

Cleanup Verification Package for the 118-F-6 Burial Ground

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

June 2008

EXECUTIVE SUMMARY

This cleanup verification package documents completion of remedial action for the 118-F-6 Burial Ground on the Hanford Site. The 118-F-6 site is located in the 100-FR-2 Operable Unit of the 100-F Area, approximately 460 m (1,500 ft) southwest of the 105-F Reactor Building. The burial ground was used between 1965 and 1973 and contained six unlined burial trenches. The trenches received waste from the 100-F Experimental Animal Farm, including animal manure, animal carcasses, laboratory waste, plastic, cardboard, metal, and concrete debris. The burial ground also contained a railroad tank car.

Remedial action at the 118-F-6 site began on December 12, 2005, and was completed on December 13, 2007. Remedial action activities involved removing the uncontaminated overburden, the buried contaminated debris, and the underlying contaminated soil. Contaminated materials were disposed at the Environmental Restoration Disposal Facility and all liquid mixed waste was sent for off-site treatment and disposal. Results of the verification sampling, laboratory analyses, and data evaluations for the 118-F-6 site (which includes the remediation footprint and the overburden/layback stockpiles) indicate that all remedial action objectives and goals for direct exposure, protection of groundwater, and protection of the Columbia River have been met (see Table ES-1).

Soil cleanup levels were established in the ROD (EPA 2000) based on a limited ecological risk assessment. Although not required by the ROD (EPA 2000), a comparison against ecological risk screening levels is made for the site COCs/COPCs. However, the single detected nonradionuclide, bis(2-ethylhexyl)phthalate, is not a chemical of concern for this ecological risk screening.

**Table ES-1. Summary of Cleanup Verification Results for the
118-F-6 Burial Ground. (2 Pages)**

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?	Ref.
Direct Exposure – Radionuclides	1. Attain 15 mrem/yr dose rate above background over 1,000 years.	1. Maximum dose rate predicted using generic dose equivalence lookup values is 11.4 mrem/yr.	Yes	a, b
Direct Exposure – Nonradionuclides	1. Attain individual COC RAGs.	1. All individual COPC concentrations of the nonradionuclide focused samples are below the RAGs. Nonradionuclides were not COCs for the verification samples.	Yes	b
Meet Nonradionuclide Risk Requirements	1. Hazard quotient of less than 1 for noncarcinogens.	1. One constituent (bis [2-ethylhexyl]phthalate) was detected in focused sampling at levels well below RAGs.	Yes	NA
	2. Cumulative hazard quotient of less than 1 for noncarcinogens.	2. One constituent (bis [2-ethylhexyl]phthalate) was detected in focused sampling at levels well below RAGs.		NA
	3. Excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	3. One constituent (bis [2-ethylhexyl]phthalate) was detected in focused sampling at levels well below RAGs.		NA
	4. Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	4. One constituent (bis [2-ethylhexyl]phthalate) was detected in focused sampling at levels well below RAGs.		NA
Groundwater/River Protection – Radionuclides	1. Attain single COC groundwater and river RAGs. 2. Attain National Primary Drinking Water Regulations 4-mrem/yr (beta/gamma) dose standard to target receptor/organ. ^c	1&2.No radionuclide COCs were quantified in the soil samples above groundwater/river protection lookup values. Contaminated soil was removed to the groundwater interface in trenches 3 and 4. Three samples of water accumulated in the base of trench 4 were taken for information purposes. These samples contained strontium-90 above the MCL (DOE-RL 2005), but are believed to not be representative of groundwater. Groundwater is within the scope of the 100-FR-3 Groundwater Operable Unit. Information regarding this site has been shared with groundwater and source integration activities. The groundwater program will install an additional monitoring well near the burial ground in September 2008; perform quarterly sampling for strontium-90, trichloroethylene, uranium, nitrate, hexavalent	Yes	a, b

**Table ES-1. Summary of Cleanup Verification Results for the
118-F-6 Burial Ground. (2 Pages)**

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?	Ref.
Groundwater/River Protection – Radionuclides (continued)		chromium, and field parameters; and perform water-level monitoring at representative well locations to collect additional data for seasonal variations. Any appropriate additional follow-on investigations will be described in the 100-FR-3 Remedial Investigation/Feasibility Study Work Plan.		
	3. Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25 th of the derived concentration guide for DOE Order 5400.5. ^d	3. No alpha-emitting radionuclide COCs were quantified above groundwater/river protection lookup values.	Yes	a
	4. Meet total uranium standard of 21.2 pCi/L. ^e	4. Isotopic uranium concentrations in cleanup verification and focused samples are below background.	Yes	a
Groundwater/River Protection – Nonradionuclides	1. Attain individual nonradionuclide groundwater and river cleanup requirements.	1. All individual COC concentrations are below the RAGS.	Yes	a
Other Supporting Information	Attainment of Radionuclide Direct Exposure RAG (Table 6). 118-F-6 Burial Ground Sample Design (Appendix C).			f

^a 118-F-6 Burial Ground Cleanup Verification 95% UCL Calculation, Calculation No. 0100F-CA-V0337, Rev. 0 (Appendix C).

^b 118-F-6 Burial Ground Cleanup Verification using Generic Dose-equivalence Lookup Values (Table 6).

^c “National Primary Drinking Water Regulations” (40 Code of Federal Regulations 141).

^d Radiation Protection of the Public and the Environment (DOE Order 5400.5).

^e Based on the isotopic distribution of uranium in the Hanford Site background, the 30 µg/L MCL (40 CFR 141) corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038 (BHI 2001).

^f 118-F-6 Burial Ground Sample Design, 0100F-CA-V0340, Rev. 0, Washington Closure Hanford, Richland, Washington (Appendix C).

COC = contaminant of concern

MCL = maximum contaminant level

NA = not applicable

RAG = remedial action goal

The site meets cleanup standards and has been reclassified as Interim Closed Out in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) and the Waste Site Reclassification Guideline TPA-MP-14 (RL-TPA-90-0001) (DOE-RL 2007). A copy of the waste site reclassification form is included as Attachment ES-1 to this document.

Attachment ES-1

Waste Site Reclassification Form

Date Submitted: <u>5/12/08</u> Originator: <u>J. M. Capron</u> Phone: <u>372-9227</u>	WASTE SITE RECLASSIFICATION FORM Operable Unit(s): <u>100-FR-2</u> Waste Site Code: <u>118-F-6</u> Type of Reclassification Action: Closed Out ☐ Interim Closed Out ☒ No Action ☐ RCRA Postclosure ☐ Rejected ☐ Consolidated ☐	Control Number: <u>2008-018</u>
---	---	---------------------------------

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:

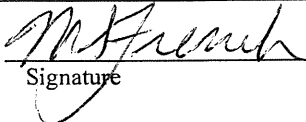
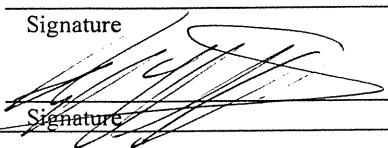
The 118-F-6 Burial Ground, formerly called the Pacific Northwest Laboratory Solid Waste Burial Ground, primarily received waste from the 100-F Experimental Animal Farm. This burial ground consisted of six trenches containing animal waste and carcasses, laboratory equipment and bottles, cylinders and crushed drums, and a railroad tank car used for carcass incineration. The site has been remediated and backfilled with concurrence from the lead regulatory agency. Remediation, verification sampling, and RESidual RADioactivity (RESRAD) modeling 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), U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 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 RESRAD modeling 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 results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in 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*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 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. The 118-F-6 excavation area has a maximum depth of approximately 6.5 m (21 ft), which includes a shallow zone and a deep zone. However, the entire excavation area is considered one decision unit and is closed out using the more restrictive shallow zone cleanup criteria; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the *Cleanup Verification Package for the 118-F-6 Burial Ground* (CVP-2008-00001), Washington Closure Hanford, Richland, Washington.

Waste Site Controls:

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

M. S. French		<u>9/18/08</u>
DOE Federal Project Director (printed)	Signature	Date
N/A		
Ecology Project Manager (printed)		<u>9-23-08</u>
R. A. Lobos	Signature	Date
EPA Project Manager (printed)		

CONTENTS

1.0	STATEMENT OF PROTECTIVENESS	1
2.0	BACKGROUND AND GENERAL SITE INFORMATION	1
2.1	GENERAL SITE INFORMATION	3
3.0	REMEDIAL ACTION SUMMARY	5
3.1	EXCAVATION AND DISPOSAL	5
3.2	FIELD SCREENING	5
4.0	SAMPLING ACTIVITIES	7
4.1	CONTAMINANTS OF CONCERN FOR VERIFICATION SAMPLING	7
4.2	CONTAMINANTS OF POTENTIAL CONCERN FOR FOCUSED SAMPLING	7
4.3	VERIFICATION SAMPLING DESIGN	9
4.3.1	Decision Unit Sampling	9
4.4	FIELD SCREENING	11
4.4.1	Radiological Surveys	11
4.5	FOCUSED SAMPLING	11
4.6	VERIFICATION SAMPLING	13
5.0	SAMPLING RESULTS	13
5.1	FOCUSED SAMPLE RESULTS	15
5.2	INFORMATIONAL SAMPLES	16
5.3	DATA QUALITY ASSESSMENT PROCESS	17
6.0	CLEANUP VERIFICATION DATA EVALUATION	17
6.1	COMPARISON OF SAMPLE DATA TO RAGS	18
6.2	ATTAINMENT OF RADIONUCLIDE DIRECT EXPOSURE RAG	18
6.2.1	Nonradionuclides	19
6.3	GROUNDWATER AND COLUMBIA RIVER REMEDIAL ACTION GOALS ATTAINED	19
6.3.1	Nonradionuclides	19
7.0	SUMMARY FOR WASTE SITE RECLASSIFICATION	19
8.0	REFERENCES	20

APPENDICES

A	REMEDATION PHOTOGRAPHS	A-i
B	118-F-6 GPERS SURVEYS	B-i
C	CALCULATIONS.....	C-i
C1	Shallow Zone and Overburden Sampling Plan, 0100F-CA-V0340, Rev. 0	C-3
C2	118-F-6 Burial Ground Cleanup Verification 95% UCL Calculations, 0100F-CA-V0337, Rev. 0	C-11
D	TRENCH 4 INFORMATIONAL SAMPLE RESULTS.....	D-i
E	DATA QUALITY ASSESSMENT.....	E-i

FIGURES

1.	Overall Site Location Map of the 118-F-6 Burial Ground.....	2
2.	Geophysical Investigation Results for the 118-F-6 Burial Ground.....	4
3.	Post-Excavation Topography of 118-F-6 Burial Ground.....	6
4.	118-F-6 Focused and Informational Sampling Locations.	8
5.	General Overview of the Sample Design for the 118-F-6 Burial Ground.....	10

TABLES

1.	Number of Verification Samples for the 118-F-6 Burial Ground.	9
2.	118-F-6 Focused Sample Locations	12
3.	118-F-6 Informational Sample Locations.	13
4.	Comparison of Statistical Contaminant Concentrations to Action Levels for the 118-F-6 Excavation Shallow Zone Verification Sampling.....	14
5.	Comparison of Statistical Contaminant Concentrations to Action Levels for the 118-F-6 Overburden/Layback Verification Sampling.....	15
6.	Comparison of Maximum Contaminant Concentrations to Action Levels for the 118-F-6 Focused Sampling Verification Sampling	16
7.	Attainment of Radionuclide Direct Exposure RAGs.	18

ACRONYMS AND ABBREVIATIONS

COC	contaminant of concern
COPC	contaminant of potential concern
CVP	Cleanup Verification Package
DOE-RL	U.S. Department of Energy, Richland Operations Office
DQA	data quality assessment
ENRE	ENvironmental REstoration database
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
GPERS	Global Positioning Environmental Radiological Surveyor
HEIS	Hanford Environmental Information System
PNL	Pacific Northwest Laboratory
RAG	remedial action goal
RDR/RAWP	remedial design report/remedial action work plan
ROD	record of decision
SAP	sampling and analysis plan
UCL	upper confidence limit
WAC	<i>Washington Administrative Code</i>
WIDS	Waste Information Data System

1.0 STATEMENT OF PROTECTIVENESS

This report demonstrates that the 118-F-6 Burial Ground (also referred to as the Pacific Northwest Laboratory [PNL] Solid Waste Burial Ground) waste site meets the objectives for interim closure as established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005) and the *Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units, Hanford Site (100 Area Burial Grounds), Benton County, Washington* (ROD) (EPA 2000). 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.

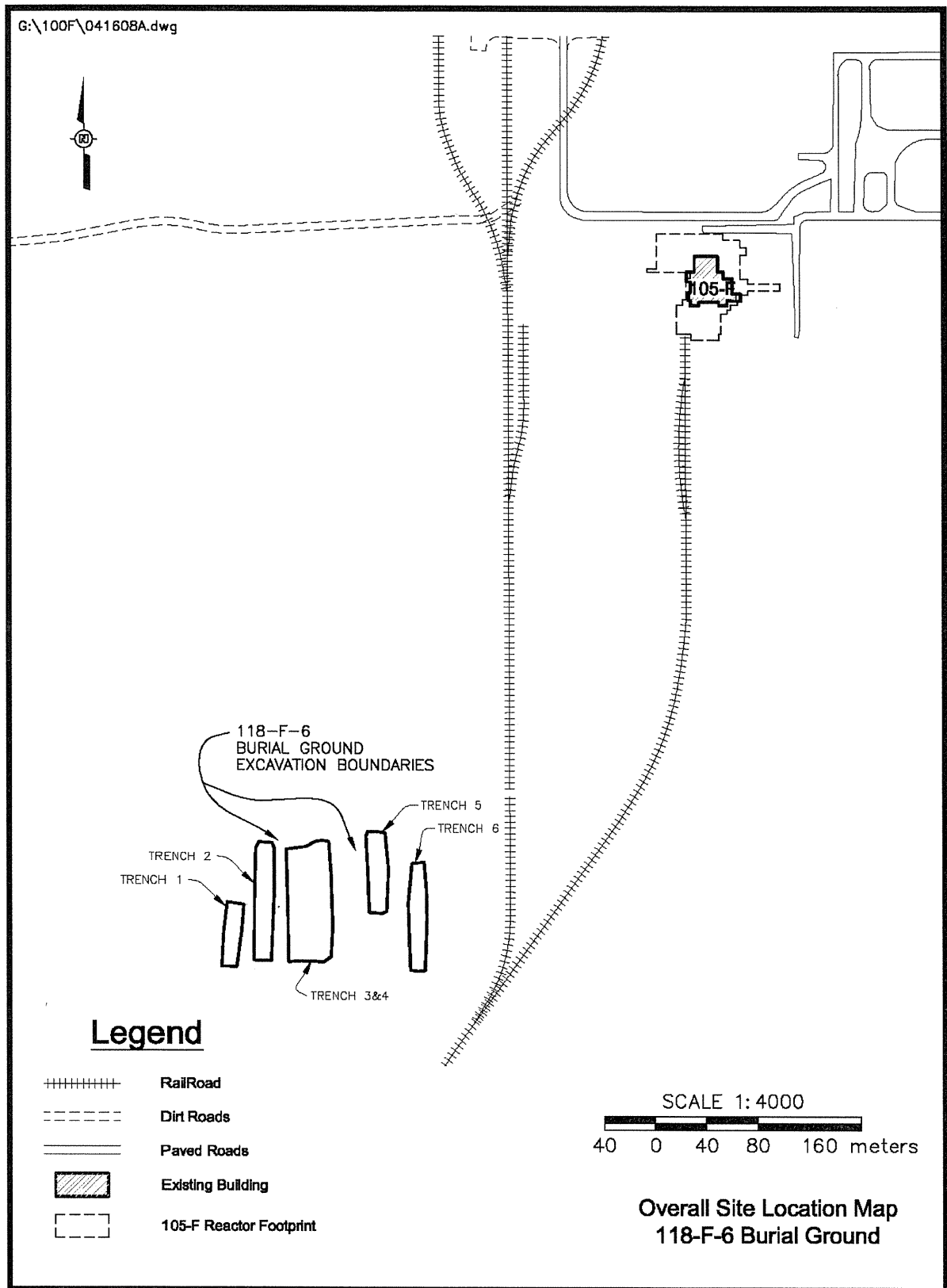
Soil cleanup levels were established in the ROD (EPA 2000) based on a limited ecological risk assessment. Although not required by the ROD (EPA 2000), a comparison against ecological risk screening levels is made for the site COCs/COPCs. However, the single detected nonradionuclide, bis(2-ethylhexyl)phthalate, is not a chemical of concern for this ecological risk screening.

2.0 BACKGROUND AND GENERAL SITE INFORMATION

The purpose of this cleanup verification package (CVP) is to document that the 118-F-6 Burial Ground was remediated in accordance with the ROD (EPA 2000). Remedial action objectives and goals for the 118-F-6 site were established by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy, Richland Operations Office (DOE-RL), in concurrence with the Washington State Department of Ecology. These goals and objectives are documented in the ROD (EPA 2000) and the RDR/RAWP (DOE-RL 2005). The ROD (EPA 2000) provides DOE-RL the authority, guidance, and objectives to conduct this remedial action.

The preferred remedy specified in the ROD (EPA 2000) and conducted for the 118-F-6 site included (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility (ERDF) at the 200 Area of the Hanford Site, and (3) backfilling the site with overburden and clean soil to the average adjacent grade elevation. Excavation was driven by remedial action objectives for direct exposure, protection of groundwater, and protection of the Columbia River.

Figure 1. Overall Site Location Map of the 118-F-6 Burial Ground.



2.1 GENERAL SITE INFORMATION

The 118-F-6 Burial Ground is within the 100-FR-2 Operable Unit of the 100-F Area. The site is located approximately 460 m (1,500 ft) southwest of the 105-F Reactor Building (Figure 1).

According to the Waste Information Database System (WIDS), the burial ground was used between 1965 and 1973. The site dimensions were originally estimated at 122 m by 61 m by 5.5 m (400 ft by 200 ft by 18 ft) deep. The 118-F-6 Burial Ground contained six, unlined trenches in a north to south orientation. The trenches received animal and laboratory wastes related to the 100-F Experimental Animal Farm.

A geophysical survey was performed over the site in March 2002 (BHI 2002b) to locate and map the trenches and other surface and subsurface anomalies. Six distinct north-south-trending trenches were mapped (Figure 2). The investigation results indicated the waste and debris in these areas contained a high percentage of nonmetallic materials. The location of a buried railroad tank car was projected to be in the easternmost trench based on a large anomaly located during the mapping (Figure 2).

