Department of Energy
Richland Operations Office
P.O. Box 550
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10-AMRC-0041

DEC 22 2009

Mr. D. A. Faulk, Program Manager
Office of Environmental Cleanup
Hanford Project Office
U.S. Environmental Protection Agency
309 Bradley Boulevard, Suite 115
Richland, Washington 99352

Dear Mr. Faulk:

TRANSMITTAL OF APPROVED CLEANUP VERIFICATION PACKAGE FOR THE 618-13 BURIAL GROUND AND THE 600-290:1 PAD AND LOADING DOCK NEAR 618-13, CVP-2009-00005, REVISION 0

This letter transmits, "Cleanup Verification Package for the 618-13 Burial Ground and the 600-290:1 Pad and Loading Dock Near 618-13, CVP-2009-00005," Revision 0, for your use. If you have questions, please contact me or your staff may contact Chris Smith, of my staff, on (509) 372-1544.

Sincerely,

Mark S. French, Federal Project Director
for the River Corridor Closure Project

AMRC:DCS

Enclosure

cc w/encl:
L. E. Gadbois, EPA
Administrative Record, H6-08

cc w/o encl:
M. L. Proctor, WCH

CVP-2009-00005
Rev. 0

Cleanup Verification Package for the 618-13 Burial Ground and the 600-290:1 Pad and Loading Dock Near 618-13

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

November 2009

EXECUTIVE SUMMARY

This cleanup verification package documents completion of remedial action for the 618-13 Burial Ground. This site is located in the 300-FF-2 Operable Unit in the 300 Area of the Hanford Site in southeastern Washington State. Prior to remediation, the 618-13 site was a mound of soil approximately 4.6 to 6.1 m high by 38 m long by 15 m wide. Historical research indicates the site was used for one-time disposal of uranium-contaminated soil that was excavated from around the 313 Building in 1950. The contaminated soil was covered with approximately 0.6 m of clean soil.

Adjacent to the 618-13 Burial Ground was a concrete pad and loading dock on which was stored solvents in 208-L barrels. Although this loading dock is part of the 600-290, Contaminated Concrete Foundation West of 618-13, 300 West Storage, waste site the concrete loading dock was within the excavation area of the 618-13 Burial Ground and was removed during remediation of the 618-13 site. The concrete loading dock is also known as the 600-290:1 Pad and Loading Dock Near 618-13 and is included within the footprint of the 618-13 cleanup verification sampling plan.

Site excavation of the 618-13 Burial Ground is complete and the exposed surfaces have been sampled and analyzed to verify attainment of the remedial action goals (RAGs). Results of the sampling, laboratory analyses, and data evaluations for the 618-13 Burial Ground site indicate that all remedial action objectives for direct exposure, protection of groundwater, and protection of the Columbia River have been met for unrestricted land use (see Table ES-1).

Soil cleanup levels were established in the *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington* (ROD) (EPA 2001) based on a limited ecological risk assessment. Although not required by the ROD, a comparison against ecological risk screening levels has been made for the site contaminants of concern and contaminants of potential concern. Screening values were exceeded for boron, manganese, and vanadium. Exceeding screening values

does not necessarily indicate the existence of risk to ecological receptors. It is believed that the presence of manganese and vanadium at this site does not pose a risk to ecological receptors because the concentrations are within the range of natural site

Table ES-1. Summary of Cleanup Verification Results for the 618-13 Burial Ground and the 600-290:1 Pad and Loading Dock.

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain 15 mrem/yr dose rate above background over 1,000 years. Attain the CERCLA risk range of 10^{-4} to 10^{-6}.	The maximum predicted dose rates and risk from the statistical and the focused samples in the 618-13 Burial Ground footprint were estimated using conservative dose equivalence lookup values. The sum of fractions at the site is less than 15 mrem/yr. The risk range for the decision unit is within the recommended range of 10^{-4} to 10^{-6}.	Yes
Direct Exposure – Nonradionuclides	Attain individual COC/COPC RAGs.	All individual COC/COPC concentrations are below the RAGs.	Yes
Nonradionuclide Risk Requirements	Attain hazard quotient of <1 for noncarcinogens.	All hazard quotients are below 1.	Yes
	Attain cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient (1.0×10^{-3}) is less than 1.	
	Attain excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	All excess cancer risks for individual nonradionuclide COCs/COPCs are less than $<1 \times 10^{-6}$.	
	Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The total excess cancer risk (0) is less than $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single COC/COPC groundwater and river protection RAGs.	No radionuclide COCs/COPCs were quantified above groundwater/river protection lookup values.	Yes
	Attain National Primary Drinking Water Standards: 4 mrem/yr (beta/gamma) dose rate to target receptors/organs.[a]	No radionuclide COCs/COPCs were quantified above groundwater/river protection lookup values.	
	Meet drinking water standards for nonuranium 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]	No alpha-emitting radionuclide COCs/COPCs were quantified above groundwater/river protection lookup values.	
	Meet total uranium standard of 21.2 pCi/L.[c]	Uranium was quantified below levels that are protective of 300 Area groundwater.	

Table ES-1. Summary of Cleanup Verification Results for the 618-13 Burial Ground and the 600-290:1 Pad and Loading Dock.

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	All individual COC/COPC concentrations are below the RAGs.	Yes

[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 uranium MCL (40 *Code of Federal Regulations* 141.66) 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).

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COC = contaminant of concern
COPC = contaminant of potential concern
MCL = maximum contaminant level (drinking water standard)
RAG = remedial action goal

background (DOE-RL 2001). Boron concentrations will be evaluated in the context of additional lines of evidence for ecological effects as part of the final closeout decision for this site.

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 2007). Copies of the waste site reclassification forms are included as Attachment ES-1 and ES-2.

Attachment ES-1. Waste Site Reclassification Form for 618-13

Date Submitted: 11/5/2009 Originator: M. L. Proctor Phone: 372-9227	**WASTE SITE RECLASSIFICATION FORM** Operable Unit(s): 300-FF-2 Waste Site Code: 618-13 Type of Reclassification Action: Closed Out ☐ Interim Closed Out ☒ No Action ☐ RCRA Postclosure ☐ Rejected ☐ Consolidated ☐	Control Number: 2009-032

This form documents agreement among parties listed authorizing classification of the subject unit as Closed Out, Interim Closed Out, No Action, RCRA Postclosure, Rejected, or Consolidated. This form also authorizes backfill of the waste management unit, if appropriate, for Closed Out and Interim Closed Out units. Final removal from the NPL of No Action and Closed Out waste management units will occur at a future date.

Description of current waste site condition:

The 618-13 Burial Ground was used one time for disposal of uranium contaminated soil from around the 313 Building. The soil was placed in a mound west of the 300-Area and covered with clean soil. Remedial actions at this site were performed in accordance with remedial action objectives and goals established by the U.S. Environmental Protection Agency and the U.S. Department of Energy, Richland Operations Office, in concurrence with the Washington State Department of Ecology. The selected remedial action involved (1) excavating the site to the extent required to meet specified soil cleanup levels, and (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility in the 200 Area of the Hanford Site. Because this site was an above grade mound, the remedial excavation did not extend below grade, and therefore backfilling was not necessary. Adjacent to the 618-13 waste site were a concrete loading dock and pad that were removed as part of this remedial action. Although part of a different waste site (600-290:1), the area of the loading dock and pad will be interim closed out with 618-13.

Basis for reclassification:

The 618-13 site has been remediated to meet the remedial action objectives specified in the *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington,* U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2001). Remedial actions were performed so as to allow unrestricted land use and to protect groundwater and the Columbia River. The 618-13 excavation was a single decision unit. The entire excavation area is closed out using shallow zone cleanup criteria; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the *Cleanup Verification Package for the 618-13 Burial Ground* (CVP-2008-00005), Washington Closure Hanford, Richland, Washington.

Waste Site Controls:

Engineered Controls: Yes ☐ No ☒ Institutional Controls: Yes ☐ No ☒ O&M requirements: Yes ☐ No ☒

If any of the Waste Site Controls are checked Yes specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents.

~~M. S. French~~ RF Guercia DOE Federal Project Director (printed)	Signature	11/10/9 Date
NA Ecology Project Manager (printed)	Signature	Date
L. E. Gadbois EPA Project Manager (printed)	Larry Gadbois Signature	11-12-2009 Date

Attachment ES-2. Waste Site Reclassification Form for 600-290:1

Date Submitted: 11/5/2009 Originator: M. L. Proctor Phone: 372-9227	**WASTE SITE RECLASSIFICATION FORM** Operable Unit(s): 300-FF-2 Waste Site Code: 600-290:1 Type of Reclassification Action: Closed Out ☐ Interim Closed Out ☒ No Action ☐ RCRA Postclosure ☐ Rejected ☐ Consolidated ☐	Control Number: 2009-055

This form documents agreement among parties listed authorizing classification of the subject unit as Closed Out, Interim Closed Out, No Action, RCRA Postclosure, Rejected, or Consolidated. This form also authorizes backfill of the waste management unit, if appropriate, for Closed Out and Interim Closed Out units. Final removal from the NPL of No Action and Closed Out waste management units will occur at a future date.

Description of current waste site condition:

The 600-290:1, Pad and Loading Dock Near 618-13, were described in the 300-FF-2 Operable Unit Technical Base Line Report as having been used for the storage of depleted solvents that were subsequently buried in the nearby 618-9 burial ground. The 600-290:1 site was physically located within the excavation footprint of the 618-13 remedial action as has been removed concurrently with materials from 618-13.

Remedial actions at this site were performed in accordance with remedial action objectives and goals established by the U.S. Environmental Protection Agency and the U.S. Department of Energy, Richland Operations Office, in concurrence with the Washington State Department of Ecology. The selected remedial action involved (1) excavating the site to the extent required to meet specified soil cleanup levels, and (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility in the 200 Area of the Hanford Site. Because this site was an above grade mound, the remedial excavation did not extend below grade, and therefore backfilling was not necessary.

Basis for reclassification:

The 600-290:1 subsite has been remediated concurrently with the 618-13 waste site and has been remediated to meet the remedial action objectives specified in the *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2001). Remedial actions were performed so as to allow unrestricted land use and to protect groundwater and the Columbia River. The 600-290:1 site was included in the 618-13 excavation which was treated as a single decision unit. The entire excavation area is closed out using shallow zone cleanup criteria; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the *Cleanup Verification Package for the 618-13 Burial Ground and the 600-290:1 Pad and Loading Dock Near 618-13* (CVP-2008-00005), Washington Closure Hanford, Richland, Washington.

Waste Site Controls:

Engineered Controls: Yes ☐ No ☒ Institutional Controls: Yes ☐ No ☒ O&M requirements: Yes ☐ No ☒
If any of the Waste Site Controls are checked Yes specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents.

~~M. S. French~~ RF Guercia		11/10/9
DOE Federal Project Director (printed)	Signature	Date
NA		
Ecology Project Manager (printed)	Signature	Date
L. E. Gadbois	Larry Gadbois	11-12-2009
EPA Project Manager (printed)	Signature	Date

CONTENTS

1.0 INTRODUCTION 1

2.0 SITE DESCRIPTION AND SUPPORTING INFORMATION 2

3.0 REMEDIAL ACTION FIELD ACTIVITIES 5
3.1 EXCAVATION AND DISPOSAL 5
3.2 WASTE SUMMARY 6
3.3 IN-PROCESS MONITORING AND SAMPLING 6
3.4 POST-EXCAVATION RADIOLOGICAL SURVEYS 7
3.5 POST-EXCAVATION GEOPHYSICAL SURVEY 7
3.6 POST-EXCAVATION TOPOGRAPHIC SURVEY 8

4.0 SAMPLING ACTIVITIES 8
4.1 VERIFICATION SAMPLING DESIGN 8
4.1.1 Decision Unit Sampling 8
Decision Unit 10
Decision Subunits 10
4.1.2 Statistical Sampling Design 10
4.1.3 Focused Sampling Design 10
4.2 CONTAMINANTS OF POTENTIAL CONCERN FOR VERIFICATION SAMPLING 10

5.0 SAMPLING RESULTS 11
5.1 STATISTICAL SAMPLE RESULTS 11
5.2 FOCUSED SAMPLE RESULTS 13
5.3 DATA QUALITY ASSESSMENT PROCESS 14

6.0 CLEANUP VERIFICATION DATA EVALUATION 15
6.1 ATTAINMENT OF RADIONUCLIDE RAGS 15
6.1.1 Comparison of Sample Data to RAGs 15
6.1.2 Attainment of Radionuclide Direct Exposure RAG 15
6.2 ATTAINMENT OF NONRADIONUCLIDE RAGS 17
6.2.1 Direct Comparison to RAGs 17
6.2.2 Direct Contact Noncarcinogenic Hazard Quotient RAG Attained 17
6.2.3 Direct Contact Carcinogenic Risk RAG Attained 17
6.3 THREE-PART TEST FOR NONRADIONUCLIDES 17

7.0 STATEMENT OF PROTECTIVENESS 18

8.0 REFERENCES 18

APPENDICES

A. GLOBAL POSITIONING ENVIRONMENTAL RADIOLOGICAL SURVEYS ..... A-i

B. VERIFICATION SAMPLE DESIGN ..... B-i

C. FOCUSED SAMPLE DESIGN ..... C-i

D. CALCULATIONS ..... D-i
D1 *618-13 Burial Ground Cleanup Verification 95% UCL Calculation*, Calculation No. 0300X-CA-V0105, Rev. 1 ..... D-3
D2 *618-13 Burial Ground Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation*, Calculation No. 0300X-CA-V0106, Rev. 0 ..... D-29

E. DATA QUALITY ASSESSMENT ..... E-i

FIGURES

1. Overall Site Location Map of the 618-13 Burial Ground and the 600-290:1 Pad and Loading Dock Near 618-13. 3
2. 618-13 Burial Ground Looking East (September 1985). 4
3. Aerial Photograph of the 618-13 Burial Ground (August 1986). 4
4. 600-290:1 Pad and Loading Dock on West Side of the Mound. 5
5. 618-13 Remediation Activities. 6
6. Close-Up View of the Decayed Woody Material Found in 618-13. 7
7. 618-13 Post-Excavation Civil Survey. 9

TABLES

1. Number of Verification Samples for the 618-13 Burial Ground. 10
2. Comparison of Statistical Sample Results to Action Levels for the 618-13 Burial Ground and the 600-290:1 Pad and Loading Dock. 11
3. Comparison of Maximum Focused Sample Results to Action Levels for the 618-13 and the 600-290:1 Waste Sites. 13
4. Attainment of Radionuclide Direct Exposure RAG (Statistical Samples). 16
5. Attainment of Radionuclide Direct Exposure RAG (Focused Samples). 16

ACRONYMS AND ABBREVIATIONS

COC	contaminant of concern
COPC	contaminant of potential concern
CVP	cleanup verification package
DQA	data quality assessment
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ESD	Explanation of Significant Differences
GPERS	Global Positioning Environmental Radiological Surveyor
ICP	inductively conducted plasma
RAG	remedial action goal
RAO	remedial action objective
RDR/RAWP	remedial design report/remedial action work plan
ROD	record of decision
SAP	sampling and analysis plan
UCL	upper confidence limit
WAC	*Washington Administrative Code*

1.0 INTRODUCTION

This cleanup verification package (CVP) documents that the 618-13 Burial Ground and the collocated 600-290:1 Pad and Loading Dock Near 618-13 have been remediated in accordance with the *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington* (ROD) (EPA 2001), as modified by the *Explanation of Significant Differences for the 300-FF-2 Operable Unit Interim Record of Decision* (ESD) (EPA 2004). Remedial action objectives (RAOs) and remedial action goals (RAGs) for this site are documented in the ROD (EPA 2001) and the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (RDR/RAWP) (DOE-RL 2009b). The ROD provides the U.S. Department of Energy, Richland Operations Office, the authority, guidance, and objectives to conduct this remedial action.

The remedy specified in the ROD (EPA 2001) and conducted for the 618-13 Burial Ground included (1) excavating the site to the extent required to meet specified soil cleanup levels and (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility (ERDF) in the 200 Area of the Hanford Site or other approved facilities. Because the 618-13 site consisted of an above-grade mound that was removed to grade, backfilling was not necessary. Excavation was driven by RAOs for direct exposure, protection of groundwater, and protection of the Columbia River. Although the interim action ROD (EPA 2001) for the 618-13 Burial Ground established remedial action objectives based on an industrial land use, the subsequent ESD (EPA 2004) revised the remediation objectives to reflect more stringent standards associated with an unrestricted land-use scenario. Preliminary contaminants of potential concern (COPCs) were identified in the *300 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2009a). Observations of the type and quantity of material removed from the site and associated characterization sampling performed during the excavation process were used to identify final contaminants of concern (COCs)/COPCs for the verification sampling as discussed in the *Closeout Plan for the 618-13 Burial Ground* (WCH 2009b).

Soil cleanup levels were established in the ROD based on a limited ecological risk assessment. Although not required by the ROD, a comparison against ecological risk screening levels has been made for the site COCs/COPCs. Screening values were exceeded for boron, manganese, vanadium. Exceeding screening values does not necessarily indicate the existence of risk to ecological receptors. It is believed that the presence of manganese and vanadium at this site does not pose a risk to ecological receptors because the concentrations are within the range of natural site background (DOE-RL 2001). Boron concentrations will be evaluated in the context of additional lines of evidence for ecological effects as part of the final closeout decision for this site.

2.0 SITE DESCRIPTION AND SUPPORTING INFORMATION

The 618-13 Burial Ground, part of the 300-F-2 Operable Unit, is located approximately 0.8 km (0.5 mi) west of the 300 Area across Route 4 South in the vicinity of Washington State Plane coordinates N 116238 E 592880 (Figure 1). It consisted of a mound of soil approximately 4.6 to 6.1 m (15 to 20 ft) high by 38 m (125 ft) long by 15 m (50 ft) wide, covered with 0.6 m (2 ft) of clean soil (Figures 2 and 3). Adjacent to the west side of the 618-13 mound was the 600-290:1 pad and loading dock (Figure 4) that were used for storage of solvents contained in 208 L (55-gal) drums and were part of the 600-290 waste site. The concrete pad and loading dock were remediated with the 618-13 mound and their footprint was included in the 618-13 cleanup verification sampling plan.

The 618-13 site was first identified in 1955 during an inventory of buried radioactive wastes in the 300 Area (Paas 1955). The report states that "top soil from the 303 Area removed in 1950 was piled approximately one-half to three-quarters of a mile northwest of the 300 Area, and covered with two feet of clean soil. Total activity buried here is not known. The mound of covered contaminated material has been posted as a radiation zone."

The 313 Metal Fabrication Building was constructed in 1943 in 303 portion of the 300 Area. It was used to machine uranium fuel rods into slugs, which were then canned or jacketed. The finished fuel elements were then tested and inspected. The operations resulted in the spread of particles containing aluminum, barium, bismuth, cadmium, lead, thorium, uranium, and other heavy metals in the soils throughout the northern portion of the 300 Area. The use of hazardous chemicals including acenapthene, acetone, carbon tetrachloride, methanol, trichloroethylene, hydrofluosilicic acid, nitric acid, phosphoric acid, sodium hydroxide, sodium dichromate, and sodium nitrate further contributed to soil contamination around the 313 Building from these operations (Gerber 1992).

The 600-290:1 pad and loading dock is thought to have been used for storage of hexone from solvent extraction studies in the 321 Building. The hexone was stored in 208 L (55-gal) drums between March 1950 and June 1954 prior to being buried in the 618-9 Burial Ground. Physical evidence (rust-colored patterns on the concrete) and the proximity of the pad to the 618-9 Burial Ground support this theory. The solvent waste buried at the 618-9 Burial Ground consisted of methyl isobutyl ketone (hexone), kerosene, and uranyl nitrate hexahydrate, suggesting that hexone may not have been the only solvent stored here. The concrete pad was posted as a radiological fixed contamination area; however, no information has been found to indicate the timing of this posting or the level of contamination present.

