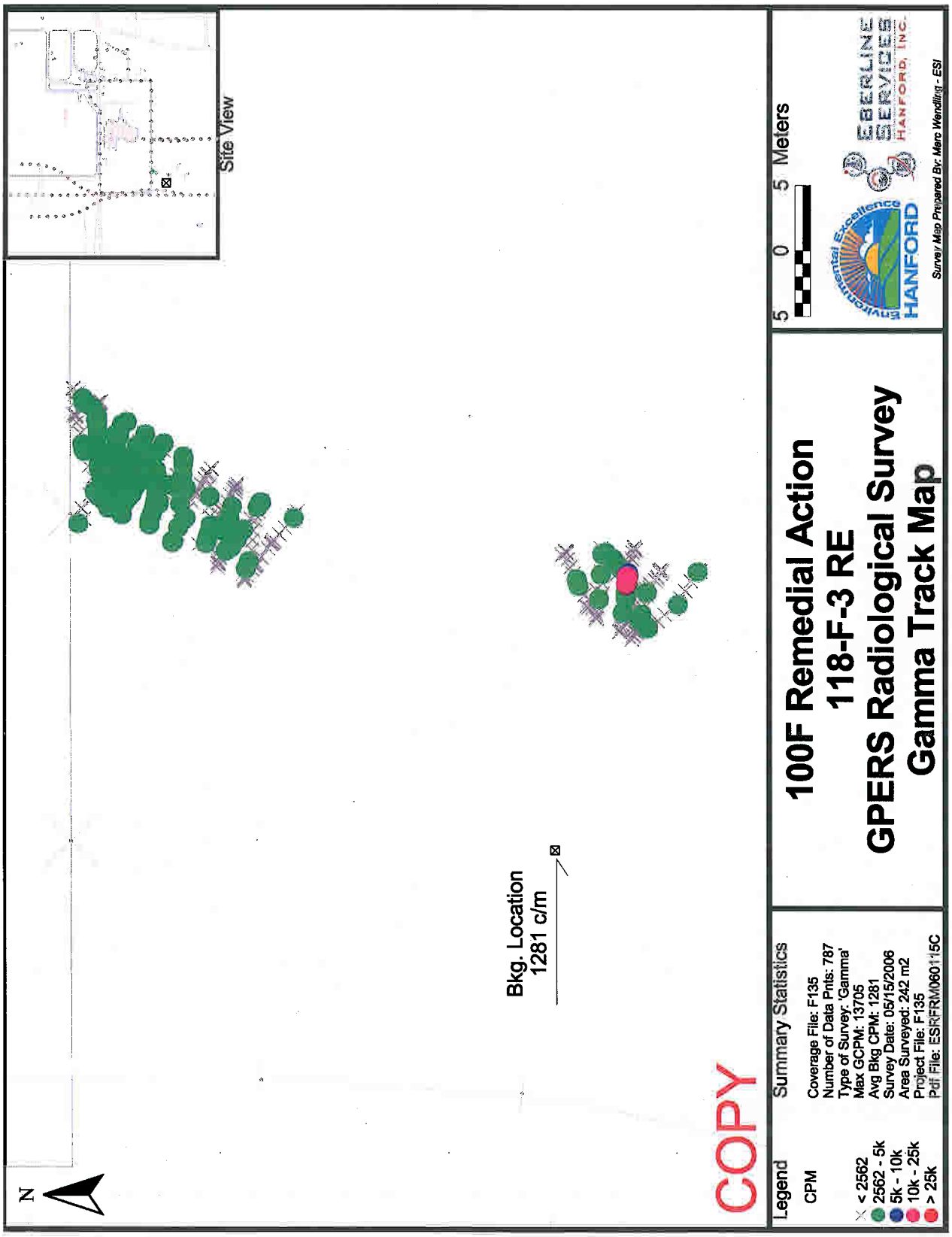


Figure 8. GPERS Radiological Survey Gamma Track Map of the 118-F-3 Remediation Footprint (May 15, 2006).



3.3 FOCUSED SAMPLING AND ANALYSIS

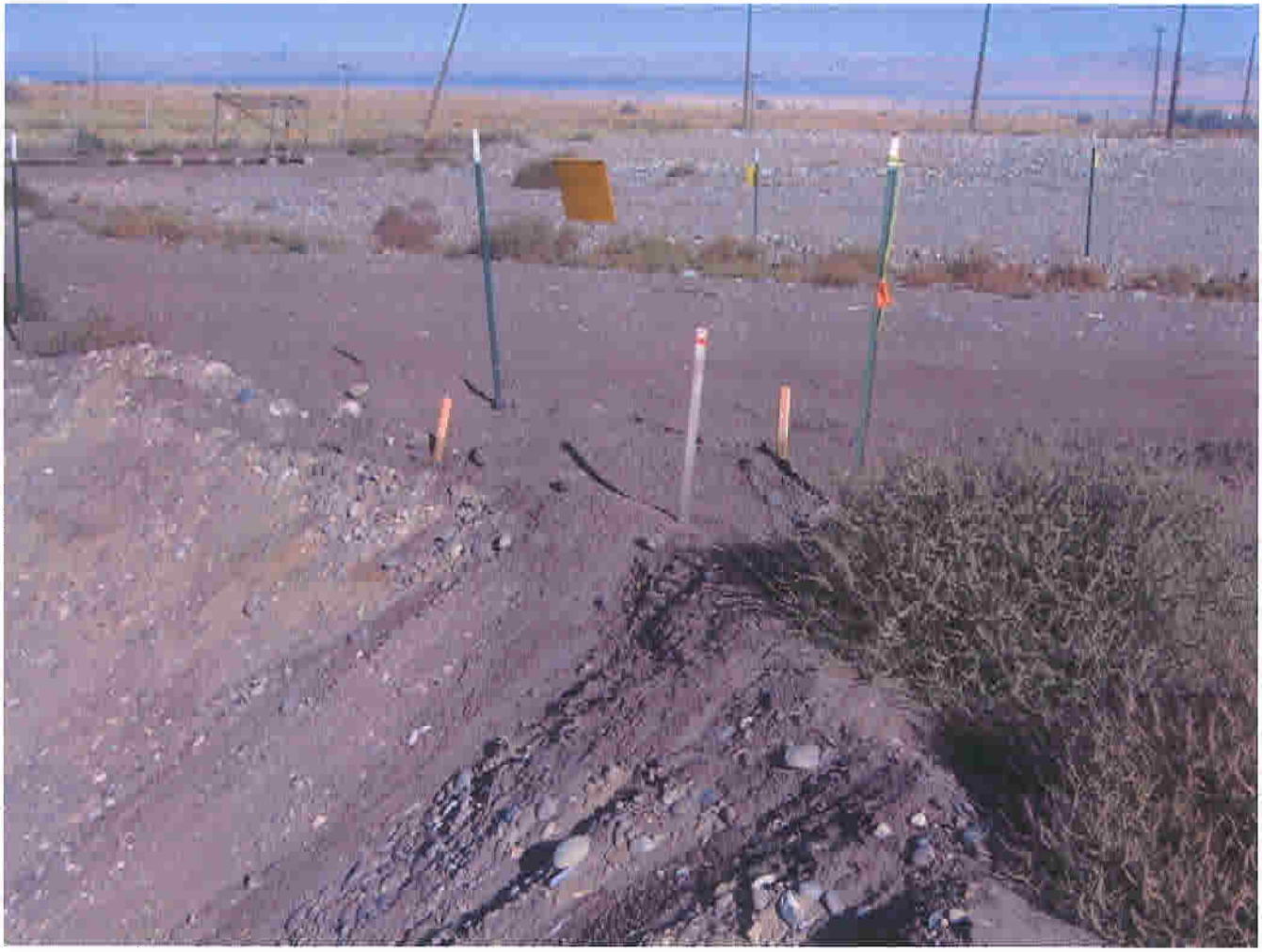
A focused sample was collected from the area of black surface ash located to the immediate north of the 118-F-3 waste site (Figures 3 and 9). The surface ash covers an area of approximately 130 square meters (1,400 square feet). On August 3, 2005, a focused sample and regulatory split were collected of the black surface ash. These samples were analyzed for the listed COCs. In addition, the regulatory split was analyzed for ICP metals, polychlorinated biphenyls, gross alpha and gross beta. No PCBs were detected in the EPA split sample, and the gross alpha and gross beta results were below their respective trigger limits of 15 pCi/g and 23 pCi/g. Therefore, no further analysis was required. The results of the focused sampling for the waste site COCs are discussed further in Section 5.0 of this cleanup verification package.

3.4 CLEANUP VERIFICATION SAMPLING AND ANALYSIS

Final cleanup verification samples were collected in August of 2006 to confirm acceptability of residual contaminant concentrations in the soil at the 118-F-3 waste site. The verification samples were submitted to offsite laboratories for analysis using approved EPA analytical methods, as required per the *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (DOE-RL 2001). The 118-F-3 site was excavated to a depth of approximately 3.5 m (12 ft). The 118-F-3 remediation excavation footprint was classified as one shallow-zone decision unit based on its size and depth. The overburden (stockpiled soil) and the above-cleanup-level (ACL) staging pile footprint are separate decision units. As specified in the SAP (DOE-RL 2001), four composite samples and a duplicate were collected from each of the waste site decision units. Additionally, one regulatory split was collected per decision unit at the request of the EPA. The duplicate samples and regulatory splits were analyzed for ICP metals, polychlorinated biphenyls, gross alpha, and gross beta, in addition to the listed COCs. No PCBs were detected in the duplicate or EPA split samples and the gross alpha results were below the trigger limit of 15 pCi/g, therefore, no further analysis was required. One EPA split sample (EPA-J134T9) was above the gross beta trigger limit (23 pCi/g) at 23.5 pCi/g. Strontium-90, the primary beta emitter, was analyzed and reported below the limit of detection. The results of the statistical sampling for the waste site COCs (which includes strontium-90) are discussed further in Section 5.0 of this cleanup verification package.

Verification sampling was performed by dividing each decision unit (i.e., the excavation footprint, stockpiled soil, and ACL staging pile footprint) into four sampling areas (A1, A2, A3, and A4) with the sampling areas further divided into 16-node sample grids. One statistical verification sample was collected per sampling area by compositing soil collected at four randomly selected nodes. As such, each decision unit was represented by four composite statistical verification samples. The sample design methodology and sample location figures are presented in the verification sample design calculation brief in Appendix C.

Figure 9. Photograph of Black Surface Ash Located at Northern End of Remediation Footprint.



4.0 CLEANUP VERIFICATION DATA EVALUATION

This section presents the evaluation of the 118-F-3 cleanup verification data for comparison with the data quality criteria and RAGs.

4.1 DATA QUALITY ASSESSMENT PROCESS

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 118-F-3 site determined that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. All analytical data were found to be acceptable for decision-making purposes. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The cleanup verification sample analytical data are stored in the Environmental Restoration project-specific database for data evaluation prior to being submitted for inclusion in the Hanford Environmental Information System database. The verification data are summarized in Appendix A. The detailed DQA is presented in Appendix B.

4.2 CONTAMINANTS OF CONCERN 95% UPPER CONFIDENCE LIMIT

The primary statistical calculation to support cleanup verification is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. The 95% UCL values for each COC are computed for each decision unit (e.g., for the shallow zone, overburden [stockpiled soil], and ACL staging pile footprint). Prior to calculating the 95% UCL, the individual sample results are reviewed and, as appropriate, adjusted per the SAP (DOE-RL 2001) and RDR/RAWP (DOE-RL 2005). This process is summarized below.

For radionuclides, the laboratory-reported value is used in the calculation of the 95% UCL. In cases where the laboratory does not report a value for data qualified with a "U" (i.e., less than the detection limit), one-half of the minimum detectable activity is used in the calculation of the 95% UCL. For nonradionuclides, a value equal to one-half the practical quantitation limit is used for data flagged with a "U" (i.e., less than the detection limit) in the calculation of the 95% UCL, as required by *Washington Administrative Code* (WAC) 173-340-740[7][g]. If greater than half of the sample results for a given nonradionuclide COC are below detection, the statistical value is set equal to the maximum concentration detected (i.e., versus computing a 95% UCL).

Verification sampling summary statistics (95% UCL values) are listed in Table 2. Individual sample cleanup verification results are presented in Appendix A. The columns on the left side of Table 2 are the COCs and the 95% UCL values before subtraction of background. The fifth column of Table 2 presents the background, where values exist, and the last three columns present the statistical values adjusted for background, if appropriate, which becomes the cleanup verification data set used for further evaluation and modeling.

Table 2. Cleanup Verification Data Set.

COCs	95% UCL Statistical Values[a] (pCi/g)			Hanford Site Background[b] (pCi/g)	Cleanup Verification Data Set[c] (pCi/g)		
	Shallow Zone	Overburden	ACL Staging Pile Footprint		Shallow Zone	Overburden	ACL Staging Pile Footprint
Cobalt-60	0.378	0.150 (ND)	0.299	0.008	0.378	0.142 (ND)	0.299
Cesium-137	0.144	0.050 (ND)	0.170	1.1	0.144	0 (<BG) (ND)	0.170
Nickel-63	16.5	0.801 (ND)	13.4	N/A	16.5	0.801 (ND)	13.4
Strontium-90	0.235	0.082 (ND)	0.045 (ND)	0.18	0.235	0 (< BG) (ND)	0.045 (ND)
COCs	95% UCL Statistical Values[a] (mg/kg)			Hanford Site Background (mg/kg)	Cleanup Verification Data Set (mg/kg)		
	Shallow Zone	Overburden	ACL Staging Pile Footprint		Shallow Zone	Overburden	ACL Staging Pile Footprint
Barium	104	70.6	99.7	132	104	70.6	99.7
Boron	10.4	2.4	5.4	N/A	10.4	2.4	5.4

[a] The shallow zone, ACL staging pile footprint, and BCL overburden are from the *118-F-3 Cleanup Verification 95% UCL Calculations*, Calculation No. 0100F-CA-V0273, Rev. 0. Refer to Appendix C for additional details on determination of statistical values.
[b] Represents the 90th percentile of the lognormal distribution (DOE-RL 1996).
[c] For overburden the anthropogenic background (DOE-RL 1996) and naturally occurring background is subtracted from all radionuclides. For other decision units (shallow zone and ACL staging pile footprint), only naturally occurring background (uranium) is subtracted. Refer to the 95% UCL calculation brief in Appendix C for additional details on determination of statistical values.

ACL = above cleanup level
BG = background
COCs = contaminants of concern
BCL = below cleanup level
N/A = not applicable
ND = not detected (in all samples in the data set)
UCL = upper confidence limit

4.3 FOCUSED SAMPLE RESULTS

One focused sample was collected from the area of black surface ash located to the immediate north of the 118-F-3 waste site and analyzed for the site COCs. Statistical analysis (e.g., calculation of a 95% UCL value) is inappropriate to use for evaluation of the focused sample; therefore, the sample results are evaluated using a direct comparison of the detected values to the cleanup levels. Table 3 provides a comparison of the focused sample results against the cleanup criteria.

Table 3. Comparison of Focused Sample Results to Remedial Action Goals.

COCs	Maximum Result (pCi/g)	Generic Site Lookup Values[a] (pCi/g)			Does the Maximum Result Exceed Lookup values?	Does the Maximum Result Pass Modeling?
		Shallow Zone Lookup Value[b]	Soil Concentration for Groundwater Protection	Soil Concentration for River Protection		
Cesium-137	0.180 (ND)	6.2	1,465[c]	1,465[c]	No	N/A
Cobalt-60	0.180 (ND)	1.4	13,900[c]	13,900[c]	No	N/A
Nickel-63	4.05 (ND)	4,013[c]	83[c]	83[c]	No	N/A
Strontium-90	0.217 (ND)	4.5	27.6[c]	27.6[c]	No	N/A
COCs	**Maximum Result (mg/kg)**	**Remedial Action Goals[a] (mg/kg)**			**Does the Maximum Result Exceed RAGs?**	**Does the Maximum Result Pass Modeling?**
		Direct Exposure	Soil Concentration for Groundwater Protection	Soil Concentration for River Protection		
Barium	902	5,600[d]	132[e,f]	224[g]	Yes	Yes[h]
Boron[i]	150	16,000	320	--[j]	No	N/A

[a] Lookup values and RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2005) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.

[b] Activity corresponding to a single-radionuclide 15 mrem/yr exposure as calculated using a generic RESRAD model (DOE-RL 2005).

[c] Revised lookup value per *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Interim Remedial Action Record of Decision* (BHI 2004).

[d] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), 1996 (Method B for soils) (as presented in the 100 Area RDR/RAWP [DOE-RL 2005]). Updated oral reference dose values (as provided in IRIS) yield Method B direct exposure RAG values of 16,000 mg/kg and 120,000 mg/kg for barium and chromium, respectively.

[e] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996).

[f] Barium soil cleanup level for groundwater protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule") and WAC 173-340-720(3), 1996 (Method B for groundwater) is 112 mg/kg (as presented in the 100 Area RDR/RAWP [DOE-RL 2005]). The updated oral reference dose value (as provided in IRIS) yields a Method B groundwater cleanup criteria of 7 mg/L, as compared to the more restrictive MCL of 2 mg/L (40 CFR 141). Per WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), the most restrictive updated soil cleanup level for groundwater protection would be 200 mg/kg.