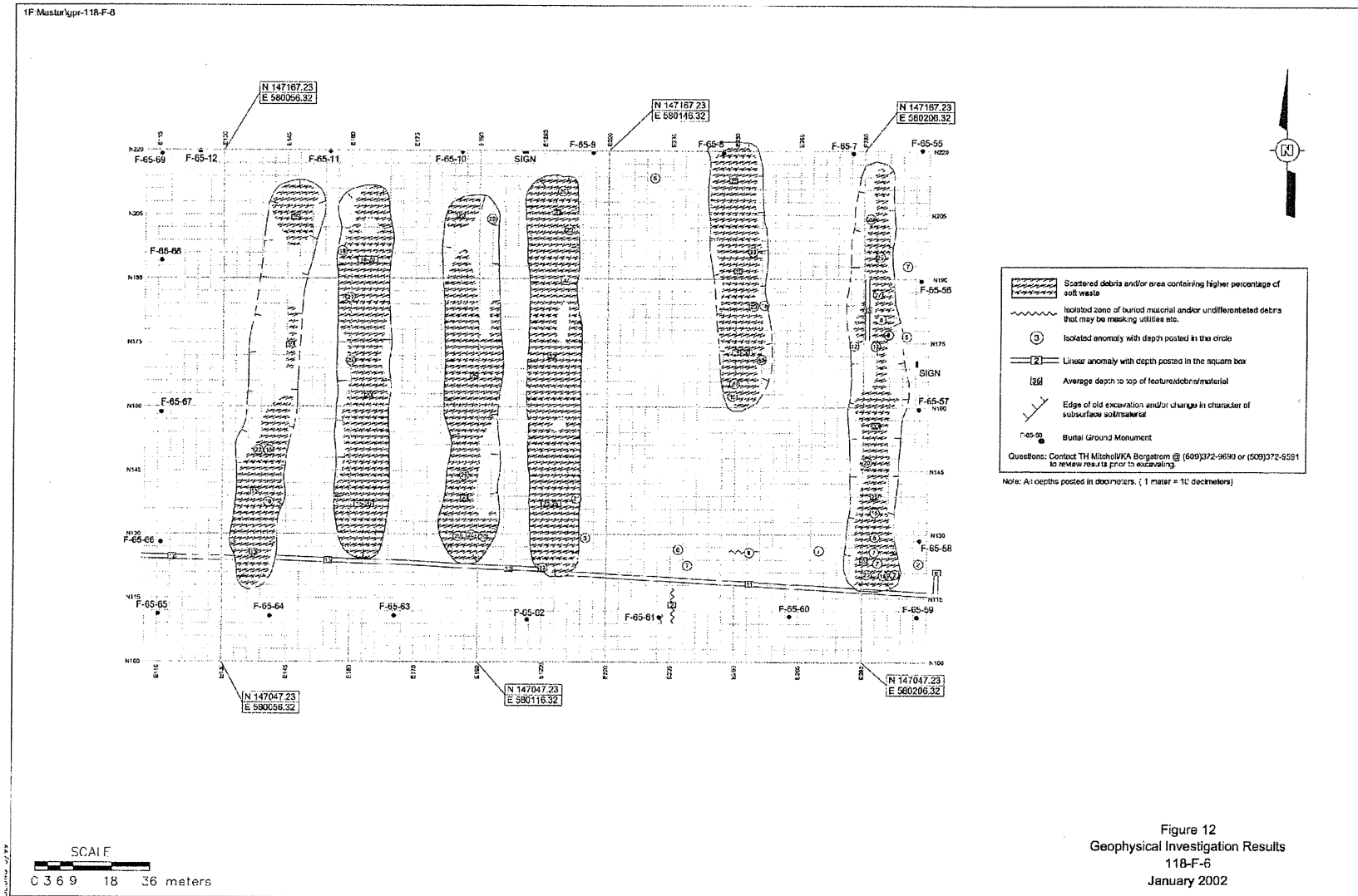
All areas identified by geophysical survey as potentially containing debris or waste were excavated during remediation activities. While an area north of trench 1 showed subsurface disturbance in the geophysical survey, this portion of the burial ground did not contain waste or contamination. It is likely that this area was excavated for the purpose of waste disposal but was never used.

The geophysical results indicated that the original WIDS boundary of the 118-F-6 Burial Ground was greater than the area actually used for disposal. To verify the interpretation of the geophysical data, three test pits were dug on April 22, 2002, (BHI 2002a). A geologist was present during the test pitting and determined through observation of the soil lithology that test pitting found only native, undisturbed soil in the areas between the presumed trenches. These test pit findings were consistent with the geophysical investigation results.

Historical documents (BHI 1994) reported that the 118-F-6 Burial Ground contained two railroad tank cars used for incineration of animal tissue and carcasses. During its time of operation, animal carcasses were dropped into the tank car through a manhole. Lime was then added to facilitate decomposition. When the tank car reached capacity, 1,500 L to 1,900 L (400 gal to 500 gal) of fuel oil were added to the tank and ignited. The residual ash was left in the tank after incineration.

During remediation, only a single tank car containing animal carcasses was found at the site. This tank car was located in the easternmost trench as had been predicted by geophysical investigations. It is not believed that a second tank car ever existed at the burial ground as geophysical investigations and remedial activities that would have detected such a large metal object were conducted at the site.

**Figure 2. Geophysical Investigation Results
for the 118-F-6 Burial Ground.**



Waste disposed at the burial ground was primarily from the 100-F Experimental Animal Farm. Contaminated manure and sawdust removed from animal pens were placed in plastic-lined cardboard radioactive waste disposal boxes. BHI (1994) also reported that plutonium-238 contaminated carcasses were incinerated at the 114-F laboratory and then placed into radioactive waste disposal boxes for burial in the 118-F-6 trenches. Other waste found at the burial ground included laboratory equipment, biological and animal wastes, animal carcasses, and a limited amount of reactor hardware.

3.0 REMEDIAL ACTION SUMMARY

3.1 EXCAVATION AND DISPOSAL

Remedial action at the 118-F-6 site began on December 12, 2005. Excavation and sorting of contaminated material from the areas within the trenches was performed within the trenches of the waste site excavation. As seen in Figures 1 and 2, trenches 3 and 4, which were initially separate, were expanded during remediation in an east-to-west orientation to the point that the excavations nearly became one unit. Figure 3 presents the post-excavation topography of the site.

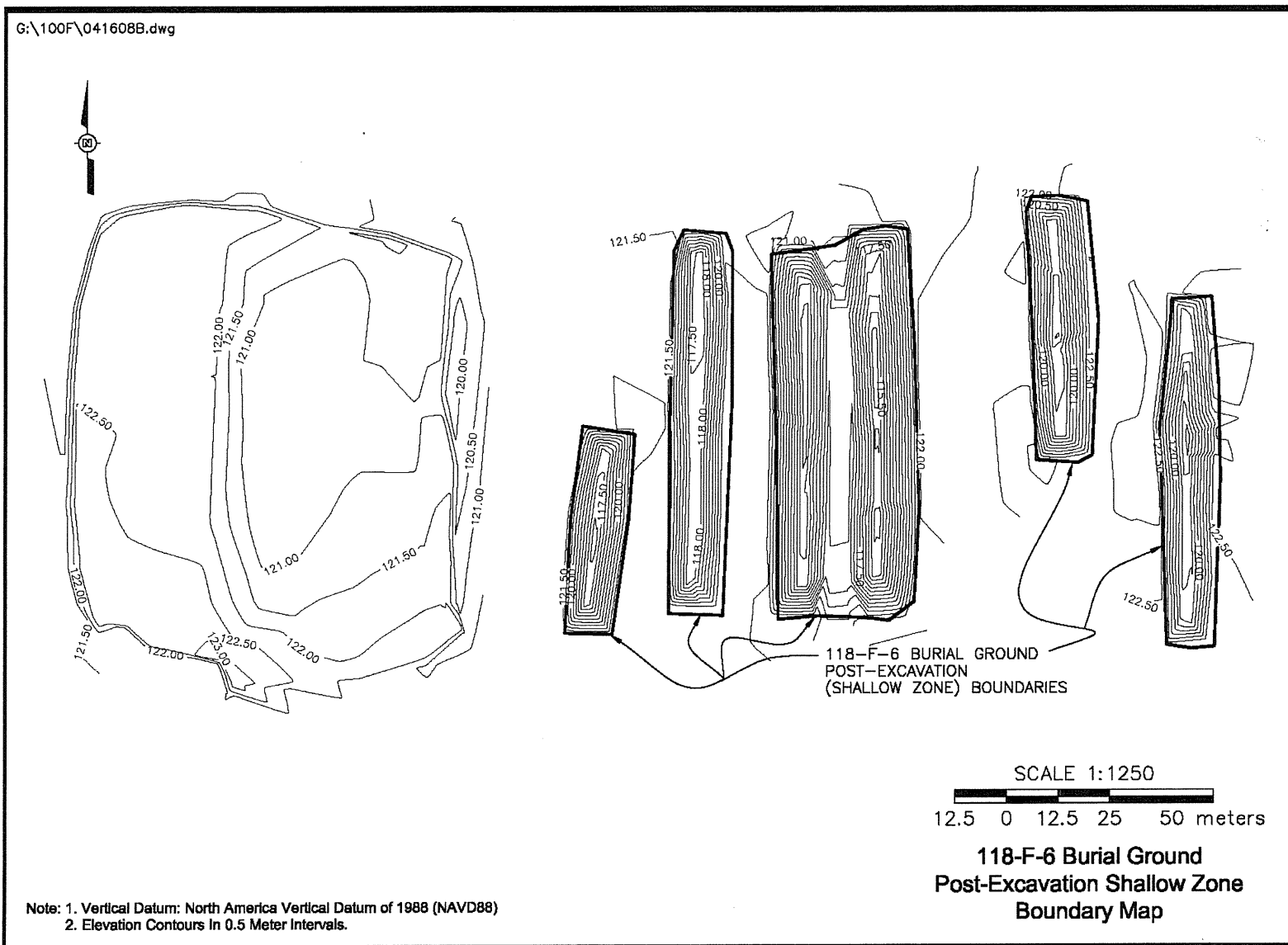
All remedial activities (excavation, sorting, and load out) were completed on December 13, 2007. Approximately 13,100 bank cubic meters (BCM) of material and contaminated soil from the 118-F-6 Burial Ground was disposed to the ERDF. Approximately 12,000 BCM of soil (overburden/layback stockpile material) was segregated for use as clean backfill material. At the conclusion of excavation activities, the excavation was approximately 7,075 m² (76,155 ft²) in area with a maximum depth of approximately 6.5 m (21 ft). The deepest part of the remedial excavation (trench 4) was at an elevation of 115.5 m (379 ft) above sea level.

Wastes encountered in the 118-F-6 Burial Ground included a railroad tank car, laboratory equipment and bottles, cylinders and crushed drums, biological and animal wastes and carcasses, and limited reactor hardware. Some of these items contained small amounts of liquids. Selected photographs of waste excavated from the 118-F-6 Burial Ground are provided in Appendix A.

3.2 FIELD SCREENING

Radiological field screening was conducted during and after the site remedial actions as specified in the *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (Burial Ground SAP) (DOE-RL 2001). 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 Global Positioning Environmental Radiological Surveyor (GPERS) with instrumentation specific to the detection of radiation associated with gamma-emitting and beta-emitting radionuclides. The radiological surveys for the 118-F-6 Burial Ground are provided in Appendix B.

Figure 3. Post-Excavation Survey of 118-F-6 Burial Ground.



Areas of elevated radiological activity in trenches 4, 5, and 6 requiring additional remediation were identified using the GPERS (Figures B-3, B-4, B-6, and B-8). Additional remediation was performed targeting the “hot spots.” These areas were resurveyed to confirm that waste site excavation was complete (Figures B-5, B-7, and B-9).

Radiological field screening was also performed on the undisturbed, interstitial areas between the remediated trenches to support waste site closeout. Radiological surveys of the overburden/layback soil stockpiles were also performed to support evaluation of the soil for use as backfill material. These GPERS surveys are provided in Appendix B. No significant levels of radiological activity were detected and, therefore, no further remediation was required.

4.0 SAMPLING ACTIVITIES

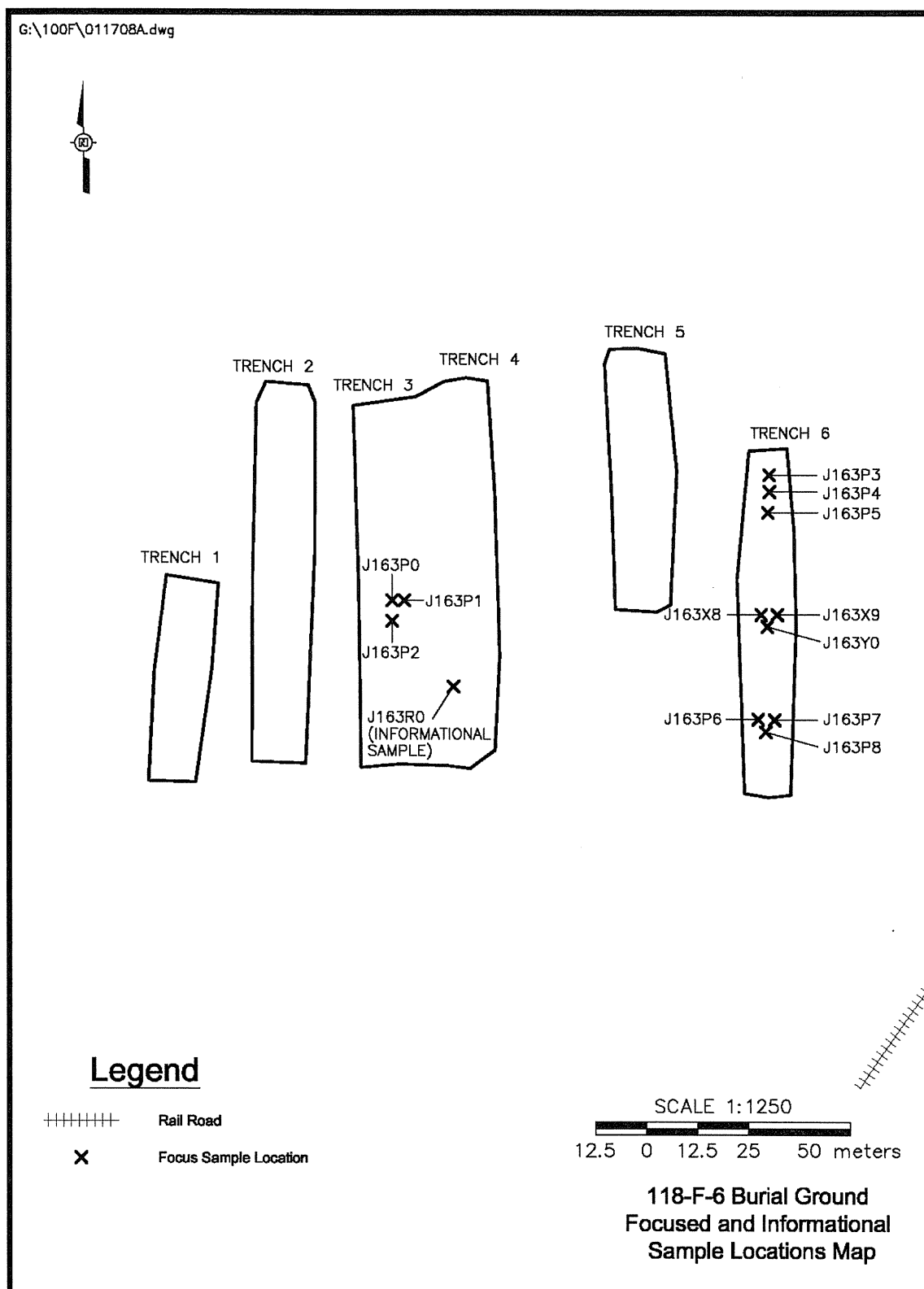
4.1 CONTAMINANTS OF CONCERN FOR VERIFICATION SAMPLING

The Burial Ground SAP (DOE-RL 2001) identified contaminants of concern (COCs) for the 118-F-6 Burial Ground as cobalt-60, strontium-90, and plutonium-239/240. Plutonium-238 was identified as a COC based on the BHI (1994) report. During excavation, in-process samples were collected as necessary and analyzed for the identified COCs and for a wide range of metals, semi-volatile organic compounds, polychlorinated biphenyls, pesticides, gamma energy emitting isotopes, gross alpha activity, and gross beta activity. Based on the results of this sampling, europium-152 and cesium-137 were added as COCs. The COCs/contaminants of potential concern (COPCs) detected at the 118-F-6 Burial Ground, their respective points of compliance, and the remedial action goals (RAGs), are summarized in Tables 4 through 6 (Section 5.0) of this CVP.

4.2 CONTAMINANTS OF POTENTIAL CONCERN FOR FOCUSED SAMPLING

During remediation activities, several distinct waste forms and locations were encountered at the 118-F-6 Burial Ground. These include trench 3 where pesticide-contaminated soil was discovered and the areas of trench 6 in which the tank car, non-pressurized cylinders, and silver metal drums were found. The relative locations of individual trenches are shown in Figure 4. In-process and waste characterization sampling at these areas indicated the presence of specific contamination; therefore, focused samples were collected at specified areas and analyzed for the following COPCs: pesticides for trench 3; total petroleum hydrocarbons and semi-volatile organic compounds for the tank car; tritium for the cylinders; and carbon-14, tritium, strontium-90, americium-241, isotopic plutonium, and isotopic uranium for the metal

Figure 4. 118-F-6 Focused and Informational Sampling Locations.



drums. These samples were collected from the appropriate areas of trenches 3 and 6 and the locations are shown in Figure 4.

4.3 VERIFICATION SAMPLING DESIGN

This section describes the basis for selection of an appropriate sample design and the determination of the number of verification samples to collect at the 118-F-6 Burial Ground.

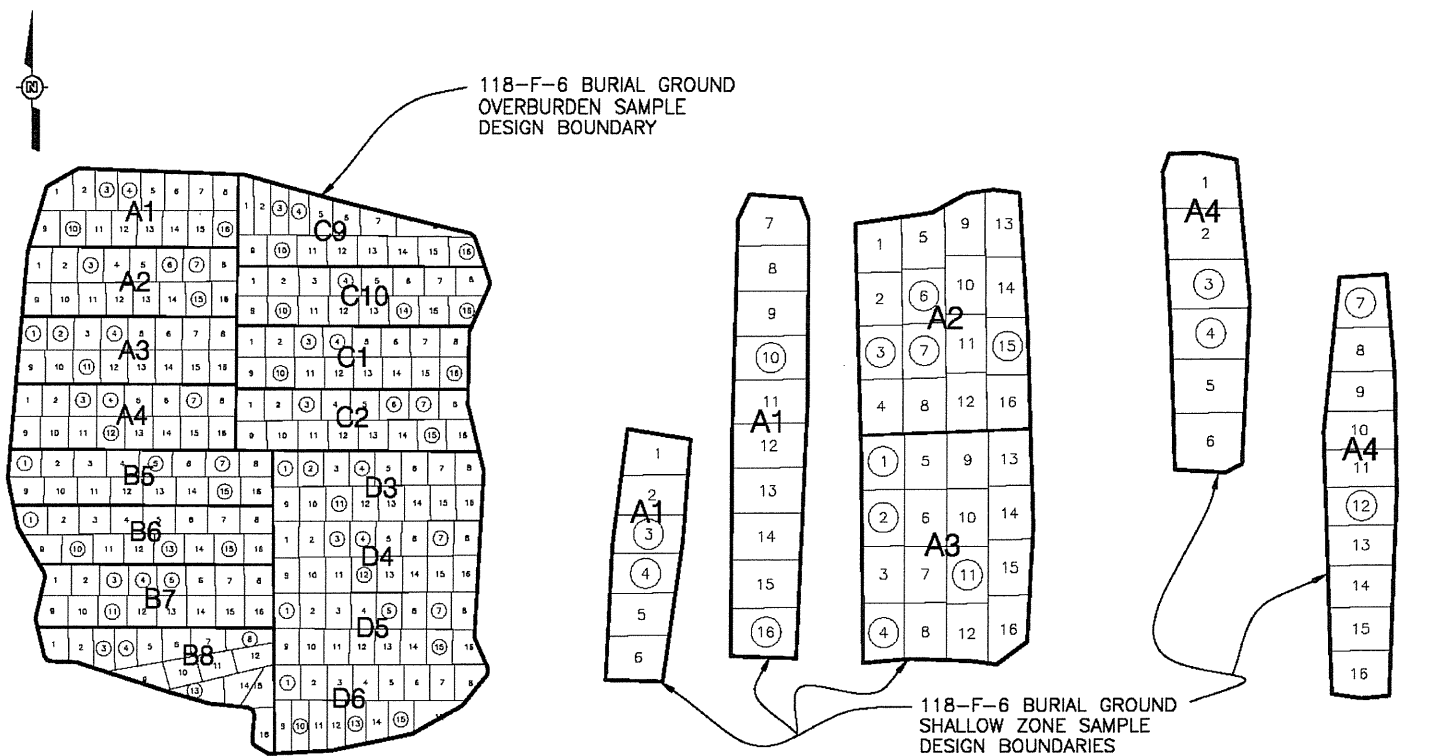
4.3.1 Decision Unit Sampling

The sample strategy for the 118-F-6 Burial Ground is identified in the Burial Ground SAP (DOE-RL 2001) and specifies the site to be divided into shallow and deep zone based on the size of the site. However, the entire excavation area is considered one decision unit and is closed out using the more restrictive shallow zone cleanup criteria.