Figure 1. Overall Site Location Map of the 618-13 Burial Ground and the 600-290:1 Pad and Loading Dock Near 618-13.

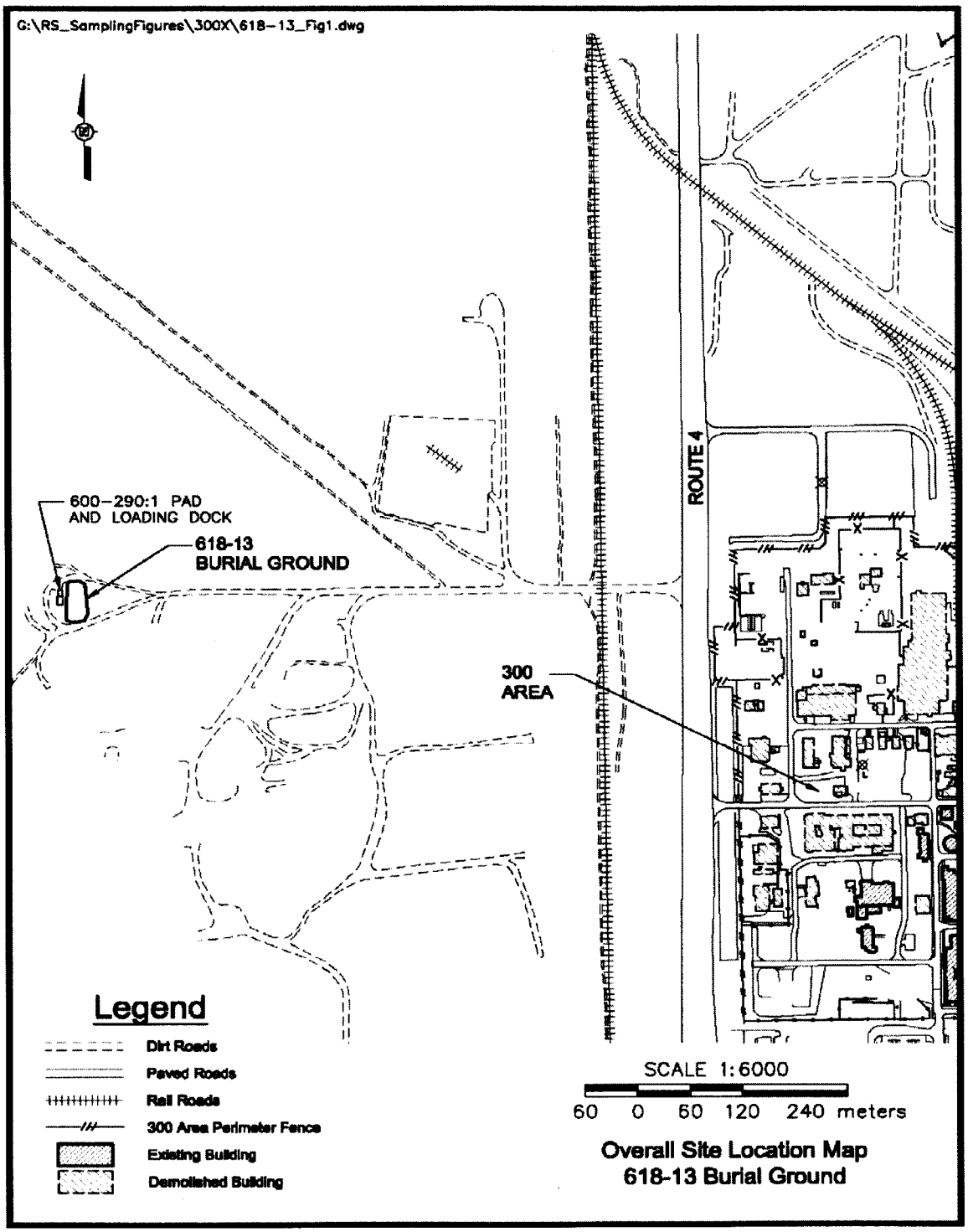

Figure 2. 618-13 Burial Ground Looking East (September 1985).

Figure 3. Aerial Photograph of the 618-13 Burial Ground (August 1986).

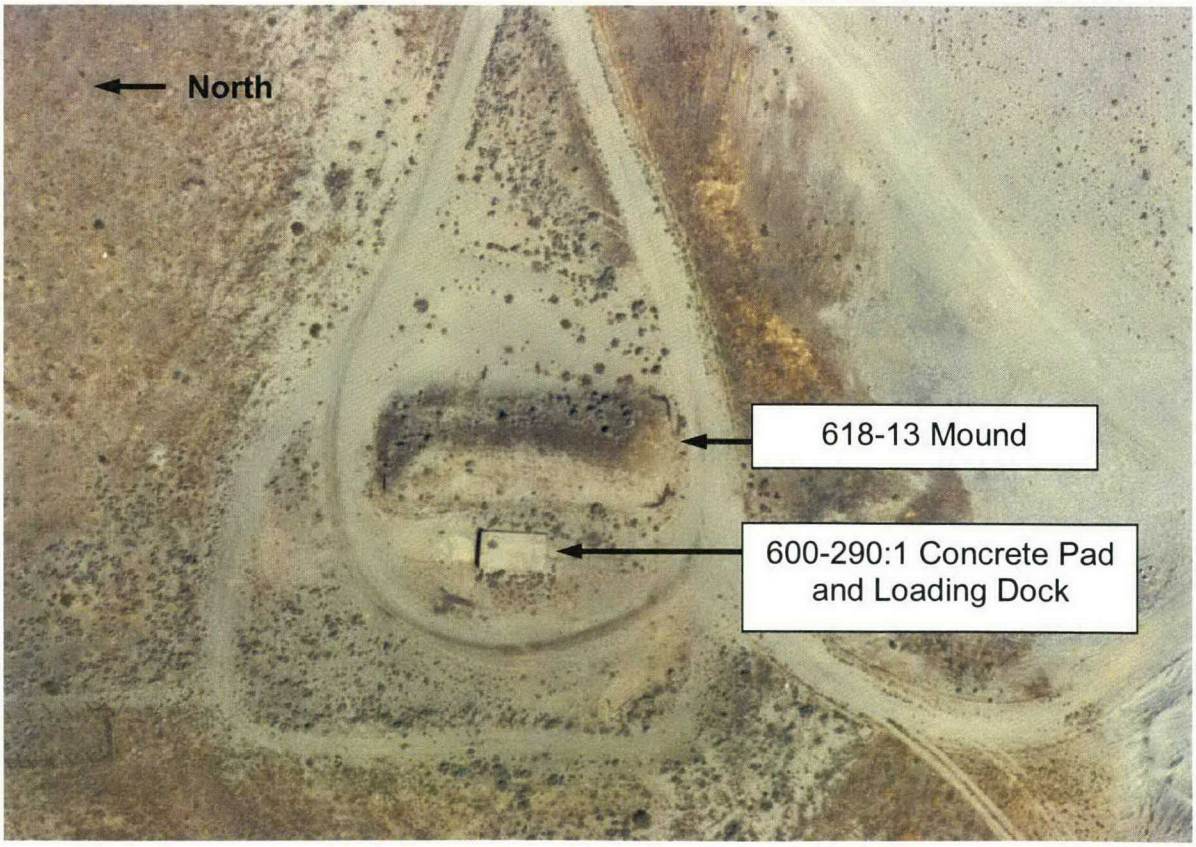

Figure 4. 600-290:1 Pad and Loading Dock on West Side of the Mound.

3.0 REMEDIAL ACTION FIELD ACTIVITIES

3.1 EXCAVATION AND DISPOSAL

Field remediation of the 618-13 Burial Ground occurred between January 5 and February 2, 2009, to remove the mound, concrete pad, and loading dock. The excavated material was maintained within the waste site footprint; therefore, no staging piles were generated outside of the waste site boundary. Contaminated soil, pieces of decayed wood, and concrete were the only materials found during remediation of the site. Approximately 3,132 bank cubic meters (4,097 cubic yards) of soil weighing 4,300 metric tons (4,742 tons) was excavated and disposed of at the ERDF. Figure 5 is a photograph taken during remediation of the 618-13 mound.

Figure 5. 618-13 Remediation Activities.

3.2 WASTE SUMMARY

The waste encountered in the 618-13 Burial Ground consisted of soil with a small amount of decayed woody material scattered throughout (Figure 6). No other debris was noted in the pile.

3.3 IN-PROCESS MONITORING AND SAMPLING

In-process Industrial Hygiene monitoring was performed throughout the excavation using the following instruments:

- Thermo Fisher Personal DataRAM 1000AN for real-time dust monitoring
- RAE Systems MultiRAE Plus PGM-50/5P multiple gas monitor with photoionization detector and RAELink2 remote monitoring capability.

All real-time monitoring results were normal background throughout the duration of the project.

Figure 6. Close-Up View of the Decayed Woody Material Found in 618-13.

3.4 POST-EXCAVATION RADIOLOGICAL SURVEYS

A radiological survey of the 618-13 Burial Ground footprint was performed on February 12, 2009, using Global Positioning Environmental Radiological Surveyor (GPERS) with instrumentation specific to detection of gamma (sodium iodide detector) and beta-gamma (plastic scintillator). Results of the surveys are included in Appendix A of this closeout document. The beta track (plastic scintillator) survey map is shown in Figure A-1, and the gamma track (sodium iodide) survey map is shown in Figure A-2. The results indicated that the soil beneath the excavated waste site was less than two times background for beta- and gamma-emitting radionuclides.

3.5 POST-EXCAVATION GEOPHYSICAL SURVEY

A post-remediation geophysical survey was performed at the 618-13 site using ground-penetrating radar, magnetic field, and metal detector instrumentation (WCH 2009c). The objective of the survey was to verify that there was no buried debris remaining at the site after remediation. Results confirmed there was no buried debris at the site and also indicated the unlikelihood that there was ever subsurface burial. This last

interpretation was based on the presence of a continuous subsurface geologic horizon across the site at approximately 0.75 m depth.

3.6 POST-EXCAVATION TOPOGRAPHIC SURVEY

A civil survey was performed to provide the excavation boundary for designing the verification sampling plan (Figure 7). The mound and concrete pad were removed to ground surface; therefore there is no excavation in the traditional sense of a sub-grade void.

4.0 SAMPLING ACTIVITIES

Following remediation and field-screening of the 618-13 Burial Ground, verification sampling was conducted in February 2009 to determine if the RAGs were met. RAGs are the specific numeric goals against which the verification data are evaluated to demonstrate attainment of the RAOs as established in the ROD (EPA 2001) and the ESD (EPA 2004). The following subsections provide additional discussion of the information used to determine the COCs/COPCs for verification and focused sampling, as well as the sampling design selection and basis.

4.1 VERIFICATION SAMPLING DESIGN

Verification sampling was performed at the 618-13 Burial Ground waste site to demonstrate that the residual soil in the waste site meets the unrestricted land-use scenario remedial action objectives in accordance with the ROD (EPA 2001), as modified by the ESD (EPA 2004). Two methods for selecting the sampling locations were utilized: statistical sampling designs and focused sampling locations.

4.1.1 Decision Unit Sampling

The number of decision subunits was determined by the overall footprint area of the decision unit, with the default number of verification samples for each decision unit being four composite samples. The footprint includes the area beneath the 618-13 Burial Ground mound, the concrete pad and loading dock, and the surrounding soils that contacted the waste during loadout. The total area was small (<9,290 m^2 [100,000 ft^2]) and, therefore, required only a single decision subunit.

The 618-13 Burial Ground excavation was sampled as a shallow zone decision unit. The required number of verification samples for each of the decision units associated with the 618-13 Burial Ground waste site is listed in Table 1.

Figure 7. 618-13 Post-Excavation Civil Survey.

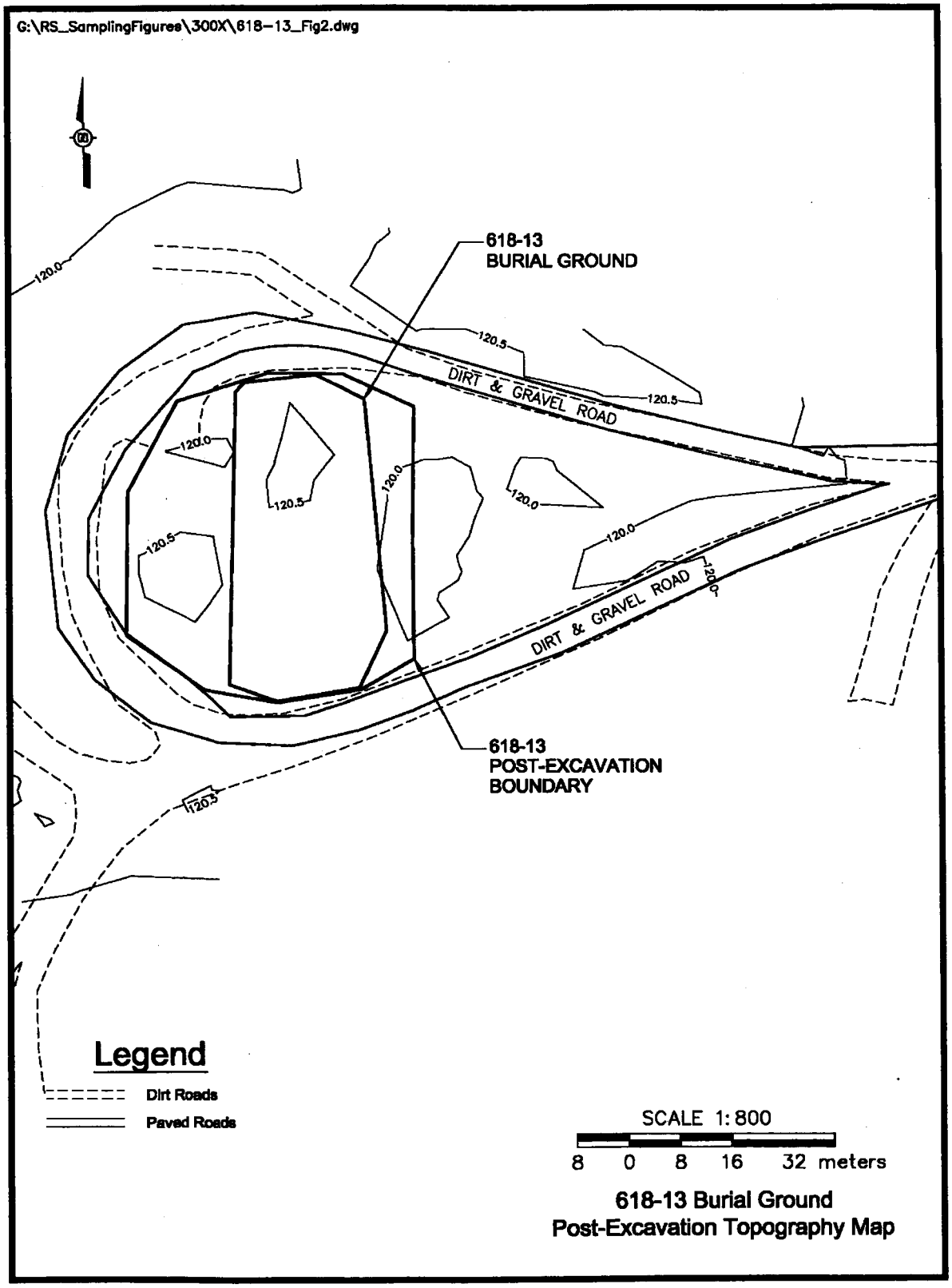

Table 1. Number of Verification Samples for the 618-13 Burial Ground.

Decision Unit	Waste Site Footprint (ft^2)	Size Classification (ft^2)	Decision Subunits	Verification Samples (composite)
Verification – shallow zone	21,709	Small (≤100,000)	1	4

4.1.2 Statistical Sampling Design

The decision rule for demonstrating compliance with the cleanup criteria requires comparison of the true population mean, as estimated by the 95% upper confidence limit (UCL) on the sample mean, with the cleanup level. Therefore, a statistical sampling design was the preferred verification sampling approach for this site because the distribution of potential residual soil contamination over the study area (site) was uncertain. The Washington State Department of Ecology publication, *Guidance on Sampling and Data Analysis Methods* (Ecology 1995) recommends that systematic sampling with sample locations distributed over the entire study area be used.

Visual Sample Plan was used as a tool to develop the statistical sampling design for the verification sampling. The verification sample design is included in Appendix B. Methodology for the development of the sample design and associated sample location coordinates is documented in calculation brief 0300X-CA-V0082 (WCH 2009a).

4.1.3 Focused Sampling Design

In addition to performing statistical sampling of the remedial footprint, two focused soil samples were collected within the excavation footprint: beneath the 618-13 Burial Ground and beneath the concrete pad and loading dock. These locations were chosen to ensure that samples were obtained directly beneath these two features. The focused sample locations are shown in Appendix C. During excavation of the site, no hazardous debris, stained soil, or other anomalous material was identified that warranted additional focused samples.

4.2 CONTAMINANTS OF POTENTIAL CONCERN FOR VERIFICATION SAMPLING

The COPCs are based on site history, process knowledge, available characterization data, and visual observations during excavation. The initial list of COPCs for this waste site included just uranium as identified in Appendix A, Table A-2, of the RDR/RAWP (DOE-RL 2009b) and in Appendix A, Table A-1, of the SAP (DOE-RL 2009a). The COPC list was expanded based on the historical research and process knowledge related to the 313 Building operations.

The expanded list of COPCs for the verification sampling includes uranium (total metal), uranium-233/234, uranium-235, uranium-238, thorium-232, inductively coupled plasma (ICP) metals, mercury, hexavalent chromium, acenaphthene, and volatile organic compounds.

5.0 SAMPLING RESULTS

The verification samples were submitted to offsite laboratories for analysis using approved U.S. Environmental Protection Agency (EPA) analytical methods, as required per the SAP (DOE-RL 2009a).

5.1 STATISTICAL SAMPLE RESULTS

The laboratory-reported analytical results from the verification sampling were used in the statistical calculations. The primary statistical calculation to evaluate compliance with cleanup standards is the 95% UCL on the arithmetic mean of the data. The 95% UCL values for each COC were computed for the 618-13 Burial Ground as specified by the RDR/RAWP (DOE-RL 2009b). The standard laboratory analysis performed to quantify the concentrations of the COCs also detected other analytes. Statistical calculations were performed on the additional, non-COC analytes that are anthropogenic and were detected in the analysis. Statistical calculations were not performed on naturally occurring analytes that are not related to the operational history of the site and/or analytes that were detected below background levels.

Comparisons of the statistical results for site COCs and additional analytes with the RAGs (cleanup criteria) for the 618-13 Burial Ground are listed in Table 2.