[g] Barium soil cleanup level for river protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), a DAF of 2, and WAC 173-340-720(3), 1996 (Method B for groundwater) is 224 mg/kg (as presented in the 100 Area RDR/RAWP [DOE-RL 2005]). No surface water bioconcentration factor is available for barium and no ambient water quality criteria exists separate from the previous drinking water standard; therefore, no WAC 173-340-730(3), 1996 (Method B for surface waters) value can be determined.

[h] Based on *100 Area Analogous Sites RESRAD Calculations* (BHI 2005), and a K_d (distribution coefficient) value of 25 mL/g, barium is not expected to migrate more than 3 m (10 ft) vertically in 1,000 years (BHI 2005).

[i] No Hanford Site-specific or Washington State background value available.

[j] No cleanup level is available from the Ecology Cleanup Levels and Risk Calculations database (Ecology 2005), and no bioconcentration factor or AWQC values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).

AWQC = ambient water quality criteria
CFR = *Code of Federal Regulations*
COC = contaminant of concern
DAF = dilution attenuation factor
IRIS = Integrated Risk Information System
MCL = maximum contaminant level
N/A = not applicable
ND = not detected
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose model)
RDR/RAWP = remedial design report/remedial action work plan
WAC = *Washington Administrative Code*

4.4 RESRAD MODELING

A site-specific RESidual RADioactivity (RESRAD) model was not developed for the 118-F-3 waste site. The radionuclide statistical sampling results, shown in Table 2, meet the remedial action goals summarized in Table 1 as demonstrated using the sum-of-fractions method in section 5.1.1, below. Additionally, no radionuclides were detected in the focused soil sample, as shown in Table 3.

5.0 EVALUATION OF REMEDIAL ACTION GOAL ATTAINMENT

This section demonstrates that remedial actions at the 118-F-3 site have achieved the applicable RAGs. Sections 5.1, 5.2, and 5.3 address attainment of direct exposure RAGs, groundwater protection RAGs, and Columbia River protection RAGs, respectively. Section 5.4 documents application of the WAC 173-340 three-part test to the shallow zone, overburden (stockpiled soil), and the ACL staging pile footprint. This test is required for nonradionuclide COCs only and is based on the most restrictive RAG for each zone.

5.1 DIRECT EXPOSURE SOIL REMEDIAL ACTION GOALS ATTAINED

5.1.1 Radionuclides

The cumulative radionuclide dose was calculated separately for the shallow zone remediation footprint (Table 4) and ACL staging pile footprint (Table 5), using the sum-of-fractions method. The columns on the left side of Tables 4 and 5 are the COCs and the 95% UCL values. The third column of each table presents the single radionuclide 15 mrem/yr dose-equivalence activity, and the last column presents the statistical values divided by the dose-equivalence activity. The cumulative dose of 5.2 mrem/yr for the shallow zone remediation footprint is less than the 15 mrem/yr RAG. The cumulative dose of 3.6 mrem/yr for the ACL staging pile footprint is also less than the 15 mrem/yr RAG. Therefore, both the shallow zone decision unit and ACL staging pile footprint achieve the remedial action goals.

The statistical values for the overburden (stockpiled soil) radionuclide COCs were not detected and, therefore, the radionuclide direct exposure RAGs have been met. Similarly, no radionuclide COCs were detected in the focused sample collected from black surface ash located at the northern end of the 118-F-3 excavation. All applicable radionuclide RAGs have been met for direct exposure at the 118-F-3 waste site.

Table 4. Attainment of Radionuclide Direct Exposure RAG for the Shallow Zone Remediation Footprint.

Contaminants of Potential Concern	95% UCL Value (pCi/g)	Activity Equivalent to 15 mrem/yr Dose (pCi/g)	Fraction
Cobalt-60	0.378	1.4	0.27
Cesium-137	0.144	6.2	0.023
Nickel-63	16.5	4,013	0.0041
Strontium-90	0.235	4.5	0.052
		Sum of Fractions	0.35
		Equivalent Dose (mrem/yr)	5.2

Table 5. Attainment of Radionuclide Direct Exposure RAG for the ACL Staging Pile Footprint.

Contaminants of Potential Concern	95% UCL Value (pCi/g)	Activity Equivalent to 15 mrem/yr Dose (pCi/g)	Fraction
Cobalt-60	0.299	1.4	0.21
Cesium-137	0.170	6.2	0.027
Nickel-63	13.4	4,013	0.0033
		Sum of Fractions	0.24
		Equivalent Dose (mrem/yr)	3.6

5.1.2 Nonradionuclides

5.1.2.1 Direct Comparison to RAGs. Table 6 compares the cleanup verification statistical values presented in Tables 2 and 3 to the direct exposure RAGs presented in Table 1. All residual concentrations are below the direct exposure RAG and, as such, all applicable nonradionuclide RAGs have been met for direct exposure.

Table 6. Attainment of Nonradionuclide Direct Exposure Standards. (2 pages)

Nonradionuclides	Cleanup Verification Data Set (mg/kg)	Direct Exposure RAG[a] (mg/kg)	Direct Exposure RAGs Attained?[b]
Shallow Zone			
Barium	104	5,600[c]	Yes
Boron[d]	10.4	16,000	Yes

Table 6. Attainment of Nonradionuclide Direct Exposure Standards. (2 pages)

Nonradionuclides	Cleanup Verification Data Set (mg/kg)	Direct Exposure RAG[a] (mg/kg)	Direct Exposure RAGs Attained?[b]
Overburden			
Barium	70.6	5,600[c]	Yes
Boron[d]	2.4	16,000	Yes
ACL Staging Pile Footprint			
Barium	99.7	5,600[c]	Yes
Boron[d]	5.4	16,000	Yes
Focused Sample			
Barium	902	5,600[c]	Yes
Boron[d]	150	16,000	Yes

[a] Lookup values and RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2005) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.
[b] Criterion is comparison to the cleanup criteria (RAG).
[c] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), 1996 (Method B for soils) (as presented in the 100 Area RDR/RAWP [DOE-RL 2005]). Updated oral reference dose values (as provided in IRIS) yield Method B direct exposure RAG values of 16,000 mg/kg and 120,000 mg/kg for barium and chromium, respectively.
[d] No Hanford Site-specific or Washington State background value available.

ACL = above cleanup level
IRIS = Integrated Risk Information System
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
WAC = *Washington Administrative Code*

5.1.2.2 Noncarcinogenic Hazard Quotient RAG Attained. For noncarcinogenic COCs, WAC 173-340-740(5)(a) and (b) specify the evaluation of the hazard quotient, which is given as the daily intake divided by a reference dose (DOE-RL 2005). This evaluation is shown for the 118-F-3 shallow zone, overburden (stockpiled soil) and ACL staging pile footprint in the 95% UCL calculation brief (Appendix C). Barium was detected below background in all three decision units, and as such was not included in the hazard quotient calculation. Because there is no established background value for boron, an individual hazard quotient was calculated for this COC. The calculated individual hazard quotient for residual concentrations of boron was less than 1.0 for all three decision units, therefore, the noncarcinogenic hazard quotient RAG has been attained for the 118-F-3 waste site.

5.1.2.3 Carcinogenic Risk RAG Attained. For individual nonradionuclide carcinogenic COCs, the WAC 173-340 Method B cleanup limits are based on an incremental cancer risk of 1×10^{-6}. For nonradionuclide carcinogenic COCs, the total excess cancer risk must be less than 1×10^{-5} (DOE-RL 2005). There are no carcinogenic nonradionuclide COCs for 118-F-3, therefore calculation of the carcinogenic risk is not required.

5.2 GROUNDWATER REMEDIAL ACTION GOALS ATTAINED

5.2.1 Radionuclides

Cesium-137, cobalt-60, nickel-63, and strontium-90 were detected in the verification samples for the 118-F-3 shallow zone remediation footprint and cobalt-60, cesium-137, and nickel-63 were detected in the verification samples for the ACL staging pile footprint. Based on *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Remedial Action Record of Decision* (BHI 2004), the residual concentrations of the radionuclide COCs in soil are significantly less than the concentrations predicted to cause the 4 mrem/yr drinking water standard (DOE-RL 2005) to be exceeded. RESRAD modeling in BHI 2004, using K_d (distribution coefficient) values of 50 mL/g for cesium-137 and cobalt-60, 30 mL/g for nickel-63, and 25 mL/g for strontium-90, predicts that the residual soil concentrations of these radionuclides at 118-F-3 will be protective of groundwater (and therefore, the Columbia River) at the maximum contaminant level (MCL) that meets the 4 mrem/yr drinking water standard (DOE-RL 2005). As such, the groundwater RAGs have been attained for the shallow zone and ACL staging pile footprint decision units at the 118-F-3 waste site.

No radionuclide COCs were detected in the overburden (stockpiled soil) or the focused sample of the black surface ash, thus achieving the groundwater RAGs for radionuclides.

5.2.2 Nonradionuclides

Table 7 illustrates the comparison of cleanup verification values to the soil RAGs for groundwater protection. The statistical values for barium and boron meet the soil RAGs for groundwater protection in the shallow zone, overburden (stockpiled soil) and ACL staging pile footprint. The regulatory split collected from sampling area A3 of the remediation footprint exceeded the groundwater protection RAG for barium at a concentration of 155 mg/kg (Appendix C). The regulatory split sample was within the 35% acceptability criteria for relative percent difference between the primary sample and the regulatory split.

The table shows that residual concentrations of barium in the focused sample exceeded the soil RAGs for groundwater protection. Additionally, the regulatory split of the ash sample exceeded the groundwater soil protection RAGs for copper and selenium at 32.9 mg/kg and 1.5 mg/kg, respectively (Appendix C). In the primary sample, copper was detected below background and selenium was undetected (Appendix C). None of these constituents (barium, copper, or selenium) are expected to reach groundwater based on their soil partitioning coefficients. Data were not collected on the vertical extent of residual contamination, but given the soil-partitioning coefficients of barium (25 mL/g), copper (22 mL/g), and selenium (150 mL/g) the results of the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005) indicate that these constituents will not reach groundwater (and therefore, the Columbia River) in 1,000 years given a clean zone extending at least 3 m (10 ft).

Table 7. Attainment of Nonradionuclide Remedial Action Goals for Protection of Groundwater and the Columbia River. (1 page)

Nonradionuclides	Cleanup Verification Data Set (mg/kg)	Soil RAG for Groundwater Protection[a] (mg/kg)	Soil RAG for Columbia River Protection[a] (mg/kg)	Groundwater and/or River Protection RAGs Exceeded?	Does the Maximum Result Pass Modeling?
Shallow Zone					
Barium	104	132[b,c]	224[d]	No	N/A
Boron[e]	10.4	320	--[f]	No	N/A
Overburden					
Barium	70.6	132[b,c]	224[d]	No	N/A
Boron[e]	2.4	320	--[f]	No	N/A
ACL Staging Pile Footprint					
Barium	99.7	132[b,c]	224[d]	No	N/A
Boron[e]	5.4	320	--[f]	No	N/A
Focused Sample					
Barium	902	132[b,c]	224[d]	Yes	Yes[g]
Boron[e]	150	320	--[f]	No	N/A

[a] Lookup values and RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2005) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.

[b] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996).

[c] Barium soil cleanup level for groundwater protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule") and WAC 173-340-720(3), 1996 (Method B for groundwater) is 112 mg/kg (as presented in the 100 Area RDR/RAWP [DOE-RL 2005]). The updated oral reference dose value (as provided in IRIS) yields a Method B groundwater cleanup criteria of 7 mg/L, as compared to the more restrictive MCL of 2 mg/L (40 CFR 141). Per WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), the most restrictive updated soil cleanup level for groundwater protection would be 200 mg/kg.

[d] Barium soil cleanup level for river protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), a DAF of 2, and WAC 173-340-720(3), 1996 (Method B for groundwater) is 224 mg/kg (as presented in the 100 Area RDR/RAWP [DOE-RL 2005]). No surface water bioconcentration factor is available for barium and no ambient water quality criteria exists separate from the previous drinking water standard; therefore, no WAC 173-340-730(3), 1996 (Method B for surface waters) value can be determined.

[e] No Hanford Site-specific or Washington State background value available.

[f] No cleanup level is available from the Ecology Cleanup Levels and Risk Calculations database (Ecology 2005), and no bioconcentration factor or AWQC values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).

[g] Based on *100 Area Analogous Sites RESRAD Calculations* (BHI 2005), and a K_d (distribution coefficient) value of 25 mL/g, barium is not expected to migrate more than 3 m (10 ft) vertically in 1,000 years (BHI 2005).

AWQC = ambient water quality criteria
ACL = above cleanup level
CFR = *Code of Federal Regulations*
DAF = dilution attenuation factor
IRIS = Integrated Risk Information System
MCL = maximum contaminant level
N/A = Not applicable. RESRAD modeling was not performed because residual concentrations meet the groundwater and river protection RAGs.
NV = no value
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose model)
RDR/RAW = remedial design report/remedial action work plan
WAC = *Washington Administrative Code*

5.3 COLUMBIA RIVER REMEDIAL ACTION GOALS ATTAINED

5.3.1 Radionuclides

The river protection RAGs for radionuclides are identical to the groundwater protection RAGs. The results indicated that radionuclides are not predicted to reach groundwater (and, by extension, not predicted to reach the Columbia River) at levels that would cause the 4 mrem/yr drinking water standard (DOE-RL 2005) to be exceeded. Therefore, the Columbia River protection RAGs have been attained.

5.3.2 Nonradionuclides

Table 7 illustrates the comparison of cleanup verification statistical values to the soil RAGs for protection of the Columbia River. The statistical values for barium and boron meet the soil RAGs for river protection in the shallow zone, overburden (stockpiled soil), and ACL staging pile footprint (Table 7). The regulatory split collected from sampling area A3 of the remediation footprint exceeded the groundwater protection RAG for barium at a concentration of 155 mg/kg (Appendix C). The regulatory split sample was within the 35% acceptability criteria for relative percent difference between the primary sample and the regulatory split.

Table 7 shows that residual concentrations of barium in the focused sample exceeded the soil RAGs for groundwater protection. Additionally, the regulatory split for the focused sample exceeded the copper (39.2 mg/kg) and selenium(1.5 mg/kg) soil RAGs for river protection. Data were not collected on the vertical extent of residual contamination but given the soil-partitioning coefficients of barium (25 mL/g), copper (22 mL/g), and selenium (150 mL/g) the results of the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005) indicate that these constituents will not reach groundwater (and therefore, the Columbia River) in 1,000 years given a clean zone extending at least 3 m (9.8 ft).

5.4 WAC 173-340 THREE-PART TEST FOR NONRADIONUCLIDES

Sections 5.1, 5.2, and 5.3 look separately at compliance with direct exposure RAGs, groundwater protection soil RAGs, and Columbia River protection soil RAGs. Section 5.4 documents application of the WAC 173-340 three-part test for nonradionuclides using the most restrictive RAGs applicable to each decision unit (i.e., shallow zone, overburden [stockpiled soil], and ACL staging pile footprint). The most restrictive RAG is defined as the lowest of the direct exposure, groundwater protection, and river protection RAGs. The direct exposure, groundwater protection, and river protection RAGs are applicable to the shallow zone, overburden [stockpiled soil], and ACL staging pile footprint. The WAC 173-340 three-part test consists of the following criteria: (1) the cleanup verification statistical value must be less than the cleanup level, (2) no single detection can exceed two times the cleanup criteria, and (3) the percentage of samples exceeding the cleanup criteria must be less than 10%.

Table 8 summarizes the results of the WAC 173-340 three-part test (WAC 173-340-740[7]) for the shallow zone, overburden (stockpiled soil), and ACL staging pile footprint sample data sets. For barium and boron, the table lists the most restrictive applicable RAG (selected from the RAGs in Table 1), the maximum detected value, the total number of samples collected, and the number of samples exceeding the most restrictive RAG. The final column of the table describes the result of

applying the three WAC 173-340 criteria using the values listed in the preceding columns. Table 8 shows that barium and boron pass the WAC 173-340 three-part test for all data sets.

Table 8. Application of the WAC 173-340 Three-Part Test. (1 Page)

Nonradionuclides	Most Stringent Applicable RAG (mg/kg)	Statistical Value (mg/kg)[a]	Maximum Detected Value (mg/kg)[b]	Total Number of Samples[c]	Number Exceeding Criteria[d]	RAGs Attained? (Yes/No)
Shallow Zone						
Barium	132[e,f]	104	116	5	0	Yes
Boron[g]	320	10.4	12.7	5	0	Yes
Overburden						
Barium	132[e,f]	70.6	73.2	5	0	Yes
Boron[g]	320	2.31	2.6	5	0	Yes
ACL Staging Pile Footprint						
Barium	132[e,f]	98.4	98.3	5	0	Yes
Boron[g]	320	5.5	6.6	5	0	Yes

[a] Criterion is comparison to the cleanup criteria (RAG).
[b] Criterion is no single detection can exceed two times the cleanup criteria.
[c] The total number of samples includes field duplicate samples, which are included in the evaluation as separate samples.
[d] Criterion is the percentage of samples exceeding the cleanup criteria must be less than 10%.
[e] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996).
[f] Barium soil cleanup level for groundwater protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule") and WAC 173-340-720(3), 1996 (Method B for groundwater) is 112 mg/kg (as presented in the 100 Area RDR/RAWP [DOE-RL 2005]). The updated oral reference dose value (as provided in IRIS) yields a Method B groundwater cleanup criteria of 7 mg/L, as compared to the more restrictive MCL of 2 mg/L (40 CFR 141). Per WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), the most restrictive updated soil cleanup level for groundwater protection would be 200 mg/kg.
[g] No Hanford Site-specific or Washington State background value available.

