CVP-2007-00003
Rev. 0

Cleanup Verification Package for the 118-F-5 PNL Sawdust Pit

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

February 2008

EXECUTIVE SUMMARY

This cleanup verification package documents completion of remedial action, sampling activities, as well as assessment of compliance with cleanup criteria for the 118-F-5 Burial Ground (PNL [Pacific Northwest Laboratory] Sawdust Pit). The 118-F-5 Burial Ground, part of the 100-FR-2 Operable Unit, is located in the 100-F Area of the Hanford Site in southeastern Washington State. The 118-F-5 Burial Ground was an unlined trench that received radioactive sawdust from the floors of animal pens in the 100-F Experimental Animal Farm. The 118-F-5 burial ground was in operation between 1954 and 1975.

Remediation of the 118-F-5 Burial Ground began on November 28, 2005, and was completed on August 29, 2007. Remedial action activities involved removing the uncontaminated overburden, the buried contaminated material, and the underlying contaminated soil for disposal to the Environmental Restoration Disposal Facility.

Following excavation, verification sampling was performed to determine if the remedial action was adequate to support site closure. Results of the verification sampling, laboratory analyses, and data evaluations for the 118-F-5 Burial Ground indicate that all remedial action objectives for direct exposure, protection of groundwater, and protection of the Columbia River have been met (see Table ES-1).

Table ES-1. Summary of Remedial Action Goals for the 118-F-5 Burial Ground. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?	Ref.
Direct Exposure – Radionuclides	Attain 15 mrem/yr dose rate above background over 1,000 years.	Maximum dose rate estimated using generic dose equivalence lookup values is 5.7 mrem/yr.	Yes	a, b, c
Direct Exposure – Nonradionuclides	Attain individual COC RAGs.	There are no non-radionuclide COCs for the 118-F-5 Burial Ground.	Yes	a, b
Nonradionuclide Risk Requirements	Attain hazard quotient of <1 for all individual noncarcinogens.	There are no non-radionuclide COCs for the 118-F-5 Burial Ground.	N/A	N/A
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	There are no non-radionuclide COCs for the 118-F-5 Burial Ground.		N/A
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	There are no non-radionuclide COCs for the 118-F-5 Burial Ground.		N/A
	Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	There are no non-radionuclide COCs for the 118-F-5 Burial Ground.		N/A
Groundwater/River Protection – Radionuclides	Attain single COC groundwater and river protection RAGS.	No radionuclide COCs were quantified above groundwater/river protection lookup values.	Yes	a, b
	Attain national primary drinking water regulations:[d] 4-mrem/yr (beta/gamma) dose rate to target receptor/organs.	No radionuclide COCs were quantified above groundwater/river protection lookup values.		a, b
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide for DOE Order 5400.5.[e]	No alpha-emitting radionuclide COCs were quantified above groundwater/river protection lookup values.	Yes	a, b
	Meet total uranium standard of 21.2 pCi/L.[f]	Uranium was not identified as a site COC.	N/A	N/A

Table ES-1. Summary of Remedial Action Goals for the 118-F-5 Burial Ground. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?	Ref.
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	There are no non-radionuclide COCs for the 118-F-5 Burial Ground.	N/A	N/A
Other Supporting Information	Sample design calculation brief.			g, h

[a] *118-F-5 Burial Ground Cleanup Verification 95% UCL Calculation,* Calculation No. 0100F-CA-V0289, Rev. 0 (Appendix D).
[b] *118-F-5A Cleanup Verification 95% UCL Calculation,* Calculation No. 0100F-CA-V0316, Rev. 0 (Appendix D).
[c] *118-F-5 Burial Ground Cleanup Verification using Generic Dose-equivalence Lookup Values* (Table 4).
[d] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).
[e] *Radiation Protection of the Public and the Environment* (DOE Order 5400.5).
[f] Based on the isotopic distribution of uranium in the 100 Areas, the 30 µg/L MCL 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* (BHI 2001).
[g] *Shallow Zone/Stockpile (BCL) Sampling Plan*, Calculation No. 0100F-CA-V0291, Rev. 0 (Appendix D).
[h] *118-F-5A Burial Ground Shallow Zone Sampling Plan*, Calculation No. 0100F-CA-V0330, Rev. 0 (Appendix D).

COC = contaminant of concern
MCL = maximum contaminant level (drinking water standard)
N/A = not applicable
RAG = remedial action goal

This evaluation supports a reclassification of this waste site to Interim Closed Out, in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) and the *Tri-Party Agreement Handbook Management Procedures,* Waste Site Reclassification Guideline TPA-MP-14 (DOE-RL 2007). A copy of the waste site reclassification form is included as Attachment ES-1.

Attachment ES-1.

Waste Site Reclassification Form.

Date Submitted: 1/31/08 Originator: L. M. Dittmer Phone: 372-9227	**WASTE SITE RECLASSIFICATION FORM** Operable Unit(s): 100-FR-2 Waste Site Code: 118-F-5 Type of Reclassification Action: Closed Out ☐ Interim Closed Out ☒ No Action ☐ RCRA Postclosure ☐ Rejected ☐ Consolidated ☐	Control Number: 2007-022

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 118-F-5 Burial Ground was an unlined trench that received radioactive sawdust from the floors of animal pens in the 100-F Experimental Animal Farm. Remediation, verification sampling, and evaluation against the single-radionuclide dose-equivalence lookup values have been performed in accordance with remedial action objectives and goals established by the *Record of Decision for the 100 BC-1, 100-BC-2, 100 DR-1, 100-DR-2, 100 FR 2, 100-HR-2, and 100-KR-2 Operable Units, Hanford Site (100 Area Burial Grounds), Benton County, Washington* (Burial Ground ROD) (EPA 2000). The selected remedy involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility at the 200 Area of the Hanford Site, (3) demonstrating through verification sampling and data evaluations that cleanup goals have been achieved, and (4) proposing the site for reclassification as Interim Closed Out.

Basis for reclassification:

In accordance with this evaluation, the verification sampling and modeling results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives established in the Burial Ground ROD. The results show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Site contamination did not extend into the deep zone soils; 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 118-F-5 PNL Sawdust Pit* (CVP-2007-00003), Washington Closure Hanford, Richland, Washington (attached).

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.

S. L. Charboneau DOE Federal Project Director (printed)	Signature	5/1/08 Date
NA Ecology Project Manager (printed)	Signature	Date
R. A. Lobos EPA Project Manager (printed)	Signature	5/6/08 Date

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ACRONYMS AND ABBREVIATIONS

BCM	bank cubic meters
BCY	bank cubic yards
BCL	below cleanup level
BG	background
CFR	*Code of Federal Regulations*
COC	contaminant of concern
DOE	U.S. Department of Energy
DQA	data quality assessment
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
GPERS	Global Positioning Environmental Radiological Surveyor
MCL	maximum contaminant level (drinking water standard)
PNL	Pacific Northwest Laboratory
RAG	remedial action goal
ROD	record of decision
RDL	required detection limit
RDR/RAWP	remedial design report/remedial action work plan
RESRAD	RESidual RADioactivity dose assessment model
SAP	sampling and analysis plan
UCL	upper confidence limit
WAC	*Washington Administrative Code*
WCS83S	Washington State Plane Coordinate System of 1983 South Zone

1.0 STATEMENT OF PROTECTIVENESS

This report demonstrates that the 118-F-5 PNL (Pacific Northwest Laboratory) Sawdust Pit (118-F-5 Burial Ground) was remediated in accordance with the *Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units, Hanford Site (100 Area Burial Grounds), Benton County, Washington* (Burial Ground ROD) (EPA 2000), and meets the objectives and goals for interim closure as established in the Burial Ground ROD and the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005).

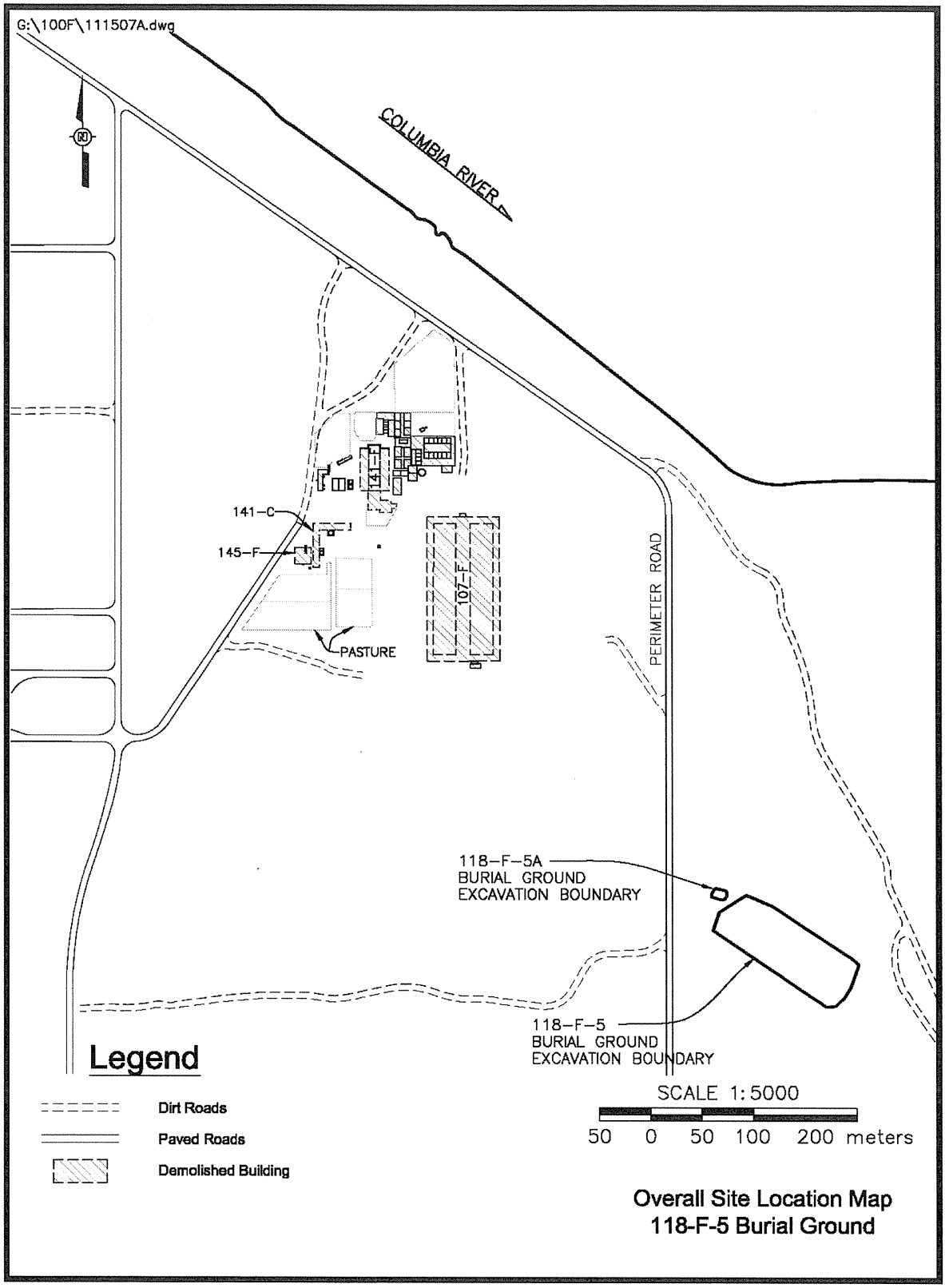
The results of verification sampling show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Site contamination did not extend into the deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

2.0 BACKGROUND AND GENERAL SITE INFORMATION

The 118-F-5 Burial Ground is located approximately 305 m (1,000 ft) southeast of the 107-F Retention Basin (Figure 1) at coordinates: E 581342.8 meters, N 147459.6 meters (WCS83S). The burial ground was an unlined trench that received radioactive sawdust from the floors of animal pens in the 100-F Experimental Animal Farm. It operated from 1954 to 1975. According to the *100-F Reactor Site Technical Baseline Report Including Operable Units 100-FR-1 and 100-FR-2* (WHC 1993), past Hanford Site employees recall that sawdust from the Experimental Animal Farm was placed in boxes or 208-L (55-gal) drums before burial at this site.

A geophysical investigation was performed in January 2002 to locate and map the documented attributes of the waste site. Five different types of deposits were identified and mapped during the geophysical investigation (Bergstrom and Mitchell 2002). Three of the deposits had a geophysical signature that was interpreted as natural, and the remaining two deposits had the character of buried sawdust (not in enclosed containers) or fill material. There were no anomalous features with the characteristics of metal drums detected. Two test pits were dug on April 25, 2002, to verify the interpretation of the geophysical data (Kahler-Royer and Mitchell 2002). A geologist was present during the test pitting and determined through the soil lithology that the burial ground was 1.98 m (6.5 ft) deep. The test pitting findings were consistent with the geophysical investigation results. There was no evidence of buried metal containers discovered.

Figure 1. Location of the 118-F-5 Burial Ground (Post-Remediation Boundary).



3.0 REMEDIAL ACTION SUMMARY

This section contains specific information about the excavation and disposal activities for the 118-F-5 Burial Ground. It also contains information about the types of wastes encountered and the field screening that was conducted.

3.1 EXCAVATION AND DISPOSAL INFORMATION

Remedial action of the 118-F-5 Burial Ground began on November 28, 2005, and was completed on August 29, 2007. Excavation of the site involved removing the uncontaminated overburden and the underlying contaminated soil. Sawdust was evident throughout the area excavated. There was no evidence of containers (i.e., boxes or metal drums) that were used for disposal of sawdust. A post-excavation aerial photograph is shown in Figure 2. Additional photographs of the remediation activities are included in Appendix A.

A small area (referred to herein as 118-F-5A), northwest of the main 118-F-5 excavation, was also remediated (Figure 3). The area had been identified by the geophysics investigation as a disturbed zone distinct from the larger area. During remediation of this area, no evidence of sawdust or other buried waste was discovered. The area was sampled on August 2, 2007. The analytical results for the 118-F-5A samples were slightly elevated for carbon-14. Additional material was removed from the 118-F-5A excavation and verification samples were collected.

Collectively, the sites had approximately 7,100 bank cubic meters (BCM) (9,287 bank cubic yards [BCY]) of uncontaminated overburden soil that would be reused as backfill. Approximately 25,500 BCM (33,354 BCY) of contaminated soil was excavated and disposed of at the Environmental Restoration Disposal Facility (ERDF).

At the conclusion of remediation activities, the elevation at the deepest part of the excavation was approximately 119.5 m (392 ft) above mean sea level with a maximum depth of approximately 5.5 m (18 ft) below ground surface. The remediation excavation was approximately 7,392 m^2 (79,535 ft^2) in area. The post-excavation topography is shown in Figure 4. No anomalies or stained soil were discovered during remediation.

Figure 2. 118-F-5 Burial Ground Post-Excavation Aerial Photograph (August 2007).

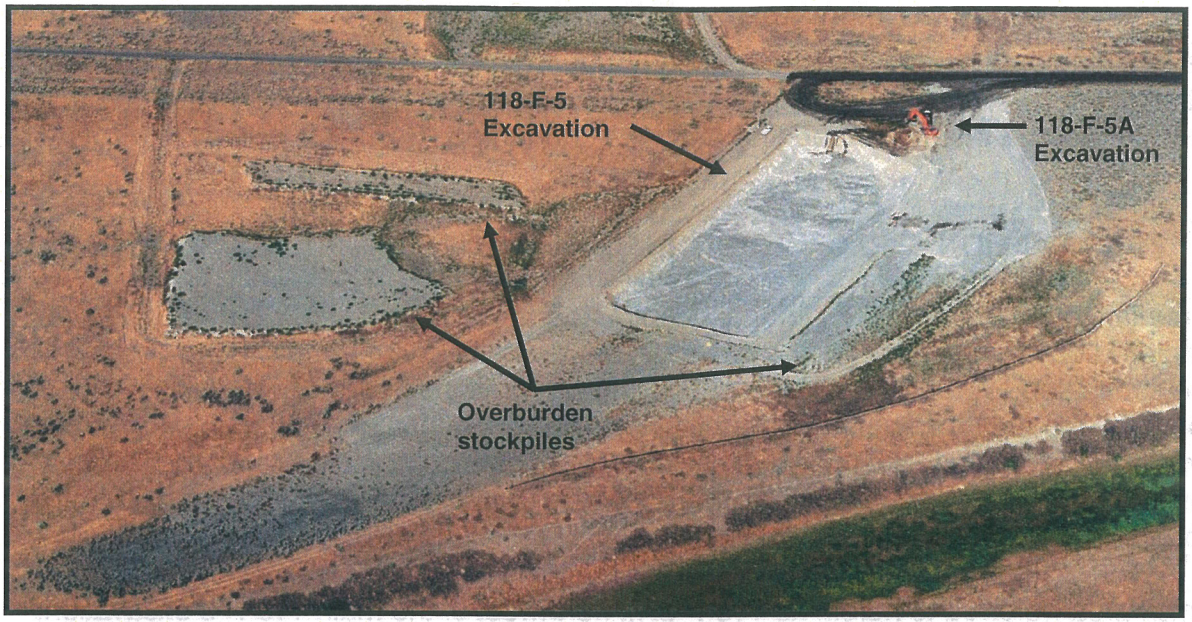


Figure 3. Aerial Photograph Showing the 118-F-5A Area Being Excavated.