Table 2. Comparison of Statistical Sample Results to Action Levels for the 618-13 Burial Ground and the 600-290:1 Pad and Loading Dock. (2 Pages)

COC/COPC	Statistical Result (pCi/g)	Generic Site Lookup Values [a] (pCi/g)			Does the Result Exceed Lookup Values?	Does the Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value	Groundwater Protection Lookup Value	River Protection Lookup Value		
Radionuclides						
Cesium-137	0.031 (<BG)	6.2	NA	NA	No	--
Thorium-232	0.14 [b]	1.0	NA	NA	No	--
Uranium-233/234	0 [b]	27.2	17.9	17.9	No	--
Uranium-235	U	2.7	1.8	1.8	No	--
Uranium-238	0 [b]	26.2	17.9	17.3	No	--

Table 2. Comparison of Statistical Sample Results to Action Levels for the 618-13 Burial Ground and the 600-290:1 Pad and Loading Dock. (2 Pages)

COC/COPC	Statistical Result (mg/kg)	Remedial Action Goals [a] (mg/kg)			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Protective of Groundwater	Protective of the River		
Metals						
Antimony	0.310 (<BG)	32	5 [c, d]	5 [c, d]	No	--
Arsenic	3.16 (<BG)	20 [e]	20 [e]	20 [e]	No	--
Barium	69.3 (<BG)	1,600 [f]	200	400	No	--
Beryllium	0.208 (<BG)	10.4 [f]	1.51 [c]	1.51 [c]	No	--
Boron	1.03	16,000	320	NA	No	--
Cadmium	0.0575 (<BG)	13.9 [f]	0.81 [c, d]	0.81 [c, d]	No	--
Chromium	10.2 (<BG)	120,000	18.5 [c]	18.5 [c]	No	--
Cobalt	6.39 (<BG)	24	15.7 [c]	NA	No	--
Copper	11.4 (<BG)	2,960	59.2	22.0 [c]	No	--
Lead	3.61 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	321 (<BG)	11,200	512 [c]	512 [c]	No	--
Mercury	U	24	0.33 [c]	0.33 [c]	No	--
Molybdenum	0.362	400	8	NA	No	--
Nickel	12.1 (<BG)	1,600	19.1 [c]	27.4	No	--
Uranium (KPA)	2.80	81	53	106	No	--
Vanadium	56.7 (<BG)	560	85.1 [c]	NA	No	--
Zinc	41.1 (<BG)	24,000	480	67.8 [c]	No	--
Volatile Organics Analytes						
Acetone	0.00755	72,000	720	NA	No	--
Acenaphthene	U	4,800	96	129	No	--

[a] Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (300 Area RDR/RAWP) (DOE-RL 2009b) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.
[b] Hanford Site background values for thorium-232 (1.32 pCi/g), uranium-233/234 (1.06 pCi/g), and uranium-238 (1.06 pCi/g) (DOE-RL 1996) have been subtracted from statistical results.
[c] Where cleanup levels are less than background cleanup levels default to background per WAC 173-340-700(4)(d).
[d] Hanford Site-specific background not available. Value is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[e] The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers.
[f] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3]) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (WDOH 1997).

-- = not applicable
BG = background (obtained from DOE-RL (1996) and DOE-RL (2009b), unless otherwise noted)
COC = contaminant of concern
COPC = contaminant of potential concern
KPA = kinetic phosphorescence analysis
NA = not applicable
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose assessment model)
U = undetected
WAC = *Washington Administrative Code*

The laboratory-reported data results for all constituents are stored in the Environmental Restoration project-specific database prior to archival in the Hanford Environmental Information System and are presented as part of the 95% UCL calculation in Appendix D.

5.2 FOCUSED SAMPLE RESULTS

Two focused samples were collected from the 618-13 waste site. Statistical analysis (e.g., calculation of a 95% UCL value) is inappropriate to use for evaluation of focused samples; therefore, the sample results for the focused samples are evaluated using the maximum detected concentration for each COC/COPC and comparing the value directly to the cleanup level. Table 3 provides a comparison of the maximum result of the focused samples against the cleanup criteria. Complete sample results are presented in Appendix D.

Table 3. Comparison of Maximum Focused Sample Results to Action Levels for the 618-13 and the 600-290:1 Waste Sites. (2 Pages)

COC/COPC	Maximum Result (pCi/g)	Generic Site Lookup Values [a] (pCi/g)			Does the Result Exceed Lookup Values?	Does the Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value	Groundwater Protection Lookup Value	River Protection Lookup Value		
Radionuclides						
Cesium-137	U	6.2	NA	NA	No	--
Thorium-232	0 [b]	1.0	NA	NA	No	--
Uranium-233/234	0.08 [b]	27.2	17.9	17.9	No	--
Uranium-235	U [b]	2.7	1.8	1.8	No	--
Uranium-238	0 [b]	26.2	17.9	17.3	No	--
COC/COPC	**Maximum Result (mg/kg)**	**Remedial Action Goals [a] (mg/kg)**			**Does the Result Exceed RAGs?**	**Does the Result Pass RESRAD Modeling?**
		Direct Exposure	**Protective of Groundwater**	**Protective of the River**		
Metals						
Antimony	0.233 (<BG)	32	5 [c, d]	5 [c, d]	No	--
Arsenic	3.39 (<BG)	20 [e]	20 [e]	20 [e]	No	--
Barium	57.7 (<BG)	1,600 [f]	200	400	No	--
Beryllium	0.184 (<BG)	10.4 [f]	1.51 [c]	1.51 [c]	No	--
Boron	0.960	16,000	320	NA	No	
Cadmium	0.0471 (<BG)	13.9 [f]	0.81 [c, d]	0.81 [c, d]	No	--
Chromium (total)	8.74 (<BG)	120,000	18.5 [c]	18.5 [c]	No	--
Cobalt	5.71 (<BG)	24	15.7 [c]	NA	No	--
Copper	10.1 (<BG)	2,960	59.2	22.0 [c]	No	--

Table 3. Comparison of Maximum Focused Sample Results to Action Levels for the 618-13 and the 600-290:1 Waste Sites. (2 Pages)

COC/COPC	Maximum Result (mg/kg)	Remedial Action Goals [a] (mg/kg)			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Protective of Groundwater	Protective of the River		
Hexavalent chromium	U	2.1 [f]	4.8	2	No	
Lead	4.94 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	268 (<BG)	11,200	512 [c]	512 [c]	No	--
Mercury	U	24	0.33 [c]	0.33 [c]	No	
Molybdenum	0.297	400	8	NA	No	
Nickel	10.0 (<BG)	1,600	19.1 [c]	27.4	No	--
Thallium	U	5.6	0.112	0.156	No	
Uranium (ICP)	1.50	81	53	106	No	--
Uranium (KPA)	3.00	81	53	106	No	
Vanadium	48.6 (<BG)	560	85.1 [c]	NA	No	--
Zinc	37.1 (<BG)	24,000	480	67.8 [c]	No	--
Zirconium	14.9	NA	NA	NA	NA	
Volatile Organics Analytes						
Acetone	0.0059	72,000	720	NA	No	
Acenaphthene	U	4,800	96	129	No	

[a] Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (300 Area RDR/RAWP) (DOE-RL 2009b) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.
[b] Hanford Site background values for thorium-232 (1.32 pCi/g), uranium-233/234 (1.06 pCi/g), and uranium-238 (1.06 pCi/g) (DOE-RL 1996) have been subtracted from statistical results.
[c] Where cleanup levels are less than background cleanup levels default to background per WAC 173-340-700(4)(d).
[d] Hanford Site-specific background not available. Value is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[e] The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers.
[f] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3]) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (WDOH 1997).

-- = not applicable
BG = background (obtained from DOE-RL (1996) and DOE-RL (2009b), unless otherwise noted)
COC = contaminant of concern
COPC = contaminant of potential concern
KPA = kinetic phosphorescence analysis
NA = not applicable
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose assessment model)
U = undetected
WAC = *Washington Administrative Code*

5.3 DATA QUALITY ASSESSMENT PROCESS

A data quality assessment (DQA) is 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

618-13 Burial Ground 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 also verified that the sample design was sufficient to support clean site verification. The cleanup verification sample analytical data are stored in the Environmental Restoration database prior to archiving in the Hanford Environmental Information System and are presented as attachments to the 95% UCL calculations in Appendix D. The detailed DQA is presented in Appendix E.

6.0 CLEANUP VERIFICATION DATA EVALUATION

This section demonstrates that remedial actions at the 618-13 Burial Ground have achieved the RAGs to support unrestricted land use at the 300 Area as established in the ESD (EPA 2004) and documented in the RDR/RAWP (DOE-RL 2009b). This section also demonstrates the remedial actions comply with *Washington Administrative Code* (WAC) 173-340-740(7)(e) three-part test criteria. Because the analytical results were below single-radionuclide dose-equivalence lookup values, a site-specific cleanup verification model was not developed for the 618-13 Burial Ground. Evaluation of RAG attainment for radionuclides was performed using the single-radionuclide dose-equivalence lookup values.

6.1 ATTAINMENT OF RADIONUCLIDE RAGS

6.1.1 Comparison of Sample Data to RAGs

Evaluation of the results listed in Tables 2 and 3 from verification sampling at the 618-13 Burial Ground indicates that all nonradionuclide COC/COPCs were undetected and/or quantified below RAGs and lookup values.

6.1.2 Attainment of Radionuclide Direct Exposure RAG

Evaluation of RAG attainment for radionuclides was performed using the single-radionuclide dose-equivalence lookup values. The model used to develop these dose-equivalence lookup values is presented in the RDR/RAWP (DOE-RL 2009b).

Tables 4 and 5 present the dose-equivalence evaluation for the statistical and focused data sets, respectively. In the analysis, results for each of the radionuclide COC/COPCs are used to calculate the dose equivalence fraction, which are then summed to determine the cumulative dose equivalence. Concentrations used in the analysis have had background values subtracted, where appropriate. Compliance with the RAG requires the cumulative dose equivalence to be less than 15 mrem/yr. Inspection of Tables 4 and 5 shows the cumulative dose equivalence for both the

statistical and focused data sets are significantly below the RAG at 2.1 mrem/yr and 0.044 mrem/yr, respectively.

Table 4. Attainment of Radionuclide Direct Exposure RAG (Statistical Samples).

COC/COPC	95% UCL Statistical Values [a] (pCi/g)	Activity Equivalent to 15 mrem/yr Dose[b] (pCi/g)	Fraction
Thorium-232	0.14	1.0	0.14
Uranium-233/234	0	27.2	0
Uranium-235	U	2.7	0
Uranium-238	0	26.2	0
		Sum of Fractions	0.14
		Equivalent Dose (mrem/yr)	2.1

[a] Hanford Site background values for thorium-228 (1.32 pCi/g), thorium-230 (1.06 pCi/g), thorium-232 (1.32 pCi/g), uranium-233/234 (1.06 pCi/g), uranium-235 (0.11 pCi/g), and uranium-238 (1.06 pCi/g) (DOE-RL 1996) have been subtracted from 95% UCL values. A zero indicates 95% UCL value was below background. A "U" indicates analyte was not detected.

[b] Single radionuclide 15 mrem/yr dose-equivalence values and derivation methodology are presented in the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (DOE-RL 2009b) unless otherwise noted.

COC = contaminant of concern
COPC = contaminant of potential concern
RAG = remedial action goal
U = undetected (in all samples in the data set)
UCL = upper confidence limit

Table 5. Attainment of Radionuclide Direct Exposure RAG (Focused Samples).

COC/COPC	Maximum Focused Samples [a] (pCi/g)	Activity Equivalent to 15 mrem/yr Dose[b] (pCi/g)	Fraction
Thorium-232	0	1.0	0
Uranium-233/234	0.08	27.1	0.003
Uranium-235	U	2.7	0
Uranium-238	0	26.2	0
		Sum of Fractions	0.003
		Equivalent Dose (mrem/yr)	0.044

[a] Hanford Site background values for thorium-228 (1.32 pCi/g), thorium-230 (1.06 pCi/g), thorium-232 (1.32 pCi/g), uranium-233/234 (1.06 pCi/g), uranium-235 (0.11 pCi/g), and uranium-238 (1.06 pCi/g) (DOE-RL 1996) have been subtracted from maximum detected values (DOE-RL 1996).

[b] Single radionuclide 15 mrem/yr dose-equivalence values and derivation methodology are presented in the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (DOE-RL 2009b) unless otherwise noted.

COC = contaminant of concern
COPC = contaminant of potential concern
RAG = remedial action goal
U = undetected (in all samples in the data set)

6.2 ATTAINMENT OF NONRADIONUCLIDE RAGS

6.2.1 Direct Comparison to RAGs

Evaluation of the results listed in Tables 2 and 3 from the verification sampling at the 618-13 Burial Ground indicates that all COC/COPCs were undetected and/or quantified below RAGs and lookup values.

6.2.2 Direct Contact Noncarcinogenic Hazard Quotient RAG Attained

For nonradionuclide, noncarcinogenic COCs/COPCs, WAC 173-340-740(3)(a)(iii)(A) and (B) specifies the evaluation of the hazard quotient, which is given as a daily intake divided by a reference dose. Both individual and cumulative hazard quotient values must be less than 1.0. For the 618-13 waste site, all individual hazard quotients are less than 1.0 and the cumulative hazard quotient of 1.0×10^{-3} is less than 1.0 (Appendix D). Therefore, the noncarcinogenic hazard quotient RAG has been attained for the 618-13 Burial Ground.

6.2.3 Direct Contact Carcinogenic Risk RAG Attained

For individual nonradionuclide carcinogenic COCs/COPCs, the WAC 173-340 Method B cleanup limits are based on an incremental cancer risk of 1×10^{-6}. For nonradionuclide carcinogenic COCs/COPCs, the total excess cancer risk must be less than 1×10^{-5}. For the 618-13 Burial Ground, no carcinogenic constituents were detected above background soil levels; therefore, no calculations of excess carcinogenic risk were performed and the carcinogenic risk RAG has been attained.

6.3 THREE-PART TEST FOR NONRADIONUCLIDES

When using a statistical sampling approach, a RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. The WAC 173-340 three-part test consists of the following criteria: (1) the cleanup verification 95% UCL 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% of the data set.

The application of the three-part test for the 618-13 waste site is included in the 95% UCL calculation (Appendix D). The results of this evaluation indicate that all residual COC/COPC concentrations pass the three-part test in comparison against applicable RAGs. Therefore, the requirements of the three-part test are met.

7.0 STATEMENT OF PROTECTIVENESS

This cleanup verification package demonstrates that remedial action at the 618-13 Burial Ground and the collocated 600-290:1 Pad and Loading Dock Near 618-13 has achieved the RAOs and corresponding RAGs established for the unrestricted land-use scenario in the ROD (EPA 2001), the ESD (EPA 2004), and the RDR/RAWP (DOE-RL 2009b). The contaminated materials from the site have been excavated and disposed at ERDF. The remaining soil at the 618-13 and 600-290:1 sites have been sampled, analyzed, and evaluated. Results indicate that the site supports future land uses that can be represented (or bounded) by the residential land-use scenario and poses no threat to groundwater or the Columbia River. Both sites are closed to shallow zone criteria and, therefore, do not require any institutional controls.

The 618-13 Burial Ground and adjacent 600-290:1 Pad and Loading Dock Near 618-13 are verified to be remediated in accordance with the ROD (EPA 2001), ESD (EPA 2004), and the RDR/RAWP (DOE-RL 2009b).

8.0 REFERENCES

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APPENDIX A

GLOBAL POSITIONING ENVIRONMENTAL RADIOLOGICAL SURVEYS

Figure A-1. GPERS Beta Track Map.

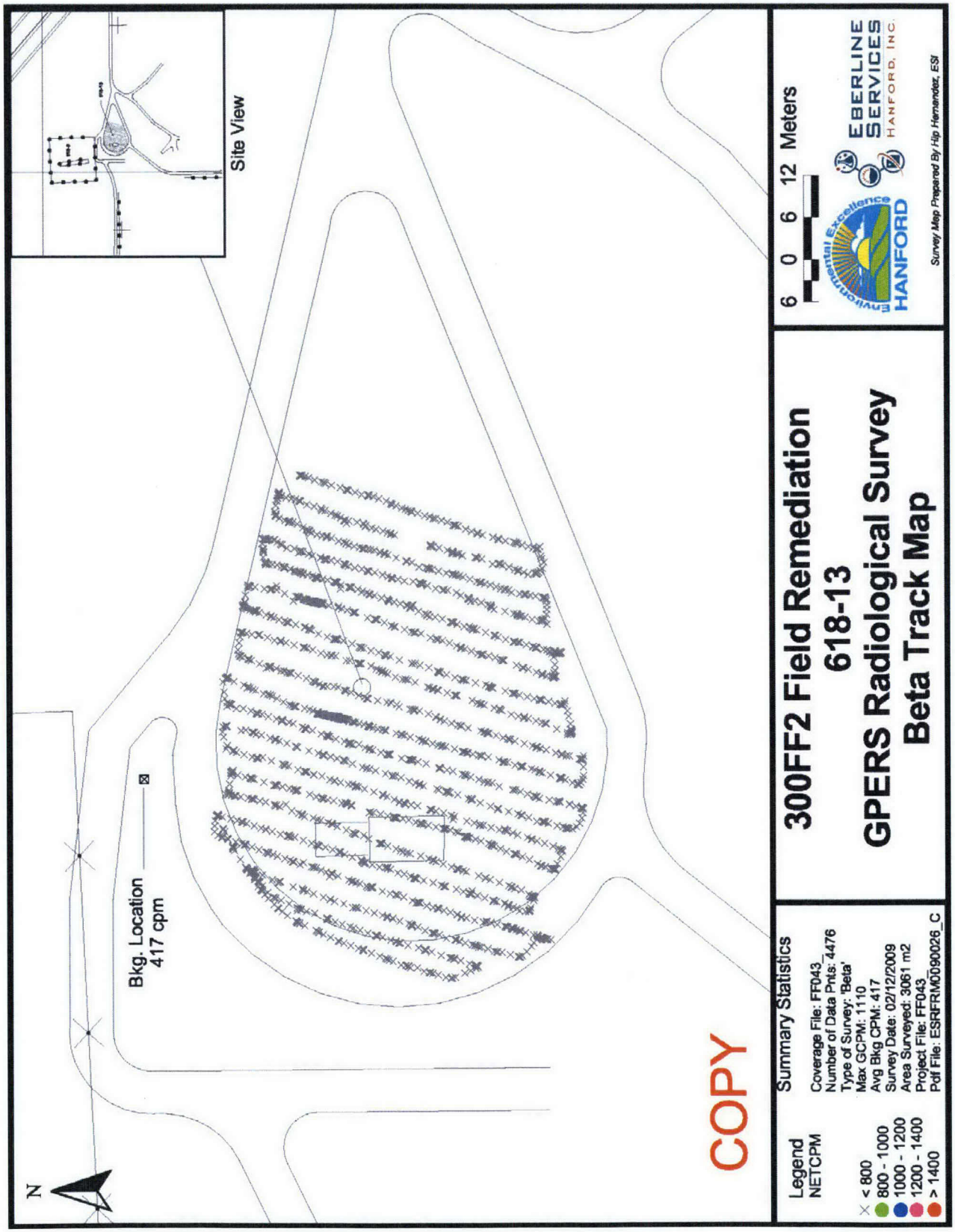
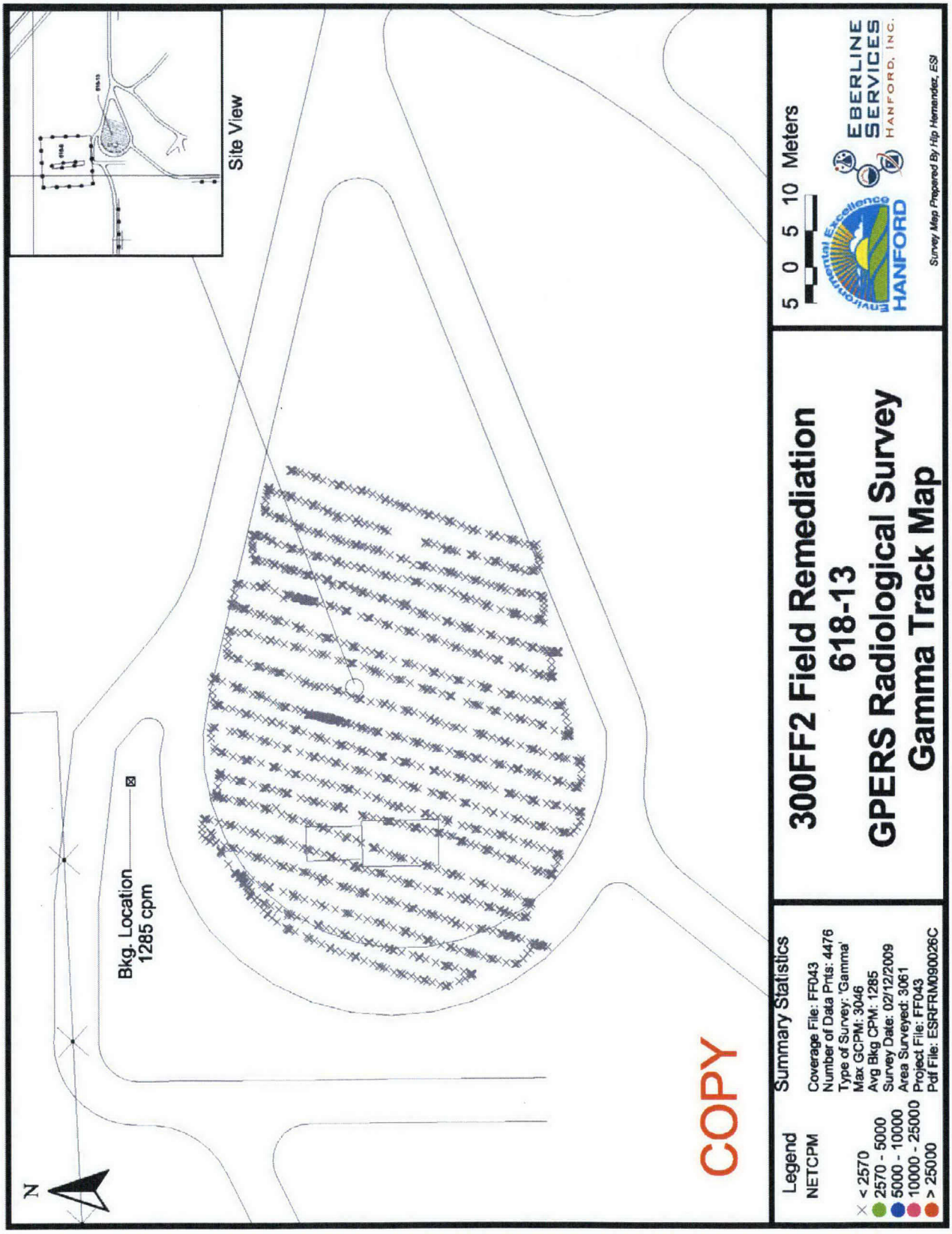


Figure A-2. GPERS Gamma Track Map.