ACL = above cleanup level
IRIS = Integrated Risk Information System
MCL = maximum contaminant level
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
WAC = *Washington Administrative Code*

6.0 STATEMENT OF PROTECTIVENESS

This cleanup verification package demonstrates that remedial action at the 118-F-3 site has achieved the remedial action objectives and corresponding RAGs established in the ROD (EPA 2000) and RDR/RAWP (DOE-RL 2005). The contaminated materials from the site have been excavated and disposed of at the ERDF. The remaining soils at the 118-F-3 site have been sampled, analyzed, and evaluated. The results of this effort indicate that residual concentrations will support future land uses that can be represented (or bounded) by a rural-residential scenario and that residual concentrations throughout the site pose no threat to groundwater or the Columbia River. This site has no deep zone; therefore, no institutional controls are required. The 118-F-3 site is verified to be remediated in accordance with the ROD (EPA 2000) and may be backfilled.

7.0 REFERENCES

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APPENDIX A

SUMMARY OF VERIFICATION SOIL SAMPLING RESULTS FOR THE 118-F-3 WASTE SITE COCs

118-F-3 Shallow Zone Verification Sampling Results (3 Pages).

Sample Location	Sample Number	Sample Date	Cesium-137			Cobalt-60			Nickel-63			Strontium-90		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J134T6	8/3/06	0.121		0.090	0.120	U	0.120	3.78		3.40	0.177	U	0.210
A2	J134T9	8/2/06	0.110	U	0.110	0.140	U	0.140	4.21		3.20	0.276	U	0.440
A3	J134T8	8/3/06	0.200	U	0.200	0.378		0.057	23.7		4.20	0.276		0.240
A4	J134T7	8/3/06	0.160		0.049	0.042	U	0.042	-0.764	U	3.60	0.028	U	0.210
Duplicate of J134T9	J134V0	8/2/06	0.094		0.069	0.093	U	0.093	2.06	U	3.30	-0.045	U	0.390
Split of J134T9	J134V1	8/2/06	0.020		0.0176	0.0199	U	0.0254	6.93		6.00	0.00411	U	0.202
Black Ash Focused Sample	J134Y0	8/3/06	0.180	U	0.180	0.180	U	0.180	4.05	U	4.70	0.127	U	0.210
EPA Split of J134T9	EPA-J134T9	8/2/06	0.017		NR	0.026		NR				-0.166		1.70
EPA Split of J134T8	EPA-J134T8	8/3/06	0.029		NR	0.43		NR				-0.388		2.00
EPA Split of J134Y0	EPA-J134Y0	8/3/06	0.38		NR	0.02		NR				-0.087		1.70

Sample Location	Sample Number	Sample Date	Barium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL
A1	J134T6	8/3/06	89.4	C	0.060	7.8		0.70
A2	J134T9	8/2/06	52.3	C	0.060	0.81		0.70
A3	J134T8	8/3/06	12.7		0.060	116	C	0.70
A4	J134T7	8/3/06	66.1	C	0.060	1.9		0.69
Duplicate of J134T9	J134V0	8/2/06	49.0	C	0.060	1.2		0.70
Split of J134T9	J134V1	8/2/06	59.0		0.51	3.3	BC	1.5
Black Ash Focused Sample	J134Y0	8/3/06	902		0.060	150	C	0.73
EPA Split of J134T9	EPA-J134T9	8/2/06	120		0.090			
EPA Split of J134T8	EPA-J134T8	8/3/06	155		0.090			
EPA Split of J134Y0	EPA-J134Y0	8/3/06	1160		0.35			

Note: The following abbreviations apply to all Appendix A tables.

Note: Data qualified with N, C and J are considered acceptable values.

ACL = above cleanup levels

C = analyte found in method blank

J = estimated

MDA = minimum detectable activity

N = Spiked analyte recovery is outside stated control limits.

NR = not reported

PQL = practical quantitation limit

Q = qualifier

U = undetected

118-F-3 Overburden Verification Sampling Results (3 Pages).

Sample Location	Sample Number	Sample Date	Cesium-137			Cobalt-60			Nickel-63			Strontium-90		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J134Y1	8/7/06	0.120	U	0.120	0.150	U	0.150	1.12	U	2.50	0.078	U	0.210
A2	J134Y2	8/9/06	0.041	U	0.041	0.037	U	0.037	-1.43	U	2.70	0.027	U	0.200
A3	J134Y4	8/7/06	0.035	U	0.035	0.041	U	0.041	-0.083	U	2.50	0.064	U	0.250
A4	J134Y5	8/7/06	0.092	U	0.092	0.110	U	0.110	0.623	U	2.70	-0.013	U	0.220
Duplicate of J134Y2	J134Y3	8/9/06	0.044	U	0.044	0.045	U	0.045	-2.44	U	2.90	-0.100	U	0.230
Split of J134Y2	J134Y6	8/9/06	0.005	U	0.020	-0.006	U	0.020	1.81	U	5.44	0.025	U	0.130
EPA Split of J134Y2	EPA-J134Y2	8/9/06	0.012		NR	0.019	U	0.019				-0.186		NR

Sample Location	Sample Number	Sample Date	Barium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL
A1	J134Y1	8/7/06	65.8		0.06	2.6		0.69
A2	J134Y2	8/9/06	73.2	C	0.06	1.7		0.69
A3	J134Y4	8/7/06	45.6		0.06	1.5		0.68
A4	J134Y5	8/7/06	65.7		0.06	1.5		0.68
Duplicate of J134Y2	J134Y3	8/9/06	65.8	C	0.06	2		0.69
Split of J134Y2	J134Y6	8/9/06	64.7		0.5	2.8	B	1.5
EPA Split of J134Y2	EPA-J134Y2	8/9/06	80.3		0.020			

118-F-3 ACL Staging Pile Footprint Verification Sampling Results (3 Pages).

Sample Location	Sample Number	Sample Date	Cesium-137			Cobalt-60			Nickel-63			Strontium-90		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J13538	8/10/06	0.101		0.085	0.378		0.092	15.3		2.80	-0.002	U	0.150
A2	J13539	8/10/06	0.103		0.040	0.264		0.046	12.0		2.70	-0.026	U	0.220
A3	J13541	8/7/06	0.198		0.057	0.126		0.048	1.33	U	3.00	0.001	U	0.390
A4	J13540	8/10/06	0.140	U	0.140	0.070	U	0.070	0.216	U	2.70	0.071	U	0.220
Duplicate of J13541	J13542	8/9/06	0.218		0.044	0.233		0.056	1.72	U	2.90	-0.001	U	0.330
Split of J13541	J13543	8/9/06	0.097		0.0169	0.088		0.017	8.75		5.43	0.011	U	0.142
EPA Split of J13541	EPA-J13541	8/9/06	0.120		NR	0.146		NR				-0.569		1.70

Sample Location	Sample Number	Sample Date	Barium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL
A1	J13538	8/10/06	98.1		0.060	6.6		0.67
A2	J13539	8/10/06	90.6		0.060	2.7		0.67
A3	J13541	8/7/06	91.3	C	0.060	3.5		0.69
A4	J13540	8/10/06	63.8		0.060	0.67	U	0.67
Duplicate of J13541	J13542	8/9/06	98.3	C	0.060	3.6		0.68
Split of J13541	J13543	8/9/06	82.5		0.500	5.7	B	1.5
EPA Split of J13541	EPA-J13541	8/9/06	102		0.030			

APPENDIX B

DATA QUALITY ASSESSMENT

B1.0 DATA QUALITY ASSESSMENT FOR THE 118-F-3 MINOR CONSTRUCTION BURIAL GROUND

B1.1 OVERVIEW

The data quality assessment (DQA) completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process. The DQA includes a review of the field logbook information (WCH 2006) to verify sample location, date, and time. It also involves a scientific and statistical evaluation of the data to determine if they are of the right type, quality, and quantity to support their intended use for closeout decisions (EPA 2000).

This DQA was performed in accordance with data quality objectives found in the *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2001). The DQA is based on the guidelines presented in *Guidance for Data Quality Assessment* (EPA 2000). Statistical tests used in this DQA were performed as specified in the SAP and the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005). Contaminants of concern (COCs) used for the 118-F-3 waste site are identified in the SAP (cobalt-60, nickel-63), as well as by results from in-process waste characterization samples (strontium-90, barium, boron). Environmental Protection Agency (EPA) regulatory split samples, project split samples, and the corresponding main samples were analyzed for a wider range of analytes than the COC list. Split comparisons and data quality evaluations are performed for all analytes that are present in both the main and split SDGs. No equipment blank was collected for this site.

Prior to performing statistical tests, the field logbook (WCH 2006), the sample design (Appendix C), and sample analytical data are evaluated. A portion of the cleanup verification sample analytical data is validated for compliance requirements (DOE-RL 2001). An evaluation is performed to determine if the laboratory carried out all steps required by the SAP and the laboratory contract governing the conduct of analysis and reporting of the data. Data validation, in accordance with validation procedures specified in *Data Validation Procedure for Chemical Analysis* (BHI 2000a) and in *Data Validation Procedure for Radiochemical Analysis* (BHI 2000b), is performed as part of data evaluation. After validation and data evaluation, the appropriate statistical analyses are performed on the analytical data (Appendix C) to determine statistical values, as appropriate, for each contaminant. The cleanup verification sample analytical data are stored in the Environmental Restoration project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database and are also summarized in Appendix A of this document.

B1.2 LABORATORY QUALITY MEASURES

All verification samples are subject to laboratory-specific quality assurance (QA) requirements, including instrument procurement, maintenance, calibration, and operation. Additional laboratory quality control (QC) checks are performed, as appropriate, for the analytical method at a rate of 1 per sample delivery group (SDG), or 1 in 20, whichever is more frequent. Laboratory internal QC checks include the following:

- Laboratory Contamination. Each analytical batch contains a laboratory (method) blank (material of similar composition as the samples with known/minimal concentrations of the analytes of interest) carried through the complete analytical process. The method blank is used to evaluate samples for false-positive results due to contamination at the laboratory.

- Analytical Accuracy. For most analyses, a known quantity of representative analytes of interest (matrix spike/matrix spike duplicate [MS/MSD]) are added to a separate aliquot of a sample from the analytical batch. The recovery percentage of the added MS is used to evaluate analytical accuracy. For analyses not amenable to MS techniques (e.g., gamma energy analysis) or where analytical recovery is corrected via internal standards (e.g., alpha spectral analyses), accuracy is evaluated from recovery of the QC reference sample (e.g., laboratory control sample (LCS) or blank spike sample).

- Analytical Precision. Separate aliquots removed from the same sample container (replicate samples) are analyzed for each analytical batch. The replicate sample results (evaluated as relative percent differences [RPDs]) are used to assess analytical precision. However, natural heterogeneities in the soil matrix also add to the RPD calculation.

- QC Reference Samples. A QC reference sample is prepared from an independent standard at a concentration other than that used for calibration but within the calibration range. Reference samples provide an independent check on analytical technique and methodology.

Laboratories are also subject to periodic and random assessments of the laboratory performance, systems, and overall program. These assessments are performed by the Washington Closure Hanford QA group to ensure that the laboratories are performing within laboratory contract requirements.

B1.3 DATA VALIDATION

After sampling and analysis was completed, all of the fixed-base laboratory data from SDG K0501 were submitted for third-party validation to Level C. Level C validation procedures are specified in *Data Validation Procedure for Chemical Analysis* (BHI 2000a) and *Data Validation Procedure for Radiochemical Analysis* (BHI 2000b).

Level C validation procedures were used to review and qualify the data for the following parameters:

- Sample holding times
- Method blanks

- MS/MSD recovery
- Surrogate recovery
- Sample replicates (duplicates)
- Laboratory control sample (LCS) results
- Data package completeness
- Achievement of required detection limits (RDLs) or contract required quantitation limits

Data qualified as rejected (i.e., "R" flagged) indicate that the associated analytical result is tainted by a major deficiency in the quality of the data. Rejected data are unsuitable for decision-making purposes. Data qualified as estimated (i.e., "J" flagged) indicate that the data is estimated but may be used for decision-making purposes. Data qualified as undetected (i.e., "U" flagged) indicate the analyte was analyzed for, but it was not detected. For nonradionuclides, nondetected data are reported at the practical quantitation limit (PQL). For radionuclides, nondetected data are reported at the actual value obtained from analysis (positive or negative - but less than the MDA), except for limited analyses where no value can be calculated and the analytes are reported nondetected at the MDA. All other validated results are considered accurate within the standard errors associated with the methods.

The adequacy of laboratory QA/QC was evaluated for precision, accuracy, completeness, and RDLs pursuant to the SAP (DOE-RL 2001). The organization performing the data validation reported that, of the data given formal validation, the laboratory met the standards for performance for precision (±30%), accuracy (±30%), and completeness (>90%).

SDG K0501

This data package contains two samples (J134T9, J134V0). Sample J134T9 is a shallow zone sample (A2 main), and sample J134V0 is the corresponding field duplicate. No equipment blank was collected for this site. SDG K0501 was evaluated through a formal third-party validation process.

- **Radionuclides.** No major or minor deficiencies were found in the SDG K0501 radiological data.

- **Nonradionuclides.** No major deficiencies were found in the SDG K0501 nonradiological data. Minor deficiencies are as follows:

- The inductively coupled plasma (ICP) metals analysis laboratory control sample and matrix spike (MS) recoveries for silicon are below the acceptance criteria at 32.6% and 33.0%, respectively. The relative percent difference (RPD) calculated for silicon in the laboratory duplicate is above the acceptance criteria at 49%. Third-party validation qualified all of the silicon data in SDG K0501 as estimated with "J" flags for the MS and RPD results. Estimated data are useable for decision-making purposes.

- The ICP metals analysis MS recovery for antimony is below the acceptance criteria at 58.0%. Third-party validation qualified all of the antimony data in SDG K0501 as estimated with "J" flags. Estimated data are useable for decision-making purposes.

- The ICP metals analysis MS recoveries for aluminum, iron, and manganese were outside of the acceptance criteria range. Because MSs are prepared using sample matrix, and the composition of the sample matrix is not known ahead of time, it is common for the spike

concentration(s) to be insignificant for some analytes compared to the sample matrix concentrations. To confirm quantitation of these analytes, post-digestion spikes (PDSs) are prepared and serial dilutions performed. The PDS recoveries for aluminum, iron, manganese, antimony and silicon were all acceptable, in the range of 94.6% to 102.2%. No qualifiers were added to the aluminum, iron, or manganese data. The data are useable for decision-making purposes.

- Limited, random, or sample matrix-specific influenced batch quality control (QC) issues such as these are a potential problem for any analysis. The number and types seen in this data set are within expectations for the matrix types and analyses performed. All of the data in SDG K0501 are useable for decision-making purposes.

B1.4.0 LABORATORY DATA EVALUATION

The following paragraphs include a data evaluation of the remaining verification sample SDGs (J00089, J00090, K0502, K0507, K0508, and K0517) for the 118-F-3 waste site. Comments on the comparability of the samples, project splits, and EPA splits are presented in section B1.5.

SDG J00089
This data set comprises one field sample (J134V1). Sample J134V1 is the project split of the shallow zone A2 sample (J134T9).

Radionuclides. No major or minor deficiencies were found in the SDG J00089 radiological data.

Nonradionuclides. No major deficiencies were found in the SDG J00089 nonradiological data. Minor deficiencies are as follows:

In the ICP metals analysis, the analytes boron, calcium, potassium, sodium, and zinc were all found in the method blank (MB). For each analyte, this method blank contamination is insignificant compared to the sample J134V1 concentration. There is no impact on the field sample data; the data are useable for decision-making purposes.

SDG J00090
This data set comprises two field samples (J134Y6, J13543). Sample J134Y6 is the project split of the overburden A2 sample (J134Y2). Sample J13543 is the project split of the suspected above contaminant level (ACL) A3 sample (J13541).

Radionuclides. No major or minor deficiencies were found in the SDG J00090 radiological data.

Nonradionuclides. One major deficiency was found in the SDG J00090 nonradiological data. Major and minor deficiencies are as follows:

In the ICP metals analysis, the MS recovery for silicon was below the acceptance criteria at 8.5%. MS recoveries below the acceptance criteria generally result in associated data that are considered estimated. However, when the MS recovery drops below 10% the data is, with few exceptions, rejected. The project has qualified the silicon data in SDG J00090 as rejected with

"R" flags assigned to the data. The silicon data in SDG J00090 are not acceptable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for the analytes aluminum, iron, and manganese are outside the established QC limits. The MSs were prepared with added spike concentrations for these analytes that are well below the sample matrix concentrations. The MS recoveries have been overshadowed by the analytical variability and natural heterogeneities in the sample matrix. Method performance is demonstrated by acceptable LCS recoveries. The data are useable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for the analytes antimony, zinc, silver, cadmium, chromium, and magnesium are outside the established QC limits. The RPDs and LCS recoveries are within the acceptable ranges for these analytes. Method performance is demonstrated by the acceptable LCS recoveries. The data are useable for decision-making purposes.

In the ICP metals analysis, the MS recovery for mercury is above the established QC limits. The RPDs and LCS recoveries are within the acceptable range for mercury. Method performance is demonstrated by the acceptable LCS recoveries. A possible high bias is suggested in the data. High-biased data are useable for decision making purposes.