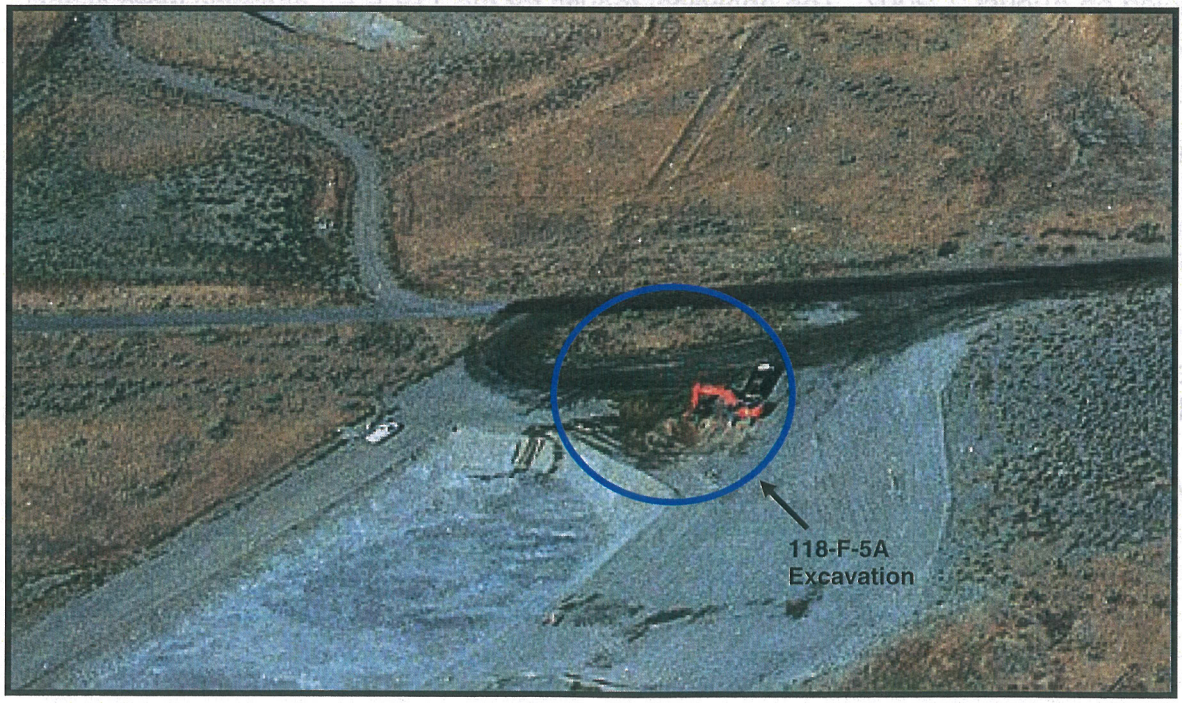
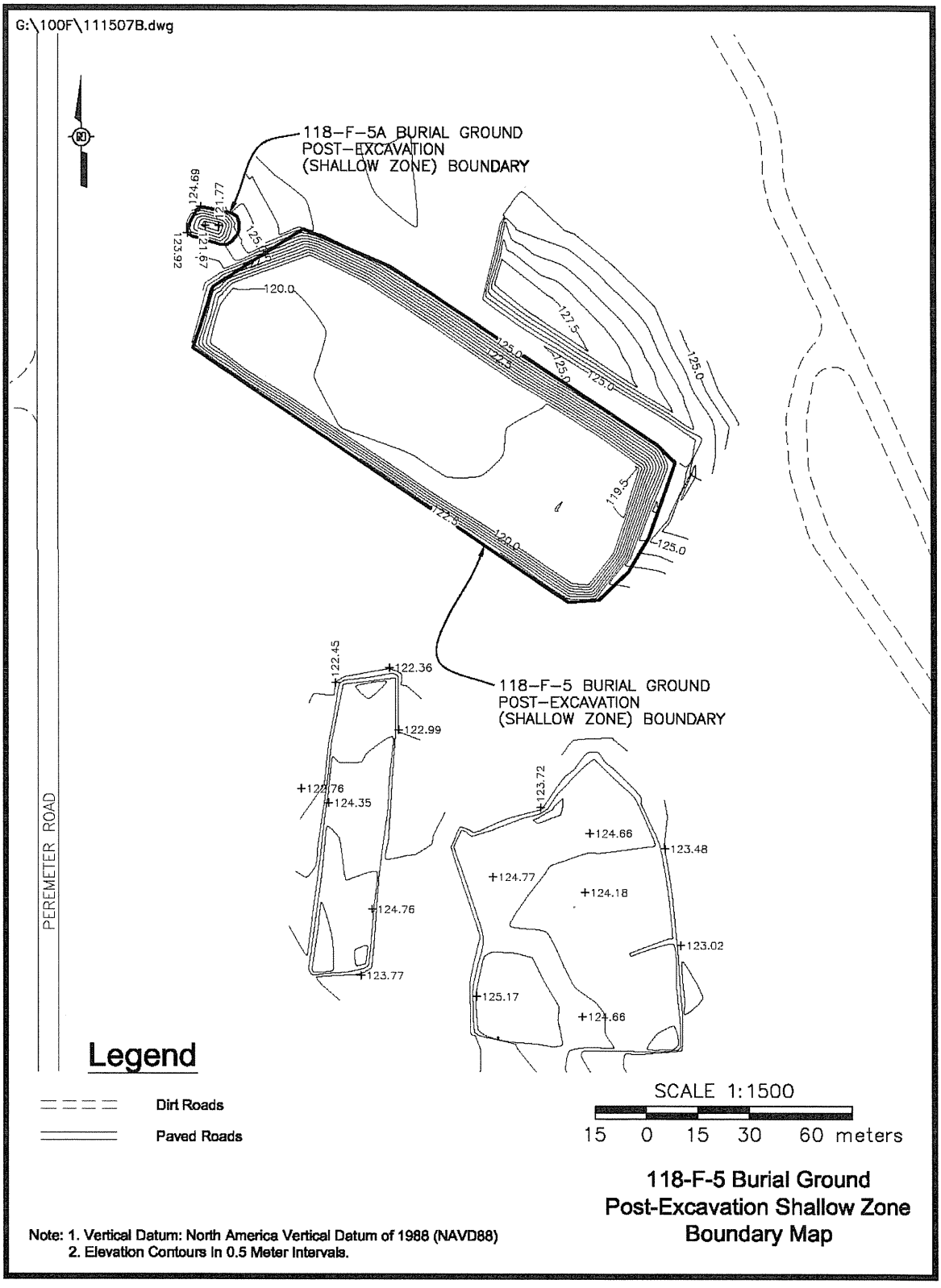


Figure 4. 118-F-5 Burial Ground Post-Excavation Topography.



3.2 FIELD SCREENING

Radiological field screening was conducted during the site remedial actions. Field screening was used to guide the excavation to quickly assess the presence and level of contamination. Field screening at the site included using a radiological data mapping system survey (Global Positioning Environmental Radiological Surveyor [GPERS]) and hand-held beta-gamma detectors. The GPERS radiological surveys for the 118-F-5 Burial Ground are provided in Appendix B.

The GPERS surveys were performed over an area larger than the excavation and stockpile footprints to provide sufficient coverage and for efficiency. The legend scale has also been adjusted in the survey plots in Appendix B relative to that typically used to enhance the visibility of the data for this site. The radiological surveys completed following remediation indicate residual radiological activity levels consistent with background. (E.g., the apparent detection of elevated activity in the survey on Page B-3 is less than twice the activity measured at the background location). Verification sampling has also demonstrated that residual radiological activity levels for the site meet the remedial action objectives.

4.0 SAMPLING ACTIVITIES

Following remediation and field screening of the 118-F-5 Burial Ground, verification sampling was conducted between August 1 and September 12, 2007 (WCH 2007). Verification sampling is performed to collect data to determine if the remedial action goals (RAGs) have been met. RAGs are the specific numeric goals against which the verification data are evaluated to demonstrate attainment of the remedial action objectives as established in the Burial Ground ROD (EPA 2000) and the 100 Area RDR/RAWP (DOE-RL 2005). The sample results are summarized in Appendix C.

The following subsections provide additional discussion of the information used to develop the contaminants of concern (COCs) for verification sampling, as well as the sampling design selection and basis.

4.1 CONTAMINANTS OF CONCERN FOR VERIFICATION SAMPLING

The Burial Ground Sampling and Analysis Plan (SAP) (DOE-RL 2001) identifies the COCs for the 118-F-5 Burial Ground as cobalt-60, plutonium-239/240 and strontium-90. In-process characterization samples were analyzed for the identified COCs and for a wide range of metals, semi-volatile organic compounds, and additional radionuclides. Analytical results for nonradionuclides were within the range of Hanford site background levels. Additional radionuclide analyses performed included: gamma energy analysis, gross alpha, gross beta, tritium, carbon-14, nickel-63, technetium-99, neptunium-237, and iodine-129. Characterization data indicated that strontium-90 is the primary 118-F-5 COC. However, carbon-14 and cesium-137 were detected at levels above

background concentrations and were added to the list of COCs for this site (Callison 2006).

4.2 SAMPLING DESIGN SELECTION AND BASIS

The sampling design for the 118-F-5 Burial Ground was established using the Burial Ground SAP (DOE-RL 2001). The site was divided into decision units (e.g., shallow zone and deep zone) based on the size of the site and depth of the excavation. This division determines the number of verification samples to collect in each decision unit. The division of the site into decision units is also a function of the applicable RAGs. The direct exposure, groundwater protection, and river protection RAGs are applicable to soils within 4.6 m (15 ft) of the ground surface. This soil zone is referred to as the shallow zone. The groundwater protection and river protection RAGs are applicable to soils greater than 4.6 m (15 ft) below the ground surface. This soil zone is referred to as the deep zone.

The 118-F-5 Burial Ground contains three decision units: (1) 118-F-5 shallow zone excavation, (2) 118-F-5A shallow zone excavation and (3) overburden stockpiles, which combines three overburden stockpile areas (also referred to as below-cleanup-level [BCL] stockpiles) into one decision unit. The calculation of the number of verification samples to collect is four composite samples per decision unit. This calculation, and the sample locations, is located in the sample design calculation in Appendix D. Figure 5 provides an overview of the three sample designs.

5.0 SAMPLING RESULTS

The verification samples were submitted to offsite laboratories for analysis using approved EPA analytical methods, as required per the Burial Ground SAP (DOE-RL 2001). The laboratory reported data results from the verification sampling were used in the statistical calculations.

The primary statistical calculation to evaluate compliance with cleanup standards is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. The 95% UCL values for each COC are computed for each of the 118-F-5 Burial Ground decision units as specified by the 100 Area RDR/RAWP (DOE-RL 2005) (Appendix D).

Comparisons of the statistical results for site COCs with the RAGs (cleanup criteria) for each of the 118-F-5 Burial Ground decision units (118-F-5 shallow zone excavation, 118-F-5A shallow zone excavation, and overburden stockpiles) are listed in Tables 1, 2, and 3. The standard laboratory analysis performed to quantify the concentrations of the COCs also detected other analytes. Potassium-40, radium-226, radium-228, thorium-228, and thorium-232 were detected in samples collected at the site, but are not considered in the statistical calculations. These isotopes are naturally occurring, not related to the operational history of the site, and/or were detected below background levels.

Figure 5. General Overview of Sample Designs for the 118-F-5 Burial Ground.

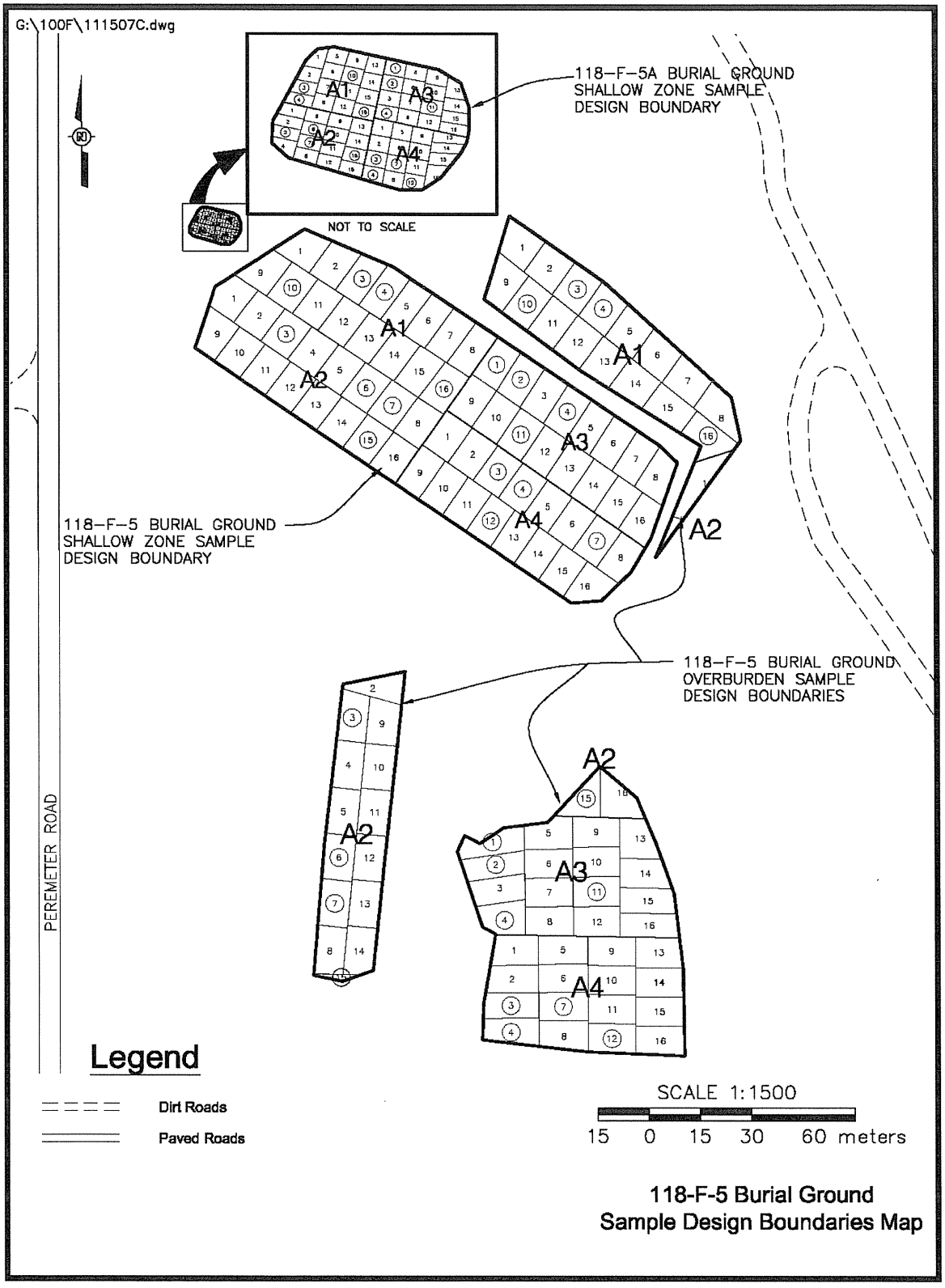


Table 1. Comparison of Statistical Contaminant Concentrations to Action Levels for the 118-F-5 Shallow Zone Excavation Verification Sampling.

COC	Statistical Result (pCi/g)	Generic Site Lookup Values[a] (pCi/g)			Does the Statistical Result Exceed Lookup Values?	Does the Statistical Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value[b]	Groundwater Protection Lookup Value	River Protection Lookup Value		
Carbon-14	-0.202 U	5.16	--[c]	--[c]	No	--
Cesium-137	0.014 U	6.2	1,465[d]	1,465[d]	No	--
Cobalt-60	0.015 U	1.4	13,900[d]	13,900[d]	No	--
Plutonium-239/240	0.120 U	33.9	--[c]	--[c]	No	--
Strontium-90	0.076 U	4.5	27.6[d]	27.6[d]	No	--

[a] Lookup values, RAGs, and/or background values obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005) or calculated per WAC 173-340-720, WAC 173-340-730, or WAC 173-340-740, Method B, 1996, unless otherwise noted.
[b] Activity corresponding to a single-radionuclide 15 mrem/yr exposure as calculated using the RESRAD model (DOE-RL 2005).
[c] No value; RESRAD modeling (BHI 2005) predicts the contaminant will not impact groundwater within 1,000 years.
[d] Revised lookup value per *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Interim Remedial Action Record of Decision* (BHI 2004).