APPENDIX B

VERIFICATION SAMPLE DESIGN

Figure B-1. Map of Verification Sample Locations.

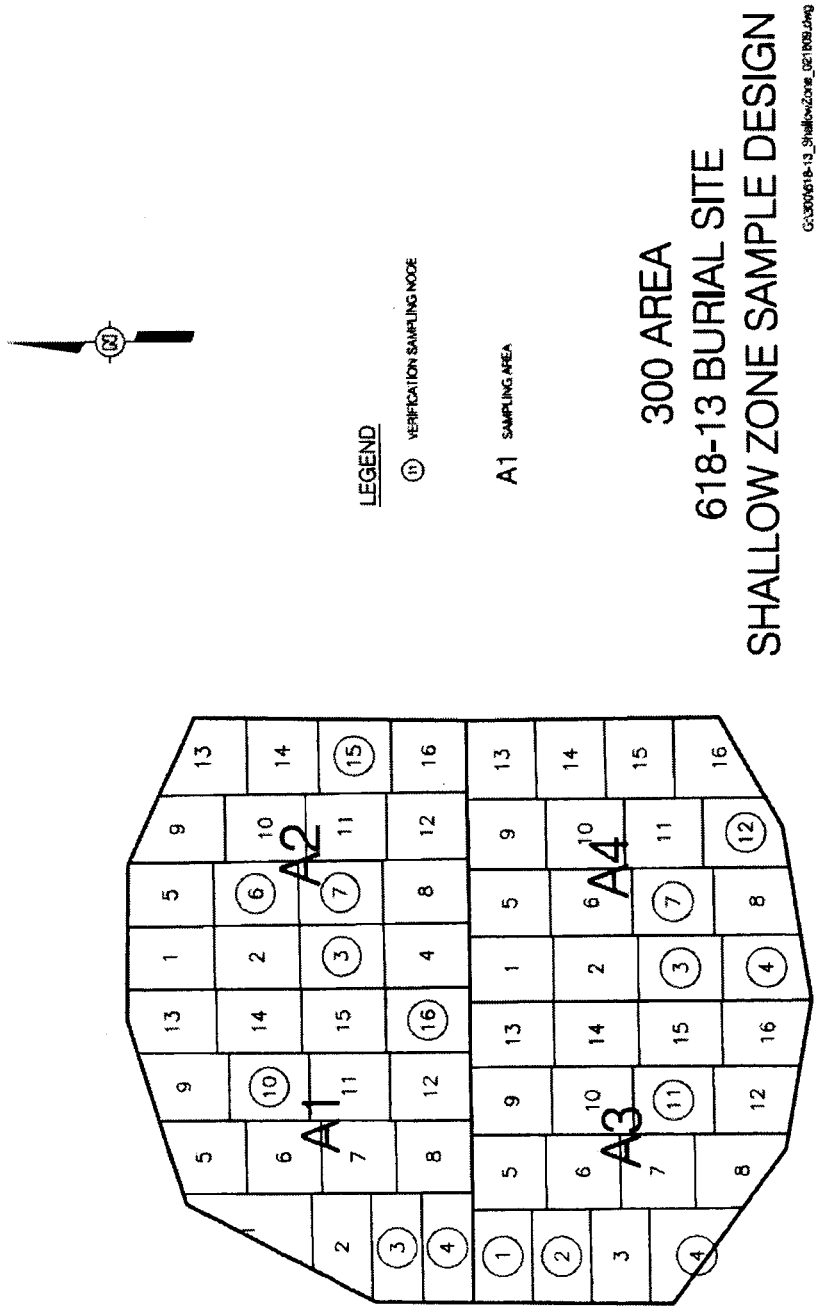


Table B-1. 618-13 and 600-290:1 Verification Sample Summary.

Decision Subunit	Sampling Area	Sample Number	Sample Node	Northing	Easting	Requested Analysis
1	A1	J18PX0	S-A1-3	116243.92	592856.73	Semivolatile organic compounds, volatile organic compounds, ICP metals,[a] mercury, hexavalent chromium, total uranium (chemical), GEA, isotopic uranium, isotopic thorium
			S-A1-4	116240.12	592856.70	
			S-A1-10	116253.57	592868.99	
			S-A1-16	116241.46	592874.00	
	A2	J18PX1	S-A2-3	116247.97	592878.91	
			S-A2-6	116254.51	592883.70	
			S-A2-7	116248.04	592883.76	
			S-A2-15	116246.88	592894.18	
	A3	J18PX2	S-A3-1	116235.96	592856.02	
			S-A3-2	116231.51	592856.00	
			S-A3-4	116221.38	592856.00	
			S-A3-11	116223.05	592867.82	
	A4	J18PX3	S-A4-3	116222.46	592877.91	
			S-A4-4	116215.93	592877.93	
			S-A4-7	116222.97	592882.97	
			S-A4-12	116217.43	592888.23	
N/A	N/A	J18PW9	Equipment blank	N/A	N/A	Semivolatile organic compounds, ICP metals,[a] mercury, hexavalent chromium, total uranium (chemical), GEA, isotopic uranium, isotopic thorium
N/A	N/A	J18PX5	Trip blank	N/A	N/A	Volatile organic compounds
1	A2	J18PX4	Duplicate	Same as primary		Same as primary
1	A2	J18PY0	Split			

[a] The expanded list of ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, silver, selenium, vanadium, and zinc.

GEA = gamma energy analysis
ICP = inductively coupled plasma
N/A = not applicable
TBD = to be determined

APPENDIX C

FOCUSED SAMPLE DESIGN

Figure C-1. 618-13 and 600-290:1 Focused Sample Locations.

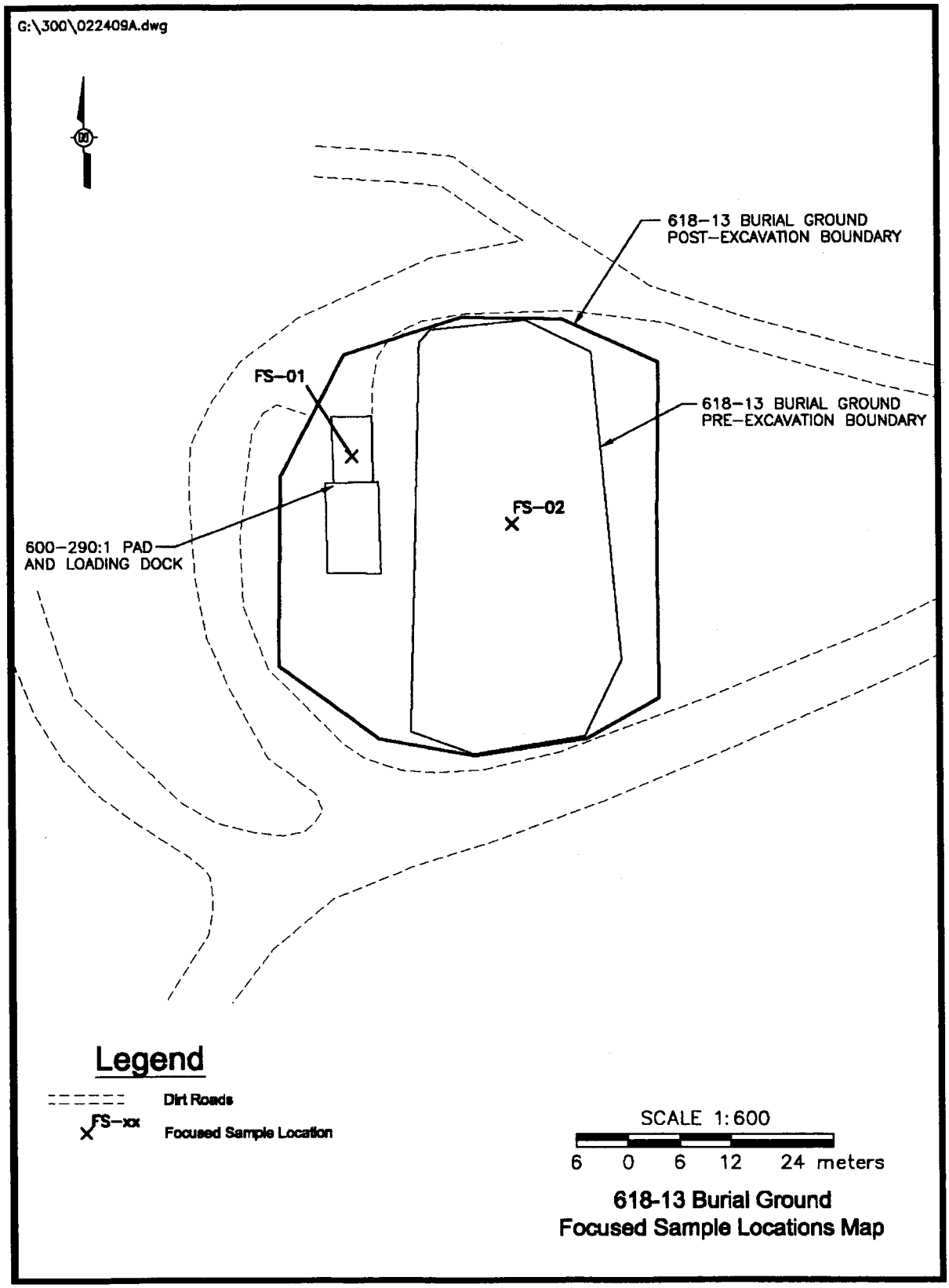


Table C-1. 618-13 and 600-290:1 Focused Sample Summary.

Sample Location	Sample Number	Northing	Easting	Requested Analysis
FS-01	J18R00	116248	592861	Semivolatile organic compounds, volatile organic compounds, ICP metals,[a] mercury, hexavalent chromium, total uranium (chemical), GEA, isotopic uranium, isotopic thorium
FS-02	J18R01	116240	592880	

[a] The expanded list of ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, silver, selenium, vanadium, and zinc.

GEA = gamma energy analysis
ICP = inductively coupled plasma
TBD = to be determined

APPENDIX D

CALCULATIONS

APPENDIX D

CALCULATIONS

The calculations in this appendix are kept in the active Washington Closure Hanford project files and are available upon request. When the project is completed, the file will be stored in a U.S. Department of Energy, Richland Operations Office, repository. These calculations have been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculation," Washington Closure Hanford, Richland, Washington. The following calculations are provided in this appendix:

618-13 Burial Ground Cleanup Verification 95% UCL Calculation, Calculation No. 0300X-CA-V0105, Rev. 1 ..... D-3

618-13 Burial Ground Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation, Calculation No. 0300X-CA-V0106, Rev. 0 ..... D-29

DISCLAIMER FOR CALCULATIONS

The calculations provided in this appendix have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents.

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 300 Area Field Remediation **Job No. 14655**

Area: 300

Discipline: Environmental *Calculation No: 0300X-CA-V0105

Subject: 618-13 Burial Ground Cleanup Verification 95% UCL Calculation

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 = 9 Attm. 1 = 14 Total = 24	J. D. Skoglie	H. M. Sulloway	L. D. Habel	J. W. Darby	Signed 8/5/09
1	Cover = 1 Sheets = 9 Attm. 1 = 14 Total = 24	J. D. Skoglie	H. M. Sulloway	L. D. Habel	J. W. Darby	Signed 8/13/09
2	Cover = 1 Sheets = 9 Attm. 1 = 14 Total = 24	J. D. Skoglie	H. M. Sulloway	NA	J. W. Darby	10.13.09

SUMMARY OF REVISION

1	Sheets 3 and 5 revised to subtract background value of thorium-232 from 95% UCL result.
2	Attachment 1, pages 10 & 14: Sample number J18PX5 did not have a complete title for the data. Added "Trip Blank - J18PX5, Sample on 4/28/09" for clarity.
WCH-DE-018 (05/08/2007)	*Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford **CALCULATION SHEET**

Originator J. D. Skoglie	**Date** 07/20/09	**Calc. No.** 0300X-CA-V0105	**Rev. No.** 0
Project 300 Area Field Remediation	**Job No.** 14655	**Checked** H. M. Sulloway	**Date** 07/20/09
Subject 618-13 Burial Ground Cleanup Verification 95% UCL Calculations			**Sheet No.** 1 of 9

Summary

Purpose:
This document contains calculations based on analytical results from data collected from the 618-13 Burial Ground. The calculations in this document include (1) calculation of the 95% upper confidence limit (UCL) to evaluate compliance with cleanup standards, (2) performance of the *Washington Administrative Code* (WAC) 173-34740(7)(e) 3-part test, as required, and (3) calculation of the relative percent difference (RPD) for each contaminant of concern (COC)/contaminant of potential concern (COPC) in each primary-duplicate and primary-split sample pair, as necessary.

Table of Contents:
Sheets 1 to 4 - Summary
Sheets 5 to 7 - Excavation Verification Data Statistical Computations
Sheets 8 to 9 - Split-Duplicate Analyses - Excavation
Attachment 1 - 618-13 Verification Sampling Results (14 sheets)

Given/References:
1) Sample Results.
2) Background values and remedial action goals (RAGs) are from DOE-RL (2001 and 2004b), and Ecology (1994).
3) 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.
4) DOE-RL, 2004a, *300 Area Remedial Action Sampling and Analysis Plan*, (SAP) DOE/RL 2001-48, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
5) DOE-RL, 2004b, *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (RDR/RAWP), DOE/RL-2001-47, Rev. 1, 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) 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.
9) 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 2004b). 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/COPC in the primary-duplicate and primary-split sample pairs.

Calculation Description:
The subject calculations were performed on data from soil verification samples from within the 618-13 Burial Ground. 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 2004b) is documented by this calculation. Split and duplicate RPD results are used in evaluation of data quality and are presented in the CVP for this site.

Methodology:
The excavation area of the 618-13 Burial Ground underwent statistical and focused sampling. Because of the small area, there were only 4 verification samples within one decison unit. Two focused samples were taken; one under the concrete pad and loading dock and one under the 618-13 Burial Ground. Analytical results for all sampling locations are provided in the summary tables on sheets 3 and 4. Further information of the sample data quality is presented in the data quality assessment section of the associated CVP.

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, as determined by direct inspection of the sample results (Attachment 1), the maximum value for the data set is used instead of the 95% UCL. For convenience, these maximum detected values are included in the summary tables that follow. The 95% UCL was not calculated for data sets with no reported detections. Calculated cleanup levels are not available in Ecology (2005) under WAC 173-340-740(3) for aluminum, calcium, iron, magnesium, potassium, sodium, and zirconium; therefore, these constituents are not considered site COCs/COPCs and are also not included in these calculations. The 95% UCL values were not calculated for radium-226, radium-228, thorium-228, and potassium-40 based on natural occurrence at the Hanford Site.

Washington Closure Hanford **CALCULATION SHEET**

Originator J. D. Skoglie	**Date** 07/20/09	**Calc. No.** 0300X-CA-V0105	**Rev. No.** 0
Project 300 Area Field Remediation	**Job No.** 14655	**Checked** H. M. Sulloway	**Date** 07/20/09
Subject 618-13 Burial Ground Cleanup Verification 95% UCL Calculations			**Sheet No.** 2 of 9

Summary (continued)

Methodology (continued):

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 minimum 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.

All calculations for thorium and uranium isotopes were performed using data from isotope-specific analysis rather than data resulting from gamma spectroscopy. The non-radiological quantitation for total uranium by kinetic phosphoresence analysis was used to determine a total uranium 95% UCL.

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 tests for distribution are performed. For nonradionuclide data sets of ten or greater, as for the subject site, distributional testing and calculation of the 95% UCL is done using Ecology's MTCAStat software (Ecology 1993). Due to differences in addressing censored data between the RDR/RAWP (DOE-RL 2004b) and MTCAStat coding and due to a limitation in the MTCAStat coding (no direct capability to address variable quantitation limits within a data set), substitutions for censored data are performed before software input and the resulting input set treated as uncensored.

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 nonradionuclide COC/COPC,
2) greater than 10% of the raw data exceed the most stringent cleanup limit for each nonradionuclide COC/COPC,
3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each nonradionuclide COC/COPC.

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 predetermined for each analytical method as listed in Table 2-1 of the SAP (DOE-RL 2004a). 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. To assist in the identification of anomalous sample pairs, when an analyte is detected in the primary or duplicate/split sample, but was quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate/split results exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. No split samples were collected for cleanup verification of the subject site. Additional discussion as necessary is provided in the data quality assessment section of the applicable CVP.

The results presented in the summary tables that follow are for use in risk analysis and the CVP for this site. In addition to the statistical samples collected at the subject site, focused samples were collected from selected locations based on observations made during site remediation. Statistical methodology is not applicable to non-statistical sampling and direct evaluation of detected values will be used as the compliance basis. The maximum detected value for each analyte from all focused samples collected is presented in the results summary for use in the CVP.

Abbreviations/Acronyms:

BG = background
B = method blank contamination (organic)
C = method blank contamination (inorganic)
COC = contaminant of concern
COPC = contaminant of potential concern
CVP = cleanup verification package
GW = groundwater
J = estimate
KPA = kinetic phosphorescence analysis
L = interference
M = duplicate precision not met
MDA= minimum detectable activity
MTCA = *Model Toxics Control Act*
NA = not applicable
PQL = practical quantitation limit
Q = qualifier
QA/QC = quality assurance/quality control
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
RPD = relative percent difference
SAP = sampling and analysis plan
TDL = target detection limit
U = undetected
UCL = upper confidence limit
WAC = *Washington Administrative Code*

Washington Closure Hanford **CALCULATION SHEET**

Originator J. D. Skoglie **Date** 08/11/09 **Calc. No.** 0300X-CA-V0105 **Rev. No.** 1
Project 300 Area Field Remediation **Job No.** 14655 **Checked** H. M. Sullowav **Date** 08/11/09
Subject 618-13 Burial Ground Cleanup Verification 95% UCL Calculations **Sheet No.** 3 of 9

Summary (continued)

Results:
The results presented in the summary tables that follow are for use in the 618-13 CVP.