In the ICP metals analysis, the analytes - calcium and copper - were found in the MB. For both analytes, the method blank contamination concentration is insignificant compared to the field sample concentrations. There is no impact on the field sample data; the data are useable for decision-making purposes.

SDG K0502

This data set comprises four field samples (J134T6, J134T7, J134T8, J134Y0). Sample J134T6 is the shallow zone A1 sample. Sample J134T7 is the shallow zone A4 sample. Sample J134T8 is the shallow zone A3 sample. Sample J134Y0 is a sample of a black ash/soil found near the site excavation.

Radionuclides. No major deficiencies were found in the SDG K0502 radiological data. Minor deficiencies are as follows:

The RPD calculated for strontium-90 is above the acceptance criteria at 183%. Elevated RPDs are attributed to natural heterogeneities in the sample matrix. The strontium-90 data in SDG K0502 are considered estimated but useable for decision-making purposes.

Nonradionuclides. No major deficiencies were found in the SDG K0502 nonradiological data. Minor deficiencies are as follows:

In the ICP metals analysis, the LCS recovery for silicon is below the acceptance criteria at 59.3%. The silicon data in SDG K0502 are considered estimated but useable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for the analytes aluminum, iron, manganese, and silicon are outside the established QC limits. The spike concentrations added for these analytes is well below the sample matrix concentrations from which the MSs were prepared. Method performance is demonstrated by preparation and analysis of PDSs and by serial dilutions. The

PDS recoveries are within the acceptance range at 94.5% to 101.4%. The data are useable for decision-making purposes.

In the ICP metals analysis, the MS recovery for antimony is outside the established QC limits. The spike concentration added for antimony is much greater than was found in the sample matrix. In this case, the MS recovery is subject to analytical variability and probable matrix interference. The antimony data in SDG K0502 are considered estimated but useable for decision-making purposes.

In the ICP metals analysis, the RPD calculated for boron was above the acceptance criteria at 34.1%. Elevated RPDs are attributed to natural heterogeneities in the sample matrix. The boron data in SDG K0502 are considered estimated but useable for decision-making purposes.

SDG K0507
This data set comprises three field samples (J134Y1, J134Y4, J134Y5). Sample J134Y1 is the overburden A1 sample. Sample J134Y4 is the overburden A3 sample. Sample J134Y5 is the overburden A4 sample.

Radionuclides. No major or minor deficiencies were found in the SDG K0507 radiological data.

Nonradionuclides. No major or minor deficiencies were found in the SDG K0507 nonradiological data.

SDG K0508
This data set comprises four field samples (J134Y2, J134Y3, J13541, J13542). Sample J134Y2 is the overburden A2 sample. Sample J134Y3 is the field duplicate of sample J134Y2. Sample J13541 is the ACL staging pile footprint A3 sample. Sample J13542 is the field duplicate of sample J13541.

Radionuclides. No major or minor deficiencies were found in the SDG K0508 radiological data.

Nonradionuclides. No major deficiencies were found in the SDG K0508 nonradiological data.

In the ICP metals analysis, the LCS recovery for silicon was below the acceptance criteria at 16.2%. The silicon data in SDG K0508 are considered estimated but useable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for the analytes aluminum, iron, and silicon are outside the established QC limits. The spike concentrations added for these analytes are well below the sample matrix concentrations from which the MSs were prepared. Method performance is demonstrated by the preparation and analysis of PDSs and by serial dilutions. The PDS recoveries are within the acceptance range at 97.5% to 102.5% for all four analytes. The data are useable for decision-making purposes.

In the ICP metals analysis, the MS recovery for antimony is outside the established QC limits. The spike concentration added for antimony is much greater than was found in the sample matrix. In this case, the MS recovery is subject to analytical variability and probable matrix interference. The antimony data in SDG K0508 are considered estimated but useable for decision-making purposes.

In the ICP metals analysis, the RPDs calculated for arsenic, chromium (total), and nickel are above the acceptance criteria at 32.6%, 74.2%, and 56.8%, respectively. Elevated RPDs are attributed to natural heterogeneities in the sample matrix. The arsenic, chromium (total), and nickel data in SDG K0508 are considered estimated but useable for decision-making purposes.

SDG K0517
This data set comprises three field samples (J13538, J13539, J13540). Sample J13538 is the above cleanup level (ACL) staging pile footprint A1 sample. Sample J13539 is the ACL staging pile footprint A2 sample. Sample J13540 is the ACL staging pile footprint A4 sample.

Radionuclides. No major or minor deficiencies were found in the SDG K0517 radiological data.

Nonradionuclides. No major or minor deficiencies were found in the SDG K0517 nonradiological data.

SDG 0600051
This data set comprises five EPA-split field samples (EPA-J134T8, EPA-J134T9, EPA-J134Y0, EPA-J134Y2, EPA-J13541). Sample EPA-J134T8 is the EPA split of the shallow zone A3 sample, J134T8. Sample EPA-J134T9 is the EPA split of the shallow zone A2 sample, J134T9. Sample EPA-J134Y0 is the EPA split of the shallow zone black ash/soil sample, J134Y0. Sample EPA-J134Y2 is the EPA split of the BCL overburden A2 sample, J134Y2. Sample EPA-J13541 is the EPA split of the ACL staging pile footprint A3 sample, J13541.

Radionuclides. No major deficiencies were found in the SDG 0600051 radiological data.

Due to technical reasons involving decay rates, overlapping spectral lines, indirect calculation, and holding times, the EPA split sample laboratory (U.S. Environmental Protection Agency National Air and Radiation Environmental Laboratory) has placed an asterisk on all of the data for two of the analytes (radium-226, uranium-235) that appear on both the main and split sample analyte lists. The laboratory's intent is to indicate that the data are estimated. For the purposes of this DQA and the calculations that appear in Appendix C, the asterisks have been replaced with "J" flags to indicate that the data are qualified as estimated. Estimated data are useable for the intended data comparison.

Nonradionuclides. No major or minor deficiencies were found in the SDG 0600051 nonradiological data.

The context for assessing the data includes evaluating the sample data using the statistical methodology and parameters specified in the SAP. This section summarizes the results of the comparison and presents an evaluation of the data.

B1.4.1 MAJOR DEFICIENCIES

Any data anomaly that causes final data to be qualified as rejected ("R" flagged) is considered a major deficiency. One major deficiency (MS recovery) is identified in the 118-F-3 data set, see discussion under SDG J00090.

B1.4.2 MINOR DEFICIENCIES

Sample Holding Times. All of the method-specific holding times were met for all samples in the 118-F-3 verification data set.

Method Blanks. The method blank is used to evaluate false-positive results in samples due to contamination during handling at the laboratory.

Radionuclides. All of the radionuclide method blank results were within the acceptance criteria.

Nonradionuclides. Minor method blank deficiencies are identified in two SDGs (See SDGs J00089 and J00090) in the 118-F-3 verification data set.

MS/MSDs Recoveries. Recovery of spiked analytes in the MS/MSD pair is used to evaluate method efficiency and the effect of the sample matrix on the environmental sample results.

Radionuclides. All MS/MSD recoveries for radionuclide COCs were within acceptance criteria.

Nonradionuclides. Minor deficiencies in the MS/MSD recoveries are identified in SDGs K0501, K0502, K0508 and J00090. The data are within project specified criteria and are useable for decision-making purposes.

RDL Comparison. Reported analytical detection levels for nondetected analytes were compared to the RDLs specified in the SAP (DOE-RL 2001). When detected results were obtained, evaluation of detection limits was not performed.

Radionuclides. All of the reported COC MDAs are sufficiently low for decision-making purposes. All values meet the site cleanup criteria as demonstrated in the calculation briefs (Appendix C) and discussed in this cleanup verification package.

Nonradionuclides. All of the reported MDLs are sufficiently low for decision-making purposes. All values meet the site cleanup criteria as discussed in this cleanup verification package.

Precision and Accuracy Evaluation. RPD evaluation of the main sample versus the laboratory duplicate are routinely performed by laboratory, and any deficiencies in those calculations are reported by SDG in section B1.4.0.

B1.5 FIELD QUALITY ASSURANCE/QUALITY CONTROL

Field QA/QC measures were used to assess potential sources of error and cross contamination of soil samples that could bias results. Field QA/QC samples listed in the field logbook (WCH 2006a) are summarized in Table B-1. The main and QA/QC sample results are presented in Appendix A.

Table B-1. Summary of Field Quality Control Samples.

Sample	Main	Duplicate	Project-split	EPA-split
Shallow zone A3	J134T8	N/A	N/A	EPA-J134T8
Shallow zone A2	J134T9	J134V0	J134V1	EPA-J134T9
Shallow zone black ash	J134Y0	N/A	N/A	EPA-J134Y0
Overburden A2	J134Y2	J134Y3	J134Y6	EPA-J134Y2
Staging Pile Footprint (ACL) A3	J13541	J13542	J13543	EPA-J13541

Field duplicate samples are collected in order to measure the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the duplicate samples for each COC. Only analytes with values above five times the detection limits for both the main and duplicate samples are compared. The 95% upper confidence limit (UCL) calculation brief in Appendix C provides details on duplicate pair evaluation and RPD calculation. The data are suitable for the intended purpose of cleanup verification.

Split samples (both project- and EPA-split) are collected in order to measure the degree of variability in the sampling, sample handling, and analytical techniques used by commercial laboratories. The field main and split samples are evaluated by computing the RPD of the split samples for each COC to determine the usability of the verification data. The U.S. Environmental Protection Agency Contract Laboratory Program duplicate sample comparison methodology, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 1994), is used as an initial test of the data from the splits. Only analytes that had values above five times the contractual RDL for both the main and split sample were compared. The 95% UCL calculation brief in Appendix C provides details on the split-pair RPD calculation. The acceptance criteria for RPDs is ≤ 30% for all but the EPA-split samples where the acceptance criteria is ≤ 35%.

Radionuclides. The RPDs calculated for potassium-40 in the overburden and the waste staging area duplicates were above the acceptance criteria (30%) at 45% and 54%, respectively. The EPA-split sample potassium-40 RPDs, for the shallow zone A2 sample and the black ash sample, were above the acceptance criteria (35%) at 41% and 47%, respectively. Elevated RPDs, such as these, in the analysis of environmental soil samples, are in a large part attributed to heterogeneities in the soil matrix, and only in a small part attributed to precision and accuracy issues at the laboratory.

A secondary check of the data variability is used to check the data when one or both of the samples being evaluated (main and duplicate or main and split) is less than 5 times the target detection limit (TDL), including undetected analytes. In these cases, a control limit of ± 2 times the TDL is used (Appendix C) to indicate that a visual check of the data is required by the reviewer. A visual inspection of the data revealed that the variability indicated by this secondary check can be explained by differences in MDAs between the laboratories and/or low level detections of the analytes in one or the other of the samples. No major deficiencies were noted. The data are useable for decision-making purposes.

Nonradionuclides. The RPDs calculated for aluminum in the EPA-splits of the shallow zone A2, A3, and black ash samples are 61.0%, 73.0%, and 118%, respectively. The RPDs calculated for aluminum in the EPA-splits of the overburden and waste staging area are 51.0% and 71.0%, respectively.

The RPD calculated for barium in the EPA-split sample of the shallow zone A2 sample is 79.0%.

The RPDs calculated for calcium in the EPA-split samples of the overburden and waste staging samples are 200% and 43.0%, respectively.

The RPDs calculated for total-chromium in the EPA-splits of the shallow zone A2, A3, and black ash samples are 36.0%, 54.0%, and 73.0%, respectively.

The RPDs calculated for copper in the EPA-splits of the shallow zone A3, and black ash samples are 35.0% and 45.0%, respectively.

The RPDs calculated for iron in the EPA-splits of the shallow zone A3, and black ash, samples are 55.0% and 59.0%, respectively. The RPDs calculated for iron in the EPA-splits of the overburden and waste staging area samples are 35.0% and 50.0%, respectively. The RPD calculated for iron in the project-split of the waste staging area sample is 39.8%.

The RPDs calculated for magnesium in the EPA-splits of the shallow zone A3 sample and waste staging area samples are 47.0% and 38.0%, respectively.

The RPDs calculated for silicon in the duplicate and split analysis of the shallow zone A2 sample are 42.2% and 73.6%, respectively.

The RPD calculated for sodium in the EPA-split analysis of the black ash sample is 62.0%.

The RPDs calculated for vanadium, in the EPA-splits of the shallow zone A3, and black ash samples are 51.0% and 60.0%, respectively. The RPD calculated for vanadium in the EPA-split of the waste staging area sample is 40.0%. The RPD calculated for vanadium in the project-split of the waste staging area sample is 42.4%.

All of these results are, to a large extent, attributed to heterogeneities in the soil matrix, and only in a small part attributed to precision and accuracy issues at the laboratory. The data are useable for decision-making purposes.

RPDs for the remaining nonradionuclide analytes were either within the acceptance criteria or were not calculated because an evaluation of the data shows the analytes were not detected in both the main and duplicate (or main and split) sample at more than 5 times the TDL. RPDs of analytes detected at low concentrations (less than five times the TDL) are not considered indicative of the analytical system performance.

A secondary check of the data variability is also used to check the data when one or both of the samples being evaluated (main and duplicate or main and split) is less than 5 times the TDL, including undetected analytes. In these cases, a control limit of ± 2 times the TDL is used (Appendix C) to indicate that a visual check of the data is required by the reviewer. A visual inspection of the data revealed that the variability indicated by this secondary check can be explained by differences in PQLs between the laboratories and/or low level detections of the

analytes in one or the other of the samples. No major deficiencies were noted. The data are useable for decision-making purposes.

B1.6 SUITABILITY OF DATA

The DQA for the 118-F-3 waste site determined that the data are of the right type, quality, and quantity to support site cleanup verification decisions within specified error tolerances. The DQA verified that the sample design was sufficient for the purpose of clean site verification. With the exception of the silicon data in SDG J00090, all analytical data were found to be acceptable for decision-making purposes.

B2.0 REFERENCES

BHI, 2000a, *Data Validation Procedure for Chemical Analysis*, BHI-01435, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2000b, *Data Validation Procedure for Radiochemical Analysis*, BHI-01433, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

DOE-RL, 2001, *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan*, DOE/RL-2001-35, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2005, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2000, *Guidance for Data Quality Assessment, EPA QA/G-9, QA00 Update*, EPA/600/R-96/084, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, D.C.

WCH, 2006, *Remedial Sampling*, Logbook EFL-1174-1, Washington Closure Hanford, Richland, Washington.

APPENDIX C

CALCULATION BRIEF EXCERPTS

DISCLAIMER FOR CALCULATIONS

The calculations that are provided in the following appendix have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents in the administrative record.

CALCULATION BRIEFS

The following calculation briefs have been prepared in accordance ENG-1, Engineering Services, Eng-1-4.5, "Project Calculations", Washington Closure Hanford, Richland, Washington.

118-F-3 Shallow Zone, ACL, and BCL Overburden Sampling Plan, Calculation Number 0100F-CA-V0268, Rev. 0, Washington Closure Hanford, Richland, Washington.

118-F-3 Waste Site Cleanup Verification 95% UCL Calculations, Calculation Number 0100F-CA-V0273, Rev. 0, Washington Closure Hanford, Richland, Washington.

NOTE: The calculation briefs referenced in this appendix are kept in the active Washington Closure Hanford project files and are available upon request. When the project is completed, the files will be stored in a U.S. Department of Energy, Richland Operations Office repository. Only excerpts of the calculation briefs are included in this appendix.

CALCULATION COVER SHEET

Project Title:	118-F-3 Burial Ground Sample Design	**Job No.**	14655
Area	100-F		
Discipline	Environmental Engineering	***Calc. No.**	0100F-CA-V0268
Subject	118-F-3 Shallow Zone, ACL, and BCL Overburden Sampling Plan		
Computer Program	Excel	**Program No.**	Excel 2003

The attached calculations have been generated to document compliance with established cleanup levels. These calculations should be used in conjuction with other relevent documents in the administrative record.