-- = not applicable
COC = contaminant of concern
RESRAD = RESidual RADioactivity (dose-assessment model)
U = not detected
WAC = Washington Administrative Code

Table 2. Comparison of Statistical Contaminant Concentrations to Action Levels for the 118-F-5A Shallow Zone Excavation Verification Sampling. (2 Pages)

COC	Statistical Result (pCi/g)	Generic Site Lookup Values[a] (pCi/g)			Does the Statistical Result Exceed Lookup Values?	Does the Statistical Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value[b]	Groundwater Protection Lookup Value	River Protection Lookup Value		
Carbon-14	-0.558 U	5.16	--[c]	--[c]	No	--
Cesium-137	0.015 U	6.2	1,465[d]	1,465[d]	No	--
Cobalt-60	0.037 U	1.4	13,900[d]	13,900[d]	No	--

Table 2. Comparison of Statistical Contaminant Concentrations to Action Levels for the 118-F-5A Shallow Zone Excavation Verification Sampling. (2 Pages)

COC	Statistical Result (pCi/g)	Generic Site Lookup Values[a] (pCi/g)			Does the Statistical Result Exceed Lookup Values?	Does the Statistical Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value[b]	Groundwater Protection Lookup Value	River Protection Lookup Value		
Plutonium-239/240	0.010 U	33.9	--[c]	--[c]	No	--
Strontium-90	0.114 U	4.5	27.6[d]	27.6[d]	No	--

[a] Lookup values, RAGs, and/or background values obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005) or calculated per WAC 173-340-720, WAC 173-340-730, or WAC 173-340-740, Method B, 1996, unless otherwise noted.
[b] Activity corresponding to a single-radionuclide 15 mrem/yr exposure as calculated using the RESRAD model (DOE-RL 2005).
[c] No value; RESRAD modeling (BHI 2005) predicts the contaminant will not impact groundwater within 1,000 years.
[d] Revised lookup value per *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Interim Remedial Action Record of Decision* (BHI 2004).

-- = not applicable
COC = contaminant of concern
RESRAD = RESidual RADioactivity (dose-assessment model)
U = not detected
WAC = *Washington Administrative Code*

Table 3. Comparison of Statistical Contaminant Concentrations to Action Levels for the 118-F-5 Overburden Verification Sampling.

COC	Statistical Result (pCi/g)	Generic Site Lookup Values[a] (pCi/g)			Does the Statistical Result Exceed Lookup Values?	Does the Statistical Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value[b]	Groundwater Protection Lookup Value	River Protection Lookup Value		
Carbon-14	1.58 U	5.16	--[c]	--[c]	No	--
Cesium-137	0 (<BG)	6.2	1,465[d]	1,465[d]	No	--
Cobalt-60	0.008 U	1.4	13,900[d]	13,900[d]	No	--
Plutonium-239/240	0.026 U	33.9	--[c]	--[c]	No	--
Strontium-90	0.309	4.5	27.6[d]	27.6[d]	No	--

[a] Lookup values, RAGs, and/or background values obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005) or calculated per WAC 173-340-720, WAC 173-340-730, or WAC 173-340-740, Method B, 1996, unless otherwise noted.
[b] Activity corresponding to a single-radionuclide 15 mrem/yr exposure as calculated using the RESRAD model (DOE-RL 2005).
[c] No value; RESRAD modeling (BHI 2005) predicts the contaminant will not impact groundwater within 1,000 years.
[d] Revised lookup value per *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Interim Remedial Action Record of Decision* (BHI 2004).

-- = not applicable
BG = background
COC = contaminant of concern
RESRAD = RESidual RADioactivity (dose-assessment model)
U = not detected
WAC = *Washington Administrative Code*

6.0 DATA EVALUATION

This section demonstrates that remedial action at the 118-F-5 Burial Ground has achieved the applicable RAGs. Because the analytical results were significantly below single-radionuclide dose-equivalence lookup values, a site-specific cleanup verification model was not developed for the 118-F-5 Burial Ground. Evaluation of RAG attainment for radionuclides was performed using the single-radionuclide dose-equivalence lookup values.

6.1 COMPARISON OF SAMPLE DATA TO RAGS

Evaluation of the results listed in Tables 1, 2, and 3 from the verification sampling at the 118-F-5 Burial Ground indicates that all COCs were undetected and/or quantified below RAGs and lookup values.

6.2 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 2005).

Table 4 compares the maximum statistical result for the shallow zone (including the subsite 118-F-5A) and the overburden radionuclide cleanup verification results presented in the 95% upper confidence limit calculations (Appendix D) to direct exposure single radionuclide 15 mrem/yr dose-equivalence values and shows the sum of fractions evaluations. The columns on the left side of the table are the COCs and the 95% UCL values, corrected for background, as appropriate. The fourth column presents the single radionuclide 15 mrem/yr dose-equivalence activity, and the last two columns present the statistical values divided by the dose-equivalence activity. As demonstrated by the summation of these fractions, the cumulative dose contributed by residual radionuclide populations will be significantly less than the 15 mrem/yr RAG.

Table 4. Attainment of Radionuclide Direct Exposure RAG. (2 Pages)

COCs	95% UCL Statistical Values (pCi/g)		Activity Equivalent to 15 mrem/yr Dose[a] (pCi/g)	Fraction	
	Shallow Zone	Overburden		Shallow Zone	Overburden
Carbon-14	-0.20 (ND)	1.58 (ND)	5.16	0[b]	0.306
Cesium-137	0.015 (ND)	0 (<BG)	6.2	0.002	0
Cobalt-60	0.037 (ND)	0.008 (ND)	1.4	0.026	0.006
Strontium-90	0.114 (ND)	0.309	4.5	0.025	0.069
Plutonium 239/240	0.120 (ND)	0.026 (ND)	33.9	0.004	0
			Total	0.057	0.381
			Equivalent Dose (mrem/yr)	<0.86	<5.7

[a] Single radionuclide 15 mrem/yr dose-equivalence values and derivation methodology are presented in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005).
[b] The negative value was defaulted to a zero in the fraction to avoid negatively biasing the summation.

BG = background
COC = contaminant of concern
ND = not detected (in all samples in the data set)
UCL = upper confidence limit

7.0 DATA QUALITY ASSESSMENT

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 118-F-5 Burial Ground established that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. All analytical data were found to be acceptable for decision-making purposes. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The detailed DQA is presented in Appendix E.

8.0 SUMMARY FOR WASTE SITE RECLASSIFICATION

This cleanup verification package demonstrates that remedial action at the 118-F-5 Burial Ground has achieved the remedial action objectives and corresponding RAGs established in the Burial Ground ROD (EPA 2000) and RDR/RAWP (DOE RL 2005). The remaining soils at this site have been sampled, analyzed, and modeled. The results indicate that the residual concentrations of COCs at this site do not preclude any future uses (as bounded by a rural-residential scenario) and allow for unrestricted use of the shallow-zone soils (i.e., surface to 4.6 m [15 ft]) deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Site contamination did not extend into the deep zone soils;

therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

In accordance with this evaluation, the verification sampling and modeling results support a reclassification of the 118-F-5 Burial Ground to Interim Closed Out.

9.0 REFERENCES

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APPENDIX A

REMEDIATION PHOTOGRAPHS

Overview of 118-F-5 Burial Ground showing overburden removal.

Removal of overburden at 118-F-5 Burial Ground.

Layer of sawdust visible in bank of excavation.

Close-up of sawdust from excavation bank.

Excavation of 118-F-5 continuing. Sawdust visible in bank.

Material handling practices used to minimize spread of contamination, include direct loading of contaminated soil.

Front end loader moves contaminated soil within reach of excavator.

Rolloff box is tarped for transportation of contaminated soil to ERDF.

Photo showing the size of the 118-F-5 Burial Ground excavation.

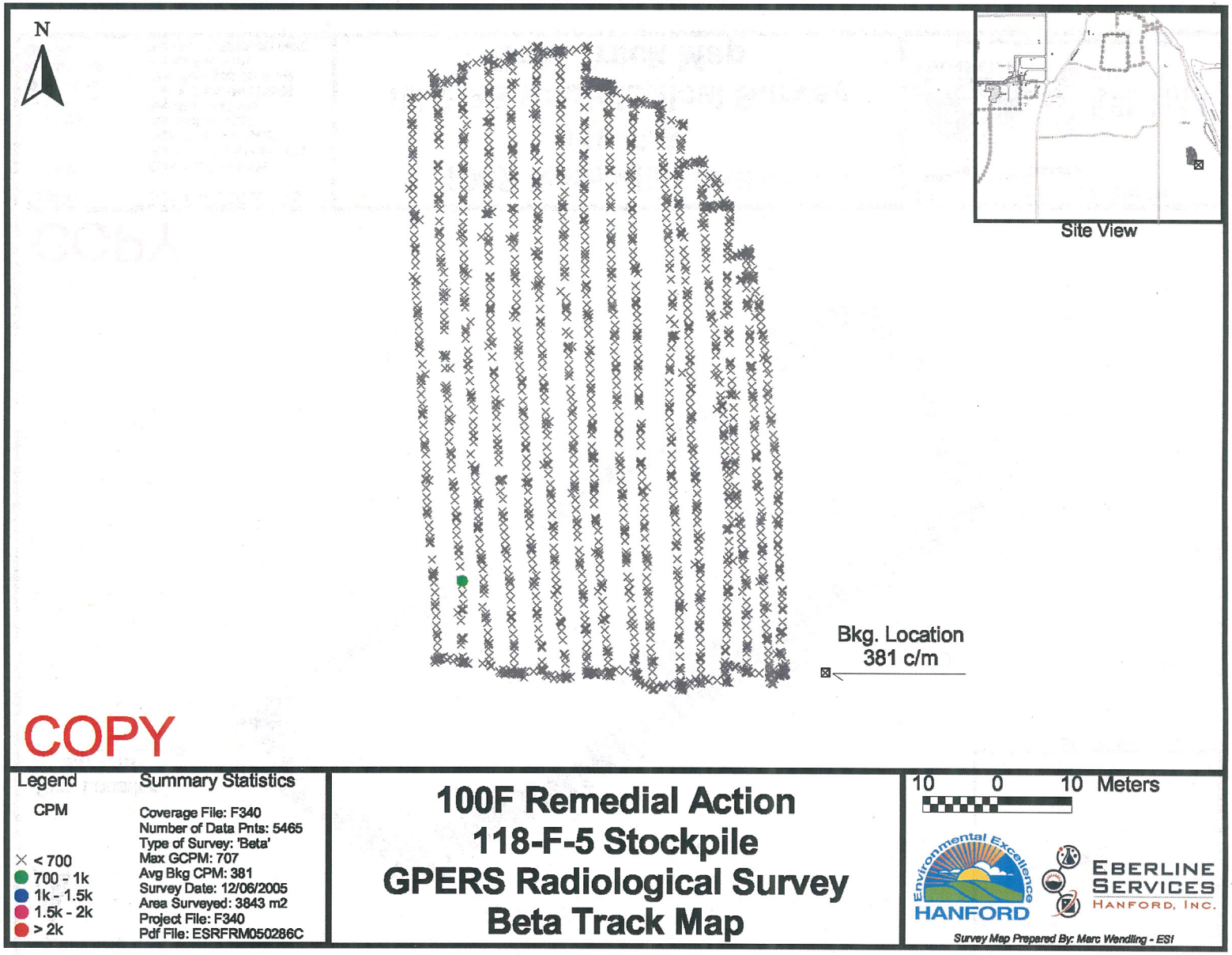
Padding (layer of clean soil) installed to minimize spread of contamination during continued excavation and load-out of contaminated soil.

Excavator sitting on top of padding and direct loading contaminated soil (June 2007).

118-F-5 Burial Ground excavation being backfilled (September 2007).