618-13 Statistical or Maximum Results Summary[a]

Analyte	Excavation		Focused	Units
	Statistical	Maximum	Maximum	
Cesium-137	0.031	--	--	pCi/g
Thorium-232	0.14	--	0 (< BG)[b]	pCi/g
Uranium-233/234	0 (< BG)	--	0.080[c]	pCi/g
Uranium-238	0 (< BG)	--	0 (< BG)[c]	pCi/g
Antimony	0.310	--	0.233	mg/kg
Arsenic	3.16	--	3.39	mg/kg
Barium	69.3	--	57.7	mg/kg
Beryllium	0.208	--	0.184	mg/kg
Boron	1.03	--	0.96	mg/kg
Cadmium	0.0575	--	0.047	mg/kg
Chromium	10.2	--	8.74	mg/kg
Cobalt	6.39	--	5.71	mg/kg
Copper	11.4	--	10.1	mg/kg
Lead	3.61	--	4.94	mg/kg
Manganese	321	--	268	mg/kg
Molybdenum	0.362	--	0.297	mg/kg
Nickel	12.1	--	10.0	mg/kg
Uranium	2.80	--	3.0	mg/kg
Vanadium	56.7	--	48.6	mg/kg
Zinc	41.1	--	37.1	mg/kg
Acetone	0.00755	--	0.00590	mg/kg

WAC 173-340 Evaluation:
3-Part Test:

95% UCL > Cleanup Limit?	NO
> 10% above Cleanup Limit?	YES
Any sample > 2x Cleanup Limit?	NO

[a]The 95% UCL result or maximum value, depending on data censorship, as described in the methodology section.

[b] Hanford site background for thorium-232 [1.32 pCi/g (DOE 1996)] has been subtracted from focused sample results.

[c] Hanford site background for uranium-233/234 (1.06 pCi/g), uranium-235 (0.11 pCi/g), and uranium-238 (1.06 pCi/g) (DOE 1996) has been subracted from focused sample results.

-- = none detected

Relative Percent Difference Results and QA/QC Analysis[a]

Analyte	Excavation[b]	
	Duplicate	Split
Potassium-40	6.3%	
Aluminum	3.9%	7.3%
Barium	26.6%	20.9%
Calcium	15.4%	23.0%
Chromium	4.1%	6.6%
Copper	6.7%	17.1%
Iron	9.9%	16.7%
Lead	7.8%	5.3%
Magnesium	17.5%	22.8%
Manganese	27.8%	7.2%
Vanadium	3.2%	25.9%
Zinc	12.8%	20.7%
Zirconium	8.2%	15.6%

[a]RPD listed where result produced, based on criteria. If RPD not required, no value is listed.
[b]The significance of the reported RPD values, including values greater than 30%, is addressed in the CVP data quality assessment section.

Washington Closure Hanford **CALCULATION SHEET**

Originator J. D. Skoglie **Date** 07/20/09 **Calc. No.** 0300X-CA-V0105 **Rev. No.** 0
Project 300 Area Field Remediation **Job No.** 14655 **Checked** H. M. Sulloway **Date** 07/20/09
Subject 618-13 Burial Ground Cleanup Verification 95% UCL Calculations **Sheet No.** 4 of 9

Summary (continued)

Maximum Result For All Detected Analytes in Statistical Data Sets[a]

Analytes	Excavation	Units
Aluminum	6340	mg/kg
Antimony	0.312	mg/kg
Arsenic	3.01	mg/kg
Barium	74.0	mg/kg
Beryllium	0.212	mg/kg
Boron	1.05	mg/kg
Cadmium	0.0625	mg/kg
Calcium	6800	mg/kg
Chromium	10.7	mg/kg
Cobalt	6.29	mg/kg
Copper	11.5	mg/kg
Iron	20100	mg/kg
Lead	3.62	mg/kg
Magnesium	4650	mg/kg
Manganese	344	mg/kg
Molybdenum	0.369	mg/kg
Nickel	12.4	mg/kg
Potassium	1050	mg/kg
Sodium	148	mg/kg
Uranium-ICP	1.35	mg/kg
Uranium-KPA	4.78	mg/kg
Vanadium	55.8	mg/kg
Zinc	41.4	mg/kg
Zirconium	16.4	mg/kg
Acetone	0.00864	mg/kg

[a]The maximum result is shown for all non-radiological analytes with at least one detected result. This summary is for use in comparison to ecological screening values.

Washington Closure Hanford

CALCULATION SHEET

Originator J. D. Skoglie
Project 300 Area Field Remediation
Subject 618-13 Burial Ground Cleanup Verification 95% UCL Calculations

Date 08/11/09
Job No. 14655

Calc. No. 0300X-CA-V0105
Checked H. M. Sulloway

Rev. No. 1
Date 08/11/09
Sheet No. 5 of 9

618-13 Verification Sample Data

Sampling Area	Sample Number	Sample Date	Cesium-137 pCi/g	Q	MDA	Thorium-232 pCi/g	Q	MDA	Uranium-233/234 pCi/g	Q	MDA	Uranium-238 pCi/g	Q	MDA	Antimony mg/kg	Q	PQL	Arsenic mg/kg	Q	PQL	Barium mg/kg	Q	PQL	Beryllium mg/kg	Q	PQL
A2	J18PX1	4/28/09	0.018	U	0.018	2.16	J	0.331	1.92		0.216	1.70		0.216	0.461	UJ	0.461	3.01	J	0.768	74.0		0.384	0.182		0.154
Duplicate of J18PX1	J18PX4	4/28/09	0.028	U	0.028	1.39	J	0.425	0.494		0.189	0.691		0.189	0.396	U	0.396	3.50	J	0.660	56.6		0.330	0.181		0.132
A1	J18PX0	4/28/09	0.038		0.029	0.909	J	0.278	0.448		0.228	0.627		0.228	0.312	BJ	0.400	2.28	J	0.667	42.0		0.333	0.144		0.133
A3	J18PX2	4/28/09	0.038	U	0.038	0.699	J	0.243	0.561		0.226	0.650		0.226	0.312	B	0.498	2.88	J	0.830	61.3		0.415	0.212		0.166
A4	J18PX3	4/28/09	0.030	U	0.030	0.882	J	0.250	0.793		0.233	0.732		0.233	0.441	U	0.441	2.91	J	0.735	69.0		0.367	0.197		0.147

Statistical Computation Input Data

Sampling Area	Sample Number	Sample Date	Cesium-137 pCi/g	Thorium-232 pCi/g	Uranium-233/234 pCi/g	Uranium-238 pCi/g	Antimony mg/kg	Arsenic mg/kg	Barium mg/kg	Beryllium mg/kg
A2	J18PX1/ J18PX4	4/28/09	0.012	1.78	1.21	1.20	0.214	3.26	65.3	0.182
A1	J18PX0	4/28/09	0.038	0.909	0.448	0.627	0.312	2.28	42.0	0.144
A3	J18PX2	4/28/09	0.019	0.699	0.561	0.650	0.312	2.88	61.3	0.212
A4	J18PX3	4/28/09	0.015	0.882	0.793	0.732	0.221	2.91	69.0	0.197

Statistical Computations

	Cesium-137	Thorium-232	Uranium-233/234	Uranium-238	Antimony	Arsenic	Barium	Beryllium
95% UCL based on	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.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.
N	4	4	4	4	4	4	4	4
% < Detection limit	75%	0%	0%	0%	50%	0%	0%	0%
Mean	0.021	1.066	0.752	0.801	0.265	2.83	59.4	0.184
Standard Deviation	0.012	0.482	0.335	0.267	0.055	0.40	12.0	0.0292
Z-statistic	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645
95% UCL on mean	0.031	1.46	1.03	1.02	0.310	3.16	69.3	0.208
Maximum Value	0.038	2.16	1.92	1.70	0.461	3.50	74.0	0.212
Statistical value	0.031	1.46	1.03	1.02	0.310	3.16	69.3	0.208
Background	NA	1.32	1.1	1.1				
Statistical value above background	0.031	0.14	0 (< BG)	0 (< BG)				
Most Stringent Cleanup Limit for nonradionuclide and RAG type					5 GW & River Protection	20 DE, GW & River Protection	200 GW Protection	1.51 GW & River Protection
WAC 173-340 3-PART Test								
95% UCL > Cleanup Limit?					NA	NA	NA	NA
> 10% above Cleanup Limit?					NA	NA	NA	NA
Any sample > 2X Cleanup Limit?					NA	NA	NA	NA
WAC 173-340 3-Part-Test Compliance?					Because all antimony values are below background (5.0 mg/kg), the 3-part test is not required.	Because all arsenic values are below background (6.5 mg/kg), the 3-part test is not required.	Because all barium values are below background (132 mg/kg), the 3-part test is not required.	Because all beryllium values are below background (1.51 mg/kg), the 3-part test is not required.

Washington Closure Hanford

CALCULATION SHEET

Originator J. D. Skoglie
Project 300 Area Field Remediation
Subject 618-13 Burial Ground Cleanup Verification 95% UCL Calculations

Date 07/27/09
Job No. 14655

Calc. No. 0300X-CA-V0105
Checked H. M. Sulloway

Rev. No. 0
Date 07/27/09
Sheet No. 6 of 9

618-13 Verification Sample Data

Sampling Area	Sample Number	Sample Date	Boron mg/kg	Q	PQL	Cadmium mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Cobalt mg/kg	Q	PQL	Copper mg/kg	Q	PQL	Lead mg/kg	Q	PQL	Manganese mg/kg	Q	PQL	Molybdenum mg/kg	Q	PQL
A2	J18PX1	4/28/09	0.865	B	1.54	0.0385	B	0.154	9.19		0.231	6.13		1.54	10.8	J	0.678	2.94	J	0.384	344		3.84	0.369	B	1.54
Duplicate of J18PX1	J18PX4	4/28/09	0.625	B	1.32	0.0444	B	0.132	8.82		0.198	5.97		1.32	10.1	J	0.660	2.72	J	0.330	260		3.30	0.420	B	1.32
A1	J18PX0	4/28/09	0.817	B	1.33	0.0405	B	0.133	7.06		0.200	4.35		1.33	8.30	J	0.667	3.16	J	0.333	199		3.33	0.241	B	1.33
A3	J18PX2	4/28/09	1.05	B	1.66	0.0515	B	0.166	10.7		0.249	5.95		1.66	10.9	J	0.830	3.60	J	0.415	298		4.15	0.291	B	1.66
A4	J18PX3	4/28/09	1.02	B	1.47	0.0625	B	0.147	8.98		0.220	6.29		1.47	11.5	J	0.735	3.62	J	0.367	311		3.67	0.311	B	1.47

Statistical Computation Input Data

Sampling Area	Sample Number	Sample Date	Boron mg/kg	Cadmium mg/kg	Chromium mg/kg	Cobalt mg/kg	Copper mg/kg	Lead mg/kg	Manganese mg/kg	Molybdenum mg/kg
A2	J18PX1/ J18PX4	4/28/09	0.745	0.0415	9.01	6.05	10.5	2.83	302	0.395
A1	J18PX0	4/28/09	0.817	0.0405	7.06	4.35	8.30	3.16	199	0.241
A3	J18PX2	4/28/09	1.05	0.0515	10.7	5.95	10.9	3.60	298	0.291
A4	J18PX3	4/28/09	1.02	0.0625	8.98	6.29	11.5	3.62	311	0.311

Statistical Computations

	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Molybdenum
95% UCL based on	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.
N	4	4	4	4	4	4	4	4
% < Detection limit	0%	0%	0%	0%	0%	0%	0%	0%
Mean	0.908	0.0490	8.94	5.66	10.3	3.30	278	0.309
Standard Deviation	0.150	0.0103	1.49	0.88	1.4	0.38	52.6	0.064
Z-statistic	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645
95% UCL on mean	1.03	0.0575	10.2	6.39	11.4	3.61	321	0.362
Maximum Value	1.05	0.0625	10.7	6.29	11.5	3.62	344	0.420
Statistical value	1.03	0.0575	10.2	6.39	11.4	3.61	321	0.362
Most Stringent Cleanup Limit for nonradionuclide and RAG type	320 GW Protection	0.81 GW & River Protection	18.5 GW & River Protection	15.7 GW Protection	22 River Protection	10.2 GW & River Protection	512 GW & River Protection	8 GW Protection
WAC 173-340 3-PART Test								
95% UCL > Cleanup Limit?	NO	NA	NA	NA	NA	NA	NA	NO
> 10% above Cleanup Limit?	NO	NA	NA	NA	NA	NA	NA	NO
Any sample > 2X Cleanup Limit?	NO	NA	NA	NA	NA	NA	NA	NO
WAC 173-340 3-Part-Test Compliance?	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.	Because all cadmium values are below background (0.81 mg/kg), the 3-part test is not required.	Because all zinc values are below background (18.5 mg/kg), the 3-part test is not required.	Because all cobalt values are below background (15.7 mg/kg), the 3-part test is not required.	Because all copper values are below background (22 mg/kg), the 3-part test is not required.	Because all lead values are below background (10.2 mg/kg), the 3-part test is not required.	Because all manganese values are below background (512 mg/kg), the 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.

Washington Closure Hanford

CALCULATION SHEET

Originator J. D. Skoglie
Project 300 Area Field Remediation
Subject 618-13 Burial Ground Cleanup Verification 95% UCL Calculations

Date 07/21/09
Job No. 14655

Calc. No. 0300X-CA-V0105
Checked H. M. Sulloway

Rev. No. 0
Date 07/21/09
Sheet No. 7 of 9

618-13 Verification Sample Data

Sampling Area	Sample Number	Sample Date	Nickel			Uranium - KPA			Vanadium			Zinc			Acetone		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A2	J18PX1	4/28/09	12.1	J	3.07	4.78		0.125	54.5	J	1.92	40.6	J	7.68	0.0113	U	0.0113
Duplicate of J18PX1	J18PX4	4/28/09	9.80	J	2.64	1.77		0.125	52.8	J	1.65	35.7	J	6.60	0.00864	J	0.0109
A1	J18PX0	4/28/09	7.91	J	2.67	1.79		0.125	37.9	J	1.67	31.5	J	6.67	0.00786	J	0.0109
A3	J18PX2	4/28/09	12.4	J	3.32	1.70		0.125	52.7	J	2.08	39.2	J	8.30	0.00660	J	0.0109
A4	J18PX3	4/28/09	10.9	J	2.94	2.03		0.125	55.8	J	1.84	41.4	J	7.35	0.0122	U	0.0122

Statistical Computation Input Data

Sampling Area	Sample Number	Sample Date	Nickel mg/kg	Uranium - KPA mg/kg	Vanadium mg/kg	Zinc mg/kg	Acetone mg/kg
A2	J18PX1/ J18PX4	4/28/09	11.0	3.28	53.7	38.2	0.00715
A1	J18PX0	4/28/09	7.91	1.79	37.9	31.5	0.00786
A3	J18PX2	4/28/09	12.4	1.70	52.7	39.2	0.00660
A4	J18PX3	4/28/09	10.9	2.03	55.8	41.4	0.00610

Statistical Computations

	Nickel	Uranium - KPA	Vanadium	Zinc	Acetone
95% UCL based on	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.
N	4	4	4	4	4
% < Detection limit	0%	0%	0%	0%	25%
Mean	10.5	2.20	50.0	37.6	0.00693
Standard Deviation	1.89	0.73	8.2	4.26	0.000755
Z-statistic	1.645	1.645	1.645	1.645	1.645
95% UCL on mean	12.1	2.80	56.7	41.1	0.00755
Maximum Value	12.4	4.78	55.8	41.4	0.0122
Statistical value	12.1	2.80	56.7	41.1	0.00755
Most Stringent Cleanup Limit for nonradionuclide and RAG type	19.1 GW Protection	3.21 GW & River Protection	85.1 GW Protection	67.8 River Protection	720 GW Protection
WAC 173-340 3-PART Test					
95% UCL > Cleanup Limit?	NA	NO	NA	NA	NO
> 10% above Cleanup Limit?	NA	YES	NA	NA	NO
Any sample > 2X Cleanup Limit?	NA	NO	NA	NA	NO
WAC 173-340 3-Part-Test Compliance?	Because all nickel values are below background (19.1 mg/kg), the 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.	Because all vanadium values are below background (85.1 mg/kg), the 3-part test is not required.	Because all zinc values are below background (67.8 mg/kg), the 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.

Washington Closure Hanford

CALCULATION SHEET

Originator J. D. Skoglie
Project 300 Area Field Remediation
Subject 618-13 Burial Ground Cleanup Verification 95% UCL Calculations

Date 7/20/09
Job No. 14655

Calc. No. 0300X-CA-V0105
Checked H. M. Sulloway

Rev. No. 0
Date 07/20/09
Sheet No. 8 of 9

Split-Duplicate Analysis

618-13 Split-Duplicate Sample Results:

Sampling Area	Sample Number	Potassium-40			Radium-226			Radium-228			Thorium-228			Thorium-230			Thorium-232			Uranium-233/234			Uranium-238		
		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	J18PX1	14.8		0.173	0.426		0.037	0.681		0.083	2.04		0.416	1.56		0.331	2.16		0.331	1.92		0.216	1.70		0.216
Duplicate of J18PX1	J18PX4	13.9		0.280	0.345		0.053	0.654		0.106	1.28		0.427	0.667		0.425	1.39		0.425	0.494		0.189	0.691		0.189
Split of J18PX1	J18PY0										0.559		0.0456	0.239		0.0402	0.553		0.0340	0.216		0.0347	0.227		0.0333

Sample Analysis:

TDL		0.5	0.1	0.2	1.0	1.0	1.0	1	1
Duplicate Analysis	Both > PQL or MDA?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	6.3%							
	Difference >2xTDL?	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable
Split Analysis	Both > PQL?				**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?				No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD								
	Difference >2xTDL?				No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable

Sampling Area	Sample Number	Aluminum			Arsenic			Barium			Beryllium			Boron			Cadmium			Calcium			Chromium		
		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	J18PX1	5700	B	3.84	3.01		0.768	74		0.384	0.182		0.154	0.865	B	1.54	0.0385	B	0.154	6800		76.8	9.19		0.231
Duplicate of J18PX1	J18PX4	5480	B	3.30	3.50		0.660	56.6		0.33	0.181		0.132	0.625	B	1.32	0.0444	B	0.132	5830		66.0	8.82		0.198
Split of J18PX1	J18PY0	5300		1.60	2.6		0.67	60		0.077	0.21	B	0.033	0.99	U	0.99	0.061	B	0.041	5400		14.0	8.6		0.059

Sample Analysis:

TDL		5	1	0.5	0.2	2	0.2	100	0.2
Duplicate Analysis	Both > PQL or MDA?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)			**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD	3.9%		26.6%				15.4%	4.1%
	Difference >2xTDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable
Split Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)			**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD	7.3%		20.9%				23.0%	6.6%
	Difference >2xTDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable

Sampling Area	Sample Number	Cobalt			Copper			Iron			Lead			Magnesium			Manganese			Molybdenum			Nickel		
		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	J18PX1	6.13		1.54	10.8		0.678	20100		15.4	2.94		0.384	4650		57.6	344		3.84	0.369	B	1.54	12.1		3.07
Duplicate of J18PX1	J18PX4	5.97		1.32	10.1		0.660	18200		13.2	2.72		0.330	3900		49.5	260		3.30	0.420	B	1.32	9.8		3.64
Split of J18PX1	J18PY0	6.1	L	0.10	9.1		0.22	17000		3.8	3.1		0.27	3700		3.7	320		0.10	0.26	U	0.26	8.6	L	0.12

Sample Analysis:

TDL		2	1	5	0.5	75	5	2	4
Duplicate Analysis	Both > PQL or MDA?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**
	Both > 5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	**Yes (calc RPD)**	**Yes (calc RPD)**	**Yes (calc RPD)**		No-Stop (acceptable)
	RPD		6.7%	9.9%	7.8%	17.5%	27.8%		
	Difference >2xTDL?	No - acceptable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	No - acceptable	No - acceptable
Split Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**
	Both > 5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	**Yes (calc RPD)**	**Yes (calc RPD)**	**Yes (calc RPD)**		No-Stop (acceptable)
	RPD		17.1%	16.7%	5.3%	22.8%	7.2%		
	Difference >2xTDL?	No - acceptable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	No - acceptable	No - acceptable

Note: The significance of the RPD values, including values greater than 30%, is addressed in the data quality assessment section of the CVP.