Committed Calculation ☒ **Preliminary** ☐ **Superseded** ☐ **Voided** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sht Calc = 2 Shts Attach1 = 1 Sht Attach2 = 1 Sht Attach3 = 3 Shts Total = 8 Shts	G. Cruz 7-27-06	C.A. Bentz 7/27/06	R.T. Coffman 7/31/06	S.W. Callison 7-31-06	7-31-06

SUMMARY OF REVISIONS

WCH-DE-018 (4/14/06)

*Obtain Calc. No. from R&DC and Form from Intranet

Washington Closure Hanford **CALCULATION SHEET**

Originator G. Cruz Date 7/27/2006 Calc. No. 0100F-CA-V0268 Rev. No. 0

Project 118-F-3 Burial Ground Sample Design Job No. 14655 Checked [signature] Date 7/27/06

Subject 118-F-3 Shallow Zone, ACL, and BCL Overburden Sampling Plan Sheet No. 1of2

1	**Problem:**	Calculate and display required sampling nodes in concurrence with 100 Area Burial Grounds Remedial Action Sampling			
2		and Analysis Plan, DOE/RL-2001-35 Rev. 0, for verification and closure.			
3					
4	**Given:**	-SAP (DOE/RL-2001-35 Rev. 0) requirements			
5		-Shallow Sampling Area (Surface area of each zone determined from CAD program,			
6		Attachment 3, Sht 1 of 3, CAD file 1F:072706A, 118-F-3 Burial Ground Shallow Zone Sampling Plan)			
7					
8		-ACL Overburden Sampling Area (Surface area of each zone determined from CAD program,			
9		Attachment 3, Sht 2 of 3, CAD file 1F:072706B, 118-F-3 Burial Ground ACL Overburden Sampling Plan)			
10		-BCL Overburden Sampling Area (Surface area of each zone determined from CAD program,			
11		Attachment 3, Sht 3 of 3, CAD file 1F:072706C, 118-F-3 Burial Ground BCL Overburden Sampling Plan)			
12					
13					
14					
15	**SAP Requirements:**				
16		-Develop a 16 node sampling grid for the sampling area			
17	Shallow Zone	-Use table 3-2 of the SAP to determine which four of the sixteen nodes will be sampled			
18		to collect clean up verification samples			
19					
20		-Develop a 16 node sampling grid for the sampling area			
21	Overburden:	-Use table 3-2 of the SAP to determine which four of the sixteen nodes will be sampled			
22		to collect clean up verification samples			
23					
24		-Develop a 16 node sampling grid for the sampling area			
25	Deep Zone:	-Use table 3-2 of the SAP to determine which four of the sixteen nodes will be sampled			
26		to collect clean up verification samples			
27					
28	**Determination of Shallow Zone Sampling Grid:**				
29					
30	Shallow Zone Sampling Grid Area determined from Table 3-2, SAP				
31	Attachment 2, Number of Decision Subunits Based on Area (Converted to Sq Meters)				
32					
33	Total Area:		984.48	m^2	
34	Area of Decision Subunits (total area 1 subunit)		984.48	m^2	
35					
36	Decision Subunit divided into 4 Sampling Areas:		246.12	m^2	
37					
38	Sampling Areas divided into a 16 node grid (node numbers 1-16):		15.38	m^2	
39					
40	Nodes to be Sampled (as determined from Attachment 1, Table A-1, Sample Grid Point Lookup Table)				
41		See Attachment 3, Sht 1 of 3, 118-F-3 Burial Ground Shallow Zone Sampling Plan,			
42		for Sample Location Table			
43					
44					
45					
46					

Washington Closure Hanford **CALCULATION SHEET**

Originator G. Cruz Date 7/27/2006 Calc. No. 0100F-CA-V0268 Rev. No. 0

Project 118-F-3 Burial Ground Sample Design Job No. 14655 Checked CAB Date 7/27/06

Subject 118-F-3 Shallow Zone, ACL, and BCL Overburden Sampling Plan Sheet No. 2of2

1			
2			
3	**Determination of ACL Overburden Sampling Grid:**		
4			
5	ACL Overburden Sampling Grid Area determined from Table 3-2, SAP		
6	Attachment 2, Number of Decision Subunits Based on Area (Converted to Sq Meters)		
7			
8	Total Area:	1814.11	m^2
9	Area of Decision Subunits (total area 1 subunit)	1814.11	m^2
10			
11	Decision Subunits divided into 4 Sampling Areas:	453.52	m^2
12			
13	Sampling Areas divided into a 16 node grid (node numbers 1-16):	28.34	m^2
14			
15	Nodes to be Sampled (as determined from Attachment 1, Table A-1, Sample Grid Point Lookup Table)		
16	See Attachment 3, Sht 2 of 3, 118-F-3 Burial Ground ACL Overburden Sampling Plan,		
17	for Sample Location Table		
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33	**Determination of BCL Overburden Sampling Grid:**		
34			
35	BCL Overburden Sampling Grid Area determined from Table 3-2, SAP		
36	Attachment 2, Number of Decision Subunits Based on Area (Converted to Sq Meters)		
37			
38	Total Area:	1081.54	m^2
39	Area of Decision Subunits (total area 1 subunit)	1081.54	m^2
40			
41	Decision Subunits divided into 4 Sampling Areas:	270.38	m^2
42			
43	Sampling Areas divided into a 16 node grid (node numbers 1-16):	16.89	m^2
44			
45	Nodes to be Sampled (as determined from Attachment 1, Table A-1, Sample Grid Point Lookup Table)		
46	See Attachment 3, Sht 3 of 3, 118-F-3 Burial Ground BCL Overburden Sampling Plan,		
47	for Sample Location Table		
48			

Washington Closure Hanford

Originator	G. Cruz	Date	7/27/2006	Calc. No.	0100F-CA-V0268	Rev. No.	0
Project	118-F-3 Burial Ground Sample Design			Job No.	14655	Checked / Date	7/27/06
Subject	118-F-3 Shallow Zone, ACL, and BCL Overburden Sampling Plan					Sheet No	1of1

ATTACHMENT 1

Sample Grid Point Lookup Table.

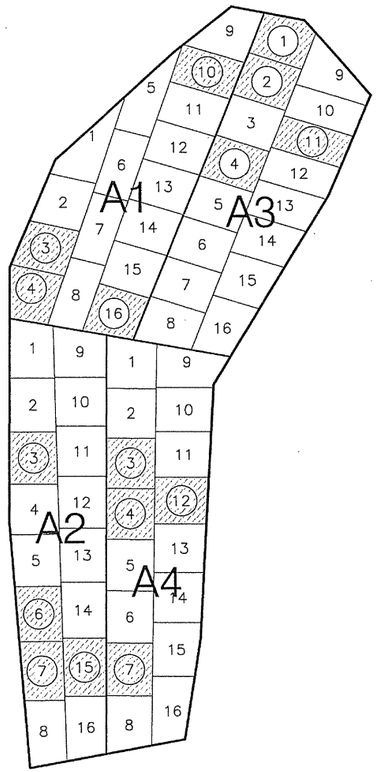
Default Plan	Sampling Area 1	Sampling Area 2	Sampling Area 3	Sampling Area 4	Sampling Area 5	Sampling Area 6	Sampling Area 7	Sampling Area 8	Sampling Area 9	Sampling Area 10
Closeout	3	6	1	4	5	1	3	3	4	16
Closeout	4	7	11	3	15	15	5	13	10	10
Closeout	16	3	2	7	7	10	11	4	3	14
Closeout	10	15	4	12	1	13	4	8	16	4
Not Sampling	2	14	5	9	13	12	8	2	14	8
Not Sampling	13	10	9	13	2	16	1	12	5	3
Not Sampling	6	1	10	8	14	4	16	5	8	6
Not Sampling	1	9	13	1	10	5	12	1	1	15
Not Sampling	9	12	7	5	6	2	6	7	15	9
Not Sampling	15	16	15	14	16	6	2	15	11	1
Not Sampling	8	13	8	10	12	11	13	14	2	12
Not Sampling	5	2	3	11	4	3	9	10	7	11
Not Sampling	7	11	14	15	11	14	14	6	13	2
Not Sampling	11	4	6	2	9	7	7	11	9	7
Not Sampling	12	8	16	16	3	8	15	9	6	13
Not Sampling	14	5	12	6	8	9	10	16	12	5

** **Note:** Grid nodes for each sampling area in each waste site should be numbered consistently, e.g., begin numbering the nodes in the northwesternmost node. Then number consecutively left to right.

1F:072706A

E 580350

N 147500



SCALE 1:400
4 0 4 8 16 meters

NOTES

1. SHALLOW ZONE NODE AREAS ARE APPROXIMATELY 15.38 SQUARE METERS.
2. SAMPLES ARE TAKEN FROM THE APPROXIMATE CENTER SQUARE METERS.
3. THE SHALLOW ZONE CONSISTS OF SAMPLING AREAS A1, A2, A3 AND A4 WITHIN DECISION SUBUNIT 1.

LEGEND

(8) VARIANCE AND VERIFICATION SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	A1	S-A1-3	147507.93	580320.78
		S-A1-4	147504.72	580319.66
		S-A1-10	147521.89	580333.53
		S-A1-16	147502.74	580326.15
	A2	S-A2-3	147491.31	580319.81
		S-A2-6	147478.98	580320.19
		S-A2-7	147474.45	580320.44
		S-A2-15	147474.76	580323.76
	A3	S-A3-1	147524.33	580339.51
		S-A3-2	147521.13	580338.24
		S-A3-4	147514.64	580335.66
		S-A3-11	147516.38	580341.81
	A4	S-A4-3	147490.92	580327.44
		S-A4-4	147486.93	580327.40
		S-A4-7	147474.58	580327.31
		S-A4-12	147487.95	580331.45

Attachment 3 Sheet No. 1 of 3
Originator L. CRUZ Date 1-27-06
Chkd By CAB Date 2/27/06
Calc. No. 0100F-CA-V0268 Rev. No. 0

ATTACHMENT 3

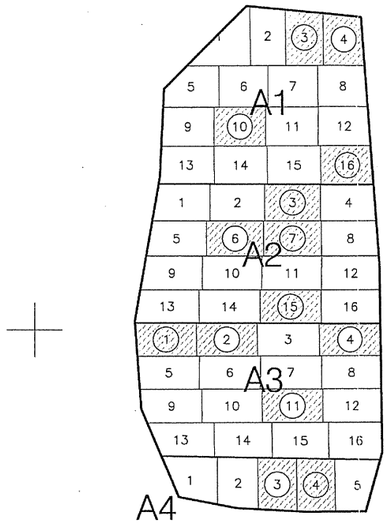
U.S DEPARTMENT OF ENERGY
DOE RICHLAND OPERATIONS OFFICE
RIVIER CORRIDOR CLOSURE CONTRACT

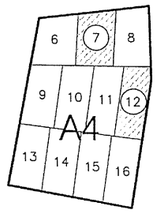
100-F AREA
118-F-3 BURIAL GROUND
SHALLOW ZONE SAMPLING PLAN

1F:072706B

E 580350

N 147500





SCALE 1:600

6 0 6 12 24 meters

NOTES

1. ACL OVERBURDEN NODE AREAS ARE APPROXIMATELY 28.34 SQUARE METERS.
2. SAMPLES ARE TAKEN FROM THE APPROXIMATE CENTER SQUARE METERS.
3. THE ACL OVERBURDEN CONSISTS OF SAMPLING AREAS A1, A2, A3 AND A4 WITHIN DECISION SUBUNIT 1.

LEGEND

(8) VARIANCE AND VERIFICATION SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	A1	0-A1-3	147534.66	580381.88
		0-A1-4	147534.46	580386.56
		0-A1-10	147524.14	580374.25
		0-A1-16	147519.57	580386.93
	A2	0-A2-3	147515.15	580380.42
		0-A2-6	147510.89	580373.63
		0-A2-7	147510.89	580380.40
		0-A2-15	147502.77	580380.15
	A3	0-A3-1	147498.87	580365.41
		0-A3-2	147498.87	580372.62
		0-A3-4	147498.86	580387.19
		0-A3-11	147490.98	580380.35
	A4	0-A4-3	147481.63	580378.55
		0-A4-4	147481.58	580383.08
		0-A4-7	147439.25	580359.83
		0-A4-12	147431.67	580364.20

Attachment 3 Sheet No. 2 of 3
Originator G. CLARK Date 7-27-06
Chk'd By CAB Date 7/27/06
Calc. No. 0100F-CA-V0260 Rev. No. 101

ATTACHMENT 3

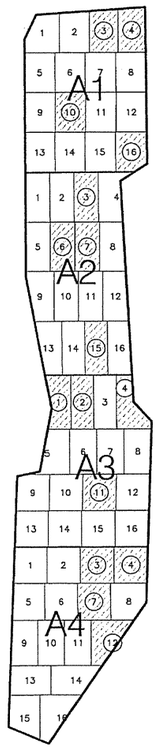
U.S DEPARTMENT OF ENERGY
DOE RICHLAND OPERATIONS OFFICE
RIVIER CORRIDOR CLOSURE CONTRACT

100-F AREA
118-F-3 BURIAL GROUND
ACL OVERBURDEN SAMPLING PLAN

1F:072706C

E 580350

N 147500



SCALE 1:600

6 0 6 12 24 meters

NOTES

1. BCL OVERBURDEN NODE AREAS ARE APPROXIMATELY 16.89 SQUARE METERS.
2. SAMPLES ARE TAKEN FROM THE APPROXIMATE CENTER SQUARE METERS.
3. THE BCL OVERBURDEN CONSISTS OF SAMPLING AREAS A1, A2, A3 AND A4 WITHIN DECISION SUBUNIT 1.

LEGEND

⑧ VARIANCE AND VERIFICATION SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	A1	0-A1-3	147511.22	580303.84
		0-A1-4	147511.29	580307.12
		0-A1-10	147501.51	580299.92
		0-A1-16	147496.80	580307.05
	A2	0-A2-3	147491.42	580301.78
		0-A2-6	147485.53	580298.98
		0-A2-7	147485.54	580301.88
		0-A2-15	147473.53	580302.93
	A3	0-A3-1	147467.12	580298.46
		0-A3-2	147467.14	580301.30
		0-A3-4	147468.80	580306.26
		0-A3-11	147456.44	580303.25
	A4	0-A4-3	147447.80	580302.95
		0-A4-4	147447.82	580306.91
		0-A4-7	147443.45	580302.59
		0-A4-12	147438.58	580304.75

Attachment 3 Sheet No. 3 of 3
Originator G. CRUZ Date 7-27-06
Chk'd By [illegible] Date 7/27/06
Calc. No. 0100F-CA-V0268 Rev. No. 0

ATTACHMENT 3

U.S DEPARTMENT OF ENERGY
DOE RICHLAND OPERATIONS OFFICE
RIVIER CORRIDOR CLOSURE CONTRACT

100-F AREA
118-F-3 BURIAL GROUND
BCL OVERBURDEN SAMPLING PLAN

CALCULATION COVER SHEET

Project Title:	100-F Area Field Remediation	**Job No.**	14655
Area	100-F		
Discipline	Environmental	***Calc. No.**	0100F-CA-V0273
Subject	118-F-3 Cleanup Verification 95% UCL Calculations		
Computer Program	Excel	**Program No.**	Excel 2003

The attached calculations have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ **Preliminary** ☐ **Superseded** ☐ **Voided** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 15 Total = 16	M J Appel 11/14/06 M. J. Appel	J M C 11/15/06 J. M. Capron	NA	S W Callison 11-16-06 S. W. Callison	11-16-06

SUMMARY OF REVISIONS

WCH-DE-018 (09/01/06) *Obtain Calc. No. from R&DC and Form from Intranet

Washington Closure Hanford **CALCULATION SHEET**

Originator M. J. Appel **Date** 11/14/06 **Calc. No.** 0100F-CA-V0273 **Rev. No.** 0
Project 100-F Area Field Remediation **Job No.** 14655 **Checked** J. M. Capron **Date** 11/15/06
Subject 118-F-3 Cleanup Verification 95% UCL Calculations **Sheet No.** 1 of 15

Summary

Purpose:
Calculate the 95% upper confidence limit (UCL) to evaluate compliance with cleanup standards for the subject site. Also, calculate the carcinogenic risk for applicable nonradionuclide analytes, perform the *Washington Administrative Code* (WAC) 173-340 (Model Toxics Control Act [MTCA]) 3-part test, if required, and calculate the relative percent difference (RPD) for each contaminant of concern (COC) and contaminant of potential concern (COPC).

Table of Contents:
Sheets 1 to 4 - Calculation Sheet Summary
Sheet 5 - Calculation Sheet Shallow Zone Verification
Sheet 6 - Calculation Sheet Overburden Verification
Sheet 7 - Calculation Sheet Waste Staging Area Verification
Sheets 8 to 15 - Calculation Sheet Split-Duplicate Analysis

Given/References: .
1) Background values and remedial action goals (RAGs) are taken from DOE-RL (2005), DOE-RL (2001), and Ecology (2005).
2) DOE-RL, 1996, Hanford Site Background: Part 2, Soil Background for Radionuclides, DOE/RL-96-12, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
3) DOE-RL, 2001, Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes, DOE/RL-92-24, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) DOE-RL, 2001, 100 Area Burial Grounds Remedial Action Sampling and Analysis Plan, DOE/RL 2001-35, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
5) DOE-RL, 2005, Remedial Design Report/Remedial Action Work Plan for the 100 Area (RDR/RAWP), DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
6) Ecology, 1992, Statistical Guidance for Ecology Site Managers, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
7) Ecology, 1993, Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-detection Limit or Below-PQL Values (Censored Data Sets), Publication #92-54, Washington Department of Ecology, Olympia, Washington.
8) Ecology, 2005, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.
9) EPA, 1994, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540/R-94/013. U.S. Environmental Protection Agency, Washington, D.C.
10) WAC 173-340, 1996, "Model Toxic Control Act - Cleanup," Washington Administrative Code.

Solution:
Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993), below, and in the RDR/RAWP (DOE-RL 2005). Use data from the attached worksheets to calculate the 95% UCL, hazard quotients, excess carcinogenic risk, perform the WAC 173-340 3-part test for nonradionuclides, and calculate the RPD for each COC and COPC in the primary-duplicate and primary-split sample pairs.

Calculation Description:
The subject calculations were performed on data from soil verification samples from the 118-F-3 waste site. The data were entered into an EXCEL 2003 spreadsheet and calculations performed by utilizing the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2005) is documented by this calculation. Split and duplicate RPD results are used in evaluation of data quality and are presented in the cleanup verification package (CVP) for this site, as necessary.