The 118-F-6 Burial Ground contains two decision units: (1) the shallow zone excavation decision unit, which includes the six trench excavations and area between them, and (2) the overburden/layback stockpile. Sorting and staging of waste prior to removal for disposal was performed within the excavated trenches, so no separate areas were created for this purpose. The number of verification samples to collect in the two decision units was based on the area of the waste site. As shown in Table 1, the shallow zone decision unit required 4 composite samples, and the overburden/layback pile required 16 composite samples. The calculation and the sample locations are located in the sample design calculation in Appendix C. Figure 5 provides an overview of the sample designs. Both decision units are closed out using the more restrictive shallow zone cleanup criteria.

Table 1. Number of Verification Samples for the 118-F-6 Burial Ground Per the Burial Ground SAP (DOE-RL 2001).

Decision Unit	Waste Site Footprint (ft ²)	Size Classification (ft ²)	Decision Subunits	Verification Samples
Excavation shallow zone	76,149	Small (≤100,000)	1	4 composite
Overburden/layback pile	102,151	Medium (>100,000 to 400,000)	4	16 composite



118-F-6 Burial Ground
Sample Design Boundaries Map

Figure 5. General Overview of the Sample Design
for the 118-F-6 Burial Ground.

4.4 FIELD SCREENING

4.4.1 Radiological Surveys

Radiological field screening was conducted during the site remedial actions as specified in the Burial Ground SAP (DOE-RL 2001). The field screening campaign was used to guide the excavation to quickly assess the presence and level of radiological contamination. Field screening at the site included radiological mapping of the site excavation using a GPERS with instrumentation specific to the detection of radiation associated with gamma-emitting and beta-emitting radionuclides. Any radiological “hot spots” identified as requiring additional remediation were targeted and soil (containing scattered metal debris) was removed until the contamination was no longer detected at the location. These areas were resurveyed to confirm that waste site excavation was complete. The GPERS surveys are provided in Figures B-1 through B-26 of Appendix B. The overburden/layback material was surveyed for using hand-held sodium iodide detectors throughout the remedial process, with final GPERS of the soil stockpiles as shown in Appendix B. No significant contamination was identified for the overburden/layback material.

4.5 FOCUSED SAMPLING

Focused samples are collected to verify the absence of contamination in residual soil beneath locations exhibiting visual stains, locations of buried liquid wastes or equipment, mercury-containing piping, or large inventories of dangerous/hazardous wastes (e.g., lead bricks). Additionally, focused samples may be collected from locations where process knowledge indicates the potential for elevated concentrations of alpha or beta contamination, or where waste characterization sampling results indicate elevated concentrations of chemical contaminants above the RAGs.

Four areas of the 118-F-6 Burial Ground excavation were identified with anomalous or distinctive type waste forms. Three focused samples were taken from each location (Table 2). The locations include (1) an area with rusty soil staining and an organic odor in trench 3, (2) the area in trench 6 in which the buried railroad tank car was excavated, (3) the area in trench 6 from which two small silver drums were excavated, and (4) the area in trench 6 from which non-pressurized cylinders were excavated (Figure 4). Selected photographs of these materials are provided in Appendix A.

Informational samples were also taken of accumulated water present at the base of trench 4 (Table 3). This trench had been excavated to the soil/groundwater interface during remediation. Information concerning these samples was discussed with Fluor Hanford, the contractor responsible for groundwater monitoring at the Hanford Site and is further discussed in Section 5.2. A photograph of the water that had seeped into the base of trench 4 is found in Appendix A.

Table 2. 118-F-6 Focused Sample Locations.

Focused Sample	Sample Number	Trench Location and Associated Anomaly	Coordinate Locations^a	COC/COPC
FS-1	J163P0	Trench 3, rusty soil staining and organic-type odor	N 147108 E 580117	Pesticides
FS-2	J163P1	Trench 3, rusty soil staining and organic-type odor	N 147108 E 580120	Pesticides
FS-3	J163P2	Trench 3, rusty soil staining and organic-type odor	N 147103 E 580117	Pesticides
FS-4	J163P3	Trench 6, buried tank car	N 147139 E 580210	SVOA, TPH
FS-5	J163P4	Trench 6, buried tank car	N 147135 E 580210	SVOA, TPH
FS-6	J163P5	Trench 6, buried tank car	N 147130 E 580209	SVOA, TPH
FS-7	J163X8	Trench 6, small silver drums	N 147105 E 580208	GEA, C-14, H-3, Sr-90, Iso Pu, Iso U, Am-241, Cm-244
FS-8	J163X9	Trench 6, small silver drums	N 147105 E 580212	GEA, C-14, H-3, Sr-90, Iso Pu, Iso U, Am-241, Cm-244
FS-9	J163Y0	Trench 6, small silver drums	N 147102 E 580209	GEA, C-14, H-3, Sr-90, Iso Pu, Iso U, Am-241, Cm-244
FS-10	J163P6	Trench 6, cylinders	N 147079 E 580207	H-3
FS-11	J163P7	Trench 6, cylinders	N 147079 E 580211	H-3
FS-12	J163P8	Trench 6, cylinders	N 147076 E 580209	H-3
Blank	J163P9	NA	NA	GEA, Sr-90, Iso-Pu

Source: Field logbook EFL-1174-4 (WCH 2007).

^a Washington State Plane meters.

COC = contaminant of concern

COPC = contaminant of potential concern

GEA = gamma energy analysis

Iso Pu = isotopic plutonium

Iso U = isotopic uranium

NA = not applicable

SVOA = semivolatile organic analysis

TPH = total petroleum hydrocarbons

Table 3. 118-F-6 Informational Sample Locations.

Focused Sample	Sample Number	Trench Location and Associated Anomaly	Coordinate Locations^a	COC/COPC
Groundwater, FS-13	J163R0	Trench 4, puddled groundwater	N 147087 E 580132	GEA, Sr-90, Iso-Pu, H-3
Trench 4 Sr-90 GW/soil FS 1	J169L6	Trench 4, puddled groundwater with suspended soil	N 147087.2 E 580133.4	Sr-90
Trench 4 Sr-90 GW/soil FS 2	J169L7	Trench 4, puddled groundwater with suspended soil	N 147086.8 E 580133.5	Sr-90

^a Washington State Plane meters.

COC = contaminant of concern

COPC = contaminant of potential concern

GEA = gamma energy analysis

GW = groundwater

Iso Pu = isotopic plutonium

4.6 VERIFICATION SAMPLING

Final cleanup verification samples were collected in December 2007 to confirm acceptability of residual contaminant concentrations in the soil at the 118-F-6 waste site. Each verification sample was a composite formed by combining soil collected at four randomly selected nodes within each of the sampling decision subunits. The sample design methodology and sample location figures are presented in the calculation brief for the verification sample design in Appendix C.

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-6 Burial Ground decision units as specified by the 100 Area RDR/RAWP (DOE-RL 2005) (Appendix C).

Comparisons of the statistical results for site COCs with the RAGs (cleanup criteria) for each of the 118-F-6 Burial Ground decision units (118-F-6 shallow zone excavation and overburden stockpiles) are listed in Tables 4 and 5 while focused sample results are listed in Table 6. 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.

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

Table 4. Comparison of Statistical Contaminant Concentrations to Action Levels for the 118-F-6 Excavation Shallow Zone Verification Sampling.

COC/COPC	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	Groundwater Protection Lookup Value	River Protection Lookup Value		
Cesium-137	0.214	6.2	1,465 ^b	1,465 ^b	No	--
Cobalt-60	0.018 (ND)	1.4	13,900 ^b	13,900 ^b	No	--
Europium-152	0.043 (ND)	3.3	NV	NV	No	--
Plutonium-238	0.030 (ND)	37.4	NV	NV	No	--
Plutonium-239/240	0.016 (ND)	33.9	NV	NV	No	--
Strontium-90	2.701	4.5	27.6 ^b	27.6 ^b	No	--

^a Soil activity obtained from the 100 Area RDR/RAWP (DOE-RL 2005) or calculated using RESRAD version 6.3 with generic site input parameters from Table B-1 of the 100 Area RDR/RAWP (DOE-RL 2005).

^b 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 (obtained from DOE-RL [1996] and DOE-RL [2001], unless otherwise noted)

COC = contaminant of concern

COPC = contaminant of potential concern

ND = not detected (in all samples in the data set)

NV = No value; RESRAD modeling reported in the *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Interim Remedial Action Record of Decision* (BHI 2004) was unable to determine a lookup value for this constituent.

RESRAD = RESidual RADioactivity (dose assessment model)

Table 5. Comparison of Statistical Contaminant Concentrations to Action Levels for the 118-F-6 Overburden/Layback Verification Sampling.

COC/COPC	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	Groundwater Protection Lookup Value	River Protection Lookup Value		
Cesium-137	0.035 (<BG)	6.2	1,465 ^b	1,465 ^b	No	--
Cobalt-60	0.013 (ND)	1.4	13,900 ^b	13,900 ^b	No	--
Europium-152	0.032 (ND)	3.3	NV	NV	No	--
Plutonium-238	0.040 (ND)	37.4	NV	NV	No	--
Plutonium-239/240	0.015 (ND)	33.9	NV	NV	No	--
Strontium-90	0.286	4.5	27.6 ^b	27.6 ^b	No	--

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

^b 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 (obtained from DOE-RL [1996] and DOE-RL [2001], unless otherwise noted)

COC = contaminant of concern

COPC = contaminant of potential concern

ND = not detected (in all samples in the data set)

NV = No value; RESRAD modeling reported in the *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Interim Remedial Action Record of Decision* (BHI 2004) was unable to determine a lookup value for this constituent.

RESRAD = RESidual RADioactivity (dose assessment model)

5.1 FOCUSED SAMPLE RESULTS

Twelve focused samples were collected from the 118-F-6 waste site (Figure 4). Statistical analysis (e.g., calculation of a 95% UCL value) is inappropriate to use for evaluation of focused samples; therefore, the sample results for each focused sample are evaluated using the maximum detected activity for each COC/COPC and comparing the value directly to the cleanup level. Table 6 provides a comparison of the maximum result of the focused samples against the cleanup criteria. Individual sample results are provided in Appendix B.

Table 6. Comparison of Maximum Contaminant Concentrations to Action Levels for the 118-F-6 Focused Sampling Verification Sampling.

COC/COPC	Maximum Result (pCi/g)	Generic Site Lookup Values ^a (pCi/g)			Does the Maximum Result Exceed Lookup Values?	Does the Maximum Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value	Groundwater Protection Lookup Value	River Protection Lookup Value		
Cesium-137	1.62	6.2	1,465 ^b	1,465 ^b	No	--
Strontium-90	0.462	4.5	27.6 ^b	27.6 ^b	No	--
Uranium-233/234	0.397 (<BG)	1.1 ^c	1.1 ^c	1.1 ^c	No	--
Uranium-238	0.391 (<BG)	1.1 ^c	1.1 ^c	1.1 ^c	No	--
COC/COPC	Maximum Result (mg/kg)	Remedial Action Goals ^a (mg/kg)			Does the Maximum Result Exceed Lookup Values?	Does the Maximum Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Bis(2-ethylhexyl) phthalate	0.042	71.4	0.625	0.36	No	--

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

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

^c The remedial action goal is below the Hanford-specific soil background concentration. The value presented is the Hanford-specific soil background concentration.

-- = not applicable

BG = background (obtained from DOE-RL [1996] and DOE-RL [2001], unless otherwise noted)

COC = contaminant of concern

COPC = contaminant of potential concern

RAG = remedial action goal

RESRAD = RESidual RADioactivity (dose assessment model)

5.2 INFORMATIONAL SAMPLES

The remediation of trench 4 in the 118-F-6 Burial Ground extended to the groundwater interface. The final remediation depth in this trench is 6.5 m (21 ft) below ground surface. Given that the excavation extended to the groundwater interface, the lead regulatory agency requested that, if available, a sample of intruded groundwater be taken from the trench for information purposes. Sample J163R0 was a groundwater sample taken at the same time the focused samples were collected (Figure 4). The total strontium concentration measured in this sample was 330 pCi/L. Because of this result, a second sampling was performed (samples J169L6 and J169L7). The two samples included suspended soil particles in the water samples. The strontium-90 in the soil fraction of these samples measured 25.6 and 10.3 pCi/g, while the water portion

measured 970 and 409 pCi/L, respectively. When filtered at 0.45 micron, the water sample from J169L6 measured 1,100 pCi/L strontium-90. Informational sample results are reported in Appendix D.

Results from the informational samples were discussed with DOE-RL, EPA, and Fluor Hanford. The groundwater in this portion of the 100-F Area has no known strontium groundwater contamination (PNNL 2007). It is possible that the strontium-90 measured in these groundwater samples is from potential cross-contamination associated with the use of dust suppression water during remedial action and subsequent snow melt running off of the excavation surfaces into the base of the trench. This area will undergo future monitoring by Fluor Hanford, the contractor responsible for groundwater monitoring at the Hanford Site, to verify that the strontium-90 seen in the informational samples is a localized phenomenon. An additional monitoring well will be installed near the 118-F-6 burial ground in September 2008, and quarterly sampling for strontium-90 performed, as well as water-level monitoring at representative well locations to collect additional data for seasonal variations. Any appropriate additional follow-on investigations will be described in the 100-FR-3 Remedial Investigation/Feasibility Study Work Plan.

5.3 DATA QUALITY ASSESSMENT PROCESS

A data quality assessment (DQA) was performed to compare the verification sampling approach, the field logbook (WCH 2007), 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-6 site 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 cleanup verification sample analytical data are stored in the ENRE project-specific database for data evaluation prior to its archival in the HEIS and are summarized in Appendix C. The detailed DQA is presented in Appendix E.

6.0 CLEANUP VERIFICATION DATA EVALUATION

This section demonstrates that remedial action at the 118-F-6 Burial Ground has achieved the applicable RAGs. Because the analytical results were below single-radionuclide dose-equivalence lookup values, a site-specific cleanup verification model was not developed for the 118-F-6 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 4, 5, and 6 from the verification sampling at the 118-F-6 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 7 compares the greater of the statistical or maximum result for the shallow zone (including focused samples) and the overburden radionuclide cleanup verification results presented in the 95% UCL calculations (Appendix C) 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 less than the 15 mrem/yr RAG.

Table 7. Attainment of Radionuclide Direct Exposure RAGs.

COC	95% UCL Statistical Values (pCi/g)		Activity Equivalent to 15 mrem/yr Dose ^a (pCi/g)	Fraction	
	Shallow Zone	Overburden		Shallow Zone	Overburden
Europium-152	0.043 (ND)	0.032 (ND)	3.3	0.013	0.010
Cesium-137	1.62	0.035	6.2	0.134	0.006
Cobalt-60	0.018 (ND)	0.013 (ND)	1.4	0.013	0.009
Strontium-90	2.70	0.286	4.5	0.600	0.064
Plutonium-238	0.030 (ND)	0.040 (ND)	37.4	8.02E-04	1.07E-03
Plutonium-239/240	0.016 (ND)	0.015 (ND)	33.9	4.72E-04	4.42E-04
Total				0.761	0.091
Equivalent Dose (mrem/yr)				11.4	1.3

^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).

COC = contaminant of concern

RAG = remedial action goal

ND = not detected (in all samples in the data set)

UCL = upper confidence limit

6.2.1 Nonradionuclides

6.2.1.1 Direct Comparison to RAGs. Nonradionuclides were not COC/COPCs for the verification samples from the 118-F-6 Burial Ground. However, several focused samples were analyzed for nonradionuclides. Table 6 compares the maximum value of bis(2-ethylhexyl)phthalate (the only nonradionuclide detected in focused samples) to the RAGs. The maximum result for bis(2-ethylhexyl)phthalate is below the direct exposure, groundwater, and river protection cleanup criteria and, therefore, all applicable RAGs are met.

6.2.1.2 Noncarcinogenic Hazard Quotient RAG Attained. For nonradionuclide noncarcinogenic COCs, *Washington Administrative Code* (WAC) 173-340-740(3)(a)(iii)(A) and (B) specifies the evaluation of the hazard quotient, which is given as a daily intake divided by a reference dose. Both individual and cumulative hazard quotient values must be less than 1.0. A separate hazard quotient calculation was not performed for the 118-F-6 Burial Ground as only one constituent (bis [2-ethylhexyl]phthalate) was detected in focused sampling. This detection was at levels well below RAGs.

6.2.1.3 Carcinogenic Risk RAG Attained. For individual nonradionuclide carcinogenic COCs, the WAC 173-340 Method B cleanup limits are based on an incremental cancer risk of 1×10^{-6} . For nonradionuclide carcinogenic COCs, the total excess cancer risk must be less than 1×10^{-5} . A separate, carcinogenic risk calculation was not performed for the 118-F-6 Burial Ground as only one constituent (bis [2-ethylhexyl]phthalate) was detected in focused sampling. This detection was at levels well below RAGs.

6.3 GROUNDWATER AND COLUMBIA RIVER REMEDIAL ACTION GOALS ATTAINED

6.3.1 Nonradionuclides

Table 6 compares the maximum focused sampling results to the groundwater protection RAGs for all sampling areas. The maximum result from the single detected analyte, bis (2-ethylhexyl)phthalate, is below the groundwater and river protections RAGs.

7.0 SUMMARY FOR WASTE SITE RECLASSIFICATION

This CVP demonstrates that remedial action at the 118-F-6 site has achieved the remedial action objectives and corresponding RAGs established in the ROD (EPA 2000) and RDR/RAWP (DOE-RL 2005). The remaining soils at the 118-F-6 site have been sampled, analyzed, and modeled. The results of this effort indicate that the materials from the 118-F-6 site containing COCs at concentrations exceeding RAGs have been excavated and disposed of at ERDF. These results also indicate that

residual concentrations will support future land uses that can be represented (or bounded) by a rural-residential scenario and that residual concentrations throughout the site pose no threat to groundwater or the Columbia River. The 118-F-6 excavation area has a maximum depth of approximately 6.5 m (21 ft), which includes a shallow zone and a deep zone. However, the entire excavation area is considered one decision unit, and will be closed out using the more restrictive shallow zone cleanup criteria; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The 118-F-6 site is verified to be remediated in accordance with the ROD (EPA 2000).

8.0 REFERENCES

40 CFR 141, "National Primary Drinking Water Regulations," *Code of Federal Regulations*, as amended.

BHI, 1994, *100-F Reactor Site Technical Baseline Report Including Operable Units 100-FR-1 and 100-FR-2*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2001, *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2002a, *Report on the Test Pitting/Trenching in the 118-F-6, 118-F-5, and 118-F-6, Burial Grounds, ERC Team Interoffice Memorandum*, CCN 101418, dated August 29, 2002, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2002b, *Results of the Geophysical Investigation Conducted at 100 F Sites, 118-F-6, 118-F-2, 118-F-3, 118-F-5, 118-F-6, 118-F-7, and 118-F-9, ERC Team Interoffice Memorandum*, CCN 096523, dated March 11, 2002, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2004, *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Interim Remedial Action Record of Decision*, 0100X-CA-V0046, Rev. 0, Bechtel Hanford Inc., Richland, Washington.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, U.S. Department of Energy, Washington, D.C.