Washington Closure Hanford

CALCULATION SHEET

Originator J. D. Skoglie
Project 300 Area Field Remediation
Subject 618-13 Burial Ground Cleanup Verification 95% UCL Calculations

Date 7/27/09
Job No. 14655

Calc. No. 0300X-CA-V0105
Checked H. M. Sulloway

Rev. No. 0
Date 07/27/09
Sheet No. 9 of 9

Split-Duplicate Analysis
618-13 Split-Duplicate Sample Results:

Sampling Area	Sample Number	Potassium			Sodium			Tin			Uranium - KPA			Vanadium			Zinc			Zirconium		
		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	J18PX1	916		307	120		38.4	0.833	UJ	7.68	4.78		0.125	54.5		1.92	40.6		7.68	15.2		3.84
Duplicate of J18PX1	J18PX4	928		364	128		33	0.742	UJ	6.6	1.77		0.125	52.8		1.65	35.7		6.6	14.0		3.30
Split of J18PX1	J18PY0	860		41	170		60	0.92	UJ	0.92	0.39	U	3.43	42		0.095	33	L	0.40	13		0.36

Sample Analysis:

TDL		400	50	10	1	2.5	1	2.5
Duplicate Analysis	Both > PQL or MDA?	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)		No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD					3.2%	12.8%	8.2%
	Difference >2xTDL?	No - acceptable	No - acceptable	No - acceptable	**Yes - assess further**	Not applicable	Not applicable	Not applicable
Split Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both > 5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)			**Yes (calc RPD)**	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD					25.9%	20.7%	15.6%
	Difference >2xTDL?	No - acceptable	No - acceptable	No - acceptable	**Yes - assess further**	Not applicable	Not applicable	Not applicable

Note: The significance of the RPD values, including values greater than 30%, is addressed in the data quality assessment section of the CVP.

Attachment 1. 618-13 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Americium-241 GEA			Cesium-137			Cobalt-60			Europium-152			Europium-154			Europium-155		
			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	J18PX1	4/28/09	0.099	U	0.099	0.018	U	0.018	0.017	U	0.017	0.052	U	0.052	0.066	U	0.066	0.072	U	0.072
Duplicate of J18PX1	J18PX4	4/28/09	0.039	U	0.039	0.028	U	0.028	0.029	U	0.029	0.066	U	0.066	0.101	U	0.101	0.071	U	0.071
Split of J18PX1	J18PY0	4/28/09				-0.0146	U	0.0313	-0.00204	U	0.0348	0.0161	U	0.0854	0.0128	U	0.114	0.0622	U	0.0855
A1	J18PX0	4/28/09	0.039	U	0.039	0.038		0.029	0.026	U	0.026	0.065	U	0.065	0.092	U	0.092	0.066	U	0.066
A3	J18PX2	4/28/09	0.287	U	0.287	0.038	U	0.038	0.044	U	0.044	0.087	U	0.087	0.148	U	0.148	0.107	U	0.107
A4	J18PX3	4/28/09	0.089	U	0.089	0.030	U	0.030	0.028	U	0.028	0.073	U	0.073	0.107	U	0.107	0.077	U	0.077
Focused sample 1	J18R00	4/28/09	0.140	U	0.140	0.042	U	0.042	0.024	U	0.024	0.062	U	0.062	0.077	U	0.077	0.074	U	0.074
Focused sample 2	J18R01	4/28/09	0.037	U	0.037	0.022	U	0.022	0.024	U	0.024	0.054	U	0.054	0.073	U	0.073	0.058	U	0.058
Equipment Blank	J18PW9	4/28/09	0.026	U	0.026	0.016	U	0.016	0.017	U	0.017	0.039	U	0.039	0.057	U	0.057	0.039	U	0.039

Sample Location	Sample Number	Sample Date	Potassium-40			Radium-226			Radium-228			Thorium-228			Thorium-228 GEA			Thorium-230		
			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	J18PX1	4/28/09	14.8		0.173	0.426		0.037	0.681		0.083	2.04	J	0.416	0.666		0.028	1.56		0.331
Duplicate of J18PX1	J18PX4	4/28/09	13.9		0.280	0.345		0.053	0.654		0.106	1.28	J	0.427	0.516		0.037	0.667		0.425
Split of J18PX1	J18PY0	4/28/09										0.559		0.0456				0.239		0.0402
A1	J18PX0	4/28/09	14.4		0.282	0.406		0.035	0.670		0.123	0.840	J	0.350	0.648		0.033	0.509		0.278
A3	J18PX2	4/28/09	14.4		0.258	0.494		0.069	0.720		0.174	0.766	J	0.392	0.685		0.049	0.794		0.304
A4	J18PX3	4/28/09	13.8		0.269	0.401		0.062	0.782		0.124	1.15	J	0.362	0.625		0.035	0.849		0.250
Focused sample 1	J18R00	4/28/09	14.5		0.232	0.448		0.045	0.684		0.101	1.03	J	0.300	0.655		0.032	0.874		0.239
Focused sample 2	J18R01	4/28/09	14.5		0.247	0.443		0.043	0.773		0.102	1.10	J	0.601	0.647		0.026	0.860		0.299
Equipment Blank	J18PW9	4/28/09	7.26		0.166	0.150		0.030	0.223		0.067	0.396	J	0.380	0.176		0.016	0.434		0.302

Note: The following abbreviations apply to all Attachment 1 tables.

Note: Data qualified with B, C, and/or J are considered acceptable values.

B = method blank contamination
C = method blank contamination
D = dilution
GEA = gamma energy analysis
J = estimated
L = interference
M = duplicate precision not met
MDA = minimum detectable activity
N = MS/MSD recovery outside control limits
PQL = practical quantitation limit
Q = qualifier
R = rejected
U = undetected

Attachment	1	Sheet No.	1 of 14
Originator	J. D. Skoglie	Date	07/20/09
Checked	H. M. Sulloway	Date	07/20/09
Calc. No.	0300X-CA-V0103	Rev. No.	0

Attachment 1. 618-13 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Thorium-232			Thorium-232 GEA			Uranium-233/234			Uranium-235			Uranium-235 GEA			Uranium-238		
			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	J18PX1	4/28/09	2.16	J	0.331	0.681		0.083	1.92		0.216	0.034	U	0.262	0.145	U	0.145	1.70		0.216
Duplicate of J18PX1	J18PX4	4/28/09	1.39	J	0.425	0.654		0.106	0.494		0.189	0.00	U	0.228	0.160	U	0.160	0.691		0.189
Split of J18PX1	J18PY0	4/28/09	0.553		0.0340				0.216		0.0347	0.00426	U	0.0280				0.227		0.0333
A1	J18PX0	4/28/09	0.909	J	0.278	0.670		0.123	0.448		0.228	0.277	U	0.277	0.149	U	0.149	0.627		0.228
A3	J18PX2	4/28/09	0.699	J	0.243	0.720		0.174	0.561		0.226	0.071	U	0.273	0.199	U	0.199	0.650		0.226
A4	J18PX3	4/28/09	0.882	J	0.250	0.782		0.124	0.793		0.233	0.037	U	0.282	0.148	U	0.148	0.732		0.233
Focused sample 1	J18R00	4/28/09	1.12	J	0.239	0.684		0.101	0.963		0.194	0.00	U	0.235	0.148	U	0.148	0.684		0.194
Focused sample 2	J18R01	4/28/09	1.06	J	0.299	0.773		0.102	1.14		0.204	0.064	U	0.247	0.131	U	0.131	0.959		0.204
Equipment Blank	J18PW9	4/28/09	0.237	UJ	0.302	0.223		0.067	0.294		0.225	0.036	U	0.272	0.089	U	0.089	0.176	U	0.225

Attachment 1. 618-13 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Uranium-238 GEA		
			pCi/g	Q	MDA
A2	J18PX1	4/28/09	2.17	U	2.17
Duplicate of J18PX1	J18PX4	4/28/09	3.57	U	3.57
Split of J18PX1	J18PY0	4/28/09			
A1	J18PX0	4/28/09	3.59	U	3.59
A3	J18PX2	4/28/09	4.69	U	4.69
A4	J18PX3	4/28/09	3.51	U	3.51
Focused sample 1	J18R00	4/28/09	2.72	U	2.72
Focused sample 2	J18R01	4/28/09	2.41	U	2.41
Equipment Blank	J18PW9	4/28/09	1.86	U	1.86

Attachment	1	Sheet No.	2 of 14
Originator	J. D. Skoglie	Date	07/20/09
Checked	H. M. Sulloway	Date	07/20/09
Calc. No.	0300X-CA-V0105	Rev. No.	0

Attachment 1. 618-13 Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	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	J18PX1	4/28/09	5700	B	3.84	0.461	UJ	0.461	3.01	J	0.768	74.0		0.384	0.182		0.154	0.865	B	1.54
Duplicate of J18PX1	J18PX4	4/28/09	5480	B	3.30	0.396	UJ	0.396	3.50	J	0.660	56.6		0.330	0.181		0.132	0.625	B	1.32
Split of J18PX1	J18PY0	4/28/09	5300		1.6	0.38	U	0.38	2.6		0.67	60		0.077	0.21	B	0.033	0.99	U	0.99
A1	J18PX0	4/28/09	4140	B	3.33	0.312	BJ	0.400	2.28	J	0.667	42.0		0.333	0.144		0.133	0.817	B	1.33
A3	J18PX2	4/28/09	6340	B	4.15	0.312	BJ	0.498	2.88	J	0.830	61.3		0.415	0.212		0.166	1.05	B	1.66
A4	J18PX3	4/28/09	5760	B	3.67	0.441	UJ	0.441	2.91	J	0.735	69.0		0.367	0.197		0.147	1.02	B	1.47
Focused sample 1	J18R00	4/28/09	5220	B	3.31	0.397	UJ	0.397	2.61	J	0.662	57.7		0.331	0.184		0.132	0.960	B	1.32
Focused sample 2	J18R01	4/28/09	4900	B	3.54	0.233	BJ	0.425	3.39	J	0.708	56.0		0.354	0.160		0.142	0.782	B	1.42
Equipment Blank	J18PW9	4/28/09	160	B	3.57	0.429	UJ	0.429	0.276	BJ	0.714	2.08		0.357	0.143	U	0.143	1.43	U	1.43

Sample Location	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper			Hexavalent Chromium		
			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	J18PX1	4/28/09	0.0385	B	0.154	6800	J	76.8	9.19		0.231	6.13		1.54	10.8	J	0.678	0.20	U	0.20
Duplicate of J18PX1	J18PX4	4/28/09	0.0444	B	0.132	5830	J	66.0	8.82		0.198	5.97		1.32	10.1	J	0.660	0.20	U	0.20
Split of J18PX1	J18PY0	4/28/09	0.061	B	0.041	5400		14	8.6		0.059	6.1	L	0.10	9.1		0.22	0.155	U	0.155
A1	J18PX0	4/28/09	0.0405	B	0.133	4630	J	66.7	7.06		0.200	4.35		1.33	8.30	J	0.667	0.20	U	0.20
A3	J18PX2	4/28/09	0.0515	B	0.166	6080	J	83.0	10.7		0.249	5.95		1.66	10.9	J	0.830	0.20	U	0.20
A4	J18PX3	4/28/09	0.0625	B	0.147	5450	J	73.5	8.98		0.220	6.29		1.47	11.5	J	0.735	0.20	U	0.20
Focused sample 1	J18R00	4/28/09	0.0471	B	0.132	5980	J	66.2	8.74		0.199	5.71		1.32	10.1	J	0.662	0.20	U	0.20
Focused sample 2	J18R01	4/28/09	0.0434	B	0.142	5000	J	70.8	8.25		0.212	5.07		1.42	9.24	J	0.708	0.20	U	0.20
Equipment Blank	J18PW9	4/28/09	0.1430	U	0.143	42.9	UJ	71.4	0.158	B	0.214	1.43	U	1.43	0.714	U	0.714	0.20	U	0.20

Sample Location	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese			Mercury			Molybdenum		
			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	J18PX1	4/28/09	20100		15.4	2.94	J	0.384	4650		57.6	344		3.84	0.0277	U	0.0277	0.369	B	1.54
Duplicate of J18PX1	J18PX4	4/28/09	18200		13.2	2.72	J	0.330	3900		49.5	260		3.30	0.0261	U	0.0261	0.420	B	1.32
Split of J18PX1	J18PY0	4/28/09	17000		3.8	3.1		0.27	3700		3.7	320		0.10	0.0056	U	0.0056	0.26	U	0.26
A1	J18PX0	4/28/09	13900		13.3	3.16		0.333	3030		50.0	199		3.33	0.0294	U	0.0294	0.241	B	1.33
A3	J18PX2	4/28/09	20000		16.6	3.60	J	0.415	4290		62.3	298		4.15	0.0253	U	0.0253	0.291	B	1.66
A4	J18PX3	4/28/09	19800		14.7	3.62	J	0.367	4020		55.1	311		3.67	0.0234	U	0.0234	0.311	B	1.47
Focused sample 1	J18R00	4/28/09	17900		13.2	4.94	J	0.331	3620		49.7	268		3.31	0.0242	U	0.0242	0.286	B	1.32
Focused sample 2	J18R01	4/28/09	17000		14.2	3.34	J	0.354	3620		53.1	265		3.54	0.0306	U	0.0306	0.297	B	1.42
Equipment Blank	J18PW9	4/28/09	197		14.3	0.715	UJ	0.357	27.1	B	53.6	4.26		3.57	0.0257	U	0.0257	1.43	U	1.43

Attachment 1 Sheet No. 3 of 14
Originator J. D. Skoglie Date 07/20/09
Checked H. M. Sulloway Date 07/20/09
Calc. No. 0300X-CA-V0105 Rev. No. 0

Attachment 1. 618-13 Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Nickel			Potassium			Selenium			Silver			Sodium			Thallium		
			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	J18PX1	4/28/09	12.1	J	3.07	916		307	0.768	U	0.768	0.154	U	0.154	120		38.4	0.384	UJ	0.384
Duplicate of J18PX1	J18PX4	4/28/09	9.80	J	2.64	928		264	0.660	U	0.660	0.132	U	0.132	128		33.0	0.330	UJ	0.330
Split of J18PX1	J18PY0	4/28/09	8.6	L	0.12	860		41	0.87	U	0.87	0.16	U	0.16	170		60	0.66	UN	0.66
A1	J18PX0	4/28/09	7.91	J	2.67	750		267	0.667	U	0.667	0.133	U	0.133	105		33.3	0.333	UJ	0.333
A3	J18PX2	4/28/09	12.4	J	3.32	1050		332	0.830	U	0.830	0.166	U	0.166	148		41.5	0.415	UJ	0.415
A4	J18PX3	4/28/09	10.9	J	2.94	1050		294	0.735	U	0.735	0.147	U	0.147	127		36.7	0.367	UJ	0.367
Focused sample 1	J18R00	4/28/09	8.23	J	2.65	966		265	0.662	U	0.662	0.132	U	0.132	129		33.1	0.331	UJ	0.331
Focused sample 2	J18R01	4/28/09	10.0	J	2.83	832		283	0.708	U	0.708	0.142	U	0.142	107		35.4	0.354	UJ	0.354
Equipment Blank	J18PW9	4/28/09	2.86	UJ	2.86	39.3	B	286	0.714	U	0.714	0.143	U	0.143	7.82	B	35.7	0.357	UJ	0.357

Sample Location	HEIS Number	Sample Date	Tin			Uranium - ICP			Uranium - KPA			Vanadium			Zinc			Zirconium		
			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	J18PX1	4/28/09	0.833	UJ	7.68	15.4	U	15.4	4.78		0.125	54.5	J	1.92	40.6	J	7.68	15.2		3.84
Duplicate of J18PX1	J18PX4	4/28/09	0.742	UJ	6.60	1.75	B	13.2	1.77		0.125	52.8	J	1.65	35.7	J	6.60	14.0		3.30
Split of J18PX1	J18PY0	4/28/09	0.92	U	0.92	2.5	U	2.5	0.39	U	3.43	42		0.095	33	L	0.40	13		0.36
A1	J18PX0	4/28/09	6.67	U	6.67	1.35	B	13.3	1.79		0.125	37.9	J	1.67	31.5	J	6.67	11.1		3.33
A3	J18PX2	4/28/09	1.05	UJ	8.30	16.6	U	16.6	1.70		0.125	52.7	J	2.08	39.2	J	8.30	16.4		4.15
A4	J18PX3	4/28/09	0.766	UJ	7.35	14.7	U	14.7	2.03		0.125	55.8	J	1.84	41.4	J	7.35	16.1		3.67
Focused sample 1	J18R00	4/28/09	0.745	UJ	6.62	13.2	U	13.2	3.00		0.125	48.6	J	1.66	37.1	J	6.62	14.9		3.31
Focused sample 2	J18R01	4/28/09	7.08	U	7.08	1.50	B	14.2	2.41		0.125	46.9	J	1.77	36.8	J	7.08	12.6		3.54
Equipment Blank	J18PW9	4/28/09	0.866	UJ	7.14	14.3	U	14.3	0.74		0.012	0.313	BJ	1.79	0.849	BJ	7.14	0.336	B	3.57

Attachment 1 — Sheet No. 4 of 14
Originator J. D. Skoglie — Date 07/20/09
Checked H. M. Sulloway — Date 07/20/09
Calc. No. 0300X-CA-V0105 — Rev. No. 0

Attachment 1. 618-13 Verification Sampling Results

CONSTITUENT	A2 - J18PX1, Sample Date 4/28/09			Duplicate of J18PX1 - J18PX4, Sample Date 4/28/09			Split of J18PX1 - J18PY0, Sample Date 4/28/09		
	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Semi Volatile Organic Compounds									
1,2,4-Trichlorobenzene	669	U	669	671	U	671	28	U	28
1,2-Dichlorobenzene	669	U	669	671	U	671	22	U	22
1,3-Dichlorobenzene	669	U	669	671	U	671	12	U	12
1,4-Dichlorobenzene	669	U	669	671	U	671	14	U	14
2,4,5-Trichlorophenol	669	UJ	669	671	UJ	671	10	U	10
2,4,6-Trichlorophenol	669	UJ	669	671	UJ	671	10	U	10
2,4-Dichlorophenol	669	UJ	669	671	U	671	10	U	10
2,4-Dimethylphenol	669	UJ	669	671	UJ	671	67	UJ	67
2,4-Dinitrophenol	3350	U	3350	3350	U	3350	340	U	340
2,4-Dinitrotoluene	669	U	669	671	U	671	67	U	67
2,6-Dinitrotoluene	669	U	669	671	U	671	28	U	28
2-Chloronaphthalene	669	U	669	671	U	671	10	U	10
2-Chlorophenol	669	U	669	671	U	671	21	U	21
2-Methylnaphthalene	669	U	669	671	U	671	19	U	19
2-Methylphenol (cresol, o-)	669	U	669	671	U	671	13	U	13
2-Nitroaniline	3350	U	3350	3350	U	3350	51	U	51
2-Nitrophenol	669	U	669	671	U	671	10	U	10
3+4 Methylphenol (cresol, m+p)	669	U	669	671	U	671	33	U	33
3,3'-Dichlorobenzidine	1340	UJ	1340	1340	UJ	1340	91	UJ	91
3-Nitroaniline	3350	U	3350	3350	U	3350	74	U	74
4,6-Dinitro-2-methylphenol	669	U	669	671	U	671	330	U	330
4-Bromophenylphenyl ether	669	UJ	669	671	UJ	671	19	U	19
4-Chloro-3-methylphenol	669	U	669	671	U	671	67	U	67
4-Chloroaniline	669	UJ	669	671	UJ	671	83	UJ	83
4-Chlorophenylphenyl ether	669	UJ	669	671	UJ	671	21	U	21
4-Nitroaniline	3350	UJ	3350	3350	UJ	3350	73	UJ	73

Attachment	1	Sheet No.	5 of 14
Originator	J. D. Skoglie	Date	07/21/09
Checked	H. M. Sulloway	Date	07/21/09
Calc. No.	0300X-CA-V0105	Rev. No.	0