APPENDIX B

RADIOLOGICAL SURVEYS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Site View
Bkg. Location
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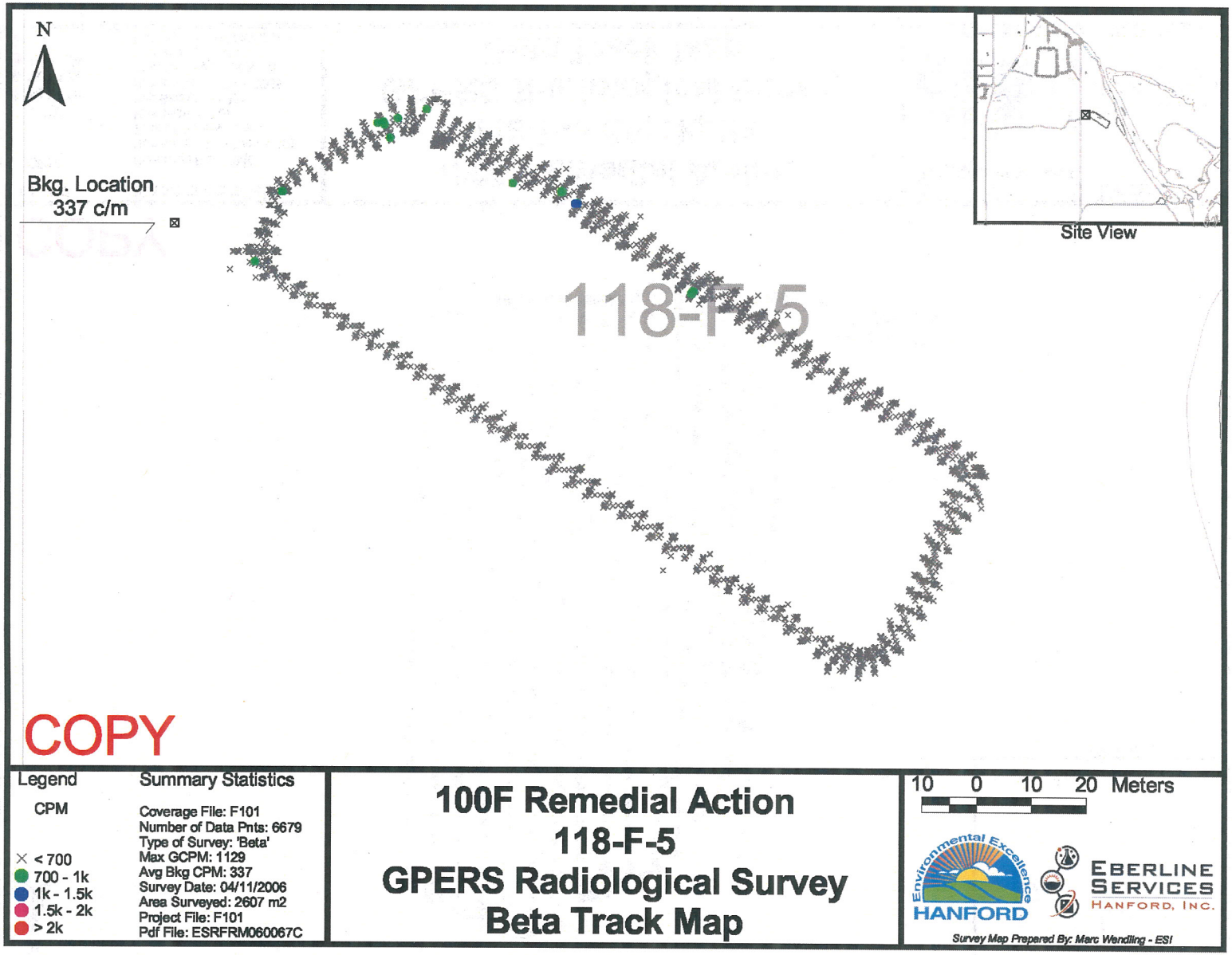
Legend
CPM
< 700
700 - 1k
1k - 1.5k
1.5k - 2k
> 2k
Summary Statistics
Coverage File: F340
Number of Data Pnts: 5465
Type of Survey: 'Beta'
Max GCPM: 707
Avg Bkg CPM: 381
Survey Date: 12/06/2005
Area Surveyed: 3843 m2
Project File: F340
Pdf File: ESRFRM050286C
100F Remedial Action
118-F-5 Stockpile
GPERS Radiological Survey
Beta Track Map
10 0 10 Meters
Environmental Excellence
HANFORD
EBERLINE SERVICES
HANFORD, INC.
Survey Map Prepared By: Marc Wendling - ESI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Bkg. Location
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Site View
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Legend
CPM
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1k - 1.5k
1.5k - 2k
> 2k
Summary Statistics
Coverage File: F101
Number of Data Pnts: 6679
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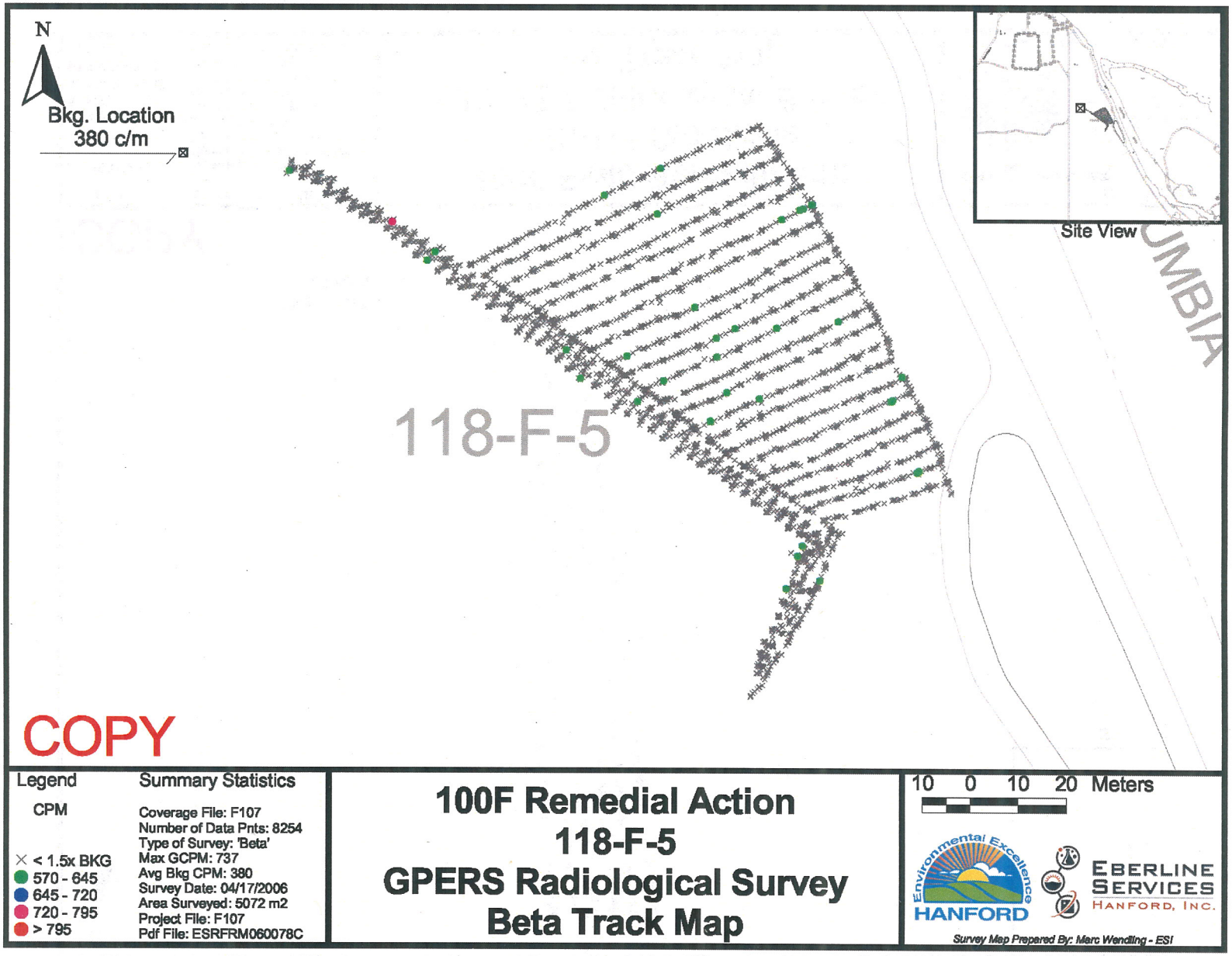
Max GCPM: 1129
Avg Bkg CPM: 337
Survey Date: 04/11/2006
Area Surveyed: 2607 m2
Project File: F101
Pdf File: ESRFRM060067C
100F Remedial Action
118-F-5
GPERS Radiological Survey
Beta Track Map
10 0 10 20 Meters
Environmental Excellence
HANFORD
EBERLINE SERVICES
HANFORD, INC.
Survey Map Prepared By: Marc Wendling - ESI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Bkg. Location
380 c/m
Site View
118-F-5
COLUMBIA
COPY
Legend
CPM
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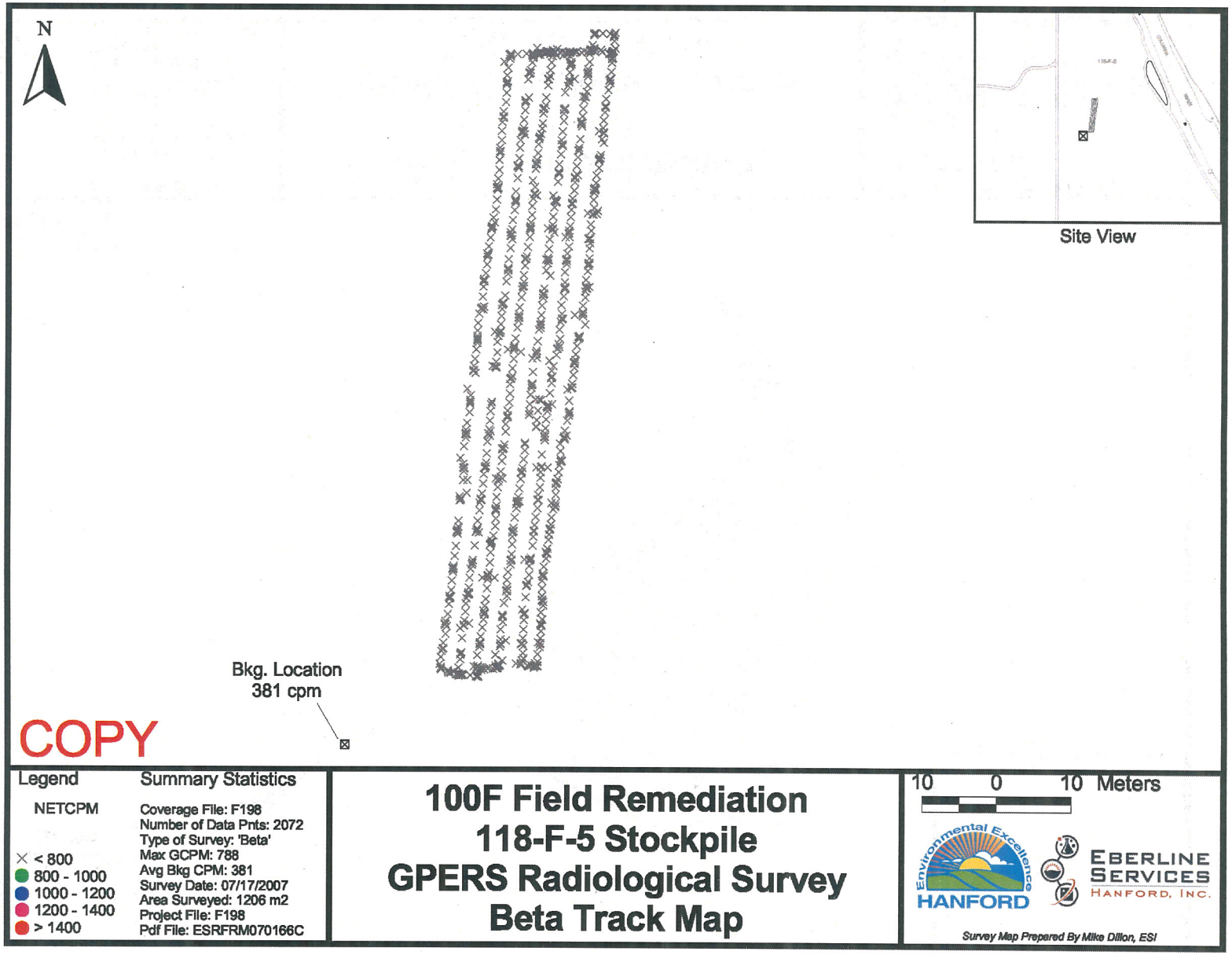
645 - 720
720 - 795
> 795
Summary Statistics
Coverage File: F107
Number of Data Pnts: 8254
Type of Survey: 'Beta'
Max GCPM: 737
Avg Bkg CPM: 380
Survey Date: 04/17/2006
Area Surveyed: 5072 m2
Project File: F107
Pdf File: ESRFRM060078C
100F Remedial Action
118-F-5
GPERS Radiological Survey
Beta Track Map
10 0 10 20 Meters
Environmental Excellence
HANFORD
EBERLINE SERVICES
HANFORD, INC.
Survey Map Prepared By: Marc Wendling - ESI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Site View
Bkg. Location
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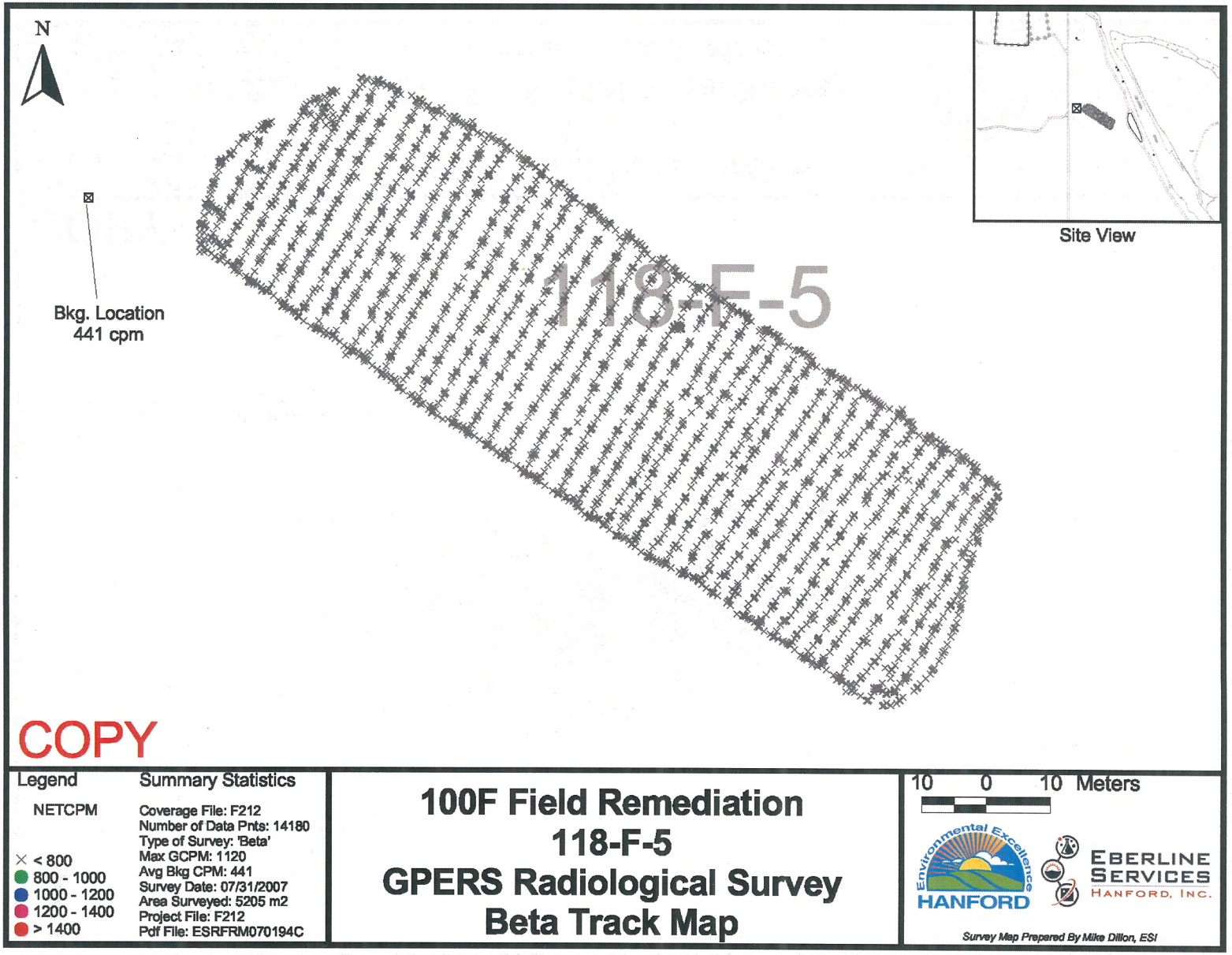
COPY
Legend
NETCPM
< 800
800 - 1000
1000 - 1200
1200 - 1400
> 1400
Summary Statistics
Coverage File: F198
Number of Data Pnts: 2072
Type of Survey: 'Beta'
Max GCPM: 788
Avg Bkg CPM: 381
Survey Date: 07/17/2007
Area Surveyed: 1206 m2
Project File: F198
Pdf File: ESRFRM070166C
100F Field Remediation
118-F-5 Stockpile
GPERS Radiological Survey
Beta Track Map
10 0 10 Meters
Environmental Excellence
HANFORD
EBERLINE SERVICES
HANFORD, INC.
Survey Map Prepared By Mike Dillon, ESI


N
Bkg. Location
441 cpm
118-F-5
Site View
COPY
Legend
NETCPM
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800 - 1000
1000 - 1200
1200 - 1400
> 1400
Summary Statistics
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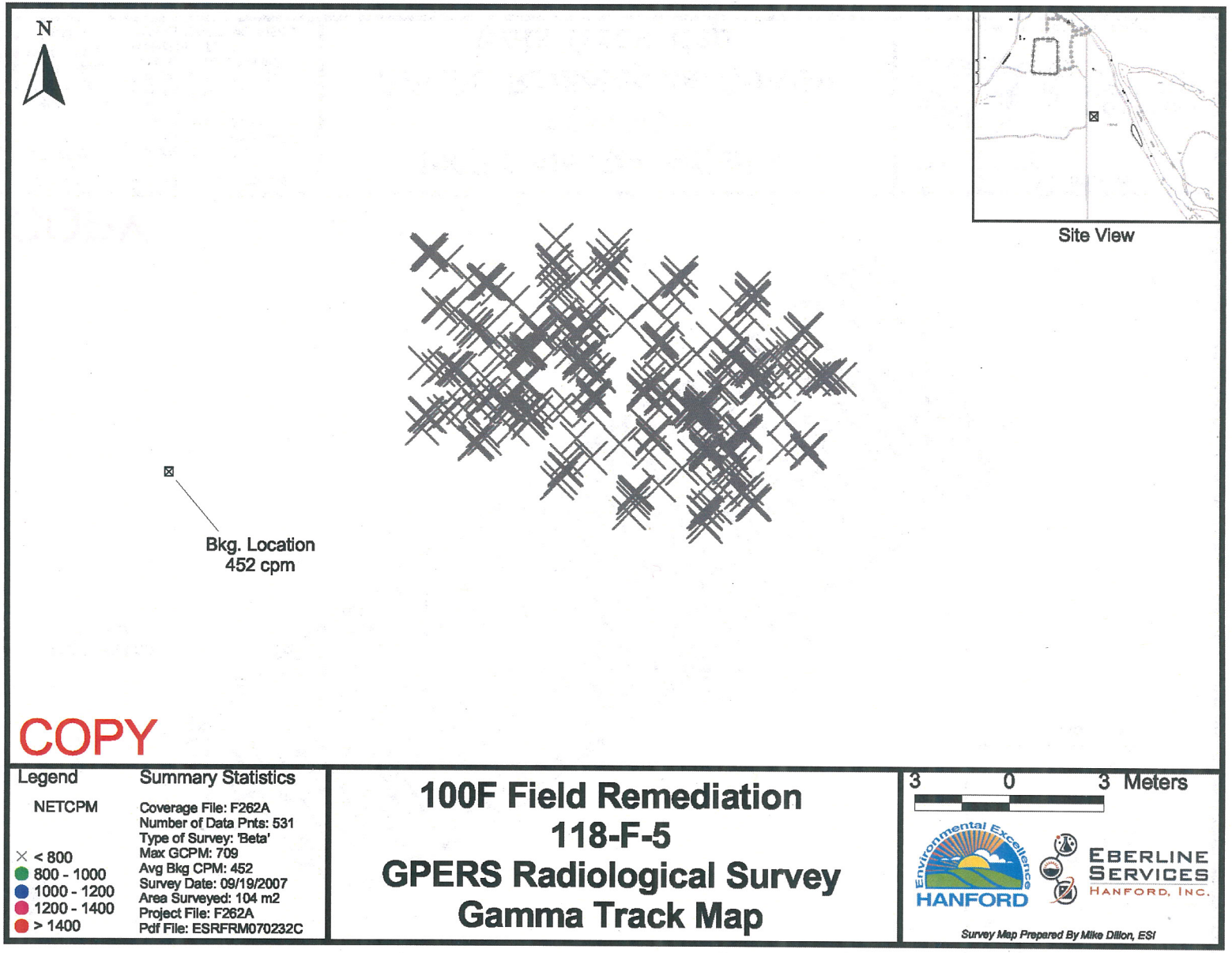
Max GCPM: 1120
Avg Bkg CPM: 441
Survey Date: 07/31/2007
Area Surveyed: 5205 m2
Project File: F212
Pdf File: ESRFRM070194C
100F Field Remediation
118-F-5
GPERS Radiological Survey
Beta Track Map
10 0 10 Meters
Environmental Excellence
HANFORD
EBERLINE SERVICES
HANFORD, INC.
Survey Map Prepared By Mike Dillon, ESI


N
Site View
Bkg. Location
452 cpm
COPY
Legend
NETCPM
< 800
800 - 1000
1000 - 1200
1200 - 1400
> 1400
Summary Statistics
Coverage File: F262A
Number of Data Pnts: 531
Type of Survey: 'Beta'
Max GCPM: 709
Avg Bkg CPM: 452
Survey Date: 09/19/2007
Area Surveyed: 104 m2
Project File: F262A
Pdf File: ESRFRM070232C
100F Field Remediation
118-F-5
GPERS Radiological Survey
Gamma Track Map
3 0 3 Meters
Environmental Excellence
HANFORD
EBERLINE SERVICES
HANFORD, INC.
Survey Map Prepared By Mike Dillon, ESI

APPENDIX C

118-F-5 WASTE SITE VERIFICATION DATA SUMMARY TABLES

Table C-1. 118-F-5 Radionuclide Data Results (2 pages)