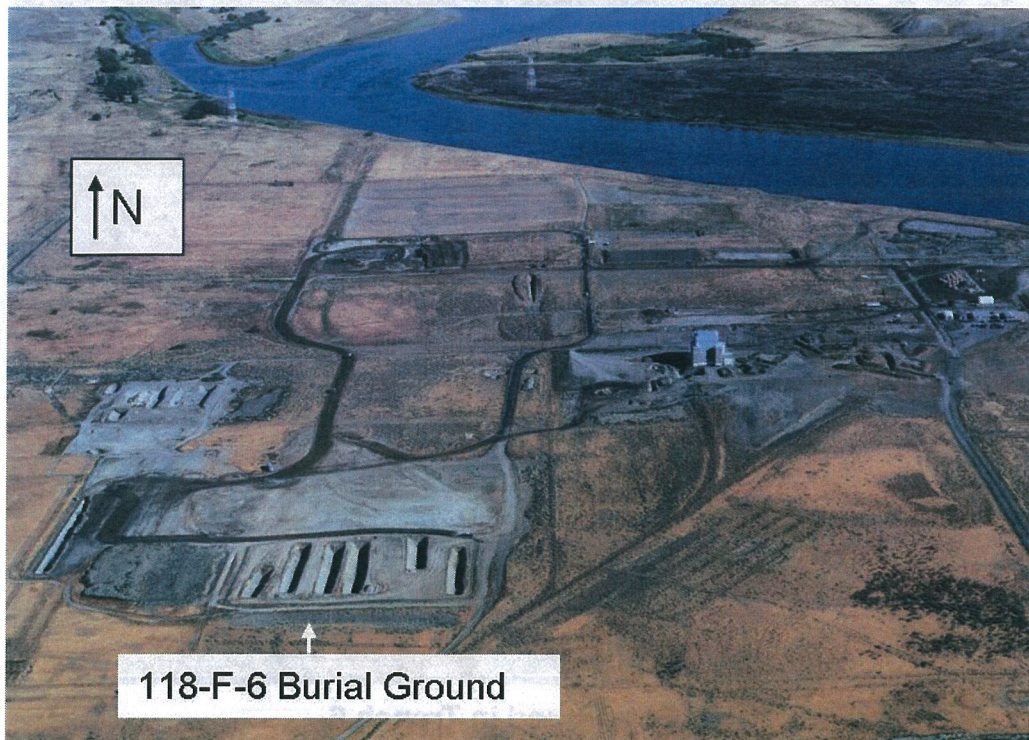
DOE-RL, 1996, *Hanford Site Background: Part 2, Soil Background for Radionuclides*, DOE/RL-96-12, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

- DOE-RL, 2005, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE-RL, 2007, *Tri-Party Agreement Handbook Management Procedures*, RL-TPA-90-0001, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.
- EPA, 2000, *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*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.
- PNNL, 2007, *Hanford Site Groundwater Monitoring for Fiscal Year 2006*, PNNL-16346, Pacific Northwest National Laboratory, Richland, Washington.
- WAC 173-340, 1996, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*.
- WCH, 2007, *100-F Remedial Sampling*, Logbook EFL-1174-4, pp. 30-33 and 40-43, Washington Closure Hanford, Richland, Washington.

APPENDIX A
REMEDIATION PHOTOGRAPHS

**Aerial Photograph of the 118-F-6 Burial Ground During Remediation.
Additional Material was Removed from All Trenches
After This Photograph.**



Metal Debris in the 118-F-6 Burial Ground.



Drums Found in Trench 6.



Cylinders Found in Trench 6.



Reactor Hardware (Perforated Spacer) from Trench 4.



Buried Bagged Waste.



Animal Waste from Trench 5.



Railroad Tank Car in Trench 6 with Manhole Visible.



Opening of Railroad Tank Car with Shears.



Photograph of Accumulated Water in Trench 4, January, 2008.



APPENDIX B
118-F-6 GPERS SURVEYS

118-F-6 RADIOLOGICAL FIELD SURVEYS

Radiological field screening was conducted during and after the site remedial actions as specified in the *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (Burial Ground SAP) (DOE-RL 2001). 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 Global Positioning Environmental Radiological Surveyor (GPERS) with instrumentation specific to the detection of radiation associated with gamma emitting radionuclides.

Several radiological "hot spots" requiring additional remediation were identified using the GPERS. The highest concentrations were located in trenches 3, 4, 5, and 6. Additional remediation was performed targeting the "hot spots." Hot spots remained in areas within trench 4 after additional remediation as this site had been excavated to the soil-groundwater interface (Figures C-3 and C-4). Additional soil was removed from trench 4 and a final GPERS was performed.

Radiological field screening was performed for the interstitial areas between the remediated trenches in order to support waste site closeout. No significant levels of radiological activity were detected.

These radiological surveys for the 118-F-6 Burial Ground are provided in the following figures.

REFERENCE

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

Figure B-1. 118-F-6 Trench 1 GPERs Survey.

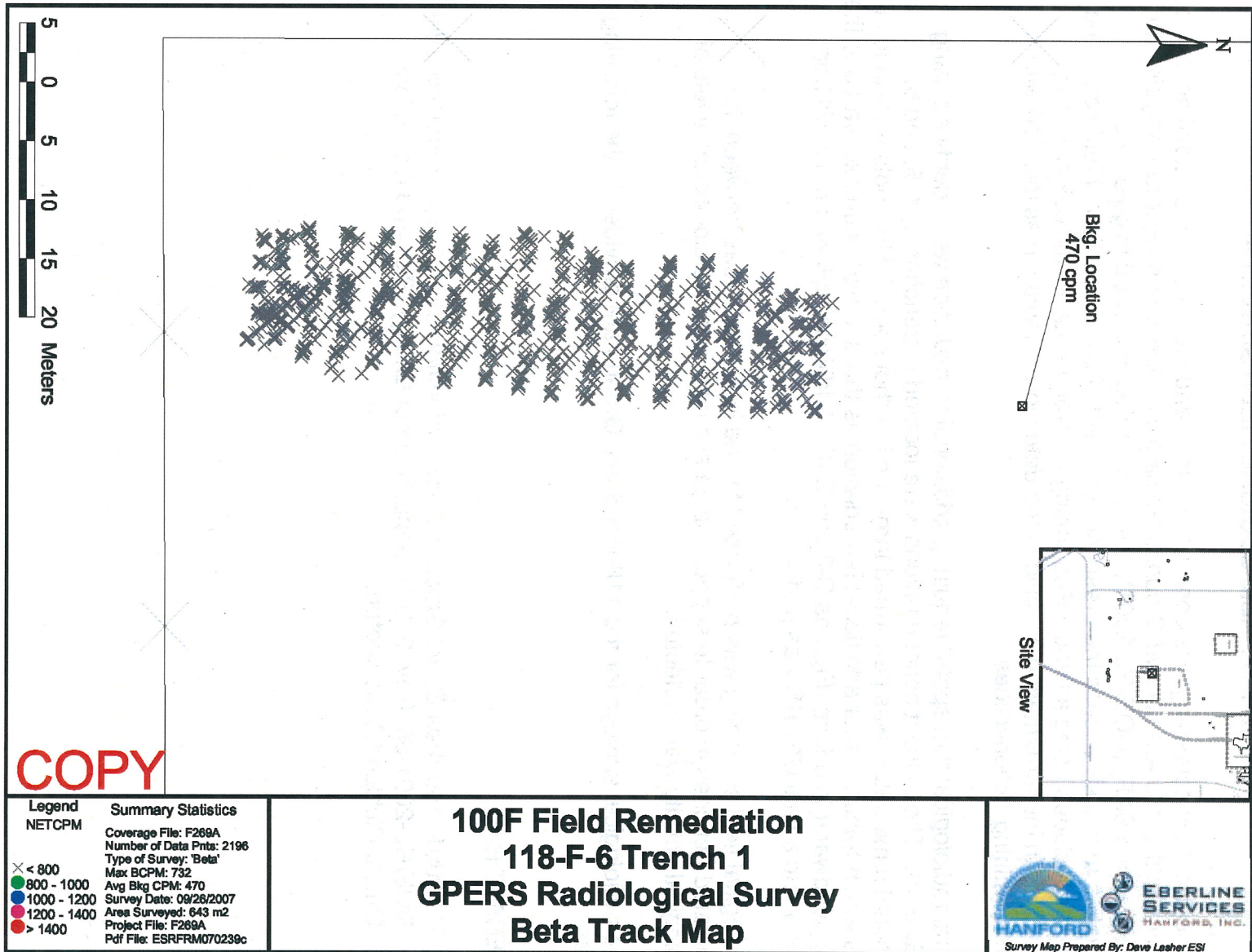
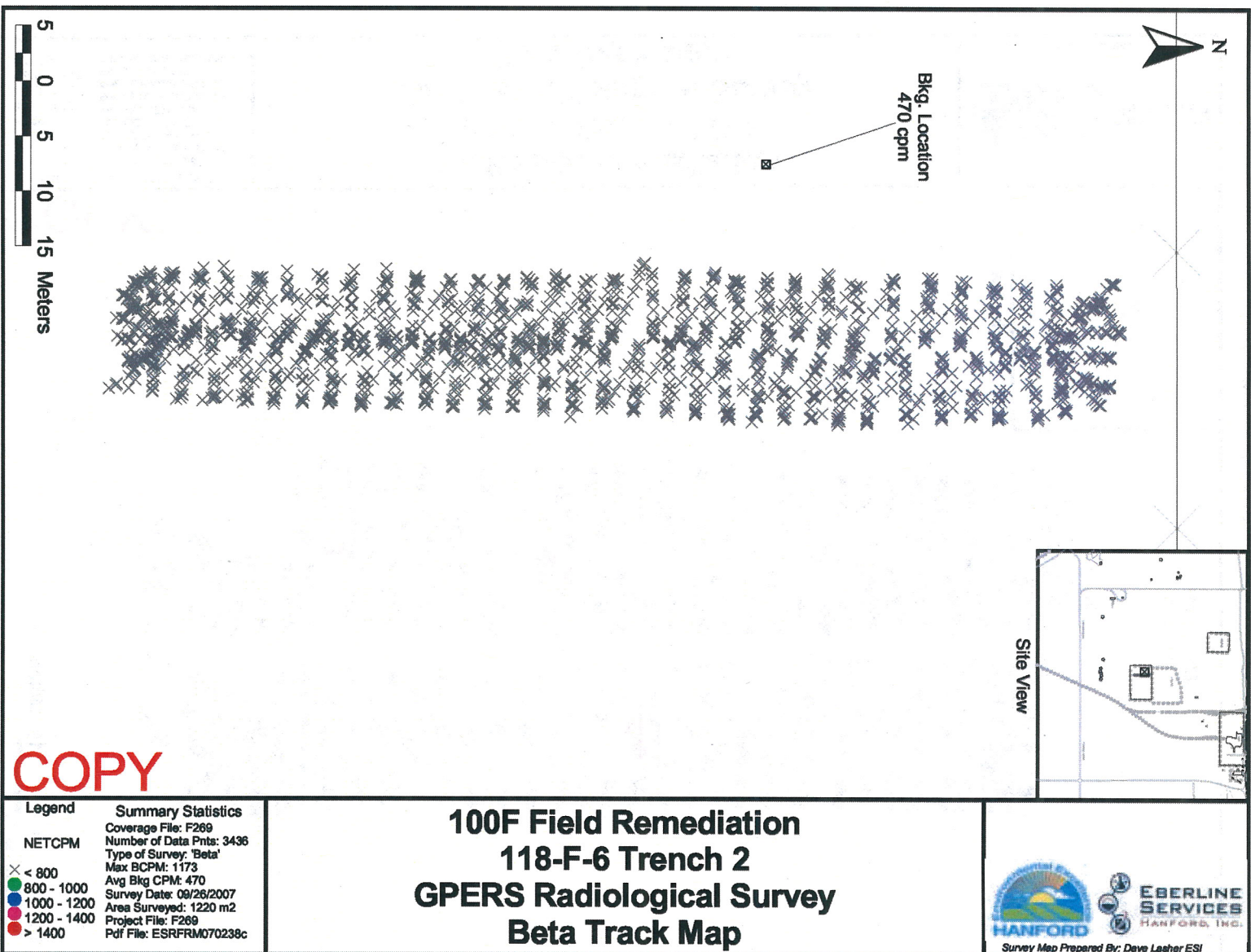


Figure B-2. 118-F-6 Trench 2 GPERs Survey.



**Figure B-3. 118-F-6 Trenches 3 and 4 GPERS Survey
Prior to Additional Soil Removal.**

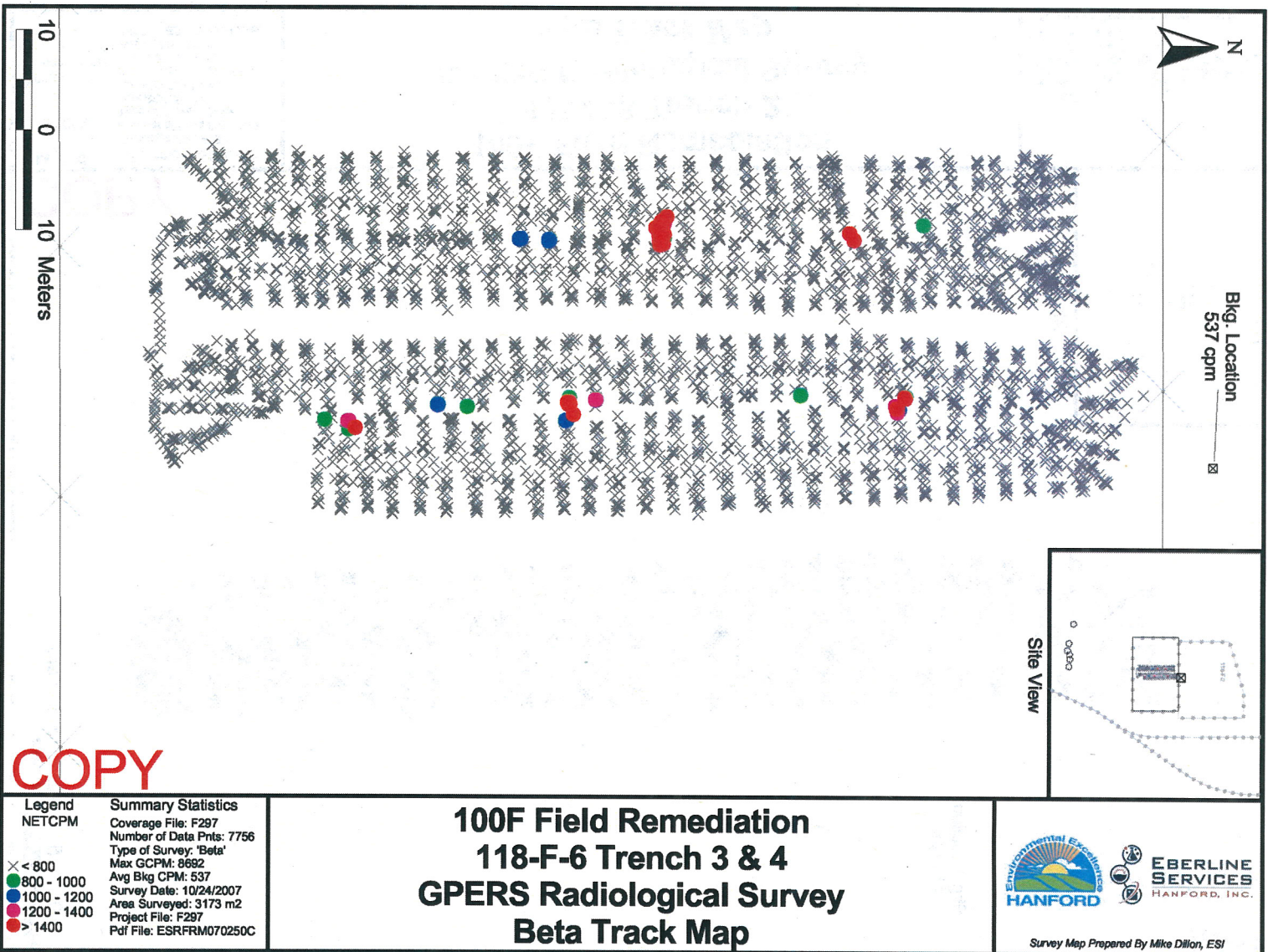


Figure B-4. 118-F-6 Trenches 3 and 4 GPERS Survey Focused on Area of Radiological Activity After Additional Soil Removal.

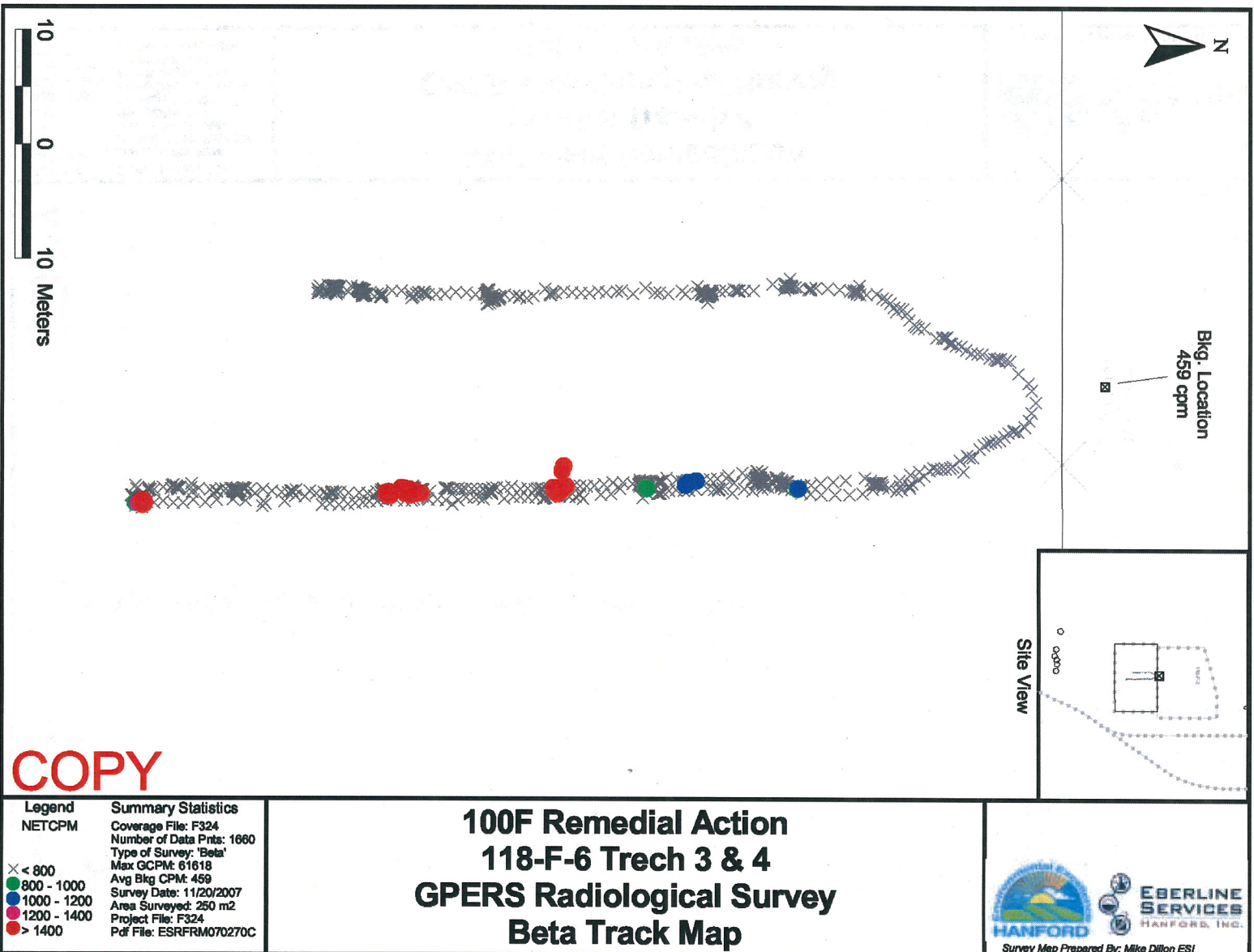


Figure B-5. 118-F-6 Trench 4 GPERS Survey Focused on Area of Radiological Activity After Final Soil Removal.