Attachment 1. 618-13 Verification Sampling Results

CONSTITUENT	A2 - J18PX1, Sample Date 4/28/09			Duplicate of J18PX1 - J18PX4, Sample Date 4/28/09			Split of J18PX1 - J18PY0, Sample Date 4/28/09		
	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Semi Volatile Organic Compounds									
4-Nitrophenol	3350	U	3350	3350	U	3350	98	U	98
Acenaphthene	669	U	669	671	U	671	10	U	10
Acenaphthylene	669	U	669	671	U	671	17	U	17
Anthracene	669	U	669	671	U	671	17	U	17
Benzo(a)anthracene	669	U	669	671	U	671	20	U	20
Benzo(a)pyrene	669	U	669	671	U	671	20	U	20
Benzo(b)fluoranthene	669	U	669	671	U	671	27	U	27
Benzo(ghi)perylene	669	U	669	671	U	671	16	U	16
Benzo(k)fluoranthene	669	U	669	671	U	671	40	U	40
Bis(2-chloro-1-methylethyl)ether	669	U	669	671	U	671	23	U	23
Bis(2-Chloroethoxy)methane	669	UJ	669	671	UJ	671	23	U	23
Bis(2-chloroethyl) ether	669	UJ	669	671	UJ	671	17	U	17
Bis(2-ethylhexyl) phthalate	669	U	669	671	U	671	87	JB	47
Butylbenzylphthalate	669	U	669	671	U	671	44	U	44
Carbazole	669	U	669	671	U	671	36	U	36
Chrysene	669	U	669	671	U	671	27	U	27
Di-n-butylphthalate	669	U	669	671	U	671	29	U	29
Di-n-octylphthalate	669	U	669	671	U	671	15	U	15
Dibenz[a,h]anthracene	669	U	669	671	U	671	19	U	19
Dibenzofuran	669	U	669	671	U	671	20	U	20
Diethylphthalate	669	U	669	671	U	671	26	U	26
Dimethyl phthalate	669	U	669	671	U	671	32	J	23
Fluoranthene	669	U	669	671	U	671	36	U	36
Fluorene	669	U	669	671	U	671	18	U	18
Hexachlorobenzene	669	U	669	671	U	671	29	U	29
Hexachlorobutadiene	669	U	669	671	U	671	10	U	10
Hexachlorocyclopentadiene	669	U	669	671	U	671	51	U	51
Hexachloroethane	669	U	669	671	U	671	22	U	22
Indeno(1,2,3-cd)pyrene	669	U	669	671	U	671	22	U	22
Isophorone	669	U	669	671	U	671	17	U	17
N-Nitroso-di-n-dipropylamine	669	U	669	671	U	671	31	U	31
N-Nitrosodiphenylamine	669	U	669	671	U	671	21	U	21
Naphthalene	669	U	669	671	U	671	31	U	31
Nitrobenzene	669	U	669	671	U	671	22	U	22
Pentachlorophenol	3350	UJ	3350	3350	UJ	3350	330	U	330
Phenanthrene	669	U	669	671	U	671	17	U	17
Phenol	669	U	669	671	U	671	18	U	18
Pyrene	669	U	669	671	U	671	12	U	12

Attachment	1	Sheet No.	6 of 14
Originator	J. D. Skoglie	Date	07/21/09
Checked	H. M. Sulloway	Date	07/21/09
Calc. No.	0300X-CA-V0105	Rev. No.	0

Attachment 1. 618-13 Verification Sampling Results

CONSTITUENT	A1 - J18PX0, Sample Date 4/28/09			A3 - J18PX2, Sample Date 4/28/09			A4 - J18PX3, Sample Date 4/28/09		
	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Semi Volatile Organic Compounds									
1,2,4-Trichlorobenzene	669	U	669	669	U	669	669	U	669
1,2-Dichlorobenzene	669	U	669	669	U	669	669	U	669
1,3-Dichlorobenzene	669	U	669	669	U	669	669	U	669
1,4-Dichlorobenzene	669	U	669	669	U	669	669	U	669
2,4,5-Trichlorophenol	669	U	669	669	U	669	669	U	669
2,4,6-Trichlorophenol	669	U	669	669	U	669	669	U	669
2,4-Dichlorophenol	669	U	669	669	U	669	669	U	669
2,4-Dimethylphenol	669	UJ	669	669	UJ	669	669	UJ	669
2,4-Dinitrophenol	3350	U	3350	3340	U	3340	3350	U	3350
2,4-Dinitrotoluene	669	U	669	669	U	669	669	U	669
2,6-Dinitrotoluene	669	U	669	669	U	669	669	U	669
2-Chloronaphthalene	669	U	669	669	U	669	669	U	669
2-Chlorophenol	669	U	669	669	U	669	669	U	669
2-Methylnaphthalene	669	U	669	669	U	669	669	U	669
2-Methylphenol (cresol, o-)	669	U	669	669	U	669	669	U	669
2-Nitroaniline	3350	U	3350	3340	U	3340	3350	U	3350
2-Nitrophenol	669	U	669	669	U	669	669	U	669
3+4 Methylphenol (cresol, m+p)	669	U	669	669	U	669	669	U	669
3,3'-Dichlorobenzidine	1340	UJ	1340	1340	UJ	1340	1340	UJ	1340
3-Nitroaniline	3350	U	3350	3340	U	3340	3350	U	3350
4,6-Dinitro-2-methylphenol	669	U	669	669	U	669	669	U	669
4-Bromophenylphenyl ether	669	U	669	669	U	669	669	U	669
4-Chloro-3-methylphenol	669	U	669	669	U	669	669	U	669
4-Chloroaniline	669	UJ	669	669	UJ	669	669	UJ	669
4-Chlorophenylphenyl ether	669	U	669	669	U	669	669	U	669
4-Nitroaniline	3350	UJ	3350	3340	UJ	3340	3350	UJ	3350
4-Nitrophenol	3350	U	3350	3340	U	3340	3350	U	3350
Acenaphthene	669	U	669	669	U	669	669	U	669
Acenaphthylene	669	U	669	669	U	669	669	U	669
Anthracene	669	U	669	669	U	669	669	U	669
Benzo(a)anthracene	669	U	669	669	U	669	669	U	669
Benzo(a)pyrene	669	U	669	669	U	669	669	U	669
Benzo(b)fluoranthene	669	U	669	669	U	669	669	U	669

Attachment	1	Sheet No.	7 of 14
Originator	J. D. Skoglie	Date	07/21/09
Checked	H. M. Sulloway	Date	07/21/09
Calc. No.	0300X-CA-V0105	Rev. No.	0

Attachment 1. 618-13 Verification Sampling Results

CONSTITUENT	A1 - J18PX0, Sample Date 4/28/09			A3 - J18PX2, Sample Date 4/28/09			A4 - J18PX3, Sample Date 4/28/09		
	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Semi Volatile Organic Compounds									
Benzo(ghi)perylene	669	U	669	669	U	669	669	U	669
Benzo(k)fluoranthene	669	U	669	669	U	669	669	U	669
Bis(2-chloro-1-methylethyl)ether	669	U	669	669	U	669	669	U	669
Bis(2-Chloroethoxy)methane	669	U	669	669	U	669	669	U	669
Bis(2-chloroethyl) ether	669	U	669	669	U	669	669	U	669
Bis(2-ethylhexyl) phthalate	669	U	669	669	U	669	669	U	669
Butylbenzylphthalate	669	U	669	669	U	669	669	U	669
Carbazole	669	U	669	669	U	669	669	U	669
Chrysene	669	U	669	669	U	669	669	U	669
Di-n-butylphthalate	669	U	669	669	U	669	669	U	669
Di-n-octylphthalate	669	U	669	669	U	669	669	U	669
Dibenz[a,h]anthracene	669	U	669	669	U	669	669	U	669
Dibenzofuran	669	U	669	669	U	669	669	U	669
Diethylphthalate	669	U	669	669	U	669	669	U	669
Dimethyl phthalate	669	U	669	669	U	669	669	U	669
Fluoranthene	669	U	669	669	U	669	669	U	669
Fluorene	669	U	669	669	U	669	669	U	669
Hexachlorobenzene	669	U	669	669	U	669	669	U	669
Hexachlorobutadiene	669	U	669	669	U	669	669	U	669
Hexachlorocyclopentadiene	669	U	669	669	U	669	669	U	669
Hexachloroethane	669	U	669	669	U	669	669	U	669
Indeno(1,2,3-cd)pyrene	669	U	669	669	U	669	669	U	669
Isophorone	669	U	669	669	U	669	669	U	669
N-Nitroso-di-n-dipropylamine	669	U	669	669	U	669	669	U	669
N-Nitrosodiphenylamine	669	U	669	669	U	669	669	U	669
Naphthalene	669	U	669	669	U	669	669	U	669
Nitrobenzene	669	U	669	669	U	669	669	U	669
Pentachlorophenol	3350	U	3350	3340	U	3340	3350	U	3350
Phenanthrene	669	U	669	669	U	669	669	U	669
Phenol	669	U	669	669	U	669	669	U	669
Pyrene	669	U	669	669	U	669	669	U	669

Attachment	1	Sheet No.	8 of 14
Originator	J. D. Skoglie	Date	07/21/09
Checked	H. M. Sulloway	Date	07/21/09
Calc. No.	0300X-CA-V0105	Rev. No.	0

Attachment 1. 618-13 Verification Sampling Results

CONSTITUENT	J18PX5			FS-1 - J18R00, Sample Date 4/28/09			FS-2 - J18R01, Sample Date 4/28/09		
	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Semi Volatile Organic Compounds									
1,2,4-Trichlorobenzene				337	U	337	673	U	673
1,2-Dichlorobenzene				337	U	337	673	U	673
1,3-Dichlorobenzene				337	U	337	673	U	673
1,4-Dichlorobenzene				337	U	337	673	U	673
2,4,5-Trichlorophenol				337	U	337	673	U	673
2,4,6-Trichlorophenol				337	U	337	673	U	673
2,4-Dichlorophenol				337	U	337	673	U	673
2,4-Dimethylphenol				337	UJ	337	673	UJ	673
2,4-Dinitrophenol				1680	U	1680	3360	U	3360
2,4-Dinitrotoluene				337	U	337	673	U	673
2,6-Dinitrotoluene				337	U	337	673	U	673
2-Chloronaphthalene				337	U	337	673	U	673
2-Chlorophenol				337	U	337	673	U	673
2-Methylnaphthalene				337	U	337	673	U	673
2-Methylphenol (cresol, o-)				337	U	337	673	U	673
2-Nitroaniline				1680	U	1680	3360	U	3360
2-Nitrophenol				337	U	337	673	U	673
3+4 Methylphenol (cresol, m+p)				337	U	337	673	U	673
3,3'-Dichlorobenzidine				673	UJ	673	1350	UJ	1350
3-Nitroaniline				1680	U	1680	3360	U	3360
4,6-Dinitro-2-methylphenol				337	U	337	673	U	673
4-Bromophenylphenyl ether				337	U	337	673	U	673
4-Chloro-3-methylphenol				337	U	337	673	U	673
4-Chloroaniline				337	UJ	337	673	UJ	673
4-Chlorophenylphenyl ether				337	U	337	673	U	673
4-Nitroaniline				1680	UJ	1680	3360	UJ	3360
4-Nitrophenol				1680	U	1680	3360	U	3360
Acenaphthene				337	U	337	673	U	673

Attachment	1	Sheet No.	9 of 14
Originator	J. D. Skoglie	Date	07/21/09
Checked	H. M. Sulloway	Date	07/21/09
Calc. No.	0300X-CA-V0105	Rev. No.	0

Attachment 1. 618-13 Verification Sampling Results

CONSTITUENT	Trip Blank - J18PX5, Sample Date 4/28/09			FS-1 - J18R00, Sample Date 4/28/09			FS-2 - J18R01, Sample Date 4/28/09		
	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Semi Volatile Organic Compounds									
Acenaphthylene				337	U	337	673	U	673
Anthracene				337	U	337	673	U	673
Benzo(a)anthracene				337	U	337	673	U	673
Benzo(a)pyrene				337	U	337	673	U	673
Benzo(b)fluoranthene				337	U	337	673	U	673
Benzo(ghi)perylene				337	U	337	673	U	673
Benzo(k)fluoranthene				337	U	337	673	U	673
Bis(2-chloro-1-methylethyl)ether				337	U	337	673	U	673
Bis(2-Chloroethoxy)methane				337	U	337	673	U	673
Bis(2-chloroethyl) ether				337	U	337	673	U	673
Bis(2-ethylhexyl) phthalate				337	U	337	673	U	673
Butylbenzylphthalate				337	U	337	673	U	673
Carbazole				337	U	337	673	U	673
Chrysene				337	U	337	673	U	673
Di-n-butylphthalate				337	U	337	673	U	673
Di-n-octylphthalate				337	U	337	673	U	673
Dibenz[a,h]anthracene				337	U	337	673	U	673
Dibenzofuran				337	U	337	673	U	673
Diethylphthalate				337	U	337	673	U	673
Dimethyl phthalate				337	U	337	673	U	673
Fluoranthene				337	U	337	673	U	673
Fluorene				337	U	337	673	U	673
Hexachlorobenzene				337	U	337	673	U	673
Hexachlorobutadiene				337	U	337	673	U	673
Hexachlorocyclopentadiene				337	U	337	673	U	673
Hexachloroethane				337	U	337	673	U	673
Indeno(1,2,3-cd)pyrene				337	U	337	673	U	673
Isophorone				337	U	337	673	U	673
N-Nitroso-di-n-dipropylamine				337	U	337	673	U	673
N-Nitrosodiphenylamine				337	U	337	673	U	673
Naphthalene				337	U	337	673	U	673
Nitrobenzene				337	U	337	673	U	673
Pentachlorophenol				1680	U	1680	3360	U	3360
Phenanthrene				337	U	337	673	U	673
Phenol				337	U	337	673	U	673
Pyrene				337	U	337	673	U	673

Attachment	1	Sheet No.	10 of 14
Originator	J. D. Skoglie	Date	10/06/09
Checked	H. M. Sulloway	Date	10/06/09
Calc. No.	0300X-CA-V0105	Rev. No.	2

Attachment 1. 618-13 Verification Sampling Results

CONSTITUENT	Equipment Blank - J18PW9, Sample Date 4/28/09		
	ug/kg	Q	PQL
Semi Volatile Organic Compounds			
1,2,4-Trichlorobenzene	330	U	330
1,2-Dichlorobenzene	330	U	330
1,3-Dichlorobenzene	330	U	330
1,4-Dichlorobenzene	330	U	330
2,4,5-Trichlorophenol	330	UJ	330
2,4,6-Trichlorophenol	330	UJ	330
2,4-Dichlorophenol	330	UJ	330
2,4-Dimethylphenol	330	UJ	330
2,4-Dinitrophenol	1650	U	1650
2,4-Dinitrotoluene	330	U	330
2,6-Dinitrotoluene	330	U	330
2-Chloronaphthalene	330	U	330
2-Chlorophenol	330	U	330
2-Methylnaphthalene	330	U	330
2-Methylphenol (cresol, o-)	330	U	330
2-Nitroaniline	1650	U	1650
2-Nitrophenol	330	U	330
3+4 Methylphenol (cresol, m+p)	330	U	330
3,3'-Dichlorobenzidine	660	UJ	660
3-Nitroaniline	1650	U	1650
4,6-Dinitro-2-methylphenol	330	U	330
4-Bromophenylphenyl ether	330	UJ	330
4-Chloro-3-methylphenol	330	U	330
4-Chloroaniline	330	UJ	330
4-Chlorophenylphenyl ether	330	UJ	330
4-Nitroaniline	1650	UJ	1650
4-Nitrophenol	1650	U	1650
Acenaphthene	330	U	330
Acenaphthylene	330	U	330
Anthracene	330	U	330
Benzo(a)anthracene	330	U	330
Benzo(a)pyrene	330	U	330

CONSTITUENT	Equipment Blank - J18PW9, Sample Date 4/28/09		
	ug/kg	Q	PQL
Semi Volatile Organic Compounds			
Benzo(b)fluoranthene	330	U	330
Benzo(ghi)perylene	330	U	330
Benzo(k)fluoranthene	330	U	330
Bis(2-chloro-1-	330	U	330
Bis(2-Chloroethoxy)methane	330	UJ	330
Bis(2-chloroethyl) ether	330	UJ	330
Bis(2-ethylhexyl) phthalate	330	U	330
Butylbenzylphthalate	330	U	330
Carbazole	330	U	330
Chrysene	330	U	330
Di-n-butylphthalate	330	U	330
Di-n-octylphthalate	330	U	330
Dibenz[a,h]anthracene	330	U	330
Dibenzofuran	330	U	330
Diethylphthalate	330	U	330
Dimethyl phthalate	330	U	330
Fluoranthene	330	U	330
Fluorene	330	U	330
Hexachlorobenzene	330	U	330
Hexachlorobutadiene	330	U	330
Hexachlorocyclopentadiene	330	U	330
Hexachloroethane	330	U	330
Indeno(1,2,3-cd)pyrene	330	U	330
Isophorone	330	U	330
N-Nitroso-di-n-dipropylamine	330	U	330
N-Nitrosodiphenylamine	330	U	330
Naphthalene	330	U	330
Nitrobenzene	330	U	330
Pentachlorophenol	1650	UJ	1650
Phenanthrene	330	U	330
Phenol	330	U	330
Pyrene	330	U	330

Attachment	1	Sheet No.	11 of 14
Originator	J. D. Skoglie	Date	07/21/09
Checked	H. M. Sulloway	Date	07/21/09
Calc. No.	0300X-CA-V0105	Rev. No.	0

Attachment 1. 618-13 Verification Sampling Results

CONSTITUENT	A2 - J18PX1, Sample Date 4/28/09			Duplicate of J18PX1 - J18PX4, Sample Date 4/28/09			Split of J18PX1 - J18PY0, Sample Date 4/28/09		
	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Volatile Organic Compounds									
1,1,1-Trichloroethane	4.7	U	4.7	4.54	U	4.54	0.53	U	0.53
1,1,2,2-Tetrachloroethane	4.7	U	4.7	4.54	U	4.54	0.62	U	0.62
1,1,2-Trichloroethane	4.7	U	4.7	4.54	U	4.54	0.89	U	0.89
1,1-Dichloroethane	4.7	U	4.7	4.54	U	4.54	0.21	U	0.21
1,1-Dichloroethene	4.7	U	4.7	4.54	U	4.54	0.6	U	0.6
1,2-Dichloroethane	5.64	U	5.64	5.44	U	5.44	0.71	U	0.71
1,2-Dichloroethene(Total)							0.39	U	0.39
1,2-Dichloropropane	4.7	U	4.7	4.54	U	4.54	0.56	U	0.56
2-Butanone	11.3	U	11.3	10.9	U	10.9	1.9	U	1.9
2-Hexanone	11.3	U	11.3	10.9	U	10.9	4.9	U	4.9
4-Methyl-2-Pentanone	11.3	U	11.3	10.9	U	10.9	4.4	U	4.4
Acetone	11.3	U	11.3	8.64	J	10.9	5.4	U	5.4
Benzene	4.7	U	4.7	4.54	U	4.54	0.48	U	0.48
Bromodichloromethane	5.64	U	5.64	5.44	U	5.44	0.22	U	0.22
Bromoform	4.7	U	4.7	4.54	U	4.54	0.23	U	0.23
Bromomethane	9.39	U	9.39	9.07	U	9.07	0.51	U	0.51
Carbon disulfide	4.7	U	4.7	4.54	U	4.54	0.43	U	0.43
Carbon tetrachloride	4.7	U	4.7	4.54	U	4.54	0.64	U	0.64
Chlorobenzene	4.7	U	4.7	4.54	U	4.54	0.55	U	0.55
Chloroethane	9.39	U	9.39	9.07	U	9.07	0.9	U	0.9
Chloroform	4.7	U	4.7	4.54	U	4.54	0.29	U	0.29
Chloromethane	9.39	U	9.39	9.07	U	9.07	0.78	U	0.78
cis-1,2-Dichloroethylene	4.7	U	4.7	4.54	U	4.54			
cis-1,3-Dichloropropene	4.7	U	4.7	4.54	U	4.54	1.3	U	1.3
Dibromochloromethane	4.7	U	4.7	4.54	U	4.54	0.58	U	0.58
Ethylbenzene	4.7	U	4.7	4.54	U	4.54	0.68	U	0.68
Methylene chloride	10	U	5.64	10	U	5.44	2.1	JB	0.76
Styrene	4.7	U	4.7	4.54	U	4.54	0.64	U	0.64
Tetrachloroethene	4.7	U	4.7	4.54	U	4.54	0.6	U	0.6
Toluene	4.7	U	4.7	4.54	U	4.54	0.7	U	0.7
trans-1,2-Dichloroethylene	4.7	U	4.7	4.54	U	4.54			
trans-1,3-Dichloropropene	4.7	U	4.7	4.54	U	4.54	0.68	U	0.68
Trichloroethene	4.7	U	4.7	4.54	U	4.54	0.23	U	0.23
Vinyl chloride	9.39	U	9.39	9.07	U	9.07	1.4	U	1.4
Xylenes (total)	5.64	U	5.64	5.44	U	5.44	0.62	U	0.62