Sample Location	Sample Number	Sample Date	Americium-241			Barium-133			Carbon-14			Cesium-137			Cobalt-60			Europium-152		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
SZ-A1	J15781	8/1/07	0.085	U	0.085	0.031	U	0.031	-2.30	U	4.19	0.023	U	0.023	0.028	U	0.028	0.062	U	0.062
SZ-A2	J15782	8/1/07	0.240	U	0.240	0.027	U	0.027	-0.105	U	4.20	0.030	U	0.030	0.030	U	0.030	0.078	U	0.078
SZ-A3	J15783	8/1/07	0.034	U	0.034	0.027	U	0.027	-1.33	U	4.08	0.024	U	0.024	0.027	U	0.027	0.065	U	0.065
SZ-A4	J15784	8/1/07	0.037	U	0.037	0.024	U	0.024	0.152	U	4.05	0.019	U	0.019	0.021	U	0.021	0.049	U	0.049
SZ-A4 - dup	J15785	8/1/07	0.130	U	0.130	0.025	U	0.025	-0.880	U	4.14	0.019	U	0.019	0.021	U	0.021	0.056	U	0.056
OB-A1	J15786	7/31/07	0.252	U	0.252	0.031	U	0.031	1.12	UJ	3.38	0.032	U	0.032	0.037	U	0.037	0.076	U	0.076
OB-A1 - dup	J15787	7/31/07	0.037	U	0.037	0.029	U	0.029	0.684	UJ	3.61	0.027	U	0.027	0.029	U	0.029	0.069	U	0.069
OB-A2	J15788	7/31/07	0.043	U	0.043	0.027	U	0.027	2.07	UJ	4.28	0.027	U	0.027	0.023	U	0.023	0.058	U	0.058
OB-A3	J15789	7/31/07	0.147	U	0.147	0.028	U	0.028	-0.287	UJ	3.96	0.026	--	0.025	0.023	U	0.023	0.061	U	0.061
OB-A4	J15790	7/31/07	0.096	U	0.096	0.036	U	0.036	0.340	UJ	4.02	0.025	U	0.027	0.031	U	0.031	0.071	U	0.071
5A SZ-A1	J15JB1	9/12/07	0.166	U	0.166	0.031	U	0.031	-1.68	U	3.06	0.025	U	0.025	0.024	U	0.024	0.070	U	0.070
5A SZ-A2	J15JB2	9/12/07	0.041	U	0.041	0.032	U	0.032	-1.74	U	3.42	0.030	U	0.030	0.032	U	0.032	0.081	U	0.081
5A SZ-A3	J15JB3	9/12/07	0.041	U	0.041	0.028	U	0.028	-0.98	U	3.20	0.025	U	0.025	0.023	U	0.023	0.060	U	0.060
5A SZ-A4	J15JB4	9/12/07	0.141	U	0.141	0.026	U	0.026	-0.34	U	3.20	0.021	U	0.021	0.023	U	0.023	0.062	U	0.062
5A SZ-A4 - dup	J15JB5	9/12/07	0.287	U	0.287	0.059	U	0.059	-0.061	U	3.19	0.037	U	0.037	0.037	U	0.037	0.091	U	0.091
5A SZ-A4 - split	J15JB6	9/12/07	--	--	--	-0.005	U	0.013	0.027	U	0.337	0.002	U	0.013	0.008	U	0.015	-0.021	U	0.032

Sample Location	Sample Number	Sample Date	Europium-154			Europium-155			Nickel-63			Plutonium-238			Plutonium-239/240			Potassium-40		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
SZ-A1	J15781	8/1/07	0.086	U	0.086	0.067	U	0.067	1.04	U	3.14	-0.026	U	0.195	0.026	U	0.195	13.6	--	0.256
SZ-A2	J15782	8/1/07	0.113	U	0.113	0.091	U	0.091	-1.44	U	3.34	0.206	U	0.206	0.027	U	0.206	14.1	--	0.272
SZ-A3	J15783	8/1/07	0.095	U	0.095	0.061	U	0.061	-0.633	U	3.03	0.079	U	0.302	0.302	U	0.302	13.2	--	0.220
SZ-A4	J15784	8/1/07	0.074	U	0.074	0.087	U	0.087	-0.122	U	3.30	0.078	U	0.296	0.078	U	0.078	13.8	--	0.207
SZ-A4 - dup	J15785	8/1/07	0.070	U	0.070	0.072	U	0.072	0.299	U	3.04	0.379	U	0.966	0.126	U	0.966	13.4	--	0.206
OB-A1	J15786	7/31/07	0.123	U	0.123	0.101	U	0.101	-0.726	U	3.48	0.033	U	0.256	0.033	U	0.256	14.1	--	0.298
OB-A1 - dup	J15787	7/31/07	0.097	U	0.097	0.062	U	0.062	-0.625	U	3.37	0	U	0.376	0.049	U	0.376	12.9	--	0.254
OB-A2	J15788	7/31/07	0.083	U	0.083	0.066	U	0.066	-2.50	U	3.53	0.024	U	0.185	0.048	U	0.185	14.1	--	0.213
OB-A3	J15789	7/31/07	0.074	U	0.074	0.083	U	0.083	-1.16	U	3.44	0	U	0.310	0.041	U	0.310	14.1	--	0.263
OB-A4	J15790	7/31/07	0.103	U	0.103	0.074	U	0.074	-2.18	U	3.42	0.025	U	0.194	0	U	0.194	13.1	--	0.261
5A SZ-A1	J15JB1	9/12/07	0.091	U	0.091	0.094	U	0.094	0.355	U	3.00	0.003	U	0.058	-0.006	U	0.029	14.8	--	0.296
5A SZ-A2	J15JB2	9/12/07	0.100	U	0.100	0.066	U	0.066	-0.20	U	3.38	-0.01	U	0.063	0.017	U	0.026	12.1	--	0.378
5A SZ-A3	J15JB3	9/12/07	0.088	U	0.088	0.068	U	0.068	1.79	U	3.36	0.031	U	0.058	-0.008	U	0.036	14.4	--	0.258
5A SZ-A4	J15JB4	9/12/07	0.068	U	0.068	0.082	U	0.082	0.578	U	3.49	-0.065	U	0.309	0.0	U	0.247	12.1	--	0.250
5A SZ-A4 - dup	J15JB5	9/12/07	0.132	U	0.132	0.11	U	0.11	-0.247	U	3.47	0.0	U	0.581	0.0	U	0.581	12.9	--	0.444
5A SZ-A4 - split	J15JB6	9/12/07	0.019	U	0.048	0.037	U	0.038	3.24	U	5.74	0.803	--	0.033	0.058	--	0.044	--	--	--

Table C-1. 118-F-5 Radionuclide Data Results (2 pages)

Sample Location	Sample Number	Sample Date	Radium-226			Radium-228			Silver-108			Thorium-228			Thorium-232			Total Strontium		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
SZ-A1	J15781	8/1/07	0.369	U	0.042	0.544	--	0.098	0.018	U	0.018	0.615	--	0.047	0.544	--	0.098	-0.090	U	0.253
SZ-A2	J15782	8/1/07	0.424	--	0.056	0.589	--	0.130	0.022	U	0.022	0.494	--	0.041	0.589	--	0.130	-0.030	U	0.256
SZ-A3	J15783	8/1/07	0.305	--	0.048	0.395	--	0.108	0.020	U	0.020	0.433	--	0.032	0.395	--	0.108	0.140	U	0.187
SZ-A4	J15784	8/1/07	0.415	--	0.038	0.510	--	0.104	0.015	U	0.015	0.582	--	0.027	0.510	--	0.104	-0.091	U	0.249
SZ-A4 - dup	J15785	8/1/07	0.368	--	0.038	0.584	--	0.094	0.015	U	0.015	0.544	--	0.029	0.584	--	0.094	-0.013	U	0.255
OB-A1	J15786	7/31/07	0.427	--	0.068	0.683	--	0.139	0.025	U	0.025	0.570	--	0.043	0.683	--	0.139	0.190	U	0.314
OB-A1 - dup	J15787	7/31/07	0.360	--	0.050	0.517	--	0.109	0.020	U	0.020	0.541	--	0.032	0.517	--	0.109	0.179	U	0.256
OB-A2	J15788	7/31/07	0.470	--	0.048	0.668	--	0.110	0.018	U	0.018	0.696	--	0.030	0.668	--	0.110	0.199	U	0.264
OB-A3	J15789	7/31/07	0.464	--	0.043	0.588	--	0.096	0.017	U	0.017	0.602	--	0.033	0.588	--	0.096	0.052	U	0.284
OB-A4	J15790	7/31/07	0.388	--	0.048	0.621	--	0.115	0.019	U	0.019	0.793	--	0.047	0.621	--	0.115	0.654	--	0.248
5A SZ-A1	J15JB1	9/12/07	0.498	--	0.049	0.760	--	0.096	0.020	U	0.020	0.690	--	0.039	0.760	--	0.096	0.015	U	0.338
5A SZ-A2	J15JB2	9/12/07	0.460	--	0.058	0.644	--	0.124	0.021	U	0.021	0.680	--	0.041	0.644	--	0.124	0.105	U	0.304
5A SZ-A3	J15JB3	9/12/07	0.499	--	0.056	0.723	--	0.119	0.017	U	0.017	0.715	--	0.034	0.723	--	0.119	0.119	U	0.353
5A SZ-A4	J15JB4	9/12/07	0.448	--	0.038	0.659	--	0.094	0.016	U	0.016	0.661	--	0.033	0.659	--	0.094	0.182	U	0.301
5A SZ-A4 - dup	J15JB5	9/12/07	0.477	--	0.062	0.871	--	0.161	0.026	U	0.026	0.729	--	0.045	0.871	--	0.161	-0.062	U	0.365
5A SZ-A4 - split	J15JB6	9/12/07	--	--	--	--	--	--	-0.003	U	0.098	--	--	--	--	--	--	0.072	U	0.179

Sample Location	Sample Number	Sample Date	Tritium			Uranium-235			Uranium-238		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
SZ-A1	J15781	8/1/07	2.54	U	4.13	0.105	U	0.105	2.90	U	2.90
SZ-A2	J15782	8/1/07	1.18	U	4.02	0.158	U	0.158	3.79	U	3.79
SZ-A3	J15783	8/1/07	2.72	U	4.21	0.099	U	0.099	3.39	U	3.39
SZ-A4	J15784	8/1/07	4.81	U	4.18	0.093	U	0.093	2.46	U	2.46
SZ-A4 - dup	J15785	8/1/07	1.04	U	4.22	0.101	U	0.101	2.49	U	2.49
OB-A1	J15786	7/31/07	1.90	UJ	2.88	0.149	U	0.149	4.05	U	4.05
OB-A1 - dup	J15787	7/31/07	0.184	UJ	5.35	0.103	U	0.103	3.53	U	3.53
OB-A2	J15788	7/31/07	2.23	UJ	5.32	0.104	U	0.104	3.03	U	3.03
OB-A3	J15789	7/31/07	0.705	UJ	5.19	0.110	U	0.110	2.87	U	2.87
OB-A4	J15790	7/31/07	0.596	UJ	5.16	0.114	U	0.114	3.29	U	3.29
5A SZ-A1	J15JB1	9/12/07	-0.520	U	4.24	0.133	U	0.133	2.86	U	2.86
5A SZ-A2	J15JB2	9/12/07	-0.439	U	4.77	0.123	U	0.123	3.94	U	3.94
5A SZ-A3	J15JB3	9/12/07	-1.55	U	4.39	0.109	U	0.109	3.3	U	3.3
5A SZ-A4	J15JB4	9/12/07	-0.335	U	4.37	0.112	U	0.112	2.58	U	2.58
5A SZ-A4 - dup	J15JB5	9/12/07	0.067	U	4.37	0.160	U	0.160	4.55	U	4.55
5A SZ-A4 - split	J15JB6	9/12/07	3.24	U	5.74	--	--	--	--	--	--

-- = not analyzed
5A = 118-F-5A
BCL = below cleanup levels
MDA = minimum detectable activity
OB = overburden
Q = qualifier
SZ = shallow zone
U = undetected

APPENDIX D

CALCULATIONS

CALCULATION BRIEFS

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

118-F-5 Burial Ground Cleanup Verification 95% UCL Calculation, 0100F-CA-V0289, Rev. 0.

118-F-5A Cleanup Verification 95% UCL Calculation, 0100F-CA-V0316, Rev. 0.

Shallow Zone/Stockpile (BCL) Sampling Plan, 0100F-CA-V0291, Rev. 0.

118-F-5A Burial Ground Shallow Zone Sampling Plan, 0100F-CA-V0330, Rev. 0.

DISCLAIMER FOR CALCULATIONS

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

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-F Field Remediation **Job No. 14655**

Area: 100-F

Discipline: Environmental *Calculation No: 0100F-CA-V0289

Subject: 118-F-5 Burial Ground Cleanup Verification 95% UCL Calculations

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Total = 5	L. D. Habel	K. A. Anselm	J. M. Capron	S. W. Callison	8-21-07

SUMMARY OF REVISION

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

CALCULATION SHEET

Washington Closure Hanford

Originator L. D. Habel
Project 100-F Field Remediation
Subject 118-F-5 Burial Ground Cleanup Verification 95% UCL Calculations

Date 08/20/07
Job No. 14655

Calc. No. 0100F-CA-V0289 **Rev. No.** 0
Checked K. A. Anselm **Date** 08/20/07
Sheet No. 1 of 3

Summary

Purpose:
Calculate the 95% upper confidence limit (UCL) values for contaminants of concern (COCs) to evaluate compliance with cleanup standards for the subject site.

Table of Contents:
Sheet 1 - Summary
Sheet 2 - 118-F-5 Excavation Shallow Zone Statistical Calculations
Sheet 3 - 118-F-5 Overburden/BCL Material Statistical Calculations
Attachment 1 - 118-F-5 Verification Sampling Results

Given/References:
1) Sample Results (Attachment 1).
2) DOE-RL, 2005, *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Solution:
Calculation methodology is described in the RDR/RAWP (DOE-RL 2005). Use data from attached worksheets to perform the 95% UCL calculation for each analyte and the RPD calculations, as required.

Calculation Description:
The subject calculations were performed on data from soil verification samples from the subject waste site. The data were entered into an EXCEL 2003 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2005) is documented by this calculation. RPD calculations were not performed, as all COCs were non-detected in the primary/duplicate sample pair(s).

Methodology:
For radionuclide data, calculation of the statistics is done using 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 duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above. Calculations for radionuclide data sets are performed assuming non-parametric distribution, without further testing for distributional form.

The results presented in the summary tables that follow are for use in risk analysis and the CVP for this site.

Results Summary:

Analyte	Shallow Zone Excavation		Overburden/ BCL Stockpile		Units
	Result	Qualifier	Result	Qualifier	
Carbon-14	-0.202	U	1.58	U	pCi/g
Cesium-137	0.014	U	0 (< BG)		pCi/g
Cobalt-60	0.015	U	0.008	U	pCi/g
Total Strontium	0.076	U	0.309		pCi/g
Plutonium 239/240	0.120	U	0.026	U	pCi/g

Abbreviations/Acronyms:
BCL = below cleanup levels
BG = background
COC = contaminant of concern
MDA = minimum detectable activity
NA = not applicable
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
U = undetected
UCL = upper confidence limit

CALCULATION SHEET

Washington Closure Hanford

Originator L. D. Habel

Project 100-F Field Remediation

Subject 118-F-5 Burial Ground Cleanup Verification 95% UCL Calculations

Date 08/20/07

Job No. 14655

Calc. No. 0100F-CA-V0289

Checked K. A. Anselm

Rev. No. 0

Date 08/20/07

Sheet No. 2 of 3

1 **118-F-5 Excavation Shallow Zone Statistical Calculations**

2 **Verification Data**

3				Carbon-14			Cesium-137			Cobalt-60			Total Strontium			Plutonium 239/240		
4	Sample Area	Sample Number	Sample Date	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
5	A-1	J15781	08/01/07	-2.30	U	4.19	0.023	U	0.023	0.028	U	0.028	-0.090	U	0.253	0.026	U	0.195
6	A-2	J15782	08/01/07	-0.105	U	4.20	0.030	U	0.030	0.030	U	0.030	-0.030	U	0.256	0.027	U	0.206
7	A-3	J15783	08/01/07	-1.33	U	4.08	0.024	U	0.024	0.027	U	0.027	0.140	U	0.187	0.302	U	0.302
8	A-4	J15784	08/01/07	0.152	U	4.05	0.019	U	0.019	0.021	U	0.021	-0.091	U	0.249	0.078	U	0.078
9	Duplicate of J15784	J15785	08/01/07	-0.880	U	4.14	0.019	U	0.019	0.021	U	0.021	-0.013	U	0.255	0.126	U	0.966

10 **Statistical Computation Input Data**

11				Carbon-14			Cesium-137			Cobalt-60			Total Strontium			Plutonium 239/240		
12	Sample Area	Sample Number	Sample Date	pCi/g			pCi/g			pCi/g			pCi/g			pCi/g		
13	A-1	J15781	8/1/2007	-2.30			0.012			0.014			-0.090			0.026		
14	A-2	J15782	8/1/2007	-0.105			0.015			0.015			-0.030			0.027		
15	A-3	J15783	8/1/2007	-1.33			0.012			0.014			0.140			0.151		
16	A-4	J15784/J15785	8/1/2007	-0.364			0.0095			0.011			-0.052			0.083		