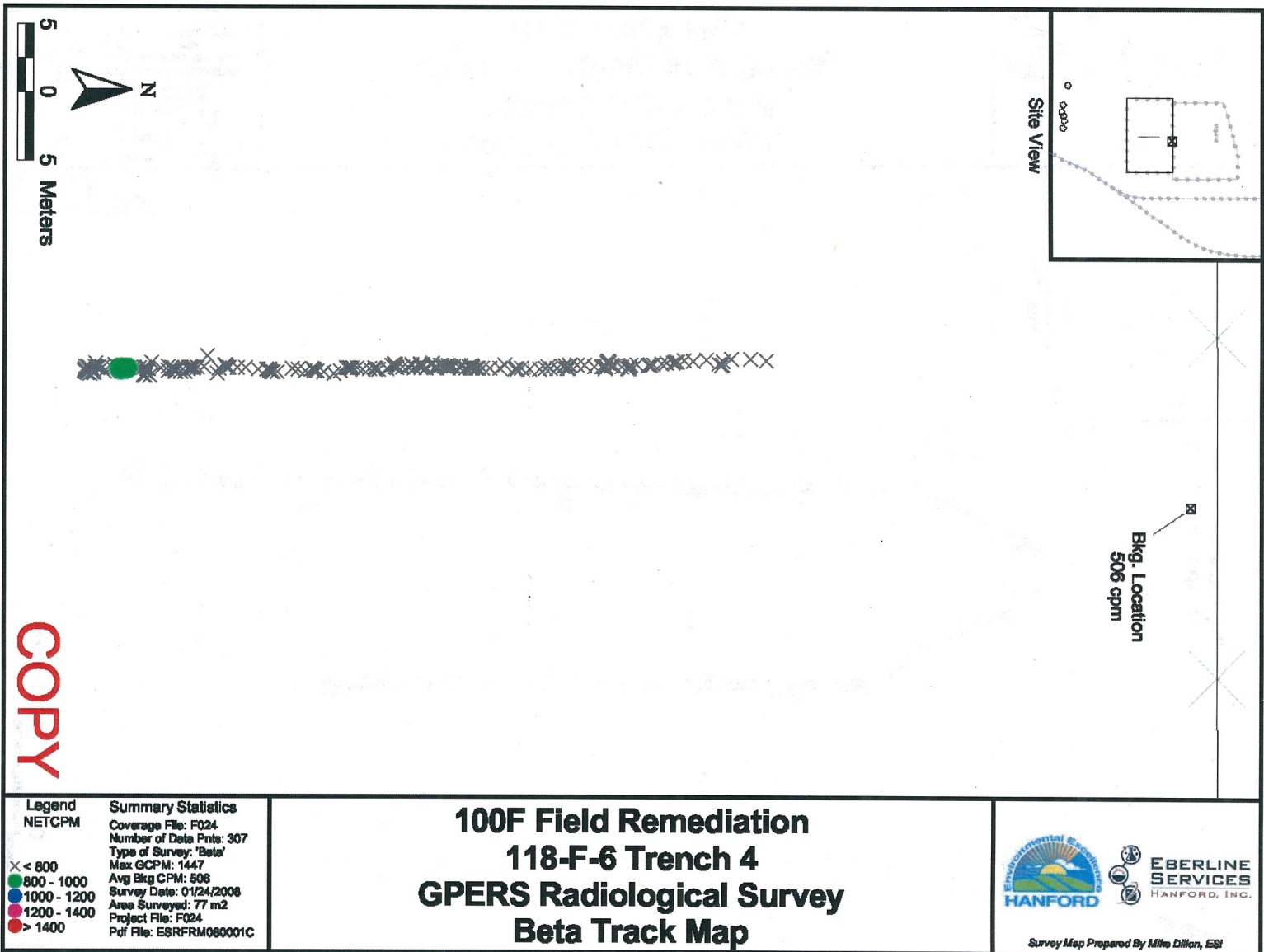


Figure B-6. 118-F-6 Trench 5 GPERS Survey
Prior to Additional Soil Removal.

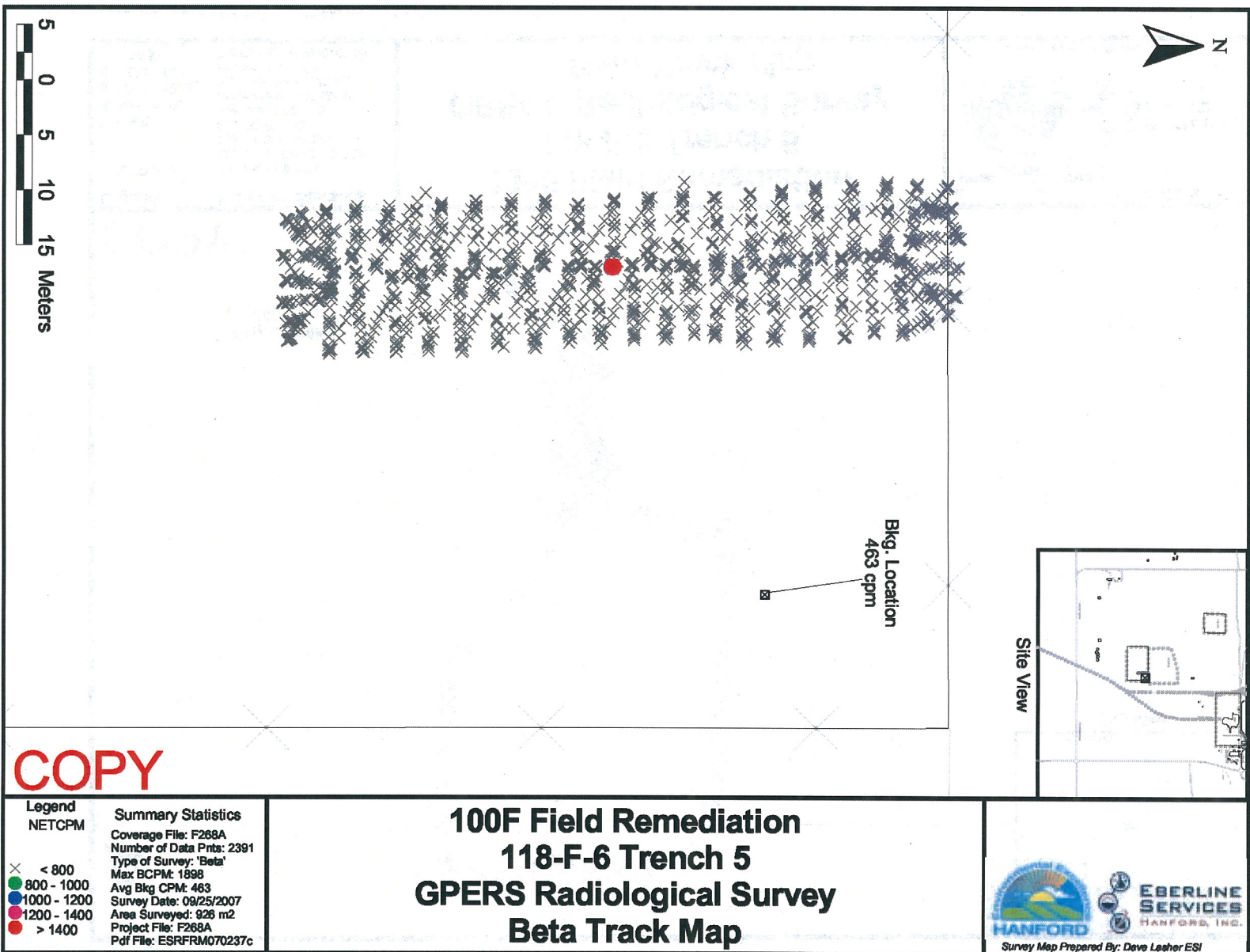


Figure B-7. 118-F-6 Trench 5 GPERS Survey Focused on Single Area of Radiological Activity After Additional Soil Removal.

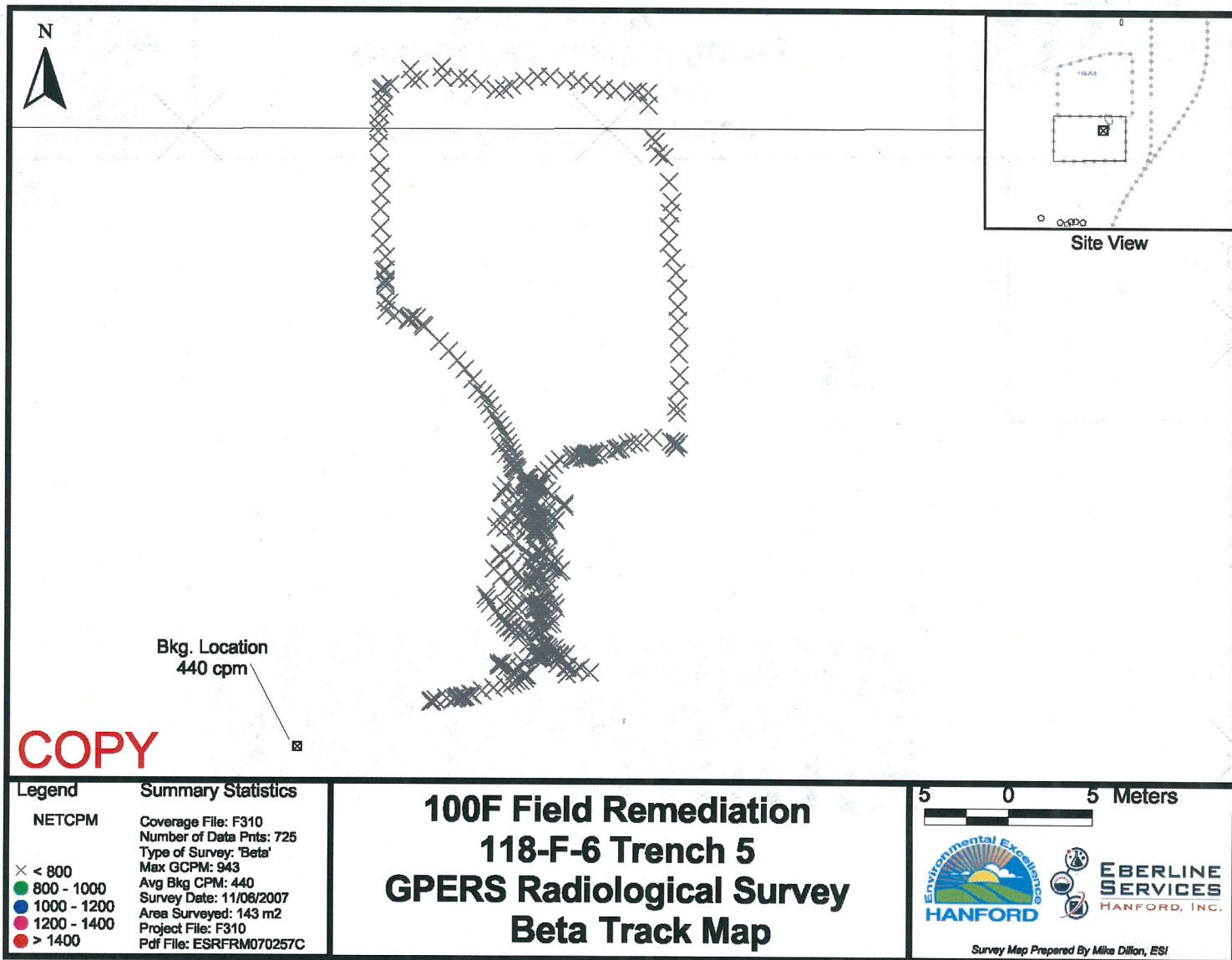


Figure B-8. 118-F-6 Trench 6 GPERs Survey
Prior to Additional Soil Removal.

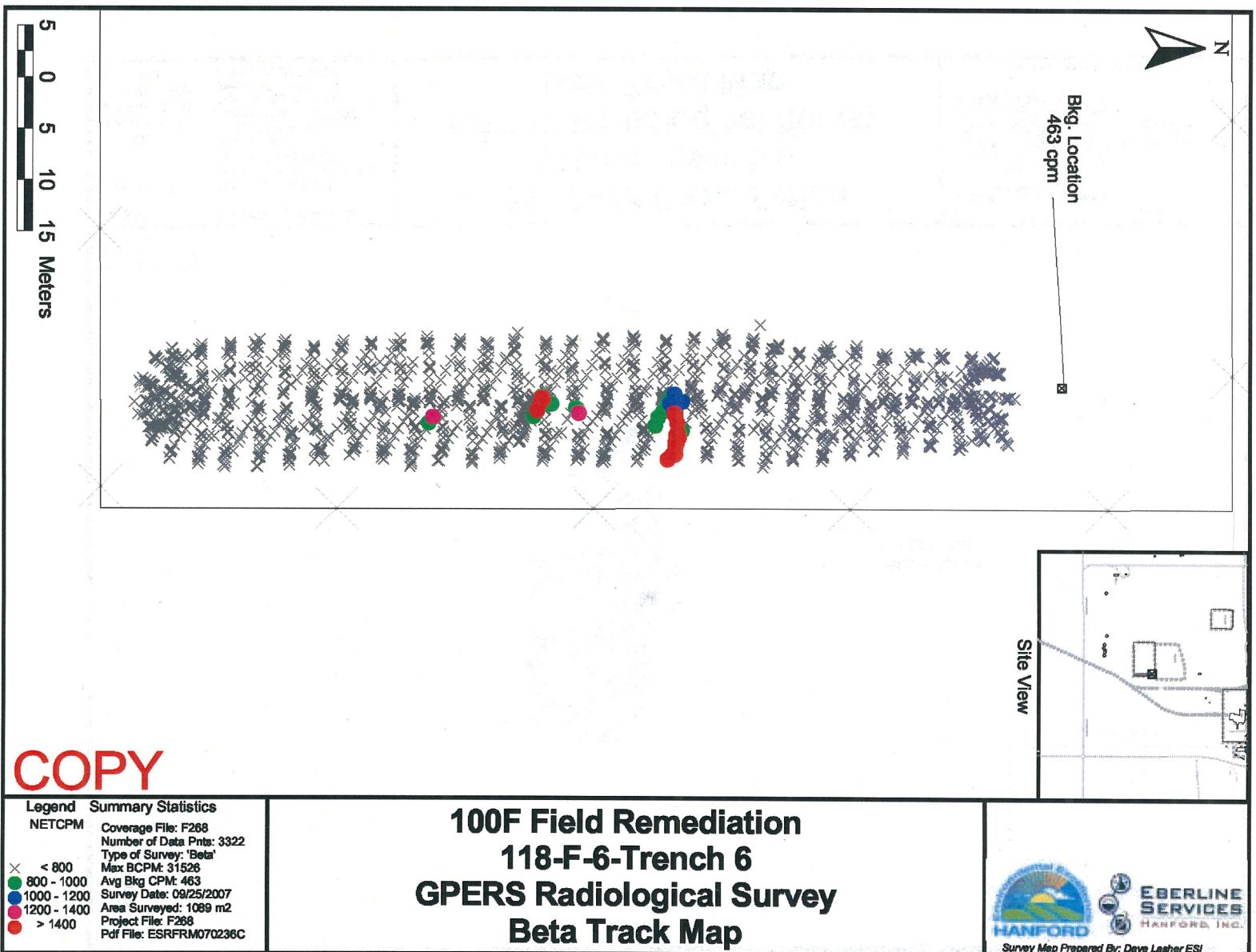


Figure B-9. 118-F-6 Trench 6 GPERS Survey Focused on Area of Radiological Activity After Additional Soil Removal.