Methodology:
For nonradioactive analytes with <50% of the data below detection limits and all radionuclide analytes, the statistical value calculated to evaluate the effectiveness of cleanup is the 95% UCL. For nonradioactive analytes with >50% of the data below detection limits, the maximum value for the data set is used instead of the 95% UCL. All nonradionuclide data reported as being below detection limits are set to ½ the detection limit value for calculation of the statistics (Ecology 1993). For radionuclide data, calculation of the statistics was done on the reported value. In cases where the laboratory does not report a value below the minimal detectable activity (MDA), half of the MDA is used in the calculation. For the statistical evaluation of primary-duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above.

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Originator M. J. Appel MJA **Date** 11/14/06 **Calc. No.** 0100F-CA-V0273 **Rev. No.** 0
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Subject 118-F-3 Cleanup Verification 95% UCL Calculations **Sheet No.** 2 of 15

Summary (continued)

Methodology (continued):

The COCs for the 118-F-3 Burial Ground are: barium, boron, cobalt-60, cesium-137, nickel-63, and strontium-90. All other sampling results for the non-COC metal analyses (shallow zone, overburden, and the waste staging pile area) were below background and, therefore, not evaluated. All COCs and all detected non-COCs were included in the evaluation of the RPD calculations for data quality assessment purposes.

For nonradionuclides, the WAC 173-340 statistical guidance suggests that a test for distributional form be performed on the data and the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets ($n < 10$) and all radionuclide data sets, the calculations are performed assuming nonparametric distribution, so no test for distribution is performed. For nonradionuclide data sets of ten or greater, distributional testing is done using Ecology's MTCAStat software (Ecology 1993). Background values are subtracted for applicable radionuclides only. Comparison against background levels for nonradionuclides is included within the CVP.

The hazard quotient (for shallow zone nonradionuclide COCs) is determined by dividing the statistical value (derived in this calculation) by the WAC 173-340 non-carcinogenic cleanup limit. The excess nonradionuclide carcinogenic risk is determined by dividing the statistical value by the WAC 173-340 carcinogenic cleanup limit and then multiplying by 10^{-6}.

The WAC 173-340 3-part test is performed for nonradionuclide analytes only and determines if:
1) the 95% UCL value exceeds the most stringent cleanup limit for each non-radionuclide COC,
2) greater than 10% of the raw data exceed the most stringent cleanup limit for each non-radionuclide COC,
3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each non-radionuclide COC.

The RPD values are evaluated for analytes detected in a primary-duplicate or primary-split sample pair for the purposes of data quality assessment within the CVP. The RPD is calculated when both the primary value and either the duplicate or split values are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method, listed in Table II-1 of the SAP (DOE-RL 2001). The RPD calculations use the following formula: RPD =[|M-S|/((M+S)/2)]*100

where, M = Main Sample Value S = Split (or duplicate) Sample Value

For quality assurance/quality control (QA/QC) split and duplicate RPD calculations, a value less than +/- 30% indicates the data compare favorably. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed. Additional discussion as necessary is provided in the data quality assessment section of the applicable CVP.

A regulator-split comparison was required for the 118-F-3 waste site and as such and additional parameter was evaluated. A control limit of +/- 2 times the TDL shall be used if either the main or regulator split value is less than 5 times the TDL and above detection. In the case where only one result is greater than 5 times the TDL and the other is below, the +/- 2 times the TDL criteria applies. Therefore, the following calculation is performed as part of the evaluation for these two cases involving regulator split data: difference = main - split. If the difference is greater than +/- 2 times the TDL, then further investigation regarding the usability of the data is performed and presented in the applicable CVP data quality assessment section.

A regulator-split comparison was not performed for the polychlorinated biphenyls (PCBs) because all PCB values were reported below the detection limits in both the main samples and the regulatory split samples. For the metals and radionuclide data, a regulator split comparison was performed for all analyses that were present in both the main samples and the regulatory split samples. Additional disucssion of these results is provided in the data quality section of the applicable CVP, as warranted.

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Summary (continued)

Results:
The results presented in the summary tables that follow are for use in the 118-F-3 CVP .

Results Summary

Analyte	Shallow Zone		Overburden		Waste Staging Area		Units
	Result	Qualifier	Result	Qualifier	Result	Qualifier	
Barium	104		70.6		99.7		mg/kg
Boron	10.4		2.4		5.4		mg/kg
Cobalt-60	0.378		0.142	U	0.299		pCi/g
Cesium-137	0.144		0 (< BG)	U	0.170		pCi/g
Nickel-63	16.5		0.801	U	13.4		pCi/g
Strontium-90	0.235		0 (< BG)	U	0.045	U	pCi/g

U = undetected

WAC 173-340 Evaluation (Shallow Zone)

3-Part Test:
95% UCL > Cleanup Limit? NO
> 10% above Cleanup Limit? NO
Any sample > 2x Cleanup Limit? NO

Risk Estimate:
Nonrad noncarcinogenic index sum: 6.5E-04
Nonrad carcinogenic risk: NA

WAC 173-340 Evaluation (Overburden)

3-Part Test:
95% UCL > Cleanup Limit? NO
> 10% above Cleanup Limit? NO
Any sample > 2x Cleanup Limit? NO

Risk Estimate:
Nonrad noncarcinogenic index sum: 1.5E-04
Nonrad carcinogenic risk: NA

WAC 173-340 Evaluation (Waste Staging Pile Footprint)

3-Part Test:
95% UCL > Cleanup Limit? NO
> 10% above Cleanup Limit? NO
Any sample > 2x Cleanup Limit? NO

Risk Estimate:
Nonrad noncarcinogenic index sum: 3.4E-04
Nonrad carcinogenic risk: NA

Summary (continued)

Results:
The results presented in the summary tables that follow are for use in the 118-F-3 CVP .

Relative Percent Difference Results* QA/QC Analysis

Analyte	Shallow Zone					Overburden			Waste Staging Pile Footprint		
	Duplicate Analysis of Sample A2**	Split Analysis of Sample A2**	EPA-Split Analysis of Sample A2**	EPA-Split Analysis of Sample A3**	EPA-Split Analysis of Black Ash Sample**	Duplicate Analysis**	Split Analysis**	EPA-Split Analysis**	Duplicate Analysis**	Split Analysis**	EPA-Split Analysis**
Aluminum	8.9%	19.6%	*61.0%*	*73.0%*	*118.0%*	6.9%	19.8%	*51.0%*	10.6%	33.1%	*71.0%*
Antimony											
Arsenic											
Barium	6.5%	12.0%	*79.0%*	29.0%	25.0%	10.7%	12.3%	9.0%	7.4%	10.1%	11.0%
Beryllium											
Boron											
Calcium	2.4%	3.9%	25.0%	22.0%	13.0%	4.7%	1.1%	*200.0%*	9.6%	9.8%	*43.0%*
Chromium Total	19.9%	0.0%	*36.0%*	*54.0%*	*73.0%*	5.8%	28.6%	28.0%	12.9%	24.9%	
Cobalt											
Copper	3.4%	4.3%	18.0%	35.0%	45.0%	0.0%	2.3%	22.0%	10.7%	7.5%	34.0%
Iron	8.5%	3.5%	30.0%	55.0%	59.0%	9.9%	24.1%	35.0%	4.4%	39.8%	50.0%
Lead											
Magnesium	5.9%	16.5%	23.0%	47.0%	33.0%	8.7%	16.7%	22.0%	8.5%	23.5%	38.0%
Manganese	10.4%	5.9%	16.0%	18.0%	31.0%	5.8%	3.5%	16.0%	2.3%	14.2%	19.0%
Nickel											
Potassium											
Selenium											
Silicon	42.2%	73.6%				2.3%	24.7%		15.0%	0.0%	
Sodium					62.0%						
Vanadium	13.2%	6.6%	22.0%	51.0%	60.0%	10.7%	25.9%	23.0%	1.9%	42.4%	40.0%
Zinc	10.7%	3.4%	12.0%	30.0%	32.0%	6.2%	2.0%	13.0%	7.3%	16.9%	24.0%
Cobalt-60				12.0%							
Cesium-137											
Nickel-63											
Europium-152											
Nickel-63			NA	NA	NA			NA			NA
Potassium-40	30.0%		41.0%	8.0%	47.0%	45.0%		8.0%	54.0%		1.3%
Radium-226					73.0%	40.0%		42.0%	26.0%		51.1%
Radium-228					23.0%						
Strontium-90											
Uranium-235											

*A blank cell indicates that RPD evaluation was not required.

**The significance of the reported RPD values, including values greater than 30%, is addressed within the Data Quality Assessment section of the CVP for this site.

NA = not applicable RPD = relative percent difference

QA/QC = quality assurance/quality control U = undetected

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CALCULATION SHEET

Originator M. J. Appel MJA
Project 100-F Area Field Remediation
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Shallow Zone Sample Data

Sampling Area	Sample Number	Sample Date	Barium			Boron			Cobalt-60			Cesium-137			Nickel-63			Strontium-90		
			mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J134T6	8/3/06	89.4	C	0.060	7.8		0.70	0.120	U	0.12	0.121		0.090	3.78		3.4	0.177	U	0.21
A2	J134T9	8/2/06	52.3	C	0.060	0.81		0.70	0.140	U	0.14	0.110	U	0.11	4.21		3.2	0.276	U	0.44
A3	J134T8	8/3/06	116		0.060	12.7	C	0.70	0.378		0.057	0.200	U	0.20	23.7		4.2	0.276		0.24
A4	J134T7	8/3/06	66.1	C	0.060	1.9		0.69	0.042	U	0.042	0.160		0.049	-0.764	U	3.6	0.028	U	0.21
Duplicate of J134T9	J134V0	8/2/06	49.0	C	0.060	1.2		0.70	0.093	U	0.093	0.094		0.069	2.06	U	3.3	-0.045	U	0.39

Statistical Computation Input Data

Sampling Area	Sample Number	Sample Date	Barium mg/kg			Boron mg/kg			Cobalt-60 pCi/g			Cesium-137 pCi/g			Nickel-63 pCi/g			Strontium-90 pCi/g		
A1	J134T6	8/3/2006	89.4			7.8			0.060			0.121			3.78			0.177		
A2	J134T9/J134V0	8/2/2006	50.7			1.0			0.082			0.075			3.14			0.116		
A3	J134T8	8/3/2006	116			12.7			0.378			0.100			23.7			0.276		
A4	J134T7	8/3/2006	66.1			1.9			0.021			0.160			-0.764			0.028		

Statistical Computations

	Barium			Boron			Cobalt-60			Cesium-137			Nickel-63			Strontium-90		
95% UCL based on	Small data set. Use nonparametric z-statistic.			Small data set. Use nonparametric z-statistic.			Radionuclide data set. Use nonparametric z-statistic.			Radionuclide data set. Use nonparametric z-statistic.			Radionuclide data set. Use nonparametric z-statistic.			Radionuclide data set. Use nonparametric z-statistic.		
N	4			4			4			4			4			4		
% < Detection limit	0%			0%			75%			25%			25%			75%		
mean	80.5			5.9			0.135			0.114			7.5			0.149		
st. dev.	28.5			5.5			0.164			0.036			11.0			0.104		
Z-statistic	1.645			1.645			1.645			1.645			1.645			1.645		
95% UCL on mean	104			10.4			0.270			0.144			16.5			0.235		
max value	116			12.7			0.378			0.200			23.7			0.276		
Statistical value	104			10.4			0.378			0.144			16.5			0.235		
Background	132			NA			NA			NA			NA			NA		
Statistical value above background	104			10.4			0.378			0.144			16.5			0.235		
Most Stringent Cleanup Limit for nonradionuclide and RAG type	132	BG/GW		320	GW Protection													
WAC 173-340 3-PART Test																		
95% UCL > Cleanup Limit?	NO			NO														
> 10% above Cleanup Limit?	NO			NO														
Any sample > 2X Cleanup Limit?	NO			NO														
EXCESS RISK EVALUATION																		
WAC 173-340 Non-Carcinogenic Cleanup:	5600			16000														
Hazard quotient for each nonradionuclide:	0			6.5E-04														
WAC 173-340 Carcinogenic Cleanup:	NA			NA														
Risk for each carcinogenic nonradionuclide:	0			0														
WAC 173-340 3-Part-Test Compliance? YES **Nonrad noncarcinogenic index sum:** 6.5E-04 **Nonrad carcinogenic risk:** NA	Because all barium values are below background (132 mg/kg), calculation of excess risk is not required.			Because there is no established background value for boron, an excess risk evaluation was performed.														

BG = background
C = analyte found in method blank
GW = groundwater
NA = not applicable
MDA= minimum detectable activity
PQL = practical quantitation limit
Q = qualifier
RAG = remedial action goal
U = undetected
UCL = upper confidence limit
WAC = *Washington Administrative Code*

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Originator M. J. Appel **Date** 11/14/06 **Calc. No.** 0100F-CA-V0273 **Rev. No.** 0
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Overburden Sample Data

Sampling Area	Sample Number	Sample Date	Barium mg/kg	Q	PQL	Boron mg/kg	Q	PQL	Cobalt-60 pCi/g	Q	MDA	Cesium-137 pCi/g	Q	MDA	Nickel-63 pCi/g	Q	MDA	Strontium-90 pCi/g	Q	MDA
A1	J134Y1	8/7/06	65.8		0.060	2.6		0.69	0.150	U	0.150	0.120	U	0.120	1.12	U	2.50	0.078	U	0.210
A2	J134Y2	8/9/06	73.2	C	0.060	1.7		0.69	0.037	U	0.037	0.041	U	0.041	-1.43	U	2.70	0.027	U	0.200
A3	J134Y4	8/7/06	45.6		0.060	1.5		0.68	0.041	U	0.041	0.035	U	0.035	-0.083	U	2.50	0.064	U	0.250
A4	J134Y5	8/7/06	65.7		0.060	1.5		0.68	0.110	U	0.110	0.092	U	0.092	0.623	U	2.70	-0.013	U	0.220
Duplicate of J134Y2	J134Y3	8/9/06	65.8	C	0.060	2.0		0.69	0.045	U	0.045	0.044	U	0.044	-2.44	U	2.90	-0.100	U	0.230

Statistical Computation Input Data

Sampling Area	Sample Number	Sample Date	Barium mg/kg	Boron mg/kg	Cobalt-60 pCi/g	Cesium-137 pCi/g	Nickel-63 pCi/g	Strontium-90 pCi/g
A1	J134Y1	8/7/2006	65.8	2.6	0.075	0.060	1.12	0.078
A2	J134Y2/J134Y3	8/9/2006	69.5	1.9	0.021	0.021	-1.94	-0.037
A3	J134Y4	8/7/2006	45.6	1.5	0.021	0.018	-0.083	0.064
A4	J134Y5	8/7/2006	65.7	2.0	0.055	0.046	0.623	-0.013

Statistical Computations

	Barium	Boron	Cobalt-60	Cesium-137	Nickel-63	Strontium-90
95% UCL based on	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.
N	4	4	4	4	4	4
% < Detection limit	0%	0%	100%	100%	100%	100%
mean	61.7	2.0	0.039	0.033	-0.299	0.035
st. dev.	10.8	0.46	0.027	0.020	1.34	0.056
Z-statistic	1.645	1.645	1.645	1.645	1.645	1.645
95% UCL on mean	70.6	2.4	0.061	0.050	0.801	0.082
max value	73.2	2.6	0.150 U	0.120 U	1.12 U	0.078 U
Statistical value	70.6	2.4	0.150 U	0.050 U	0.801 U	0.082 U
Background	132	NA	0.008	1.1	NA	0.18
Statistical value above background	70.6	2.4	0.142 U	0 (< BG) U	0.801 U	0 (< BG) U
Most Stringent Cleanup Limit for nonradionuclide and RAG type	132 BG/GW	320 GW Protection				
WAC 173-340 3-PART Test						
95% UCL > Cleanup Limit?	NO	NO				
> 10% above Cleanup Limit?	NO	NO				
Any sample > 2X Cleanup Limit?	NO	NO				
EXCESS RISK EVALUATION						
WAC 173-340 Non-Carcinogenic Cleanup:	5600	16000				
Hazard quotient for each nonradionuclide:	0	1.5E-04				
WAC 173-340 Carcinogenic Cleanup:	NA	NA				
Risk for each carcinogenic nonradionuclide:	0	0				
WAC 173-340 3-Part-Test Compliance? YES	Because all barium values are below background (132 mg/kg), calculation of excess risk is not required.	Because there is no established background value for boron, an excess risk evaluation was performed.				
Nonrad noncarcinogenic index sum: 1.5E-04						
Nonrad carcinogenic risk: NA						

BG = background
C = analyte found in method blank
GW = groundwater
NA = not applicable
MDA = minimum detectable activity
PQL = practical quantitation limit
Q = qualifier
RAG = remedial action goal
U = undetected
UCL = upper confidence limit
WAC = *Washington Administrative Code*

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CALCULATION SHEET

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Waste Staging Pile Footprint Sample Data

Sampling Area	Sample Number	Sample Date	Barium			Boron			Cobalt-60			Cesium-137			Nickel-63			Strontium-90		
			mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J13538	8/10/06	98.1		0.060	6.6		0.67	0.378		0.092	0.101		0.085	15.3		2.80	-0.002	U	0.150
A2	J13539	8/10/06	90.6		0.060	2.7		0.67	0.264		0.046	0.103		0.040	12.0		2.70	-0.026	U	0.220
A3	J13541	8/7/06	91.3	C	0.060	3.5		0.69	0.126		0.048	0.198		0.057	1.33	U	3.00	0.001	U	0.390
A4	J13540	8/10/06	63.8		0.060	0.67	U	0.67	0.070	U	0.070	0.140	U	0.140	0.216	U	2.70	0.071	U	0.220
Duplicate of J13541	J13542	8/9/06	98.3	C	0.060	3.6		0.68	0.233		0.056	0.218		0.044	1.72	U	2.90	-0.001	U	0.330