17 **Statistical Computations**

18		Carbon-14			Cesium-137			Cobalt-60			Total Strontium			Plutonium 239/240		
19	95% UCL based on	Radionuclide data set. Use nonparametric z-stat.			Radionuclide data set. Use nonparametric z-stat.			Radionuclide data set. Use nonparametric z-stat.			Radionuclide data set. Use nonparametric z-stat.			Radionuclide data set. Use nonparametric z-stat.		
20	N	4			4			4			4			4		
21	% < Detection limit	100%			100%			100%			100%			100%		
22	Mean	-1.02			0.012			0.013			-0.0080			0.072		
23	Standard deviation	1.00			0.0023			0.0019			0.10			0.059		
24	95% UCL on mean	-0.202			0.014			0.015			0.076			0.120		
25	Background	NA			NA			NA			NA			NA		
26	Statistical value above background	-0.202	U		0.014	U		0.015	U		0.076	U		0.120	U	

27

CALCULATION SHEET

Washington Closure Hanford

Originator L. D. Habel

Project 100-F Field Remediation

Subject 118-F-5 Burial Ground Cleanup Verification 95% UCL Calculations

Date 08/20/07

Job No. 14655

Calc. No. 0100F-CA-V0289

Checked K. A. Anselm

Rev. No. 0

Date 08/20/07

Sheet No. 3 of 3

118-F-5 Overburden/BCL Material Statistical Calculations

Verification Data

Sample Area	Sample Number	Sample Date	Carbon-14			Cesium-137			Cobalt-60			Total Strontium			Plutonium 239/240		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A-1	J15786	39294	1.12	U	3.38	0.032	U	0.032	0.037	U	0.037	0.190	U	0.314	0.033	U	0.256
Duplicate of J15786	J15787	39294	0.684	U	3.61	0.027	U	0.027	0.029	U	0.029	0.179	U	0.256	0.049	U	0.376
A-2	J15788	39294	2.07	U	4.28	0.027	U	0.027	0.023	U	0.023	0.199	U	0.264	0.048	U	0.185
A-3	J15789	39294	-0.287	U	3.96	0.026		0.025	0.023	U	0.023	0.052	U	0.284	0.041	U	0.31
A-4	J15790	39294	0.340	U	4.02	0.025	U	0.027	0.031	U	0.031	0.654		0.248	0	U	0.194

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Carbon-14			Cesium-137			Cobalt-60			Total Strontium			Plutonium 239/240		
			pCi/g			pCi/g			pCi/g			pCi/g			pCi/g		
A-1	J15786/J15787	7/31/2007	0.90			0.015			0.017			0.185			0.041		
A-2	J15788	7/31/2007	2.07			0.014			0.012			0.199			0.048		
A-3	J15789	7/31/2007	-0.287			0.026			0.012			0.052			0.041		
A-4	J15790	7/31/2007	0.340			0.025			0.016			0.654			0		

Statistical Computations

	Carbon-14			Cesium-137			Cobalt-60			Total Strontium			Plutonium 239/240		
95% UCL based on	Radionuclide data set. Use nonparametric z-stat.			Radionuclide data set. Use nonparametric z-stat.			Radionuclide data set. Use nonparametric z-stat.			Radionuclide data set. Use nonparametric z-stat.			Radionuclide data set. Use nonparametric z-stat.		
N	4			4			4			4			4		
% < Detection limit	100%			75%			100%			75%			100%		
Mean	0.76			0.020			0.014			0.272			0.033		
Standard deviation	1.001			0.007			0.003			0.263			0.022		
95% UCL on mean	1.58			0.025			0.016			0.489			0.051		
Background	NA			1.1			0.008			0.18			0.025		
Statistical value above background	1.58	U		0 (< BG)			0.008	U		0.309			0.026	U	

Attachment 1. 118-F-5 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Carbon-14			Cesium-137			Cobalt-60			Total Strontium			Plutonium 239/240		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Excavation Shallow Zone																	
A-1	J15781	8/1/07	-2.30	U	4.19	0.023	U	0.023	0.028	U	0.028	-0.090	U	0.253	0.026	U	0.195
A-2	J15782	8/1/07	-0.105	U	4.20	0.030	U	0.030	0.030	U	0.030	-0.030	U	0.256	0.027	U	0.206
A-3	J15783	8/1/07	-1.33	U	4.08	0.024	U	0.024	0.027	U	0.027	0.140	U	0.187	0.302	U	0.302
A-4	J15784	8/1/07	0.152	U	4.05	0.019	U	0.019	0.021	U	0.021	-0.091	U	0.249	0.078	U	0.078
Duplicate of J15784	J15785	8/1/07	-0.880	U	4.14	0.019	U	0.019	0.021	U	0.021	-0.013	U	0.255	0.126	U	0.966
Overburden/BCL																	
A-1	J15786	7/31/07	1.12	U	3.38	0.032	U	0.032	0.037	U	0.037	0.190	U	0.314	0.033	U	0.256
Duplicate of J15786	J15787	7/31/07	0.684	U	3.61	0.027	U	0.027	0.029	U	0.029	0.179	U	0.256	0.049	U	0.376
A-2	J15788	7/31/07	2.07	U	4.28	0.027	U	0.027	0.023	U	0.023	0.199	U	0.264	0.048	U	0.185
A-3	J15789	7/31/07	-0.287	U	3.96	0.026		0.025	0.023	U	0.023	0.052	U	0.284	0.041	U	0.310
A-4	J15790	7/31/07	0.340	U	4.02	0.025	U	0.027	0.031	U	0.031	0.654		0.248	0	U	0.194

BCL = below cleanup levels

MDA = minimum detectable activity

Q = qualifier

U = undetected

Attachment	1	Sheet No.	1 of 1
Originator	L. D. Habel	Date	08/20/07
Checked	K. A. Anselm	Date	8/20/07
Calc. No.	0100F-CA-V0289	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-F Area Field Remediation **Job No. 14655**

Area: 100-F

Discipline: Environmental *Calculation No: 0100F-CA-V0316

Subject: 118-F-5A Cleanup Verification 95% UCL Calculations

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 4 Attm. = 1 Total = 6	M. J. Appel 10/8/07	J. M. Capron by S.W. Callison	NA	S. W. Callison	10-9-07

SUMMARY OF REVISION

*Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford

CALCULATION SHEET

Originator M. J. Appel MJA
Project 100-F Area Field Remediation
Subject 118-F-5A Cleanup Verification 95% UCL Calculations

Date 10/08/07
Job No. 14655

Calc. No. 0100F-CA-V0316
Checked J. M. Capron
By S W Clark

Rev. No. 0
Date 10/8/07
Sheet No. 1 of 4

Summary

Purpose:
Calculate the 95% upper confidence limit (UCL) to evaluate compliance with cleanup standards for the subject site and calculate the relative percent difference (RPD) for each contaminant of concern (COC). There are no non-radionuclide COCs for this site, therefore, the *Washington Administrative Code* (WAC) 173-340 (Model Toxics Control Act-Cleanup) 3-part test and calculations for carcinogenic risk were not required.

Table of Contents:

Given/References:

1) Sample Results (Attachment 1).
2) Background values and remedial action goals (RAGs) are taken from DOE-RL (2005), DOE-RL (2001a), and Ecology (2005).
3) DOE-RL, 2001a, 100 Area Burial Grounds Remedial Action Sampling and Analysis Plan, DOE/RL 2001-35, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) DOE-RL, 2005, Remedial Design Report/Remedial Action Work Plan for the 100 Area (RDR/RAWP), DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
5) Ecology, 1992, Statistical Guidance for Ecology Site Managers, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
6) 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.
7) Ecology, 2005, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.
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 2005). Use data from the attached worksheets to calculate the 95% UCL and calculate the RPD for each COC in the primary-duplicate and primary-split sample pairs. There are no non-rad COCs, and, therefore, the WAC 173-340 test was not performed.

Calculation Description:
The subject calculations were performed on data from soil verification samples collected from a subsite of the 118-F-5 waste site, herein referred to as 118-F-5A. The data were entered into an EXCEL 2003 spreadsheet and calculations performed by utilizing the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2005) is documented by this calculation. Split and duplicate RPD results are used in evaluation of data quality and are presented in the cleanup verification package (CVP) for this site. The results from the 118-F-5A verification sampling event will be presented and discussed within the CVP for the 118-F-5 waste site.

Methodology:
For all radionuclide COCs, the statistical value calculated to evaluate the effectiveness of cleanup is the 95% UCL. For radionuclide data, calculation of the statistics was done on the reported value. In cases where the laboratory does not report a value below the minimal detectable activity (MDA), half of the MDA is used in the calculation. For the statistical evaluation of primary-duplicate sample pairs, the samples are averaged before being included in the data set. For all radionuclide data sets, the calculations are performed assuming nonparametric distribution, so no test for distribution is performed.

Washington Closure Hanford CALCULATION SHEET

Originator M. J. Appel Date 10/08/07 Calc. No. 0100F-CA-V0316 Rev. No. 0
Project 100-F Area Field Remediation Job No. 14655 Checked J. M. Capron Date 10/8/07
Subject 118-F-5A Cleanup Verification 95% UCL Calculations By S.W. Clark Sheet No. 2 of 4

Summary (continued)

Methodology (continued):
The COCs for the 118-F-5A soil verification samples are the same as those for the 118-F-5 waste site. The COCs are: cobalt-60, cesium-137, carbon-14, strontium-90, and plutonium-239/240. No non-radionuclide analysis was performed for the 118-F-5A portion of the waste site. In addition to the aforementioned COCs, the analytical laboratory reported radionuclide analytes that are not contaminants of concern for this waste site (e.g., americium-241, nickel-63, tritium). These results are also included in Attachment 1. All additional non-COC results were below detection (Attachment 1) and, therefore, did not warrant calculation of the 95% UCL. These analytes, however, were included in the analysis of the split and duplicate RPD calculations for quality assurance/quality control (QA/QC) purposes.

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

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

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

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

No regulatory split samples were collected for this site.

Results:

The results presented in the summary tables that follow are for use in the 118-F-5 CVP .

Results Summary

Analyte	Shallow Zone		Units
	Result	Qualifier	
Cesium-137	0.015	U	pCi/g
Cobalt-60	0.037	U	pCi/g
Carbon-14	-0.558	U	pCi/g
Plutonium-239/240	0.010	U	pCi/g
Strontium-90	0.114	U	pCi/g

U = undetected

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

Analyte	Shallow Zone
	Duplicate Analysis[b]
Potassium-40	6.4%

[a]Relative percent difference evaluation was not required for analytes not included in this table.
[b]As necessary, the value is discussed in the CVP.
QA/QC = quality assurance/quality control

Washington Closure Hanford

CALCULATION SHEET

Originator M. J. Appel MA
Project 100-F Area Field Remediation
Subject 118-F-5A Cleanup Verification 95% UCL Calculations

Date 10/8/07
Job No. 14655

Calc. No. 0100F-CA-V0316
Checked J. M. Capron
by S. W. Clark SWC

Rev. No. 0
Date 10/8/07
Sheet No. 3 of 4

118-F-5A Sample Data

Sampling Area	Sample Number	Sample Date	Cesium-137			Cobalt-60			Carbon-14			Plutonium-239/240			Strontium-90		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J15JB1	9/12/07	0.025	U	0.025	0.024	U	0.024	-1.68	U	3.06	-0.006	U	0.029	0.015	U	0.338
A2	J15JB2	9/12/07	0.030	U	0.030	0.032	U	0.032	-1.74	U	3.42	0.017	U	0.026	0.105	U	0.304
A3	J15JB3	9/12/07	0.025	U	0.025	0.023	U	0.023	-0.98	U	3.20	-0.008	U	0.036	0.119	U	0.353
A4	J15JB4	9/12/07	0.021	U	0.021	0.023	U	0.023	-0.34	U	3.20	0.0	U	0.247	0.182	U	0.301
Duplicate of J15JB4	J15JB5	9/12/07	0.037	U	0.037	0.037	U	0.037	-0.061	U	3.19	0.0	U	0.581	-0.062	U	0.365

Statistical Computation Input Data

Sampling Area	Sample Number	Sample Date	Cesium-137 pCi/g			Cobalt-60 pCi/g			Carbon-14 pCi/g			Plutonium-239/240 pCi/g			Strontium-90 pCi/g		
A1	J151B1	9/12/07	0.013			0.012			-1.68			-0.006			0.015		
A2	J15JB2	9/12/07	0.015			0.016			-1.74			0.017			0.105		
A3	J15JB3	9/12/07	0.013			0.012			-0.98			-0.008			0.119		
A4	J15JB4/J15JB5	9/12/07	0.015			0.015			-0.20			0.000			0.060		

Statistical Computations

	Cesium-137			Cobalt-60			Carbon-14			Plutonium-239/240			Strontium-90		
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.			Radionuclide data set. Use nonparametric z-statistic.		
N	4			4			4			4			4		
% < Detection limit	100%			100%			100%			100%			100%		
mean	0.014			0.014			-1.15			0.001			0.075		
st. dev.	0.001			0.002			0.721			0.011			0.047		
Z-statistic	1.645			1.645			1.645			1.645			1.645		
95% UCL on mean	0.015			0.015			-0.558			0.010			0.114		
max value	0.037	U		0.037	U		-0.061	U		0.017	U		0.182	U	
Statistical value	0.015	U		0.037	U		-0.558	U		0.010	U		0.114	U	

BG = background
MDA= minimum detectable activity
Q = qualifier
RAG = regulatory action goal
U = undetected
UCL = upper confidence limit

Washington Closure Hanford

CALCULATION SHEET

Originator M. J. Appel MJA
Project 100-F Area Field Remediation
Subject 118-F-5A Cleanup Verification 95% UCL Calculations

Date 10/8/07
Job No. 14655

Calc. No. 0100F-CA-V0316
Checked J. M. Capron
by S.W. Clark SWC

Rev. No. 0
Date 10/8/07
Sheet No. 4 of 4

Split-Duplicate Analysis
Shallow Zone Sample Results: Radionuclides

Sampling Area	Sample Number	Americium-241			Carbon-14			Cesium-137			Cobalt-60			Europium-152			Europium-154			Europium-155			Nickel-63			Plutonium-238			Plutonium-239/240		
		pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A4	J15JB4	0.141	U	0.141	-0.339	U	3.2	0.021	U	0.021	0.023	U	0.023	0.062	U	0.062	0.068	U	0.068	0.082	U	0.082	0.578	U	3.49	-0.065	U	0.309	0.0	U	0.247
Duplicate of J15JB4	J15JB5	0.287	U	0.287	-0.061	U	3.19	0.037	U	0.037	0.037	U	0.037	0.091	U	0.091	0.132	U	0.132	0.11	U	0.11	-0.247	U	3.47	0.0	U	0.581	0.0	U	0.581
Split of J15JB4	J15JB6				0.027	U	0.337	0.002	U	0.013	0.008	U	0.015	-0.021	U	0.032	0.019	U	0.048	0.037	U	0.038	3.24	U	5.74	0.803		0.033	0.058		0.044

Sample Analysis:

TDL		1	2	0.1	0.05	0.1	0.1	0.1	30	1.0	1.0
Duplicate Analysis	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?										
	RPD										
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable
Split Analysis	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?										
	RPD										
	Difference > 2 TDL?		No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable

Split-Duplicate Analysis
Shallow Zone Sample Results: Radionuclides

Sampling Area	Sample Number	Potassium-40			Radium-226			Radium-228			Silver-108			Strontium-90			Thorium-228			Thorium-232			Tritium			Uranium-235			Uranium-235		
		pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A4	J15JB4	12.1		0.250	0.448		0.038	0.659		0.094	0.016	U	0.016	0.182	U	0.301	0.661		0.033	0.659		0.094	-0.335	U	4.37	0.112	U	0.112	2.58	U	2.58
Duplicate of J15JB4	J15JB5	12.9		0.444	0.477		0.062	0.871		0.161	0.026	U	0.026	-0.062	U	0.365	0.729		0.045	0.871		0.161	0.067	U	4.37	0.160	U	0.160	4.55	U	4.55
Split of J15JB4	J15JB6										-0.003	U	0.098	0.072	U	0.179							3.24	U	5.74						

Sample Analysis:

TDL		1	0.1	0.2	0.1	1.0	1.0	1.0	10.0	1.0	1.0
Duplicate Analysis	Both > MDA?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?	**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)			No-Stop (acceptable)	No-Stop (acceptable)			
	RPD	6.40%									
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable
Split Analysis	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?										
	RPD										
	Difference > 2 TDL?				No - acceptable	No - acceptable			No - acceptable		

Note: The significance of the reported RPD values, including values greater than 30%, is addressed within the Data Quality Assessment for the Cleanup Verification Package for this site.