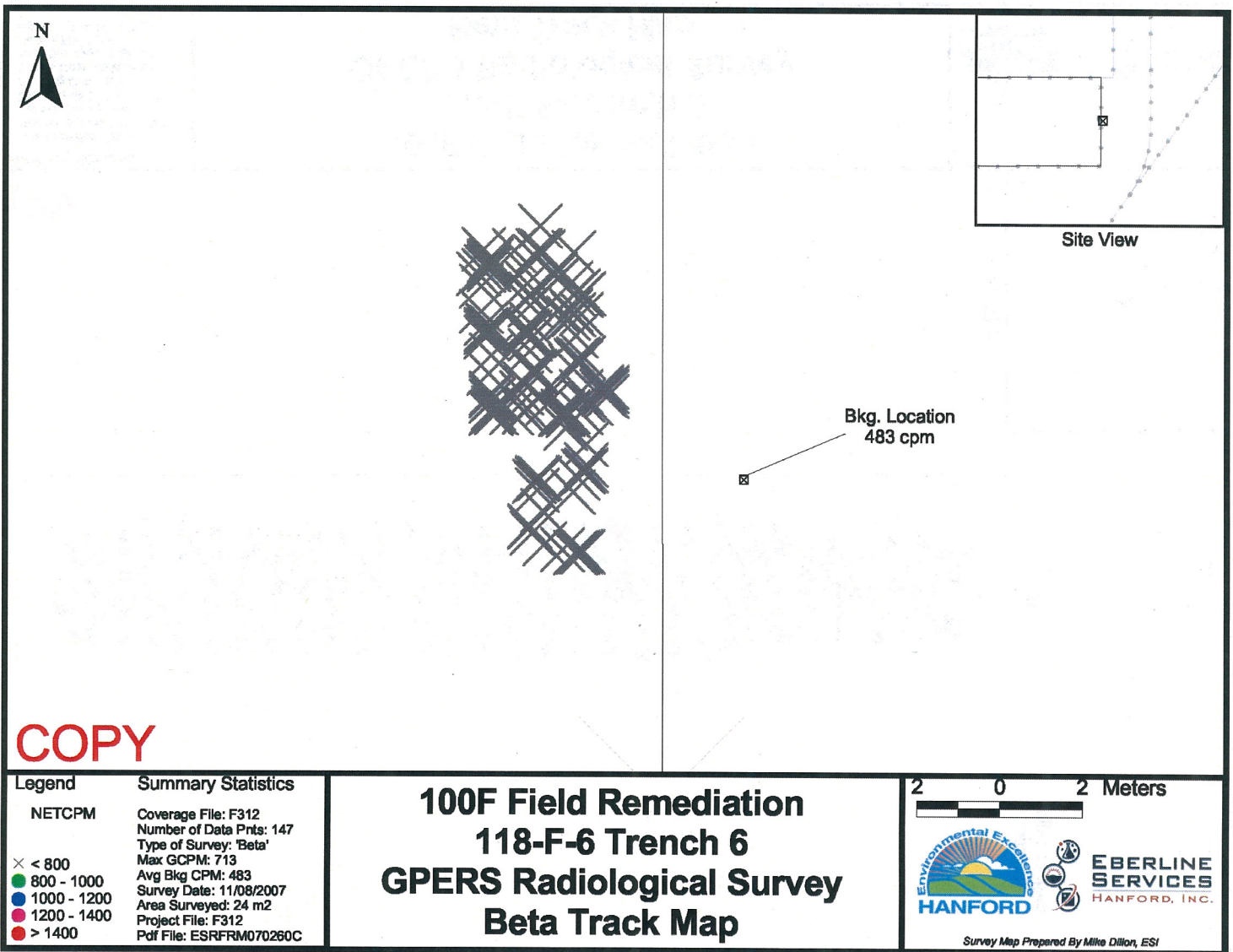
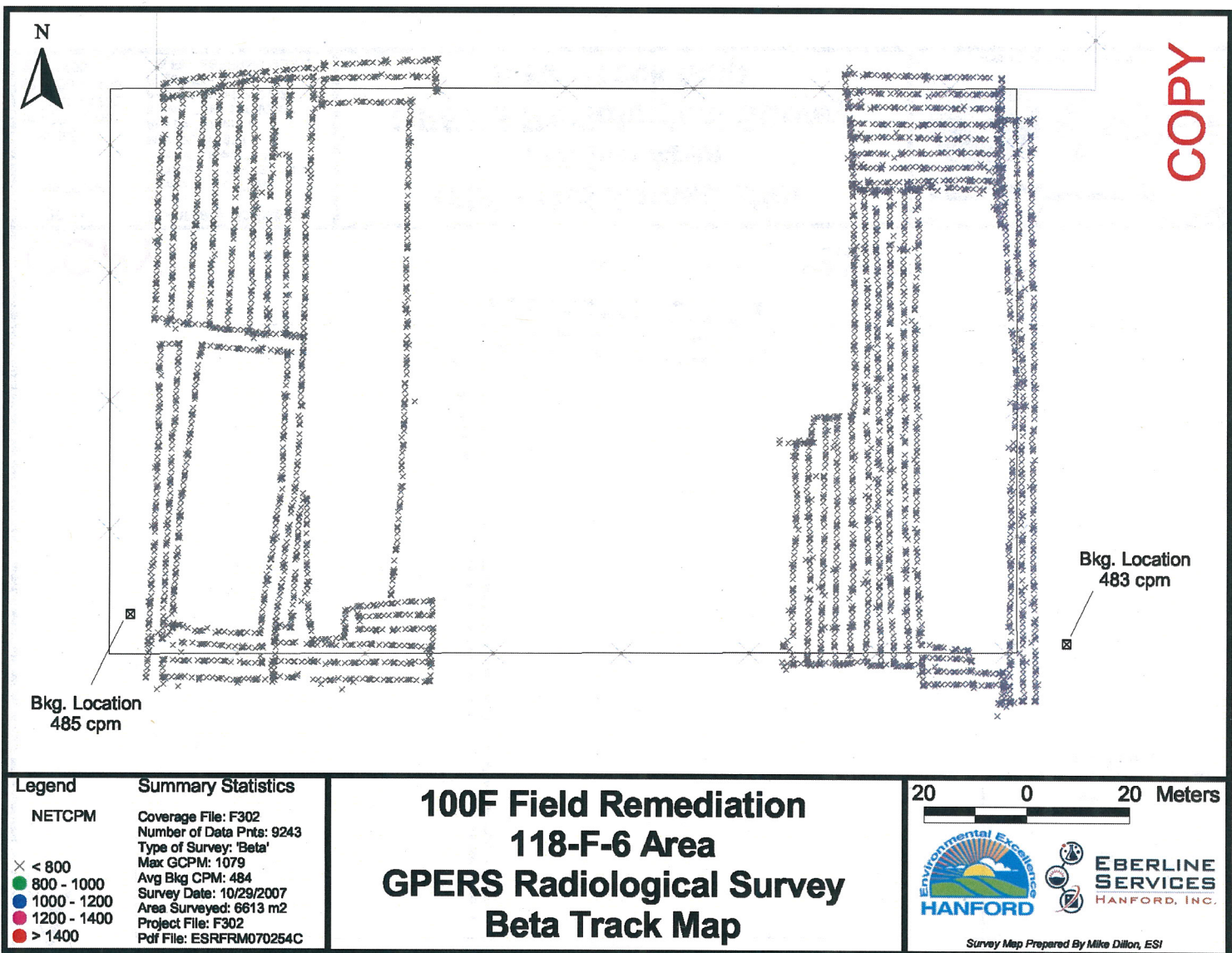
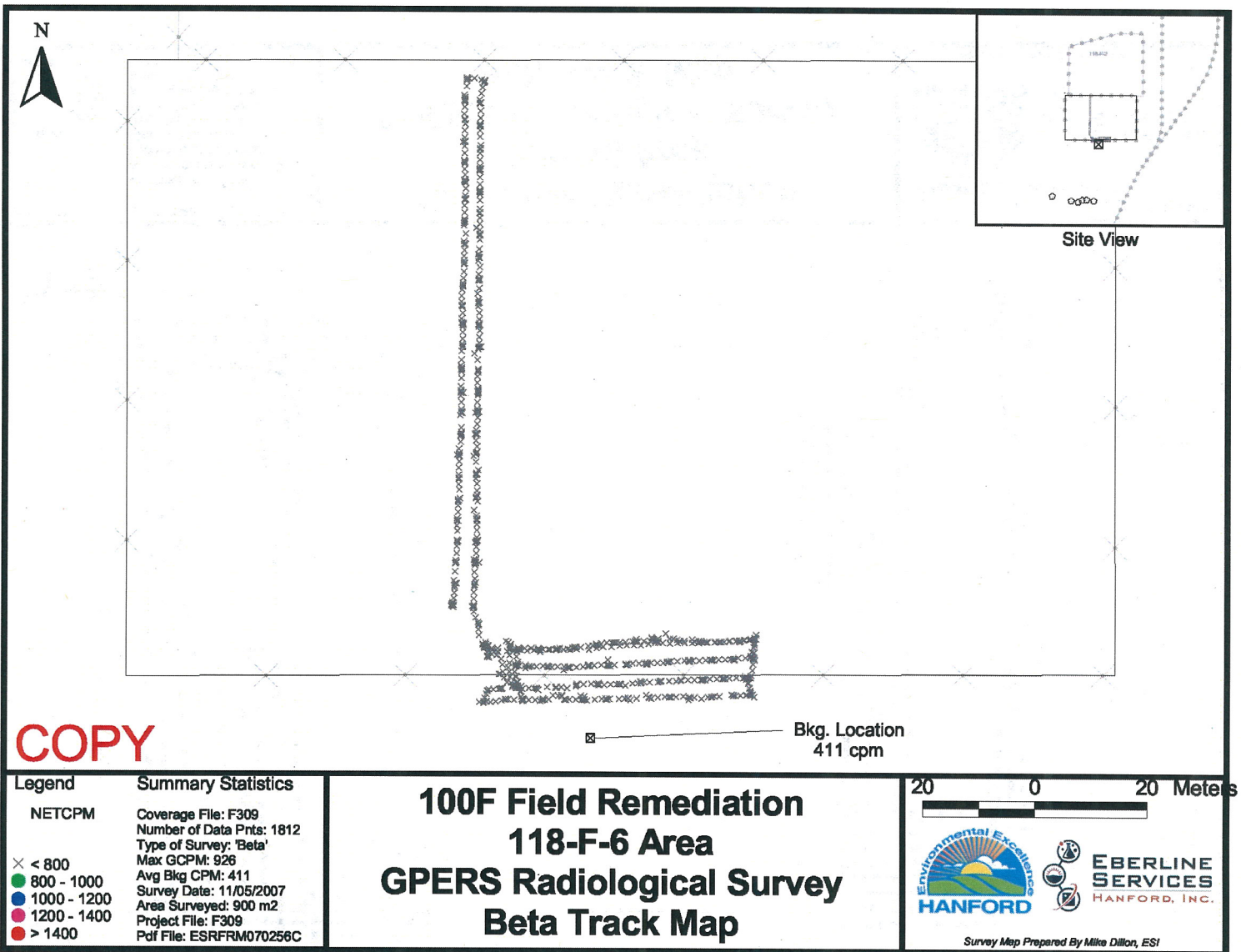


Figure B-10. 118-F-6 GPERS Survey of Areas
Surrounding Trenches 1, 2, 5, and 6.



**Figure B-11. 118-F-6 GPERS Survey of Interstitial Area
Between Trenches 2 and 3.**



**Figure B-12. 118-F-6 GPERS Survey of Interstitial Area
Between Trenches 3 and 4.**

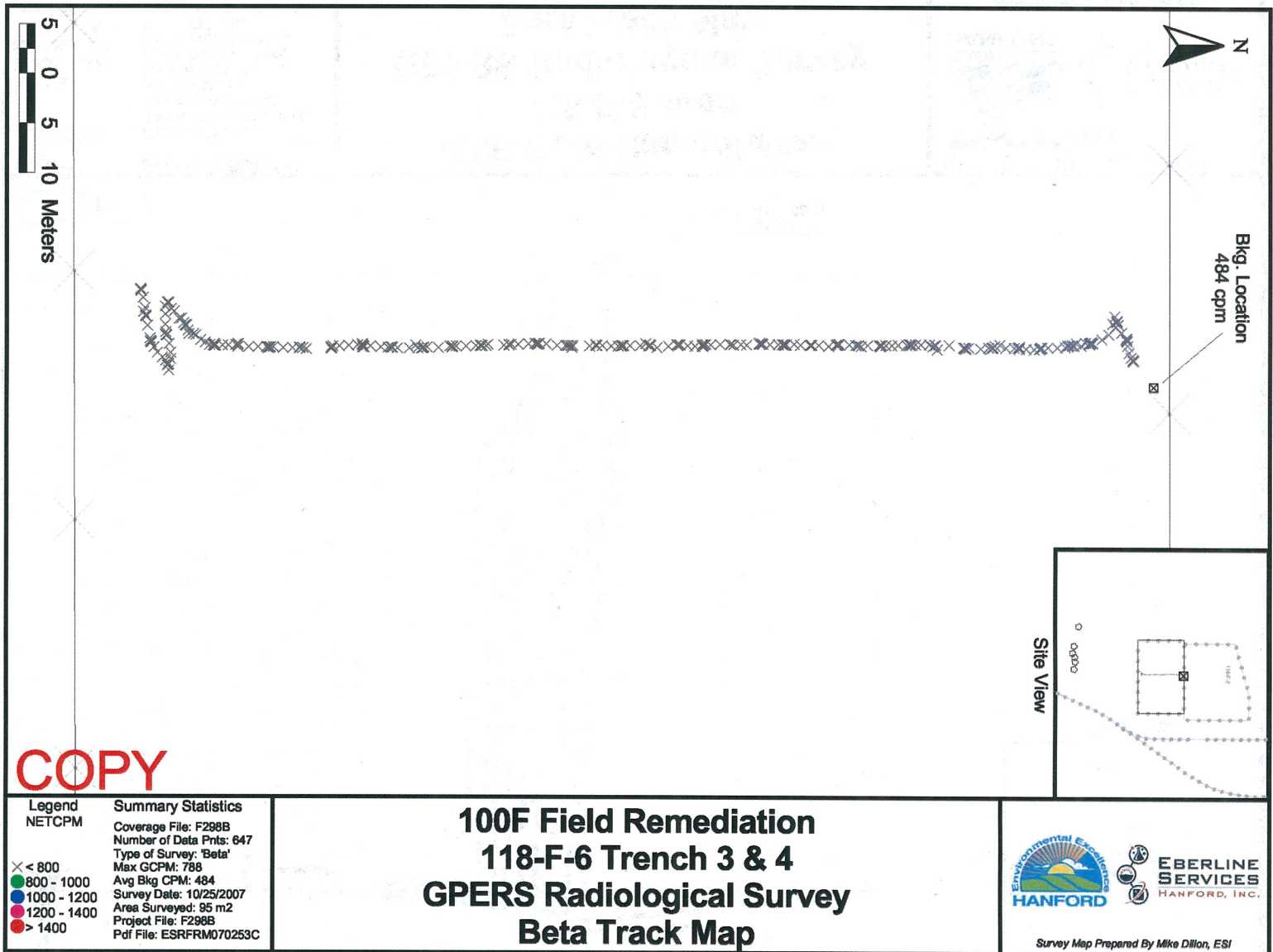


Figure B-13. 118-F-6 GPERS Survey of Area
Between Trenches 4 and 5.

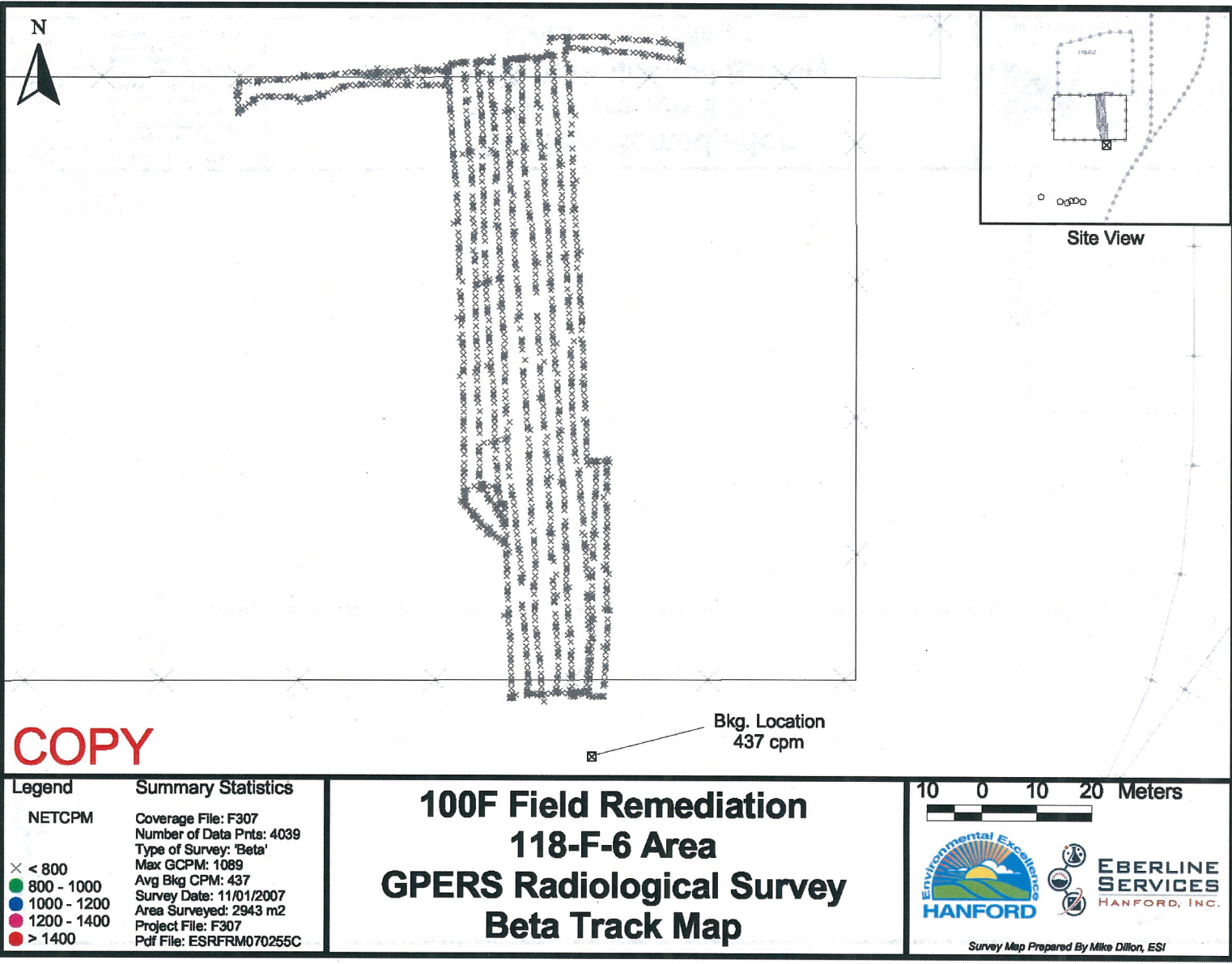
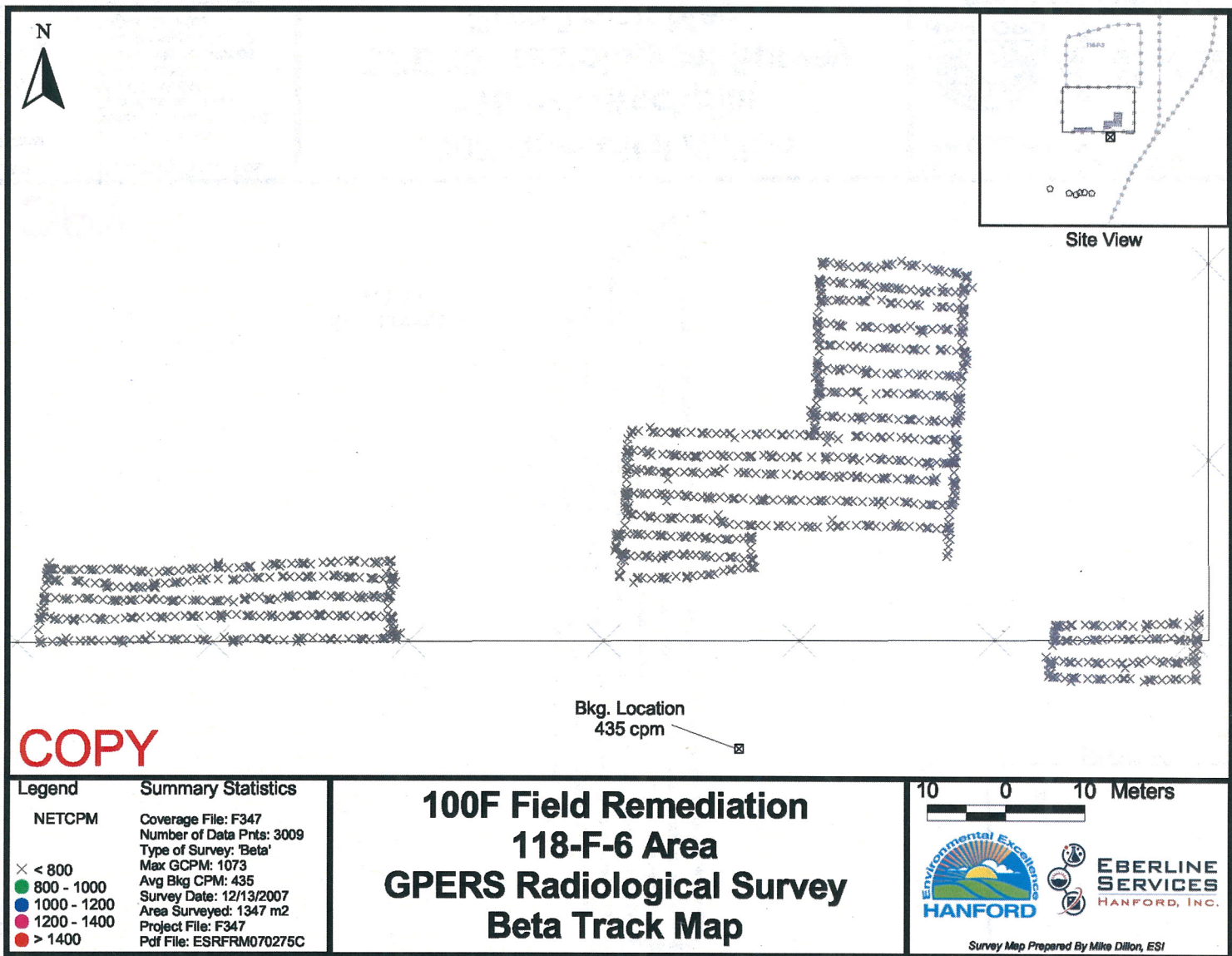


Figure B-14. 118-F-6 GPERS Survey of Area
South of Trench 5.



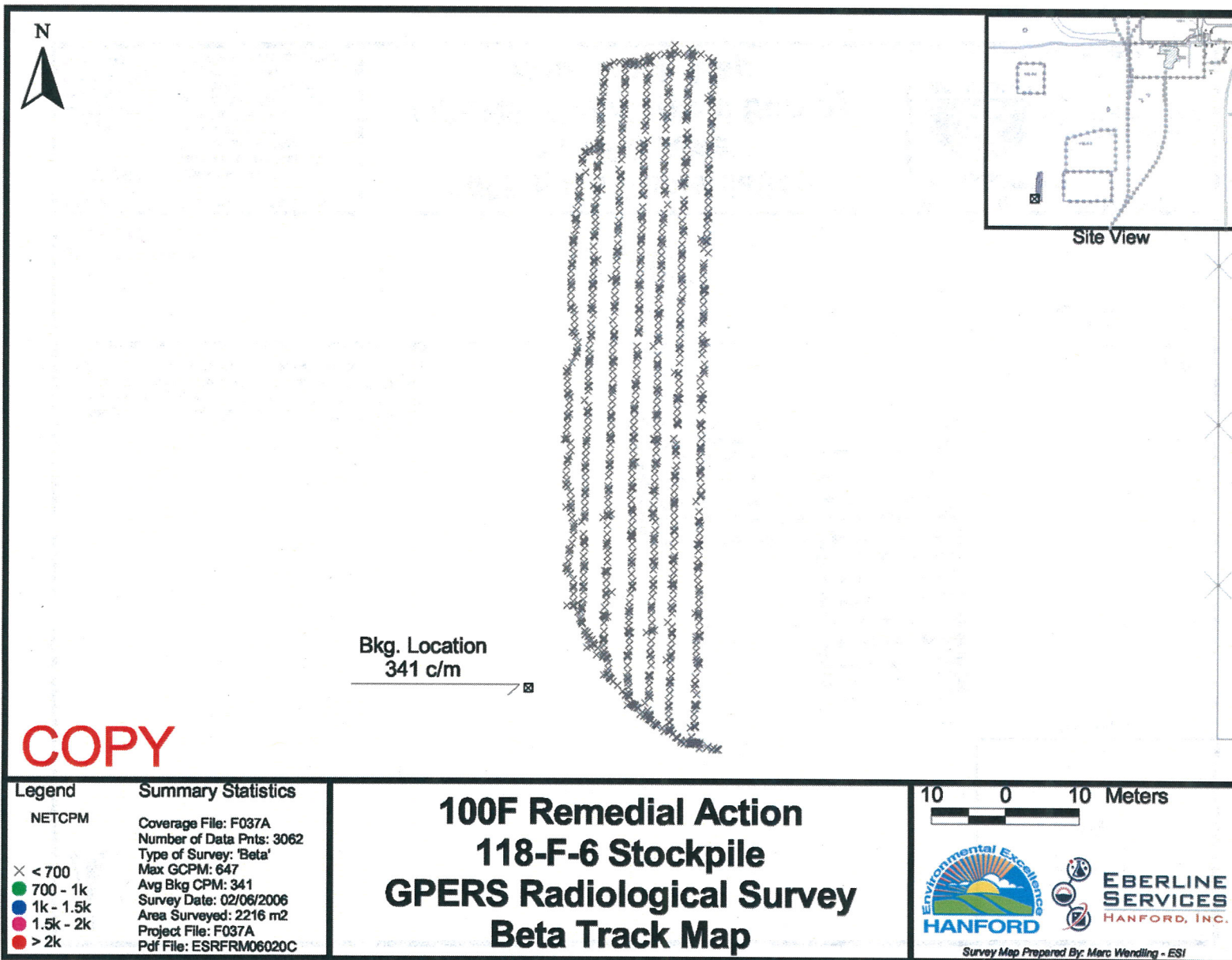


Figure B-15. GPERS Survey of 118-F-6 Stockpile.