Attachment	1	Sheet No.	12 of 14
Originator	J. D. Skoglie	Date	07/21/09
Checked	H. M. Sulloway	Date	07/21/09
Calc. No.	0300X-CA-V0105	Rev. No.	0

Attachment 1. 618-13 Verification Sampling Results

CONSTITUENT	A1 - J18PX0, Sample Date 4/28/09			A3 - J18PX2, Sample Date 4/28/09			A4 - J18PX3, Sample Date 4/28/09		
	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Volatile Organic Compounds									
1,1,1-Trichloroethane	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
1,1,2,2-Tetrachloroethane	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
1,1,2-Trichloroethane	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
1,1-Dichloroethane	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
1,1-Dichloroethene	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
1,2-Dichloroethane	5.43	U	5.43	5.43	U	5.43	6.08	U	6.08
1,2-Dichloroethene(Total)									
1,2-Dichloropropane	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
2-Butanone	10.9	U	10.9	10.9	U	10.9	12.2	U	12.2
2-Hexanone	10.9	U	10.9	10.9	U	10.9	12.2	U	12.2
4-Methyl-2-Pentanone	10.9	U	10.9	10.9	U	10.9	12.2	U	12.2
Acetone	7.86	J	10.9	6.60	J	10.9	12.2	U	12.2
Benzene	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
Bromodichloromethane	5.43	U	5.43	5.43	U	5.43	6.08	U	6.08
Bromoform	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
Bromomethane	9.05	U	9.05	9.04	U	9.04	10.1	U	10.1
Carbon disulfide	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
Carbon tetrachloride	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
Chlorobenzene	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
Chloroethane	9.05	U	9.05	9.04	U	9.04	10.1	U	10.1
Chloroform	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
Chloromethane	9.05	U	9.05	9.04	U	9.04	10.1	U	10.1
cis-1,2-Dichloroethylene	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
cis-1,3-Dichloropropene	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
Dibromochloromethane	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
Ethylbenzene	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
Methylene chloride	10	U	5.64	10	U	5.43	10	U	6.08
Styrene	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
Tetrachloroethene	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
Toluene	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
trans-1,2-Dichloroethylene	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
trans-1,3-Dichloropropene	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
Trichloroethene	4.53	U	4.53	4.52	U	4.52	5.07	U	5.07
Vinyl chloride	9.05	U	9.05	9.04	U	9.04	10.1	U	10.1
Xylenes (total)	5.43	U	5.43	5.43	U	5.43	6.08	U	6.08

Attachment	1	Sheet No.	13 of 14
Originator	J. D. Skoglie	Date	07/21/09
Checked	H. M. Sulloway	Date	07/21/09
Calc. No.	0300X-CA-V0105	Rev. No.	0

Attachment 1. 618-13 Verification Sampling Results

CONSTITUENT	Trip Blank - J18PX5, Sample Date 4/28/09			FS-1 - J18R00, Sample Date 4/28/09			FS-2 - J18R01, Sample Date 4/28/09		
	ug/L	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Volatile Organic Compounds									
1,1,1-Trichloroethane	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
1,1,2,2-Tetrachloroethane	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
1,1,2-Trichloroethane	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
1,1-Dichloroethane	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
1,1-Dichloroethene	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
1,2-Dichloroethane	5.00	UJ	5.00	5.67	U	5.67	4.93	U	4.93
1,2-Dichloroethene(Total)	5.00	UJ	5.00						
1,2-Dichloropropane	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
2-Butanone	10.0	UJ	10.0	11.3	U	11.3	9.86	U	9.86
2-Hexanone	10.0	UJ	10.0	11.3	U	11.3	9.86	U	9.86
4-Methyl-2-Pentanone	10.0	UJ	10.0	11.3	U	11.3	9.86	U	9.86
Acetone	10.0	UJ	10.0	11.3	U	11.3	5.90	J	9.86
Benzene	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
Bromodichloromethane	5.00	UJ	5.00	5.67	U	5.67	4.93	U	4.93
Bromoform	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
Bromomethane	10.0	UJ	10.0	9.44	U	9.44	8.22	U	8.22
Carbon disulfide	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
Carbon tetrachloride	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
Chlorobenzene	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
Chloroethane	10.0	UJ	10.0	9.44	U	9.44	8.22	U	8.22
Chloroform	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
Chloromethane	10.0	UJ	10.0	9.44	U	9.44	8.22	U	8.22
cis-1,2-Dichloroethylene	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
cis-1,3-Dichloropropene	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
Dibromochloromethane	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
Ethylbenzene	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
Methylene chloride	6.00	UJ	6.00	10	U	5.67	10	U	4.93
Styrene	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
Tetrachloroethene	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
Toluene	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
trans-1,2-Dichloroethylene	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
trans-1,3-Dichloropropene	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
Trichloroethene	5.00	UJ	5.00	4.72	U	4.72	4.11	U	4.11
Vinyl chloride	10.0	UJ	10.0	9.44	U	9.44	8.22	U	8.22
Xylenes (total)	5.00	UJ	5.00	5.67	U	5.67	4.93	U	4.93

Attachment	1	Sheet No.	14 of 14
Originator	J. D. Skoglie	Date	10/06/09
Checked	H. M. Sulloway	Date	10/06/09
Calc. No.	0300X-CA-V0105	Rev. No.	2

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 618-13 Field Remediation **Job No. 14655**

Area: 300

Discipline: Environmental *Calculation No: 0300X-CA-V0106

Subject: 618-13 Burial Ground Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation

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 = 3 Total = 4	J. D. Skoglie	M. M. Sullaway	L. D. Haber	J. W. Darby	8/5/09

SUMMARY OF REVISION

WCH-DE-018 (05/08/2007) *Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	08/03/09	Calc. No.:	0300X-CA-V0106	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	4/23/09
Subject:	618-13 Burial Ground Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and excess carcinogenic risk for the 618-13 Burial Ground. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2005), the following criteria must be met:

1) An HQ of <1.0 for all individual noncarcinogens
2) A cumulative HQ of <1.0 for noncarcinogens
3) An excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens
4) A cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.

GIVEN/REFERENCES:

1) DOE-RL, 2009, *Remedial Design Report/Remedial Action Work Plan for the 300 Area,* DOE/RL-2001-47, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2) WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, 1996.

3) WCH, 2009, *618-13 Burial Ground Cleanup Verification 95% UCL Calculations*, 0300X-CA-V0105, Rev 0, Washington Closure Hanford, Inc., Richland, Washington.

SOLUTION:

1) Generate an HQ for each noncarcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL 2009).

2) Sum the HQs and compare this value to the cumulative HQ of <1.0.

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the excess cancer risk of $<1 \times 10^{-6}$ (DOE-RL 2009).

4) Sum the excess cancer risk value(s) and compare it to the cumulative cancer risk of $<1 \times 10^{-5}$.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	08/03/09	Calc. No.:	0300X-CA-V0100	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	4/23/09
Subject:	618-13 Burial Ground Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	2 of 3

METHODOLOGY:

The 618-13 Burial Ground consisted of excavation and overburden stockpile areas for the purpose of verification sampling.

Hazard quotient and carcinogenic risk calculations for the 618-13 Burial Ground were conservatively calculated for the entire waste site using the greater of the statistically determined values for each analyte in both decision units from WCH (2009). Of the contaminants of potential concern (COPCs) for this site, there were not any that were quantitated at a concentration above Hanford Site background. Acetone, Boron and molybdenum require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 1.03 mg/kg, divided by the noncarcinogenic RAG value of 7,200 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 1.4×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The sum of the HQ values is 1.0×10^{-3}. Comparing this value to the requirement of <1.0, this criterion is met.

3) No carcinogenic constituents were detected above background soil levels at the 618-13 Burial Ground; therefore, no calculations of excess carcinogenic risk were performed.

RESULTS:

1) List individual noncarcinogens and corresponding HQs >1.0: None
2) List the cumulative noncarcinogenic HQ >1.0: None
3) List individual carcinogens and corresponding excess cancer risk $>1 \times 10^{-6}$: None
4) List the cumulative excess cancer risk for carcinogens $>1 \times 10^{-5}$: None.

Table 1 shows the results of the calculations.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	08/03/09	Calc. No.:	0300X-CA-V0106	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	4/23/09
Subject:	618-13 Burial Ground Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	3 of 3

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 618-13 Burial Ground.

Contaminants of Concern[a]	Maximum or Statistical Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	1.03	7,200	1.4E-04	--	--
Molybdenum	0.362	400	9.1E-04	--	--
Volatiles Organic Compounds					
Acetone	0.00755	72,000	1.0E-07	--	--
Totals					
Cumulative Hazard Quotient:			**1.0E-03**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:

[a] = From WCH (2009).

[b] = Value obtained from the RDR/RAWP (DOE-RL 2005) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996,

-- = not applicable

RAG = remedial action goal

CONCLUSION:

This calculation demonstrates that the 618-13 Burial Ground meets the requirements for the hazard quotients and excess carcinogenic risk as identified in the RDR/RAWP (DOE-RL 2009).

APPENDIX E

DATA QUALITY ASSESSEMENT

VERIFICATION SAMPLING DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific closeout plan and the *300 Area Sampling and Analysis Plan* (SAP) (DOE-RL 20049a). This DQA was performed in accordance with site-specific data quality objectives found in the SAP (DOE-RL 2009a).

A review of the closeout plan (WCH 2009a), the field logbooks (WCH 2009b), and applicable analytical data packages has been performed as part of this DQA. All samples were collected per the closeout plan. To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical and radiochemical analysis (BHI 2000a, 2000b) are used, as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2000).

Verification data for samples collected at the 618-13 Burial Ground and the 600-290:1 Pad and Loading Dock Near 618-13 waste site were provided by the laboratories in two sample delivery groups (SDGs): SDG J00487 and K1611. A third-party validation was performed on SDG K1611.

No major deficiencies were found in the data set for the 618-13 Burial Ground. Minor data deficiencies are discussed by SDG below.

SDG K1611

This SDG comprises eight field samples (J18PW9, J18PX0 through J18PX4, J18R00, J18R01) collected from the statistical and focused sampling points specified in the closeout plan (WCH 2009a). One field duplicate pair (J18PX1/J18PX4), one equipment blank (J18PW9), and a volatile organic analyte (VOA) trip blank (J18PX5) are included in this SDG. The VOA trip blank was only analyzed for VOA. The balance of these samples were analyzed for isotopic thorium, isotopic uranium, total uranium, gamma-emitting analytes, volatile organic compounds (VOCs), semivolatile organic compounds (SVOC), inductively coupled plasma (ICP) metals, mercury, and hexavalent chromium. SDG K1611 was submitted for formal third-party validation. Minor deficiencies for this SDG are as follows:

In the ICP metals analysis, the results for calcium and lead in the equipment blank (J18PW9) were less than 20 times the detected results in the method blank (MB). Third-party validation qualified the results for calcium and lead in sample J18PW9 with "UJ" flags as nondetected and estimated. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the results for tin in all of the field samples were less than 20 times the detected result in the MB. Third-party validation qualified all of the tin results in SDF K1611 with "UJ" flags as nondetected and estimated. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries for antimony (45%) and calcium (55%) were below the quality control (QC) limits. Third-party validation qualified all antimony and calcium results in SDG K1611 with "J" flags as estimated. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the laboratory control sample (LCS) recoveries for antimony (207%), arsenic (186%), copper (360%), vanadium (141%), and zinc (349%) are above the QC limits. These results may suggest a high bias in the field sample data for these analytes. Third-party validation qualified all of the antimony, arsenic, copper, vanadium, and zinc results in SDG K1611 with "J" flags as estimated. High biased or estimated data are useable for decision-making purposes.

In the ICP metals analysis, the LCS recoveries for lead (58%), thallium (0%), and nickel (57%) are below the QC limits. Third-party validation qualified all lead, thallium, and nickel results in SDG K1611 with "J" flags as estimated. Estimated data are useable for decision-making purposes.

In the isotopic thorium analysis, the laboratory did not perform LCS analysis of thorium-228 and thorium-232. Third-party validation qualified all thorium-228 and thorium-232 results in SDG K1611 with "J" flags as estimated. Estimated data are useable for decision-making purposes.

In the SVOC analysis, the LCS recoveries for 2,4-dimethylphenol (24%), 4-chloranaline (11%), and 4-nitroanaline (40%) were below the QC limits. Third-party validation qualified all results in SDG K1611 for 2,4-dimethylphenol, 4-chloranaline, and 4-nitroanaline with "J" flags as estimated. Estimated data are useable for decision-making purposes.

In the SVOC analysis, the MS and the matrix spike duplicate (MSD) results for 2,4-dimethylphenol (27%, 19%), 4-chloroanaline (19%, 16%), and 3,3-dichlorobenzidine (18%, 14%) are below QC limits. Third-party validation qualified all results in SDG K1611 for 2,4-dimethylphenol, 4-chloroanaline, and 3,3-dichlorobenzidine with "J" flags as estimated. Estimated data are useable for decision-making purposes.

In the SVOC analysis, surrogate recoveries were below QC limits in samples J18PW9, J18PX1, and J18PX4. Third-party validation qualified the associated analytes (2,4-dichlorophenol, 2,4,6-trichlorophenol, 2,4,5-trichlorophenol, pentachlorophenol, bis(2-chlorophenylphenylether, 4-bromophenylphenylether) in samples J18PW9, J18PX1, and J18PX4 with "J" flags as estimated. Estimated data are useable for decision-making purposes.

In the VOC analysis, the common laboratory contaminant methylene chloride was detected in MB and in all of the field samples, except the VOA trip blank (J18PX5) at similar concentrations. Third-party validation raised the methylene chloride results to the contract-required quantitation limit (CRQL) and qualified those results with "J" flags as estimated for all samples except sample J18PX5. Estimated data are useable for decision making purposes.

In the VOC analysis, the VOA trip blank (J18PX5) was prepared after the field samples were collected. There is no impact to the field sample data. The data are useable for decision-making purposes.

In the VOC analysis, the VOA trip blank (J18PX5), which is a liquid sample, was analyzed without corresponding liquid MS or MSD sample analysis. Third-party validation qualified all results in sample J18PX5 with "J" flags as estimated. Estimated data are useable for decision-making purposes.

In the VOC analysis, the LCS recoveries (228%, 204%) and the MS/MSD recoveries (266%, 245%) for acetone are above the QC limits. These results may indicated a high bias in the field sample data for acetone. Third-party validation qualified all detected acetone results (J18R01, J18PX0, J18PX2, J18PX4) in SDG K1611 with "J" flags as estimated. High biases or estimated data are useable for decision-making purposes.

SDG J00487

This SDG comprises one field sample (J18PY0), the field split. The main sample (J18PX1) and duplicate sample (J18PX4) associated with this field split were analyzed in SDG 1611. The field split was analyzed for isotopic thorium, isotopic uranium, total uranium, gamma-emitting analytes, VOCs, SVOCs, ICPs, mercury, and hexavalent chromium. Minor deficiencies for this SDG are as follows:

In the gamma spectroscopy, the relative percent differences (RPDs) calculated for laboratory duplicate results for cobalt-60 (1067%), cesium-137 (-141%), and europium-152 (446%) are above the QC limits. Elevated RPDs in environmental soil samples are attributed to naturally occurring heterogeneity in the sample matrix. The data are useable for the intended purpose.

In the VOC analysis, the common laboratory contaminant methylene chloride was detected in the MB. Because the detection is less then the reporting limits the laboratory determined that no corrective action is needed. The data are useable for the intended purpose.

In the SVOC analysis, the common laboratory contaminant bis(2-ethylhexyl)phthalate was detected in the MB. Because the detection is less then the reporting limits, the laboratory determined that no corrective action is needed. The data are useable for the intended purpose.

In the ICP metals analysis, a serial dilution of the sample digestate indicates that interference is present for the analytes cobalt, nickel, and zinc. The laboratory qualified these analytes with "L" flags to indicate interference. Results for cobalt, nickel, and zinc may be considered estimated. Estimated data are useable for the intended purpose.

In the ICP metals analysis, the analytes iron and manganese were detected in the MB at concentrations above the CRQL. However, the sample results for these analytes are more that than 10 times the MB results. Therefore, there is no significant impact on the field sample data. The data are useable for the intended purpose.

In the ICP metals analysis, the analytes barium, chromium, and calcium were detected in the MB at concentrations below the CRQL. Because these detections are less then the reporting limits, the laboratory determined that no corrective action is needed. The data are useable for the intended purpose.

In the ICP metals analysis, the MS recovery for the analyte thallium (76%) is below the laboratory QC limits (78%-101%). The laboratory investigated this result and found no indication that problems exist within the analytical system. Quantitation for this analysis is confirmed by the LCS result of 88%. The data are useable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

RPD evaluations of main sample(s) versus the laboratory duplicate(s) are routinely performed and reported by the laboratory. Any deficiencies in those calculations are reported by SDG in the previous sections.

Field QA/QC results are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples are summarized in Table F-1. The main and QA/QC sample data are presented in Appendix D.

Table F-1. Field Quality Assurance/Quality Control Samples.

Main Sample	Duplicate Sample	Split Sample
J18PX1	J18PX4	J18PY0

Field duplicate samples are collected to provide a relative measure of 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 D provides details on duplicate pair evaluation and RPD calculation. None of the RPDs

calculated are above the acceptance criteria for the field duplicate (30%) or the field split (35%). The data are useable for decision making purposes.

RPDs for analytes that are not detected in both the main and duplicate sample at more than 5 times the target detection limit are not calculated. RPDs of analytes detected at low concentrations (less than five times the detection limit) are not considered to be indicative of the analytical system performance. The data are useable for decision making purposes.

A secondary check of the data variability is used 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 to indicate that a visual check of the data is required by the reviewer. For the shallow zone excavation main and split sample, the strontium-90 results required this check. These results are attributed to heterogeneities in the sample matrix from which the samples were collected. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are useable for decision-making purposes.

SUMMARY

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above are a potential for any analysis. The number and types seen in this data set are within expectations for the matrix types and analyses performed. The DQA review of the 618-13 and 600-290:1 verification sampling data found the final analytical data set to be accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for 618-13 and 600-290:1 waste sites concludes that the reviewed (final) data set is of the right type, quality, and quantity to support the intended use. Detection limits, precision, accuracy, and sampling data group completeness were assessed to determine if any additional analytical results should be rejected as a result of quality assurance and QC deficiencies. The final analytical data set is acceptable for decision-making purposes. The 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. The verification sample analytical data are also summarized in Appendix D.

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.

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WCH 2009a, *Closeout Plan for the 618-13 Burial Ground*, CCN 143888, Washington Closure Hanford, Richland, Washington.

WCH 2009b, *300-FF-2 Field Remediation Project Sampling Log*, EL-1395-15, Washington Closure Hanford, Richland, Washington.

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