Statistical Computation Input Data

Sampling Area	Sample Number	Sample Date	Barium mg/kg			Boron mg/kg			Cobalt-60 pCi/g			Cesium-137 pCi/g			Nickel-63 pCi/g			Strontium-90 pCi/g		
A1	J13538	8/10/2006	98.1			6.6			0.378			0.101			15.3			-0.002		
A2	J13539	8/10/2006	90.6			2.7			0.126			0.103			12.0			-0.026		
A3	J13541/J13542	8/7/2006	94.8			3.6			0.180			0.208			1.53			0.000		
A4	J13540	8/10/2006	63.8			0.34			0.035			0.070			0.22			0.071		

Statistical Computations

	Barium			Boron			Cobalt-60			Cesium-137			Nickel-63			Strontium-90		
95% UCL based on	Small data set. Use nonparametric z-statistic.			Small data set. Use nonparametric z-statistic.			Radionuclide data set. Use nonparametric z-statistic.			Radionuclide data set. Use nonparametric z-statistic.			Radionuclide data set. Use nonparametric z-statistic.			Radionuclide data set. Use nonparametric z-statistic.		
N	4			4			4			4			4			4		
% < Detection limit	0%			25%			25%			25%			50%			100%		
mean	86.8			3.3			0.180			0.121			7.26			0.011		
st. dev.	15.65			2.6			0.145			0.060			7.52			0.042		
Z-statistic	1.645			1.645			1.645			1.645			1.645			1.645		
95% UCL on mean	99.7			5.4			0.299			0.170			13.4			0.045		
max value	98.3			6.6			0.378			0.218			15.3			0.071	U	
Statistical value	99.7			5.4			0.299			0.170			13.4			0.045	U	
Background	132			NA			NA			NA			NA			NA		
Statistical value above background	99.7			5.4			0.299			0.170			13.4			0.045	U	
Most Stringent Cleanup Limit for nonradionuclide and RAG type	132	BG/GW		320	GW Protection													
WAC 173-340 3-PART Test																		
95% UCL > Cleanup Limit?	NO			NO														
> 10% above Cleanup Limit?	NO			NO														
Any sample > 2X Cleanup Limit?	NO			NO														
EXCESS RISK EVALUATION																		
WAC 173-340 Non-Carcinogenic Cleanup:	5600			16000														
Hazard quotient for each nonradionuclide:	0			3.4E-04														
WAC 173-340 Carcinogenic Cleanup:	NA			NA														
Risk for each carcinogenic nonradionuclide:	0			0														
WAC 173-340 3-Part-Test Compliance? YES	Because all barium values are below background (132 mg/kg), calculation of excess risk is not required.			Because there is no established background value for boron, an excess risk evaluation was performed.														
Nonrad noncarcinogenic index sum: 3.4E-04																		
Nonrad carcinogenic risk: NA																		

BG = background
C = analyte found in method blank
DC = direct contact
GW = groundwater
MDA = minimum detectable activity
NA = not applicable
PQL = practical quantitation limit
Q = qualifier
RAG = remedial action goal
U = undetected
UCL = upper confidence limit
WAC = *Washington Administrative Code*

Washington Closure Hanford

CALCULATION SHEET

Originator M. J. Appel
Project 100-F Area Field Remediation
Subject 118-F-3 Cleanup Verification 95% UCL Calculations

Date 11/14/06
Job No. 14655

Calc. No. 0100F-CA-V0273
Checked J. M. Capron

Rev. No. 0
Date 11/15/06
Sheet No. 8 of 15

Split-Duplicate Analysis
Shallow Zone Sample Results: Non-radionuclides

Sampling Area	Sample Number	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A2	J134T9	4820		8.4	1.3	U	1.3	2.2		1.8	52.3	C	0.06	0.08		0.06	0.81		0.70
Duplicate of J134T9	J134V0	4410		8.5	1.3	U	1.3	1.8	U	1.8	49.0	C	0.06	0.10		0.06	1.2		0.70
Split of J134T9	J134V1	5870	N	6.4	0.93	BN	0.34	2.1		0.28	59.0		0.51	0.30	B	0.07	0.81		0.7
EPA Split of J134T9	EPA-J134T9	9040		742	0.11	B	0.02	1.6		0.06	120		0.09	0.29	B	0.01			

Sampling Area	Sample Number	Cadmium			Calcium			Chromium Total			Cobalt			Copper			Iron		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A2	J134T9	0.21	U	0.21	3790		4.8	8.3		0.38	5.6		0.41	12.0		0.35	14700	C	10.2
Duplicate of J134T9	J134V0	0.21	U	0.21	3700		4.8	6.8		0.38	5.1		0.41	11.6		0.35	13500	C	10.3
Split of J134T9	J134V1	0.14	UN	0.14	3940	C	8.7	8.3	N	0.37	7.3		0.51	11.5		0.31	14200	N	2.5
EPA Split of J134T9	EPA-J134T9	0.10	B	0.02	4880		9.4	12.0		0.05	6.8		0.13	14.4		0.04	19800		26.3

Sample Analysis:

TDL		Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium Total	Cobalt	Copper	Iron
		5	0.6	10	2	0.5	2	0.2	100	1	2	1	5
Duplicate Analysis	Both > PQL?	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	**Yes (calc RPD)**			**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)		**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD	8.9%			6.5%				2.4%	19.9%		3.4%	8.5%
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable
Split Analysis	Both > PQL?	**Yes (continue)**	No-Stop (acceptable)		**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	**Yes (calc RPD)**			**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)		**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD	19.6%			12.0%				3.9%	0.0%		4.3%	3.5%
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable
EPA Split of J134T9	Both > PQL?	**Yes (continue)**	No-Stop (acceptable)		**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	**Yes (calc RPD)**			**Yes (calc RPD)**	No-Stop (acceptable)			**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD	*60.9%*			*78.6%*				25.1%	*36.5%*		18.2%	29.6%
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable		No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable

Split-Duplicate Analysis
Shallow Zone Sample Results: Non-radionuclides

Sampling Area	Sample Number	Lead			Magnesium			Manganese			Mercury			Nickel			Potassium		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A2	J134T9	4.2		0.91	3340		2.8	264		0.09	0.01	U	0.01	8.8		0.70	914		6.7
Duplicate of J134T9	J134V0	3.8		0.91	3150		2.8	238		0.09	0.02	U	0.02	8.1		0.70	843		6.7
Split of J134T9	J134V1	4.7		0.15	3940		12.5	280	N	0.10	0.007	U	0.01	10.1		0.78	1040	C	51.4
EPA Split of J134T9	EPA-J134T9	4.7		0.04	4210		7.6	311		0.07	0.01	U	0.01	13.2		0.11	1240		5.0

Sampling Area	Sample Number	Selenium			Silicon			Silver			Sodium			Vanadium			Zinc		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A2	J134T9	1.4	U	1.4	508		6.7	0.21	U	0.21	101		2.2	33.0		0.26	37.3		0.47
Duplicate of J134T9	J134V0	1.4	U	1.4	780		6.7	0.21	U	0.21	97.7		2.2	28.9		0.26	33.5		0.47
Split of J134T9	J134V1	0.80	B	0.18	1100	N	4.1	0.20	UN	0.20	148	C	10.3	30.9		0.69	38.6	C	1.4
EPA Split of J134T9	EPA-J134T9	0.68	B	0.18				0.05	B	0.01	265	B	3.9	41.0		0.09	41.9		0.21

Sample Analysis:

TDL		Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silicon	Silver	Sodium	Vanadium	Zinc
		5	75	5	0.2	4	400	1	2	0.2	50	2.5	1
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**		No-Stop (acceptable)	No-Stop (acceptable)		**Yes (calc RPD)**		No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD		5.9%	10.4%					*42.2%*			13.2%	10.7%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable
Split Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**		No-Stop (acceptable)	No-Stop (acceptable)		**Yes (calc RPD)**		No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD		16.5%	5.9%					73.6%			6.6%	3.4%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable
EPA Split of J134T9	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**		No-Stop (acceptable)	No-Stop (acceptable)				No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD		23.0%	16.3%								21.6%	11.6%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable		No - acceptable	**Yes - assess further**	Not applicable	Not applicable

Note: The significance of the reported RPD values is addressed within the Data Quality Assessment for the Cleanup Verification Package for this site.
B = The analyte was detected at a value less than the contract required detection limit (CRDL), but greater than or equal to the IDL/MDL (as appropriate).
C = analyte found in method blank
IDL = instrument detection limit
MDA = minimum detectable activity
MDL = method detection limit
N = spiked analyte recovery is outside stated control limits
PQL = practical quantitation limit
Q = qualifier
RPD = relative percent difference
TDL = target detection limit
U = undetected

Washington Closure Hanford

CALCULATION SHEET

Originator M. J. Appel MJA
Project 100-F Area Field Remediation
Subject 118-F-3 Cleanup Verification 95% UCL Calculations

Date 11/14/06
Job No. 14655

Calc. No. 0100F-CA-V0273
Checked J. M. Capron JMC

Rev. No. 0
Date 11/15/06
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Split-Duplicate Analysis

Shallow Zone Sample Results: Radionuclides

Sampling Area	Sample Number	Cobalt-60			Cesium-137			Europium-152			Nickel-63			Potassium-40			Radium-226			Radium-228			Strontium-90			Uranium-235		
		pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A2	J134T9	0.140	U	0.140	0.110	U	0.110	0.180	U	0.180	4.21		3.20	11.7		1.20	0.279		0.190	0.833		0.620	0.276	U	0.440	0.170	U	0.170
Duplicate of J134T9	J134V0	0.093	U	0.093	0.094		0.069	0.160	U	0.160	2.06	U	3.30	8.64		0.78	0.340		0.140	0.473		0.340	-0.045	U	0.390	0.270	U	0.270
Split of J134T9	J134V1	0.020	U	0.025	0.020		0.018	0.089	U	0.050	6.93		6.00										0.004	U	0.202			
EPA Split of J134T9	EPA-J134T9	0.026		NR	0.017		NR	0.051		NR				17.8		NR	1.15	J	NR	0.726		NR	-0.166		1.70	0.070	J	NR

Sample Analysis:

TDL		0.05	0.1	0.1	30	0.5	0.1	0.2	1.0	1.0
Duplicate Analysis	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?					**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)		
	RPD					*30%*				
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable
Split Analysis	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?				No-Stop (acceptable)					
	RPD									
	Difference > 2 TDL?	**Yes - assess further**	No - acceptable	No - acceptable	No - acceptable				No - acceptable	
EPA Split Analysis	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)		No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?					**Yes (calc RPD)**				
	RPD					*41%*				
	Difference > 2 TDL?	**Yes - assess further**	No - acceptable	No - acceptable		Not applicable	**Yes - assess further**	No - acceptable	No - acceptable	No - acceptable

Note: The significance of the reported RPD values is addressed within the Data Quality Assessment for the Cleanup Verification Package for this site.

J = estimated
MDA = minimum detectable activity
NR = not reported
PQL = practical quantitation limit
Q = qualifier
RPD = relative percent difference
TDL = target detection limit
U = undetected

Washington Closure Hanford

CALCULATION SHEET

Originator M. J. Appel
Project 100-F Area Field Remediation
Subject 118-F-3 Cleanup Verification 95% UCL Calculations

Date 11/14/06
Job No. 14655

Calc. No. 0100F-CA-V0273
Checked J. M. Capron

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Date 11/15/06
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EPA Split Analysis

Shallow Zone Sample Results: Non-radionuclides

Sampling Area	Sample Number	Aluminum			Antimony			Arsenic			Barium			Beryllium			Cadmium			Calcium			Chromium Total			Cobalt			Copper			Iron		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A3	J134T8	5050		8.4	1.3	U	1.3	1.8	U	1.8	116	C	0.7	0.24		0.06	0.21	U	0.21	5230		4.8	6.8		0.38	5.4		0.41	11.8		0.35	12300		10.2
EPA Split of J134T8	EPA-J134T8	10800		724	0.06	B	0.02	2.0		0.07	155		0.09	0.41	B	0.01	0.12	B	0.02	6550		26.8	11.8		0.06	7.9		0.14	16.8		0.05	21700		26.7

Sample Analysis:

TDL		5	0.6	10	2	0.5	0.2	100	1	2	1	5
EPA Split of J134T8	Both > PQL?	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both > 5xTDL?	Yes (calc RPD)			Yes (calc RPD)	No-Stop (acceptable)		Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	*72.6%*			29%			22.4%	*53.8%*		*35.0%*	*55.3%*
	Difference > 2 TDL?	Not applicable	Yes - assess further	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable

EPA Split Analysis

Shallow Zone Sample Results: Non-radionuclides

Sampling Area	Sample Number	Lead			Magnesium			Manganese			Mercury			Nickel			Potassium			Selenium			Silver			Sodium			Vanadium			Zinc		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A3	J134T8	4.5		0.91	3170		2.8	258		0.09	0.01	U	0.01	8.0		0.7	837		6.7	1.4	U	1.4	0.21	U	0.21	144		2.2	28.5		0.26	31.3		0.47
EPA Split of J134T8	EPA-J134T8	5.8		0.05	5100		21.6	309		2.70	0.008	U	0.008	12.8		0.13	1280		5.5	0.86		0.20	0.46		0.01	379		4.3	47.8		0.11	42.3		0.24

Sample Analysis:

TDL		5	75	5	0.2	4	400	1	0.2	50	2.5	1
EPA Split of J134T8	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
	Both > 5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)	No-Stop (acceptable)			No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD		*46.7%*	18.0%							*50.6%*	29.9%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Yes - assess further	Not applicable	Not applicable

EPA Split Analysis

Shallow Zone Sample Results: Radionuclides

Sampling Area	Sample Number	Cobalt-60			Cesium-137			Europium-152			Potassium-40			Radium-226			Radium-228			Strontium-90			Uranium-235		
		pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A3	J134T8	0.378		0.057	0.200	U	0.200	0.130	U	0.130	16.0		0.440	0.722		0.110	1.06		0.280	0.276		0.240	0.180	U	0.180
EPA Split of J134T8	EPA-J134T8	0.427		NR	0.029		NR	0.160	U	0.160	14.8		NR	0.407	J	NR	0.810		NR	-0.388		2.00	0.026	J	NR

Sample Analysis:

TDL		0.05	0.1	0.1	0.5	0.1	0.2	1.0	1.0
EPA Split Analysis	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?	Yes (calc RPD)			Yes (calc RPD)				
	RPD	12.2%			7.8%				
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	Yes - assess further	No - acceptable	No - acceptable	No - acceptable

Note: The significance of the reported RPD values is addressed within the Data Quality Assessment for the Cleanup Verification Package for this site.