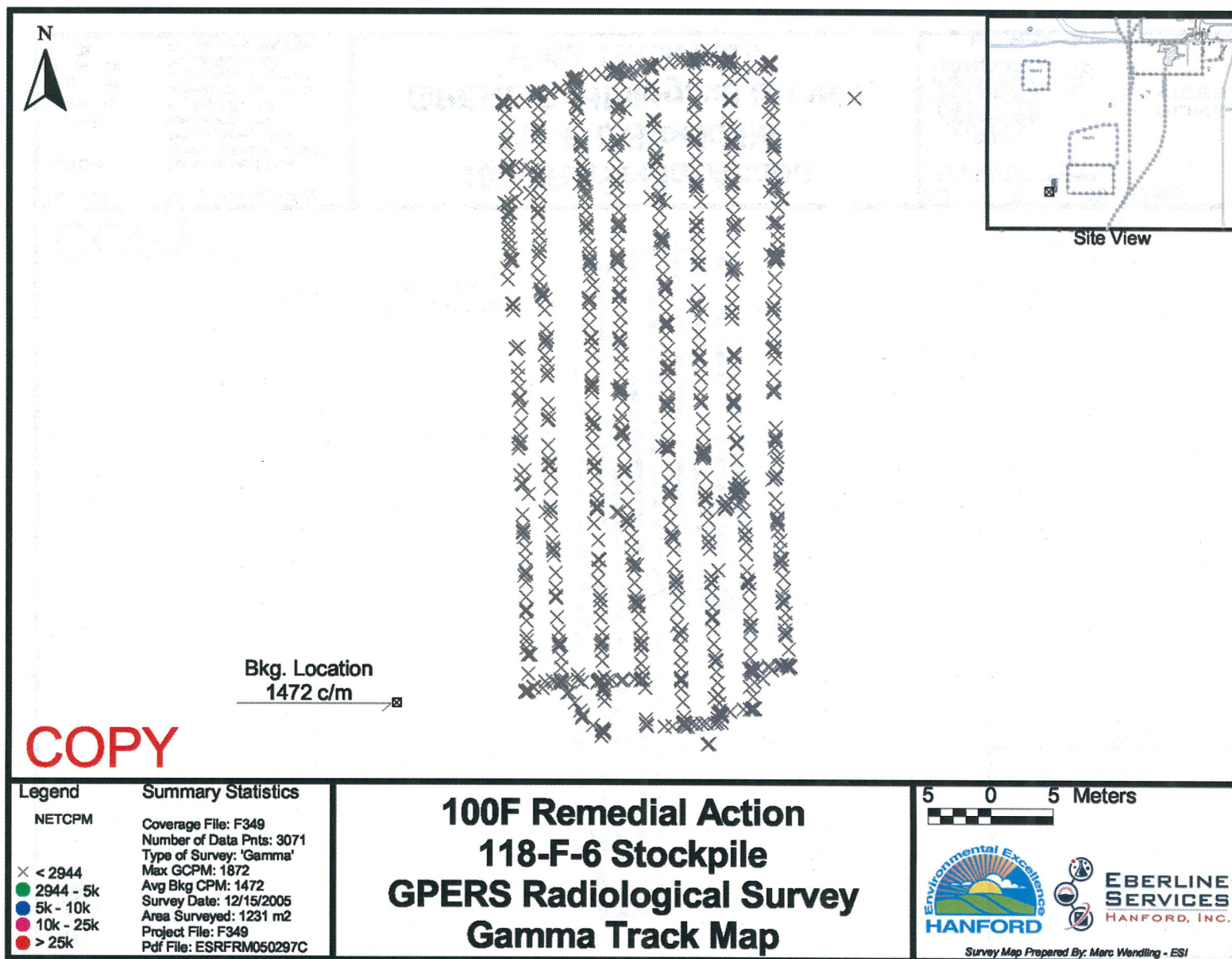
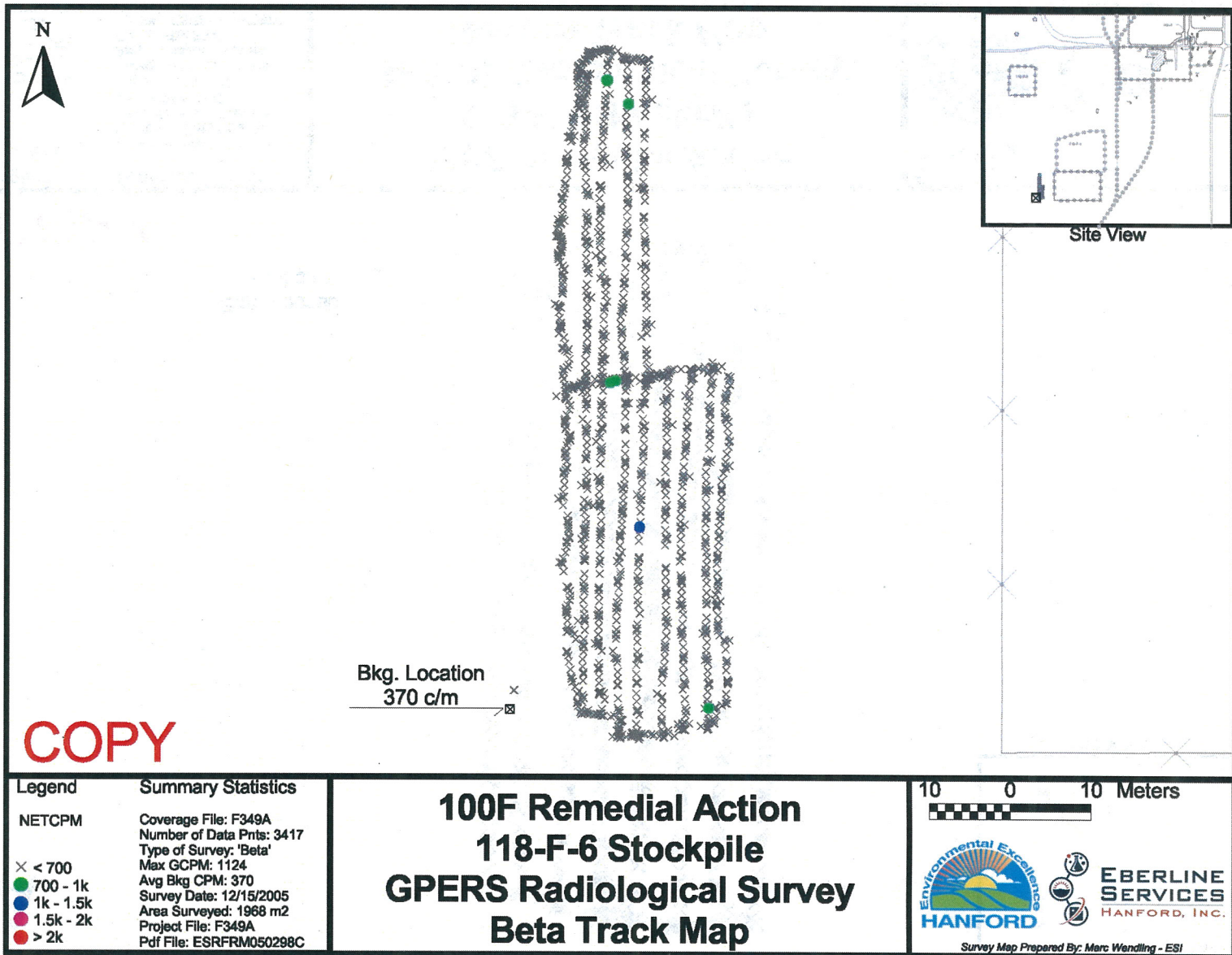


Figure B-17. GPERS Survey of 118-F-6 Stockpile.



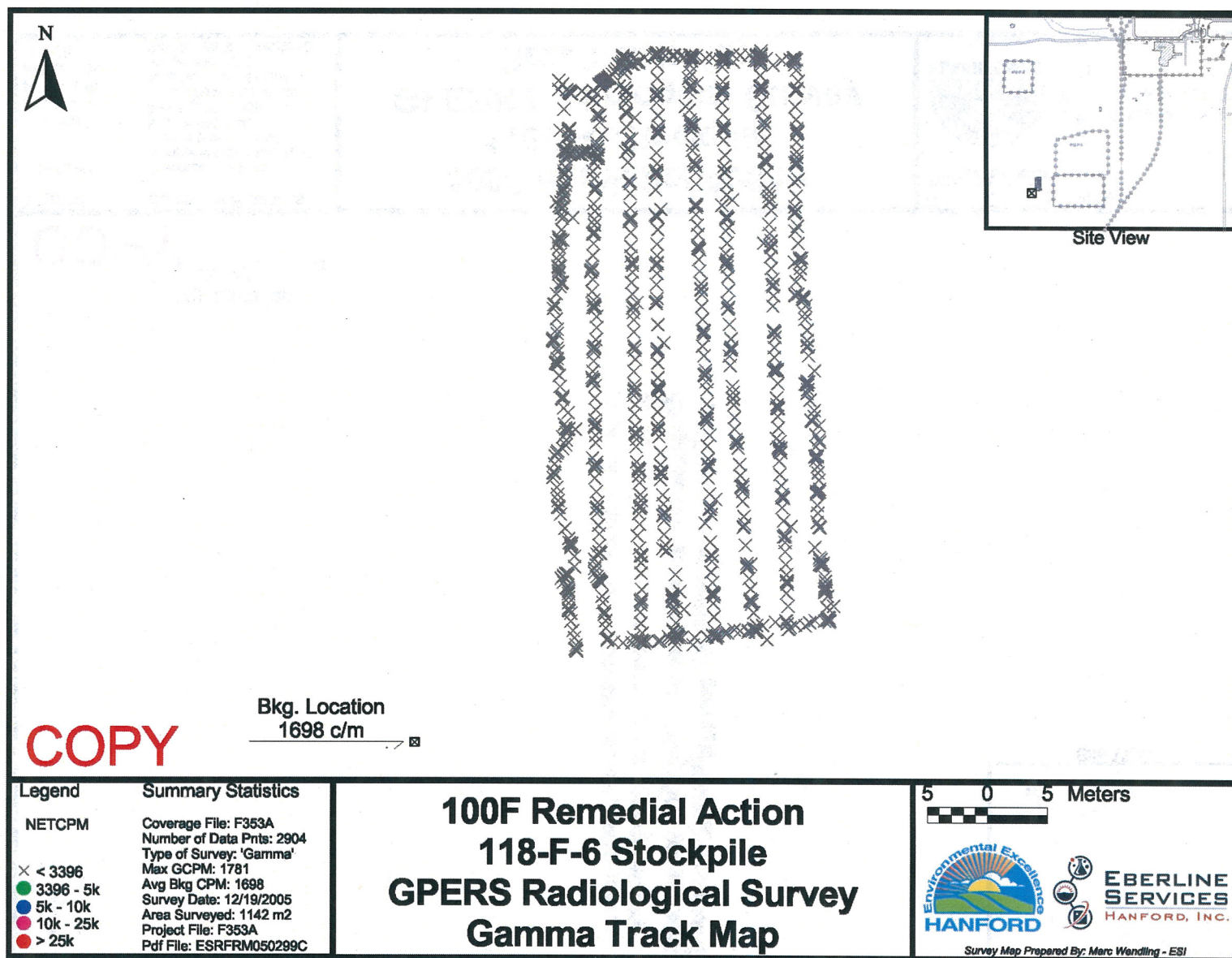


Figure B-18. GPERS Survey of 118-F-6 Stockpile.

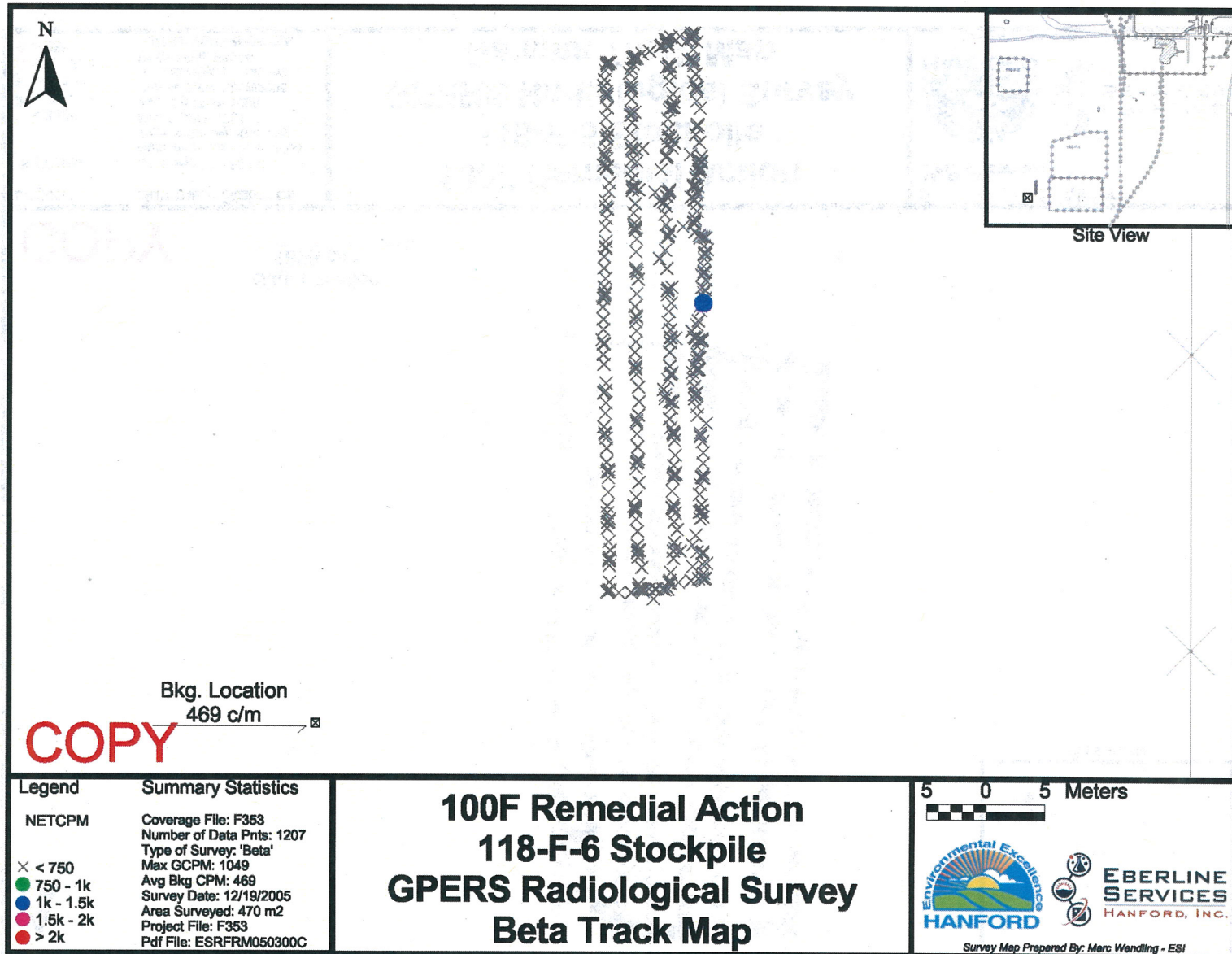
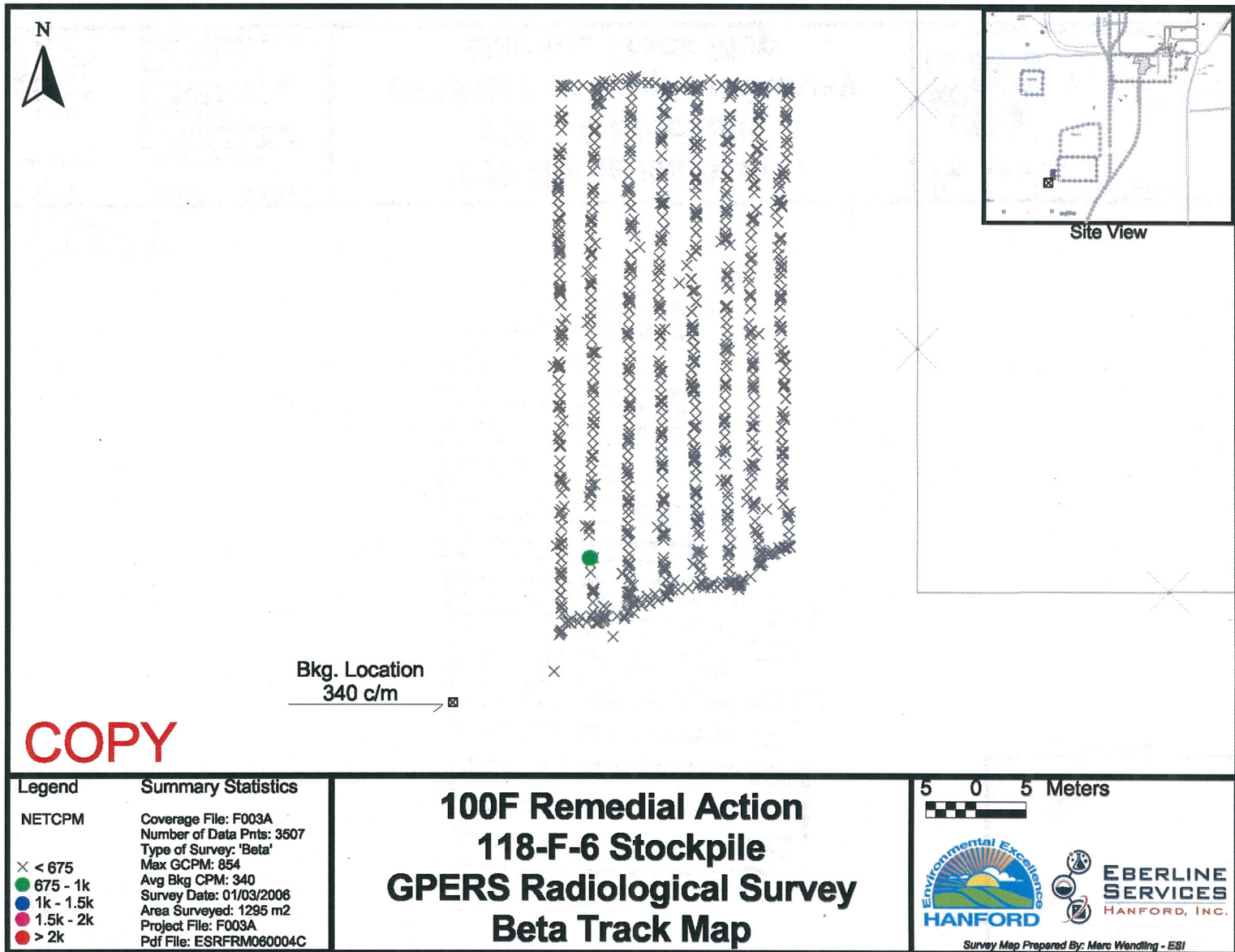


Figure B-19. GPERS Survey of 118-F-6 Stockpile.