MDA = minimum detectable activity
TDL = target detection limit
Q = qualifier
U = undetected
RPD = relative percent difference

118-F-5A Shallow Zone Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Americium-241			Barium-133			Carbon-14			Cesium-137			Cobalt-60			Europium-152		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J15JB1	9/12/07	0.166	U	0.166	0.031	U	0.031	-1.68	U	3.06	0.025	U	0.025	0.024	U	0.024	0.070	U	0.070
A2	J15JB2	9/12/07	0.041	U	0.041	0.032	U	0.032	-1.74	U	3.42	0.030	U	0.030	0.032	U	0.032	0.081	U	0.081
A3	J15JB3	9/12/07	0.041	U	0.041	0.028	U	0.028	-0.98	U	3.20	0.025	U	0.025	0.023	U	0.023	0.060	U	0.060
A4	J15JB4	9/12/07	0.141	U	0.141	0.026	U	0.026	-0.34	U	3.20	0.021	U	0.021	0.023	U	0.023	0.062	U	0.062
Duplicate of J15JB4	J15JB5	9/12/07	0.287	U	0.287	0.059	U	0.059	-0.061	U	3.19	0.037	U	0.037	0.037	U	0.037	0.091	U	0.091
Split of J15JB4	J15JB6	9/12/07				-0.005	U	0.013	0.027	U	0.337	0.002	U	0.013	0.008	U	0.015	-0.021	U	0.032

Sample Location	Sample Number	Sample Date	Europium-154			Europium-155			Nickel-63			Plutonium-238			Plutonium-239/240			Potassium-40		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J15JB1	9/12/07	0.091	U	0.091	0.094	U	0.094	0.355	U	3.00	0.003	U	0.058	-0.006	U	0.029	14.8		0.296
A2	J15JB2	9/12/07	0.100	U	0.100	0.066	U	0.066	-0.20	U	3.38	-0.01	U	0.063	0.017	U	0.026	12.1		0.378
A3	J15JB3	9/12/07	0.088	U	0.088	0.068	U	0.068	1.79	U	3.36	0.031	U	0.058	-0.008	U	0.036	14.4		0.258
A4	J15JB4	9/12/07	0.068	U	0.068	0.082	U	0.082	0.578	U	3.49	-0.065	U	0.309	0.0	U	0.247	12.1		0.250
Duplicate of J15JB4	J15JB5	9/12/07	0.132	U	0.132	0.11	U	0.11	-0.247	U	3.47	0.0	U	0.581	0.0	U	0.581	12.9		0.444
Split of J15JB4	J15JB6	9/12/07	0.019	U	0.048	0.037	U	0.038	3.24	U	5.74	0.803		0.033	0.058		0.044			

Sample Location	Sample Number	Sample Date	Radium-226			Radium-228			Silver-108			Thorium-228			Thorium-232			Total Strontium		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J15JB1	9/12/07	0.498		0.049	0.760		0.096	0.020	U	0.020	0.690		0.039	0.760		0.096	0.015	U	0.338
A2	J15JB2	9/12/07	0.460		0.058	0.644		0.124	0.021	U	0.021	0.680		0.041	0.644		0.124	0.105	U	0.304
A3	J15JB3	9/12/07	0.499		0.056	0.723		0.119	0.017	U	0.017	0.715		0.034	0.723		0.119	0.119	U	0.353
A4	J15JB4	9/12/07	0.448		0.038	0.659		0.094	0.016	U	0.016	0.661		0.033	0.659		0.094	0.182	U	0.301
Duplicate of J15JB4	J15JB5	9/12/07	0.477		0.062	0.871		0.161	0.026	U	0.026	0.729		0.045	0.871		0.161	-0.062	U	0.365
Split of J15JB4	J15JB6	9/12/07							-0.003	U	0.098							0.072	U	0.179

Sample Location	Sample Number	Sample Date	Tritium			Uranium-235			Uranium-238		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J15JB1	9/12/07	-0.520	U	4.24	0.133	U	0.133	2.86	U	2.86
A2	J15JB2	9/12/07	-0.439	U	4.77	0.123	U	0.123	3.94	U	3.94
A3	J15JB3	9/12/07	-1.55	U	4.39	0.109	U	0.109	3.3	U	3.3
A4	J15JB4	9/12/07	-0.335	U	4.37	0.112	U	0.112	2.58	U	2.58
Duplicate of J15JB4	J15JB5	9/12/07	0.067	U	4.37	0.160	U	0.160	4.55	U	4.55
Split of J15JB4	J15JB6	9/12/07	3.24	U	5.74						

MDA = minimum detectable activity
Q = qualifier
U = undetected

Attachment	1	Sheet No.	1 of 1
Originator	M. J. Appel	Date	10/08/07
Checked	J. M. Capron	Date	10/8/07
Calc. No.	0100F-CA-V0316	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 118-F-5 Burial Ground Sample Design **Job No. 14655**

Area: 100-F

Discipline: Environmental Engineering *Calculation No: 0100F-CA-V0291

Subject: Shallow Zone / Stockpile (BCL) Sampling Plan

Computer Program: Excel, Autodesk World, and Autodesk Land Map Program No: Excel 2003, World R2, and Land Map 2004

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	Total = 7 Shts	G. Cruz 8-14-2007	C.A. Bentz 8/14/07	N/A	S.W. Callison	8-16-07

SUMMARY OF REVISION

WCH-DE-018 (05/08/2007)

*Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford **CALCULATION SHEET**

Originator G. Cruz Date 8/14/2007 Calc. No. 0100F-CA-V0291 Rev. No. 0

Project 118-F-5 Burial Ground Sample Design Job No. 14655 Checked CAB Date 8/14/07

Subject Shallow Zone / Stockpile (BCL) Sampling Plan Sheet No. 1 of 2

Problem:	Calculate and display required sampling nodes in concurrence with 100 Area Burial Grounds Remedial Action Sampling and Analysis Plan, DOE/RL-2001-35 Rev. 0, for verification and closure.			
Given:	-SAP (DOE/RL-2001-35 Rev. 0) requirements			
	-Shallow Sampling Area (Surface area of each zone determined from Autodesk Land Map program, Attachment 3, Sht 1 of 2, CAD file 1F:081407A, 118-F-5 Burial Ground Shallow Zone Sampling Plan)			
	Attachment 3, Sht 2 of 2, CAD file 1F:081407B, 118-F-5 Burial Ground Stockpile (BCL) Sampling Plan)			
Sample Design Approach:				
Shallow Zone	-Develop a grid of 16 sample nodes			
	-Use table III-4 and III-5 of the SAP to determine which four of the sixteen nodes will be sampled to collect clean up verification samples			
Overburden:	-Develop a grid of 16 sample nodes			
	-Use table III-4 and III-5 of the SAP to determine which four of the sixteen nodes will be sampled to collect clean up verification samples			
Deep Zone:	-Develop a grid of 16 sample nodes			
	-Use table III-4 and III-5 of the SAP to determine which four of the sixteen nodes will be sampled to collect clean up verification samples			
Determination of Shallow Zone Sampling Grid:				
Refer to tables III-4 and III-5 sampling frequency Attachment 2, Number of Decision Subunits Based on Area, DOE/RL-2001-35 Rev. 0				
Total Area:		7267.27	m^2	
Area of Each Decision Subunits:		7267.27	m^2	
Area of Each Sampling Area:		1816.82	m^2	
Area of Each Sample Node:		113.55	m^2	
Nodes to be Sampled (as determined from Attachment 1, Table A-1, Sample Grid Point Lookup Table)				
	Attachment 3, Sht 1 of 2, 118-F-5 Burial Ground Shallow Zone Sampling Plan, for Sample Location Table			

Washington Closure Hanford **CALCULATION SHEET**

Originator G. Cruz **Date** 8/14/2007 **Calc. No.** 0100F-CA-V0291 **Rev. No.** 0

Project 118-F-5 Burial Ground Sample Design **Job No.** 14655 **Checked** AB **Date** 8/14/07

Subject Shallow Zone / Stockpile (BCL) Sampling Plan **Sheet No.** 2 of 2

1										
2										
3	**Determination of Stockpile (BCL) Sampling Grid:**									
4										
5	Refer to tables III-4 and III-5 sampling frequency Attachment 2,									
6	Number of Decision Subunits Based on Area, DOE/RL-2001-35 Rev. 0									
7										
8	Total Area:						7733.26	m^2		
9	Area of Each Decision Subunits:						7733.26	m^2		
10										
11	Area of Each Sampling Area:						1933.31	m^2		
12										
13	Area of Each Sample Node:						120.83	m^2		
14										
15	Nodes to be Sampled (as determined from Attachment 1, Table A-1, Sample Grid Point Lookup Table)									
16		Attachment 3, Sht 2 of 2, 118-F-5 Burial Ground Stockpile (BCL) Sampling Plan,								
17		for Sample Location Table								
18										
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Washington Closure Hanford

Originator	G. Cruz	Date	8/14/2007	Calc. No.	0100F-CA-V0291	Rev. No.	0
Project	118-F-5 Burial Ground Sample Design			Job No.	14655	Checked	CB
Subject	Shallow Zone / Stockpile (BCL) Sampling Plan					Date	8/14/07
						Sheet No	1 of 1

ATTACHMENT 1

Sample Grid Point Lookup Table.

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

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

Washington Closure Hanford

Originator G. Cruz Date 8/14/2007 Calc. No. 0100F-CA-V0291 Rev. No. 0
Project 118-F-5 Burial Ground Sample Design Job No. 14655 Checked CAB Date 8/14/07
Subject Shallow Zone / Stockpile (BCL) Sampling Plan Sheet No. 1 of 1

ATTACHMENT 2

Table III-4. Number of Decision Subunits Based on Area

Decision Units [a]	Waste Site Size	Number of Decision Units
Site verification (shallow) 0 to 4.6m (15 ft)	Small area of exposed surface after excavation ≤ 9290 m^2 (≤100,000 ft^2)	1
	Medium area of exposed surface after excavation >9290 m^2 but ≤ 37161 m^2 (>100,000 ft^2 but ≤ 400,000 ft^2)	4
	Large area of exposed surface after excavation >37161 m^2 (>400,000ft^2)	8
Site verification (deep) >4.6m (>15 ft)	Small area of exposed surface after excavation ≤ 9290 m^2 (≤100,000 ft^2)	1
	Medium area of exposed surface after excavation >9290 m^2 but ≤ 37161 m^2 (>100,000 ft^2 but ≤ 400,000 ft^2)	4
	Large area of exposed surface after excavation >37161 m^2 (>400,000ft^2)	8
Overburden/layback piles	Small area of exposed surface after excavation ≤ 9290 m^2 (≤100,000 ft^2)	1
	Medium area of exposed surface after excavation >9290 m^2 but ≤ 37161 m^2 (>100,000 ft^2 but ≤ 400,000 ft^2)	4
	Large area of exposed surface after excavation >37161 m^2 (>400,000ft^2)	8

[a] The shallow zone, deep zone, and overburden each represent single decision units. Because sites may not have a deep zone, there may be two or three decision units.
Note: 1.) Metric equivalents added to original SAP table.

Table III-5. Sampling Frequency Based on Size of Remediated Waste Site.

Exposed Surface Area After Excavation	Number of Decision Subunits	Number of Blocks	Number of Discreet Samples	Number of Composite Samples
Small site ≤9290 m^2 (≤100,000 ft^2)	1	4	16	4
Medium site >9290 m^2 (>100,000 ft^2) but ≤37161 m^2 (≤400,000 ft^2)	4	16	64	16
Large site ≤37161 m^2 (>400,000 ft^2)	8	32	128	32

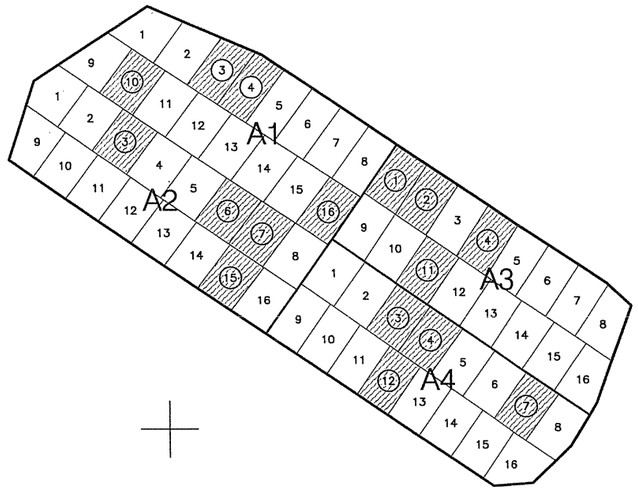
Note: 2.) The term "sample areas" is used interchangebly with "blocks" in this sample design.
3.) Metric equivalents corrected from original SAP table.

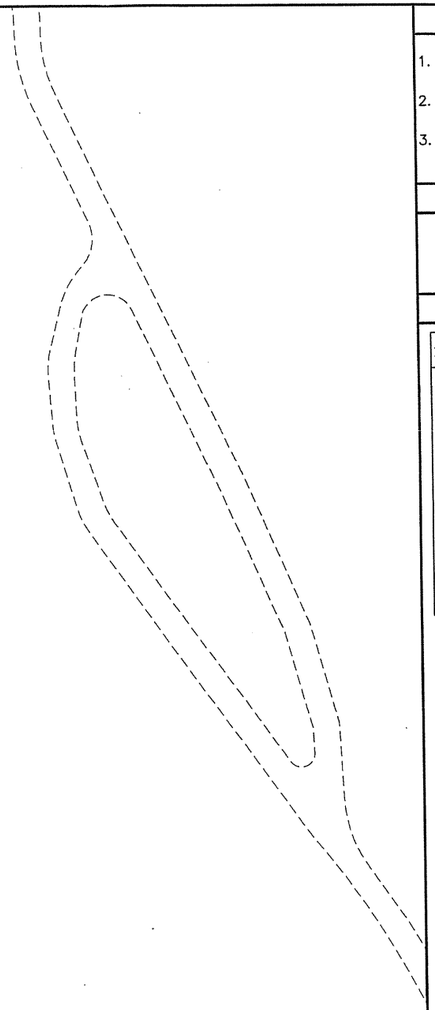
1F:081407A

FAIRBANKS AVENUE

E 581300

N 147400





SCALE 1:1200

12 0 12 24 48 meters

NOTES

1. SHALLOW ZONE NODE AREAS ARE APPROXIMATELY 113.55 SQUARE METERS.
2. SAMPLES ARE TAKEN FROM THE APPROXIMATE CENTER OF EACH NODE.
3. THE SHALLOW ZONE CONSISTS OF SAMPLING AREAS A1, A2, A3 AND A4 WITHIN DECISION SUBUNIT 1.

LEGEND

(B) VERIFICATION SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	A1	S-A1-3	147482.18	581312.41
		S-A1-4	147478.31	581318.89
		S-A1-10	147479.54	581292.00
		S-A1-16	147449.84	581336.05
	A2	S-A2-3	147465.92	581290.21
		S-A2-6	147450.06	581313.44
		S-A2-7	147444.87	581321.05
		S-A2-15	147434.78	581313.93
	A3	S-A3-1	147456.99	581351.43
		S-A3-2	147452.57	581358.49
		S-A3-4	147443.18	581372.22
		S-A3-11	147436.40	581358.49
	A4	S-A4-3	147425.44	581351.77
		S-A4-4	147420.34	581359.08
		S-A4-7	147405.07	581380.77
		S-A4-12	147411.01	581349.54

Attachment 3 Sheet No. 1 of 2
Originator G.CRUZ Date 6-14-07
Chk'd By AB Date 6/14/07
Calc. No. 0100F-CA-V0291 Rev. No. 0

ATTACHMENT 3

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

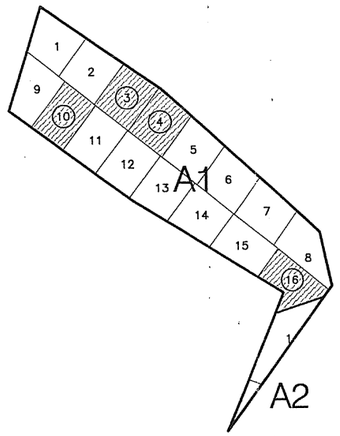
100-F AREA
118-F-5 BURIAL GROUND
SHALLOW ZONE SAMPLING PLAN

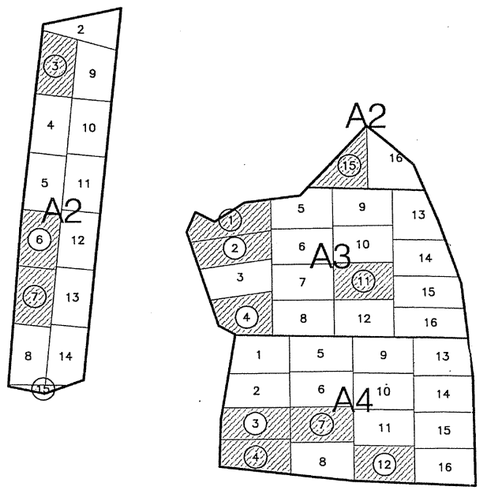
1F:081407B

FAIRBANKS AVENUE

E 581300

N 147400





NOTES

1. STOCKPILE NODE AREAS ARE APPROXIMATELY 120.83 SQUARE METERS.
2. SAMPLES ARE TAKEN FROM THE APPROXIMATE CENTER OF EACH NODE.
3. THE STOCKPILE CONSISTS OF SAMPLING AREAS A1, A2, A3 AND A4 WITHIN DECISION SUBUNIT 1.