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C = analyte found in method blank
IDL = instrument detection limit
J = estimated
MDA = minimum detectable activity
MDL = method detection limit
NR = not reported
PQL = practical quantitation limit
Q = qualifier
RPD = relative percent difference
TDL = target detection limit
U = undetected

Washington Closure Hanford

CALCULATION SHEET

Originator M. J. Appel MJA
Project 100-F Area Field Remediation
Subject 118-F-3 Cleanup Verification 95% UCL Calculations

Date 11/14/06
Job No. 14655

Calc. No. 0100F-CA-V0273
Checked J. M. Capron JMC

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EPA Split Analysis

Surface Ash Sample Results: Non-radionuclides

Sampling Area	Sample Number	Aluminum			Antimony			Arsenic			Barium			Beryllium			Cadmium			Calcium			Chromium Total			Cobalt			Copper			Iron		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Black Ash	J134Y0	12000		8.8	1.3	U	1.3	2.5		1.9	902	C	0.73	0.89		0.06	0.21	U	0.21	22000		5.0	7.2		0.40	5.0		0.43	20.9		0.37	11100		10.6
EPA Split of J134Y0	EPA-J134Y0	46800		3620	0.21	B	0.02	2.4		0.07	1160		0.35	1.37		0.01	0.16	B	0.02	25100		47.8	15.4		0.06	9.1		0.14	32.9		0.05	20500		26.7

Sample Analysis:

TDL		5	0.6	10	2	0.5	0.2	100	1	2	1	5
EPA Split of J134Y0	Both > PQL?	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both > 5xTDL?	Yes (calc RPD)		No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)		Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	*118.4%*			25.0%			13.2%	*72.6%*		*44.6%*	*59.5%*
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	Yes - assess further	Not applicable	Not applicable

EPA Split Analysis

Surface Ash Sample Results: Non-radionuclides

Sampling Area	Sample Number	Lead			Magnesium			Manganese			Mercury			Nickel			Potassium			Selenium			Silver			Sodium			Vanadium			Zinc		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Black Ash	J134Y0	8.5		0.94	4740		3	218		0.09	0.02	U	0.02	8.4		0.73	734		6.9	1.4	U	1.4	0.21	U	0.21	801		2.3	35.5		0.27	36.2		0.49
EPA Split of J134Y0	EPA-J134Y0	9.7		0.05	6620		8.1	299		0.07	0.02	B	0.01	14.8		0.13	1150		5.7	1.52		0.21	0.65		0.01	1520		4.4	65.8		0.11	49.8		0.24

Sample Analysis:

TDL		5	75	5	0.2	4	400	1	0.2	50	2.5	1
EPA Split of J134Y0	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
	Both > 5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)	No-Stop (acceptable)			Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD		*33.1%*	*31.3%*						*62.0%*	*59.8%*	*31.6%*
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Yes - assess further	Not applicable	Not applicable	Not applicable

EPA Split Analysis

Surface Ash Sample Results: Non-radionuclides

Sampling Area	Sample Number	Cobalt-60			Cesium-137			Europium-152			Potassium-40			Radium-226			Radium-228			Strontium-90			Uranium-235		
		pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Black Ash	J134Y0	0.180	U	0.180	0.180	U	0.180	0.240	U	0.240	6.84		1.7	0.992		0.280	1.49		0.580	0.127	U	0.210	0.250	U	0.250
EPA Split of J134Y0	EPA-J134Y0	0.022		NR	0.379		NR	0.100	U	0.100	11.0		NR	2.14	J	NR	1.18		NR	-0.087		1.70	0.130	J	NR

Sample Analysis:

TDL		0.05	0.1	0.1	0.5	0.1	0.2	1.0	1.0
EPA Split Analysis	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?				Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)		
	RPD				*46.6%*	*73.3%*	23.2%		
	Difference > 2 TDL?	Yes - assess further	No - acceptable	No - acceptable	Not applicable	Not applicable	Not applicable	No - acceptable	No - acceptable

Note: The significance of the reported RPD values is addressed within the Data Quality Assessment for the Cleanup Verification Package for this site.
B = The analyte was detected at a value less than the contract required detection limit (CRDL), but greater than or equal to the IDL/MDL (as appropriate).
IDL = instrument detection limit
J = estimated
MDA = minimum detectable activity
MDL = method detection limit
PQL = practical quantitation limit
NR = not reported
Q = qualifier
RPD = relative percent difference
TDL = target detection limit
U = undetected

Washington Closure Hanford

CALCULATION SHEET

Originator M. J. Appel **Date** 11/14/06
Project 100-F Area Field Remediation **Job No.** 14655
Subject 118-F-3 Cleanup Verification 95% UCL Calculations

Calc. No. 0100F-CA-V0273
Checked J. M. Capron

Rev. No. 0
Date 11/15/06
Sheet No. 12 of 15

Split-Duplicate Analysis

Overburden Sample Results: Non-radionuclides

Sampling Area	Sample Number	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium			Calcium			Chromium Total			Cobalt			Copper			Iron		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A2	J134Y2	5320		8.2	1.3	U	1.3	2.5		1.7	73.2	C	0.06	0.27		0.06	1.7		0.69	0.20	U	0.20	4570	C	4.7	8.4		0.37	6.0		0.40	12.8		0.34	15300		10.0
Duplicate of J134Y2	J134Y3	5700		8.3	1.3	U	1.3	2.9		1.7	65.8	C	0.06	0.28		0.06	2.0		0.69	0.20	U	0.20	4360	C	4.7	8.9		0.37	6.5		0.40	12.8		0.34	16900		10.0
Split of J134Y2	J134Y6	6490	N	6.2	0.88	BN	0.33	1.9		0.28	64.7		0.50	0.27	B	0.07	2.8	B	1.5	0.14	UN	0.14	4520	C	8.6	11.2	N	0.36	8.9		0.50	13.1	C	0.30	19500	N	2.4
EPA Split of J134Y2	EPA-J134Y2	6980		716	0.10	B	0.02	1.5		0.07	80.3		0.02	0.35	B	0.01				0.10	B	0.02	6420		9.3	11.1		0.06	7.6		0.13	15.9		0.04	21900		26.2

Sample Analysis:

TDL		5	0.6	10	2	0.5	2	0.2	100	1	2	1	5
Duplicate Analysis	Both > PQL?	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	**Yes (calc RPD)**		No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)		**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD	6.90%			10.6%				4.7%	5.8%		0.0%	9.9%
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable
Split Analysis	Both > PQL?	**Yes (continue)**	No-Stop (acceptable)		**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	**Yes (calc RPD)**			**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)		**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD	19.8%			12.3%				1.1%	28.6%		2.3%	24.1%
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable
EPA Split of J134Y2	Both > PQL?	**Yes (continue)**	No-Stop (acceptable)		**Yes (continue)**	**Yes (continue)**			**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	**Yes (calc RPD)**			**Yes (calc RPD)**	No-Stop (acceptable)			**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD	*51.2%*			9.3%				*200%*	27.7%		21.6%	*35.5%*
	Difference > 2 TDL?	Not applicable	**Yes - assess further**	No - acceptable	Not applicable	No - acceptable		No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable

Split-Duplicate Analysis

Shallow Zone Sample Results: Non-radionuclides

Sampling Area	Sample Number	Lead			Magnesium			Manganese			Mercury			Nickel			Potassium			Selenium			Silicon			Silver			Sodium			Vanadium			Zinc		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A2	J134Y2	4.9		0.89	3630		2.8	285		0.09	0.02	U	0.02	9.2		0.69	1030		6.5	1.3	U	1.3	801		6.5	0.20	U	0.20	101		2.2	35.3		0.26	34.2		0.46
Duplicate of J134Y2	J134Y3	4.9		0.89	3960		2.8	302		0.09	0.01	U	0.01	12.3		0.69	1060		6.5	1.3	U	1.3	783		6.5	0.20	U	0.20	106		2.2	39.3		0.26	36.4		0.46
Split of J134Y2	J134Y6	4.5		0.15	4290	N	12.2	295	N	0.10	0.007	UN	0.007	11.4		0.76	1180		50.3	0.51	B	0.17	625	R	4.0	0.20	UN	0.20	131		10.1	45.8	N	0.68	34.9		1.4
EPA Split of J134Y2	EPA-J134Y2	5.2		0.05	4510		4.2	335		0.07	0.008	U	0.008	12.3		0.12	1310		5.3	0.33	B	0.19				0.07	B	0.02	353	B	4.2	44.3		0.10	38.8		0.23

Sample Analysis:

TDL		5	75	5	0.2	4	400	1	2	0.2	50	2.5	1
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**		No-Stop (acceptable)	No-Stop (acceptable)		**Yes (calc RPD)**		No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD		8.7%	5.8%					2.3%			10.7%	6.2%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable
Split Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**		No-Stop (acceptable)	No-Stop (acceptable)		**Yes (calc RPD)**		No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD		16.7%	3.4%					24.7%			25.9%	2.0%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable
EPA Split of J134Y2	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)		No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**		No-Stop (acceptable)	No-Stop (acceptable)				No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD		21.6%	16.1%								22.6%	12.6%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable		No - acceptable	**Yes - assess further**	Not applicable	Not applicable

Note: The significance of the reported RPD values is addressed within the Data Quality Assessment for the Cleanup Verification Package for this site.

B = The analyte was detected at a value less than the contract required detection limit (CRDL), but greater than or equal to the IDL/MDL (as appropriate).
C = analyte found in method blank
IDL = instrument detection limit
MDA = minimum detectable activity
MDL = method detection limit
N = spiked analyte recovery is outside stated control limits
PQL = practical quantitation limit
Q = qualifier
R = rejected
RPD = relative percent difference
TDL = target detection limit
U = undetected

Washington Closure Hanford

CALCULATION SHEET

Originator M. J. Appel MJA
Project 100-F Area Field Remediation
Subject 118-F-3 Cleanup Verification 95% UCL Calculations

Date 11/14/06
Job No. 14655

Calc. No. 0100F-CA-V0273
Checked J. M. Capron JMC

Rev. No. 0
Date 11/15/06
Sheet No. 13 of 15

Split-Duplicate Analysis

Overburden Sample Results: Radionuclides

Sampling Area	Sample Number	Cobalt-60			Cesium-137			Europium-152			Nickel-63			Potassium-40			Radium-226			Radium-228			Strontium-90			Uranium-235		
		pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A2	J134Y2	0.037	U	0.037	0.041	U	0.041	0.097	U	0.097	-1.43	U	2.70	16.0		0.420	0.652		0.074	0.994		0.200	0.027	U	0.200	0.14	U	0.140
Duplicate of J134Y2	J134Y3	0.045	U	0.045	0.044	U	0.044	0.110	U	0.110	-2.44	U	2.90	25.2		0.410	0.976		0.083	1.47		0.190	-0.100	U	0.230	0.23	U	0.230
Split of J134Y2	J134Y6	-0.006	U	0.020	0.005	U	0.020	-0.010	U	0.044	1.81	U	5.44										0.025	U	0.130			
EPA Split of J134Y2	EPA-J134Y2	0.019	U	0.019	0.012		NR	0.160	U	0.160				14.7		NR	1.00	J	NR	0.783		NR	-0.186		NR	0.063	J	NR

Sample Analysis:

TDL		0.05	0.1	0.1	30	0.5	0.1	0.2	1.0	1.0
Duplicate Analysis	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?					**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)		
	RPD					*44.7%*	*39.8%*			
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	**Yes - assess further**	No - acceptable	No - acceptable
Split Analysis	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?									
	RPD									
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	No - acceptable				No - acceptable	
EPA Split Analysis	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?					**Yes (calc RPD)**	**Yes (calc RPD)**			
	RPD					8.5%	*42.1%*			
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable		Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable

Note: The significance of the reported RPD values is addressed within the Data Quality Assessment for the Cleanup Verification Package for this site.

J = estimated
MDA = minimum detectable activity
NR = not reported
PQL = practical quantitation limit
Q = qualifier
RPD = relative percent difference
TDL = target detection limit
U = undetected

Washington Closure Hanford

CALCULATION SHEET

Originator M. J. Appel
Project 100-F Area Field Remediation
Subject 118-F-3 Cleanup Verification 95% UCL Calculations

Date 11/14/06
Job No. 14655

Calc. No. 0100F-CA-V0273
Checked J. M. Capron

Rev. No. 0
Date 11/15/06
Sheet No. 14 of 15

Split-Duplicate Analysis
ACL Staging Pile Footprint: Non-radionuclides

Sampling Area	Sample Number	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium			Calcium			Chromium Total			Cobalt			Copper			Iron		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A3	J13541	4360		8.2	1.3	U	1.3	1.9		1.7	91.3	C	0.06	0.24		0.06	3.5		0.69	0.20	U	0.20	3870	C	4.7	7.4		0.37	5.4		0.40	11.5		0.34	13300		10.0
Duplicate of J13541	J13542	4850		8.2	1.2	U	1.2	1.9		1.7	98.3	C	0.06	0.25		0.06	3.6		0.68	0.20	U	0.20	4260	C	4.6	6.5		0.37	5.5		0.40	12.8		0.34	13900		9.9
Split of J13541	J13543	6090	N	6.2	0.89	BN	0.33	2.1		0.28	82.5		0.50	0.24	B	0.07	5.7	B	1.5	0.14	UN	0.14	4270	C	8.6	9.5	N	0.36	9.0		0.50	12.4	C	0.30	19900	N	2.4
EPA Split of J13541	EPA-J13541	9210		710	0.10	B	0.02	1.5		0.07	102		0.03	0.33	B	0.01				0.12	B	0.02				11.5		0.06	7.4		0.13	16.2		0.04	22200		25.6

Sample Analysis:

TDL		Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium Total	Cobalt	Copper	Iron
		5	0.6	10	2	0.5	2	0.2	100	1	2	1	5
Duplicate Analysis	Both > PQL?	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both > 5xTDL?	Yes (calc RPD)		No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)		Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	10.6%			7.4%				9.6%	12.9%		10.7%	4.4%
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable
Split Analysis	Both > PQL?	Yes (continue)	No-Stop (acceptable)		Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both > 5xTDL?	Yes (calc RPD)			Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)		Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	*33.1%*			10.1%				9.8%	24.9%		7.5%	*39.8%*
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable
EPA Split of J13541	Both > PQL?	Yes (continue)	No-Stop (acceptable)		Yes (continue)	Yes (continue)		No-Stop (acceptable)		Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both > 5xTDL?	Yes (calc RPD)			Yes (calc RPD)	No-Stop (acceptable)				Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	*71.5%*			11.1%					*43.4%*		*33.9%*	*50.1%*
	Difference > 2 TDL?	Not applicable	Yes - assess further	No - acceptable	Not applicable	No - acceptable		No - acceptable		Not applicable	No - acceptable	Not applicable	Not applicable

Split-Duplicate Analysis
ACL Staging Pile Footprint: Non-radionuclides

Sampling Area	Sample Number	Lead			Magnesium			Manganese			Mercury			Nickel			Potassium			Selenium			Silicon			Silver			Sodium			Vanadium			Zinc		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A3	J13541	4.5		0.89	3150		2.8	255		0.09	0.01	U	0.01	8.9		0.69	935		6.5	1.3	U	1.3	673		6.5	0.20	U	0.20	106		2.2	31.6		0.26	34.1		0.46
Duplicate of J13541	J13542	5.6		0.88	3430		2.7	261		0.08	0.02	U	0.02	8.9		0.68	996		6.4	1.3	U	1.3	782		6.4	0.20	U	0.20	126		2.2	32.2		0.24	36.7		0.45
Split of J13541	J13543	7.6		0.15	3990	N	12.2	294	N	0.10	0.007	UN	0.007	9.9		0.76	1330		50.2	0.42	B	0.17	673	R	4.0	0.20	UN	0.20	162		10.1	48.6	N	0.68	40.4		1.4
EPA Split of J13541	EPA-J13541	6.2		0.05	4610		4.2	309		0.07	0.010	B	0.008	11.8		0.12	1430		5.3	0.72	B	0.19				0.10	B	0.01	376	B	4.2	47.5		0.10	43.2		0.23

Sample Analysis:

TDL		Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silicon	Silver	Sodium	Vanadium	Zinc
		5	75	5	0.2	4	400	1	2	0.2	50	2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
	Both > 5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)	No-Stop (acceptable)		Yes (calc RPD)		No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD		8.5%	2.3%					15.0%			1.9%	7.3%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
	Both > 5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)	No-Stop (acceptable)		Yes (calc RPD)		No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD		23.5%	14.2%					0.00%			*42.4%*	16.9%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable
EPA Split of J13541	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)		No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
	Both > 5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)	No-Stop (acceptable)				No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD		*37.6%*	19.1%								*40.2%*	23.5%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable		No - acceptable	Yes - assess further	Not applicable	Not applicable

Note: The significance of the reported RPD values is addressed within the Data Quality Assessment for the Cleanup Verification Package for this site.
ACL = above cleanup level
B = The analyte was detected at a value less than the contract required detection limit (CRDL), but greater than or equal to the IDL/MDL (as appropriate).
C = analyte found in method blank
IDL = instrument detection limit
MDA = minimum detectable activity
MDL = method detection limit
N = spiked analyte recovery is outside stated control limits
PQL = practical quantitation limit
Q = qualifier
R = rejected
RPD = relative percent difference
TDL = target detection limit
U = undetected

Washington Closure Hanford

CALCULATION SHEET

Originator M. J. Appel MJA
Project 100-F Area Field Remediation
Subject 118-F-3 Cleanup Verification 95% UCL Calculations

Date 11/14/06
Job No. 14655

Calc. No. 0100F-CA-V0273
Checked J. M. Capron JMC

Rev. No. 0
Date 11/15/06
Sheet No. 15 of 15

EPA-Split Analysis

ACL Staging Pile Footprint Sample Results: Radionuclides

Sampling Area	Sample Number	Cobalt-60			Cesium-137			Europium-152			Nickel-63			Potassium-40			Radium-226			Radium-228			Strontium-90			Uranium-235		
		pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A3	J13541	0.126		0.048	0.198		0.057	0.110	U	0.110	1.33	U	3.00	15.4		0.410	0.700		0.077	0.771		0.200	0.001	U	0.390	5.20	U	5.20
Duplicate of J13541	J13542	0.233		0.056	0.218		0.044	0.120	U	0.120	1.72	U	2.90	26.9		0.420	0.913		0.084	1.40		0.190	-0.001	U	0.330	5.20	U	5.20
Split of J13541	J13543	0.088		0.017	0.097		0.017	0.050	U	0.045	8.75		5.43										0.011	U	0.142			
EPA Split of J13541	EPA-J13541	0.146		NR	0.120		NR	0.050		NR				15.6		NR	1.18	J	NR	0.78		NR	-0.569		1.70	0.074	J	NR

Sample Analysis:

TDL		0.05	0.1	0.1	30	0.5	0.1	0.2	1.0	1.0
Duplicate Analysis	Both > MDA?	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)			**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)		
	RPD					*54.4%*	26.4%			
	Difference > 2 TDL?	**Yes - assess further**	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	**Yes - assess further**	No - acceptable	No - acceptable
Split Analysis	Both > MDA?	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)							
	RPD									
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	No - acceptable				No - acceptable	
EPA Split Analysis	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?					**Yes (calc RPD)**	**Yes (calc RPD)**			
	RPD					1.3%	*51.1%*			
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable		Not applicable	Not applicable	No - acceptable	No - acceptable	**Yes - assess further**

Note: The significance of the reported RPD values is addressed within the Data Quality Assessment for the Cleanup Verification Package for this site.

ACL = above cleanup level
J = estimated
MDA = minimum detectable activity
NR = not reported
PQL = practical quantitation limit
Q = qualifier
RPD = relative percent difference
TDL = target detection limit
U = undetected

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