LEGEND

(8) VERIFICATION SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	A1	0-A1-3	147479.18	581375.26
		0-A1-4	147473.48	581382.85
		0-A1-10	147474.85	581360.50
		0-A1-16	147436.08	581413.64
	A2	0-A2-3	147352.92	581309.16
		0-A2-6	147311.67	581305.22
		0-A2-7	147298.08	581303.98
		0-A2-15A	147276.17	581305.81
		0-A2-15B	147329.12	581377.40
	A3	0-A3-1	147316.24	581349.75
		0-A3-2	147309.55	581350.74
		0-A3-4	147293.10	581353.35
		0-A3-11	147301.56	581380.37
	A4	0-A4-3	147267.90	581355.17
		0-A4-4	147259.98	581355.20
		0-A4-7	147267.61	581370.55
		0-A4-12	147258.14	581384.86

Attachment 3 — Sheet No. 2 of 2
Originator G.C.R.J. — Date 8-14-07
Chk'd By G.B. — Date 8/14/07
Calc. No. D100E-CA-V0291 — Rev. No. 0

ATTACHMENT 3

SCALE 1:1200

12 0 12 24 48 meters

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

100-F AREA
118-F-5 BURIAL GROUND
STOCKPILE (BCL) SAMPLING PLAN

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 118-F-5A Burial Ground Sample Design **Job No. 14655**

Area: 100-F

Discipline: Environmental Engineering *Calculation No: 0100F-CA-V0330

Subject: Shallow Zone Sampling Plan

Computer Program: Excel, Autodesk World, and Autodesk Land Map Program No: Excel 2003, World R2, and Land Map 2004

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	Total = 5 Shts	G. Cruz 1-22-08	C.A. Bentz 1/22/08	N/A	S.W. Callison	1-24-08

SUMMARY OF REVISION

*Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford **CALCULATION SHEET**

Originator G. Cruz Date 11/15/2007 Calc. No. 0100F-CA-V0330 Rev. No. 0

Project 118-F-5A Burial Ground Sample Design Job No. 14655 Checked CAB Date 1/22/08

Subject Shallow Zone Sampling Plan Sheet No. 1 of 1

Problem:	Calculate and display required sampling nodes in concurrence with 100 Area Burial Grounds Remedial Action Sampling and Analysis Plan, DOE/RL-2001-35 Rev. 0, for verification and closure.				
Given:	-SAP (DOE/RL-2001-35 Rev. 0) requirements				
	-Shallow Sampling Area (Surface area of each zone determined from Autodesk Land Map program, Attachment 3, Sht 1 of 1, CAD file 1F:111607A, 118-F-5A Burial Ground Shallow Zone Sampling Plan)				
Sample Design Approach:					
Shallow Zone	-Develop a grid of 16 sample nodes				
	-Use table III-4 and III-5 of the SAP to determine which four of the sixteen nodes will be sampled to collect clean up verification samples				
Overburden:	-Develop a grid of 16 sample nodes				
	-Use table III-4 and III-5 of the SAP to determine which four of the sixteen nodes will be sampled to collect clean up verification samples				
Deep Zone:	-Develop a grid of 16 sample nodes				
	-Use table III-4 and III-5 of the SAP to determine which four of the sixteen nodes will be sampled to collect clean up verification samples				
Determination of Shallow Zone Sampling Grid:					
Refer to tables III-4 and III-5 sampling frequency Attachment 2, Number of Decision Subunits Based on Area, DOE/RL-2001-35 Rev. 0					
Total Area:				124.47	m^2
Area of Each Decision Subunits:				124.47	m^2
Area of Each Sampling Area:				31.11	m^2
Area of Each Sample Node:				1.94	m^2
Nodes to be Sampled (as determined from Attachment 1, Table A-1, Sample Grid Point Lookup Table)					
	Attachment 3, Sht 1 of 1, 118-F-5A Burial Ground Shallow Zone Sampling Plan, for Sample Location Table				

Washington Closure Hanford

Originator	G. Cruz	Date	11/15/2007	Calc. No.	0100F-CA-V0330	Rev. No.	0
Project	118-F-5A Burial Ground Sample Design			Job No.	14655	Checked	GB Date 1/22/08
Subject	Shallow Zone Sampling Plan					Sheet No	1 of 1

ATTACHMENT 1

Sample Grid Point Lookup Table.

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

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

Washington Closure Hanford

Originator G. Cruz Date 11/15/2007 Calc. No. 0100F-CA-V0330 Rev. No. 0
Project 118-F-5A Burial Ground Sample Design Job No. 14655 Checked CAB Date 1/22/08
Subject Shallow Zone Sampling Plan Sheet No. 1 of 1

ATTACHMENT 2

Table III-4. Number of Decision Subunits Based on Area

Decision Units[a]	Waste Site Size	Number of Decision Units
Site verification (shallow) 0 to 4.6m (15 ft)	Small area of exposed surface after excavation ≤9290 m^2 (≤100,000 ft^2)	1
	Medium area of exposed surface after excavation >9290 m^2 but ≤37161 m^2 (>100,000 ft^2 but ≤400,000 ft^2)	4
	Large area of exposed surface after excavation >37161 m^2 (>400,000ft^2)	8
Site verification (deep) >4.6m (>15 ft)	Small area of exposed surface after excavation ≤9290 m^2 (≤100,000 ft^2)	1
	Medium area of exposed surface after excavation >9290 m^2 but ≤37161 m^2 (>100,000 ft^2 but ≤400,000 ft^2)	4
	Large area of exposed surface after excavation >37161 m^2 (>400,000ft^2)	8
Overburden/layback piles	Small area of exposed surface after excavation ≤9290 m^2 (≤100,000 ft^2)	1
	Medium area of exposed surface after excavation >9290 m^2 but ≤37161 m^2 (>100,000 ft^2 but ≤400,000 ft^2)	4
	Large area of exposed surface after excavation >37161 m^2 (>400,000ft^2)	8

[a] The shallow zone, deep zone, and overburden each represent single decision units. Because sites may not have a deep zone, there may be two or three decision units.
Note: 1.) Metric equivalents added to original SAP table.

Table III-5. Sampling Frequency Based on Size of Remediated Waste Site.

Exposed Surface Area After Excavation	Number of Decision Subunits	Number of Blocks	Number of Discreet Samples	Number of Composite Samples
Small site ≤9290 m^2 (≤100,000 ft^2)	1	4	16	4
Medium site >9290 m^2 (>100,000 ft^2) but ≤37161 m^2 (≤400,000 ft^2)	4	16	64	16
Large site ≤37161 m^2 (>400,000 ft^2)	8	32	128	32

Note: 2.) The term "sample areas" is used interchangebly with "blocks" in this sample design.
3.) Metric equivalents corrected from original SAP table.

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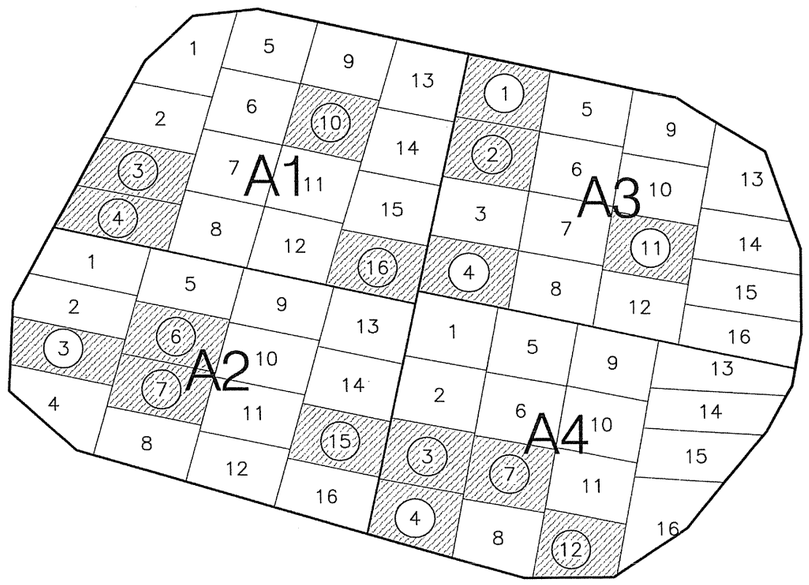

SCALE 1:100

1 0 1 2 4 meters

NOTES

1. SHALLOW ZONE NODE AREAS ARE APPROXIMATELY 1.94 SQUARE METERS.
2. SAMPLES ARE TAKEN FROM THE APPROXIMATE CENTER OF EACH NODE.
3. THE SHALLOW ZONE CONSISTS OF SAMPLING AREAS A1, A2, A3 AND A4 WITHIN DECISION SUBUNIT 1.

LEGEND

(8) VERIFICATION SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	A1	S-A1-3	147500.07	581264.31
		S-A1-4	147499.15	581263.93
		S-A1-10	147501.02	581268.04
		S-A1-16	147498.20	581268.93
	A2	S-A2-3	147496.63	581262.87
		S-A2-6	147496.86	581265.02
		S-A2-7	147495.84	581264.74
		S-A2-15	147494.83	581268.19
	A3	S-A3-1	147501.59	581271.34
		S-A3-2	147500.40	581271.10
		S-A3-4	147498.11	581270.65
		S-A3-11	147498.58	581274.14
	A4	S-A4-3	147494.54	581269.85
		S-A4-4	147493.34	581269.61
		S-A4-7	147494.20	581271.39
		S-A4-12	147492.72	581272.56

Attachment 3 Sheet No. 1 of 1
Originator G. CRIR Date 1-22-08
Chk'd By CAB Date 1/22/08
Calc. No. 0100F-CA-V0330 Rev No. 0

ATTACHMENT 3

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

100-F AREA
118-F-5A BURIAL GROUND
SHALLOW ZONE SAMPLING PLAN

APPENDIX E

DATA QUALITY ASSESSMENT

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 sample designs (DOE-RL 2001, and WCH 2007a, b). This DQA was performed in accordance with site specific data quality objectives found in the SAP (DOE-RL 2001).

A review of the sample design (DOE-RL 2001 and WCH 2007a, b), the field logbook (WCH 2007c), and applicable analytical data packages has been performed as part of this DQA. All samples were collected per the sample designs. 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).

The closeout sampling approach for the 118-F-5 Burial Ground included a sample design with multiple subunit areas. Verification sample data collected at the 118-F-5 waste site(s) were provided by the laboratories in six sample delivery groups (SDGs). For the overburden/below cleanup level (BCL) stockpiles, verification sample data was provided in two SDGs: SDG K0894 and SDG J00120. SDG K0894 was submitted for third-party validation. SDG K0894 contains data from waste sites 118-F-2 and 100-F-26:15, in addition to the 118-F-5 overburden/BCL stockpile data. SDG J00120 also contains data from waste site 118-F-2; however, this DQA limited the data review for SDG J00120 to the data from 118-F-5A. This DQA limited the data review for SDG K0894 and SDG J00120 to the data from 118-F-5. For the shallow-zone excavation, verification sample data was provided in two SDGs: SDG K0897 and SDG J00121. SDG K0897 was submitted for third-party validation.

An excavation adjacent to the original 118-F-5 Burial Ground, labeled 118-F-5A, is included in the scope of this DQA. For the 118-F-5A shallow zone excavation, verification sample data was provided in two SDGs: SDG K0956 and SDG J00131. SDG K0956 also contains data from waste site 100-F-26:12, however, this DQA limited the data review for SDG K0956 to the data from 118-F-5A.

No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed below.

SDG K0894

This SDG comprises five field samples (J15786 - J15790) collected from the BCL stockpiles. One field duplicate pair is included in this SDG (J15786/ J15787). These samples were analyzed for tritium, and nickel-63 by liquid scintillation counting (LSC), by alpha spectroscopy, beta counting, and gamma spectroscopy. In addition, samples J15788 – J15790 were analyzed for carbon-14. SDG K0894 was submitted for formal third-party validation. No major deficiencies were found in SDG K0894. Minor deficiencies are as follows:

No matrix spike analysis was performed for tritium or for carbon-14. Third-party validation qualified all tritium and carbon-14 results as estimated and flagged "J." The data are useable for decision-making purposes.

The relative percent difference (RPD) value for uranium-238 in the laboratory duplicate pair is above the acceptance criteria at 79%. Elevated RPDs are attributed to natural heterogeneity of the sample matrixes. The data are usable for decision-making purposes.

SDG J00120

This SDG comprises one field sample (J15791) collected from the BCL stockpiles, a split of sample J15786 from SDG K0894. Severn Trent Laboratories, Inc. examined this sample for carbon-14, tritium, and nickel-63 by LSC, by alpha spectroscopy, beta counting, and gamma spectroscopy. No major deficiencies were found in SDG J00120. Minor deficiencies are as follows:

For the alpha spectroscopy, the MS recovery for plutonium-238 was out of project acceptance criteria, at 63%. The plutonium-238 result for sample J15791 may be considered estimated. Estimated data are useable for decision-making purposes.

Elevated RPDs were reported for the nickel-63, tritium, and carbon-14 laboratory duplicates for sample J15791. For the nickel-63 and tritium, the results were all below the detection limits, and for carbon-14 the duplicate was below the detection limit and the primary was near the detection limit. When the duplicate pair is near the detection limit, analysis of RPDs is not considered useful in the precision determination. The data are useable for decision-making purposes.

SDG K0897

This SDG comprises five field samples (J15781 through J15785) collected from the 118-F-5 shallow zone. One field duplicate pair is included in this SDG (J15784/ J15785). These samples were analyzed for carbon-14, tritium, and nickel-63 by LSC, by alpha spectroscopy, beta counting, and gamma spectroscopy. SDG K0897 was

submitted for formal third-party validation. No major deficiencies were found in SDG K0897. Minor deficiencies are as follows:

No matrix spike analysis was performed for tritium or for carbon-14. Third-party validation qualified all tritium and carbon-14 results as estimated and flagged "J." The data are useable for decision-making purposes.

For the alpha spectroscopy, the MS recovery for plutonium-238 and plutonium-239/240 results in sample J15785 were out of project acceptance criteria, at 19%. The plutonium-238 and plutonium-239/240 results in sample J15785 were qualified as estimated and flagged "J" by third-party validation. Estimated data are useable for decision-making purposes.

SDG J00121

This SDG comprises one field sample (J15792), a split of sample J15784 from SDG K0897. This sample was analyzed at Severn Trent Laboratories, Inc., with the analyses including carbon-14, tritium, and nickel-63 by LSC, by alpha spectroscopy, beta counting, and gamma spectroscopy. No major deficiencies were found in SDG J00121. Minor deficiencies are as follows:

For the gamma spectroscopy, insufficient sample material was available to prepare a laboratory duplicate of sample J15792. The duplicate result was obtained by recounting sample J15792 on a different detector.

SDG K0956

This SDG comprises five field samples (J15JB1 through J15JB5) collected from the 118-F-5A shallow zone. One field duplicate pair is included in this SDG (J15JB4/J15JB5). These samples were analyzed for carbon-14 and nickel-63 by LSC, plutonium by alpha spectroscopy, and gamma spectroscopy. No major or minor deficiencies were found in SDG K0956.

SDG J00131

This SDG comprises one field sample (J15JB6), a split of sample J15JB4 from SDG K0956. This sample was analyzed at Severn Trent Laboratories, Inc. with the analyses including carbon-14 and nickel-63 by LSC, plutonium by alpha spectroscopy, and gamma spectroscopy. No major deficiencies were found in SDG J00131. Minor deficiencies are as follows:

Elevated RPDs were reported for the plutonium-238, plutonium-239/240, strontium-90, tritium, and carbon-14 laboratory duplicates for sample J15JB6. For these radionuclides, the results were all below the detection limits, with the exception of the plutonium isotopes. For plutonium-238 and plutonium-239/240, the duplicate was below the detection limit and the primary was near the detection limit. When the duplicate pair

is near the detection limit, analysis of RPDs is not considered useful in the precision determination. 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 quality assurance/quality control (QA/QC) measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples, listed in the field logbook (WCH 2007c), are summarized in Table E-1. The main and QA/QC sample results are presented in Appendix A.

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

Sample Area	Main Sample	Duplicate Sample	Split Sample
Overburden/BCL Stockpile Area A-1	J15786	J15787	J15791
Shallow Zone Excavation Area A-4	J15784	J15785	J15792
118-F-5A Shallow Zone Excavation	J15JB4	J15JB5	J15JB6

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 briefs in Appendix D provide details on duplicate pair evaluation and RPD calculation. The data are suitable for the intended purpose of cleanup verification.

Radionuclides

None of the RPDs calculated for radionuclide field duplicates or splits are above the acceptance criteria (30%). The data are useable for decision-making purposes.

RPDs for the remaining radionuclide analytes are not calculated because an evaluation of the data shows that the analytes are not detected in both the main and duplicate sample at more than five times the target detection limit. RPDs of analytes detected at

low concentrations (less than five times the detection limit) are not considered 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) is less than five times the target detection limit (TDL), including undetected analytes. In these cases, a control limit of ± 2 times the TDL is used (Appendix D) to indicate that a visual check of the data is required by the reviewer. No analytical results required this check. 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 these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 118-F-5 verification sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for 118-F-5 waste site concludes that the reviewed data are 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 analytical results should be rejected as a result of QA and QC deficiencies. The analytical data were found acceptable for decision-making purposes. The verification sample analytical data are stored in the Environmental Restoration (ENRE) project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System (HEIS) database. The verification sample analytical data are also summarized in Appendix A.

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, 2007a, *118-F-5 Burial Ground Sample Design*, 0100F-CA-V0291, Rev. 0, Washington Closure Hanford, Richland, Washington.

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WCH, 2007c, *100F Remedial Sampling*, Logbook EFL-1174-3 pp. 30-32 and 93-94, Washington Closure Hanford, Richland, Washington.

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