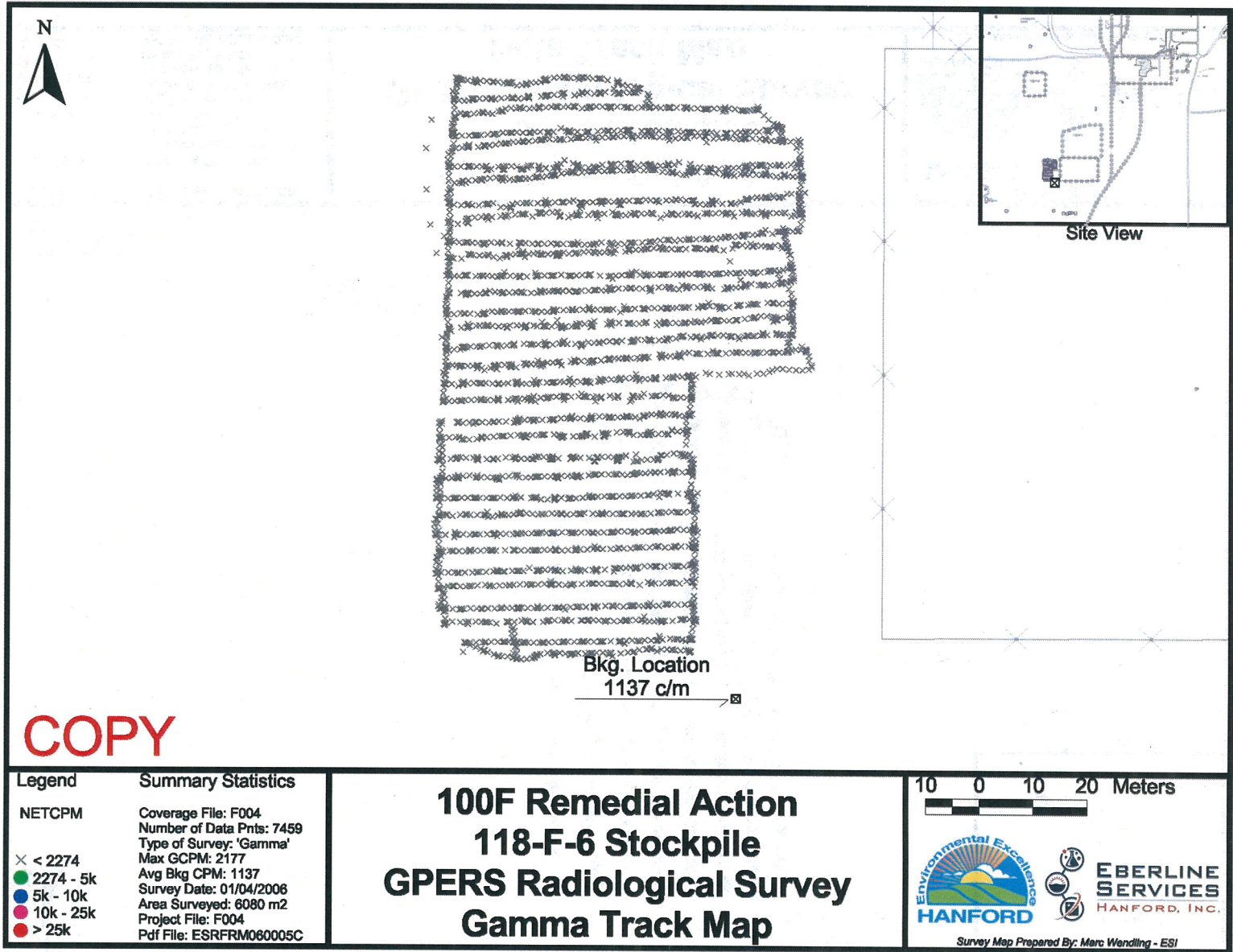


Figure B-21. GPERS Survey of 118-F-6 Stockpile.

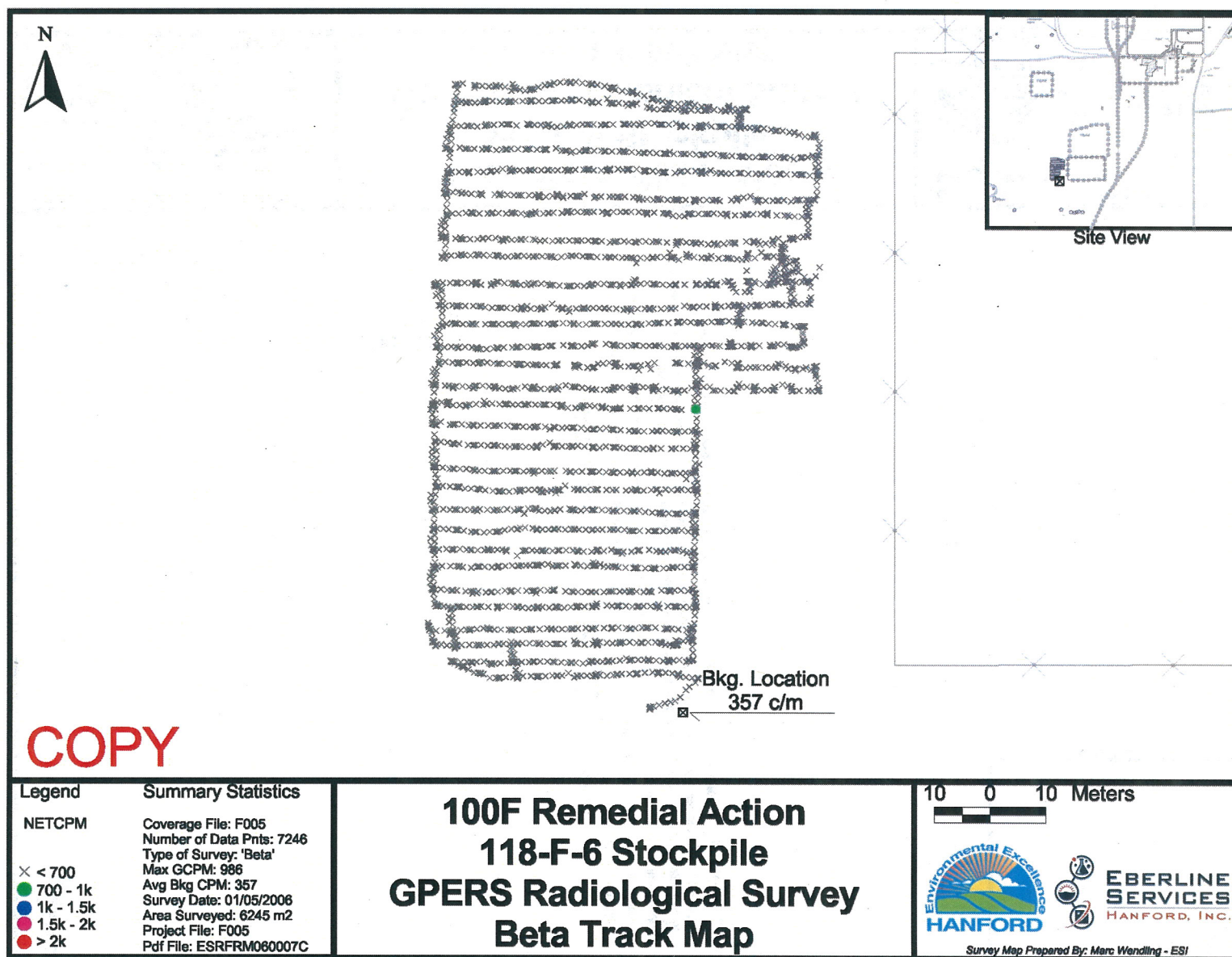


Figure B-22. GPERS Survey of 118-F-6 Stockpile.

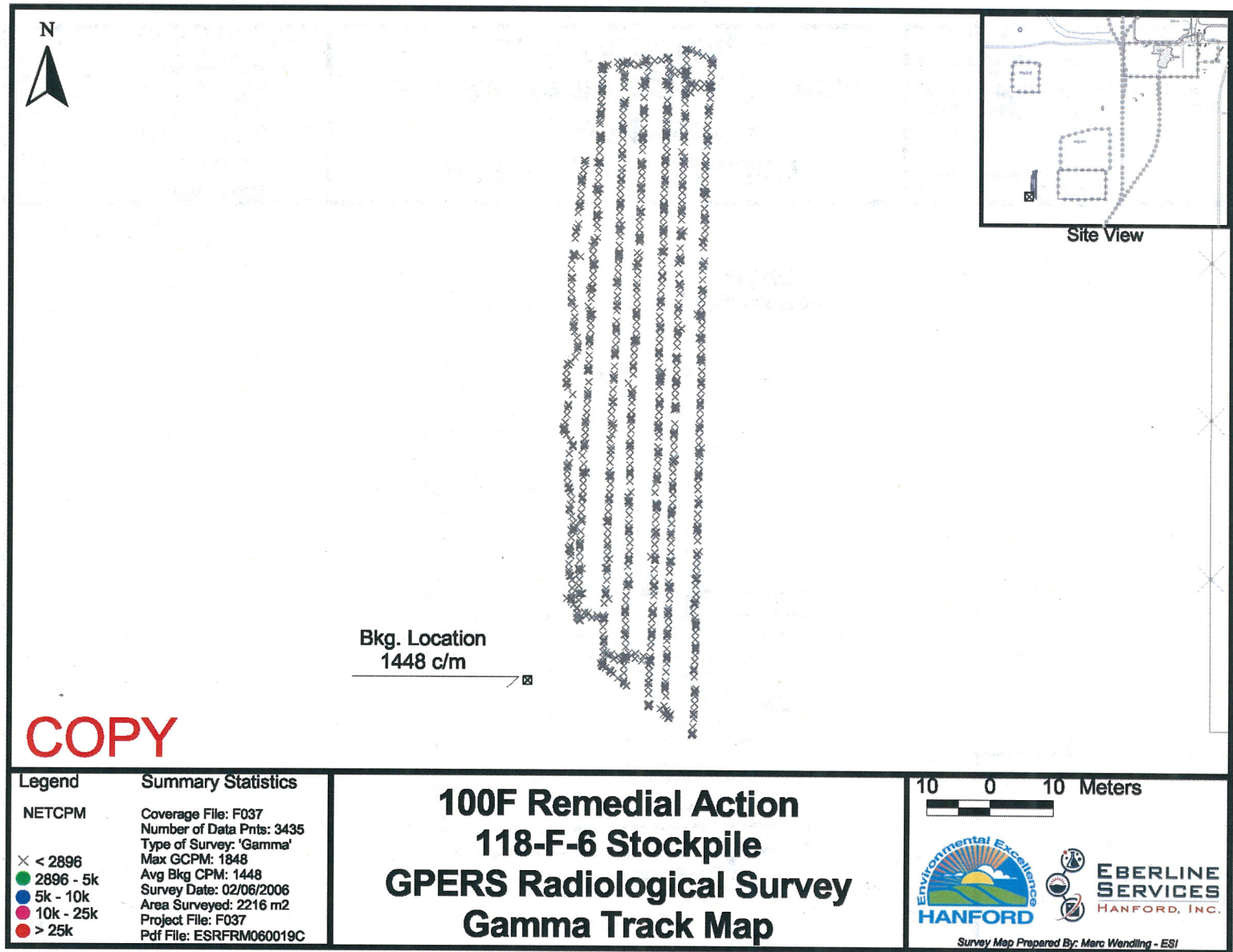


Figure B-23. GPERS Survey of 118-F-6 Stockpile.

APPENDIX C

CALCULATIONS

APPENDIX C
CALCULATIONS

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

Shallow Zone and Overburden Sampling Plan, 0100F-CA-V0340, Rev. 0 C-3

118-F-6 Burial Ground Cleanup Verification 95% UCL Calculations,
0100F-CA-V0337, Rev. 1 C-10

DISCLAIMER FOR CALCULATIONS

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

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 118-F-6 Burial Ground Sample Design Job No. 14655
Area: 100-F

Discipline: Environmental Engineering *Calculation No: 0100F-CA-V0340

Subject: Shallow Zone and Overburden Sampling Plan

Excel, Autodesk World,
and Autodesk Land
Computer Program: 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	<i>G. Cruz</i> 1-23-08	<i>C.A. Bentz</i> 1/23/08	N/A	<i>S.W. Callison</i> <i>for S.W. Callison</i>	1/23/08

SUMMARY OF REVISION

Washington Closure Hanford

CALCULATION SHEET

Originator G. Cruz Date 1/23/2008 Calc. No. 0100F-CA-V0340 Rev. No. 0
Project 118-F-6 Burial Ground Sample Design Job No. 14655 Checked AB Date 1/23/08
Subject Shallow Zone and Overburden Sampling Plan Sheet No. 2 of 2

1									
2									
3	Determination of Overburden 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:					9490.09	m ²		
9	Area of Each Decision Subunits:					2372.52	m ²		
10									
11	Area of Each Sampling Area:					593.13	m ²		
12									
13	Area of Each Sample Node:					37.07	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-6 Burial Ground Overburden Sampling Plan,								
17	for Sample Location Table								
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									

Washington Closure Hanford

Originator G. Cruz Date 1/23/2008 Calc. No. 0100F-CA-V0340 Rev. No. 0
Project 118-F-6 Burial Ground Sample Design Job No. 14655 Checked CAB Date 1/23/08
Subject Shallow Zone and Overburden 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 1/23/2008 Calc. No. 0100F-CA-V0340 Rev. No. 0
Project 118-F-6 Burial Ground Sample Design Job No. 14655 Checked CSB Date 1/23/08
Subject Shallow Zone and Overburden Sampling Plan Sheet No. 1 of 1

1 ATTACHMENT 2

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

Decision Units *	Waste Site Size	Number of Decision Units
Site verification (shallow) 0 to 4.6m (15 ft)	Small area of exposed surface after excavation $\leq 9290 \text{ m}^2 (\leq 100,000 \text{ ft}^2)$	1
	Medium area of exposed surface after excavation $>9290 \text{ m}^2$ but $\leq 37161 \text{ m}^2$ $(>100,000 \text{ ft}^2$ but $\leq 400,000 \text{ ft}^2)$	4
	Large area of exposed surface after excavation $>37161 \text{ m}^2 (>400,000 \text{ ft}^2)$	8
Site verification (deep) >4.6m (>15 ft)	Small area of exposed surface after excavation $\leq 9290 \text{ m}^2 (\leq 100,000 \text{ ft}^2)$	1
	Medium area of exposed surface after excavation $>9290 \text{ m}^2$ but $\leq 37161 \text{ m}^2$ $(>100,000 \text{ ft}^2$ but $\leq 400,000 \text{ ft}^2)$	4
	Large area of exposed surface after excavation $>37161 \text{ m}^2 (>400,000 \text{ ft}^2)$	8
Overburden/layback piles	Small area of exposed surface after excavation $\leq 9290 \text{ m}^2 (\leq 100,000 \text{ ft}^2)$	1
	Medium area of exposed surface after excavation $>9290 \text{ m}^2$ but $\leq 37161 \text{ m}^2$ $(>100,000 \text{ ft}^2$ but $\leq 400,000 \text{ ft}^2)$	4
	Large area of exposed surface after excavation $>37161 \text{ m}^2 (>400,000 \text{ ft}^2)$	8

* 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.

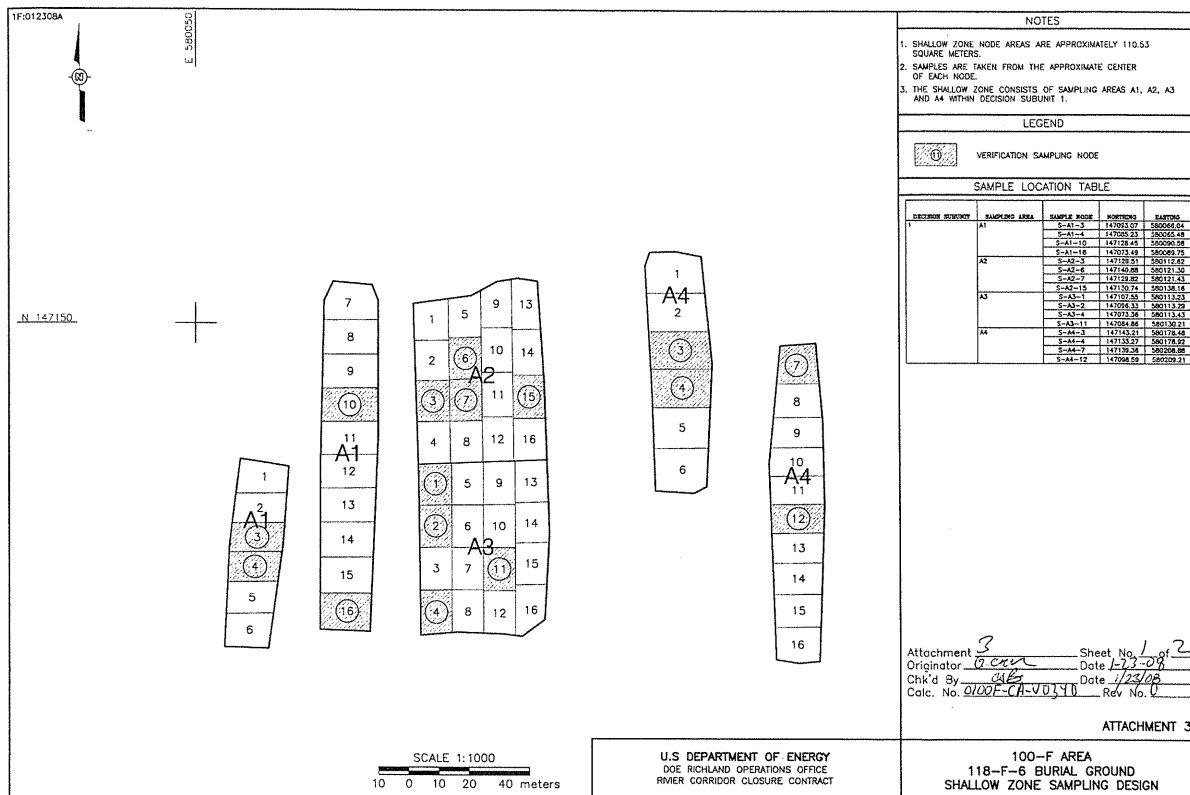
Note: 1.) Metric equivalents added to original SAP table.

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 $\leq 9290 \text{ m}^2 (\leq 100,000 \text{ ft}^2)$	1	4	16	4
Medium site $>9290 \text{ m}^2 (>100,000 \text{ ft}^2)$ but $\leq 37161 \text{ m}^2 (\leq 400,000 \text{ ft}^2)$	4	16	64	16
Large site $\leq 37161 \text{ m}^2 (>400,000 \text{ ft}^2)$	8	32	128	32

Note: 2.) The term "sample areas" is used interchangeably with "blocks" in this sample design.

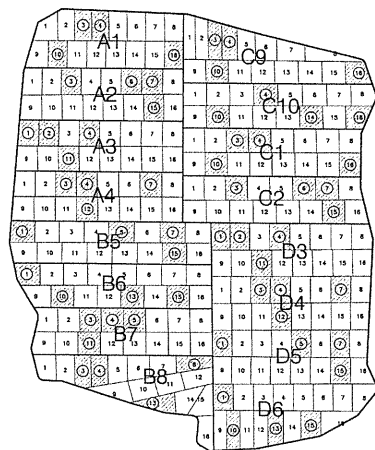
3.) Metric equivalents corrected from original SAP table.



1F-012308B

E 579900

N 147150



SCALE 1:800
8 0 8 16 32 meters

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING	DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	A1	D-A1-3	147182.14	579958.82	2	B5	D-B5-1	147227.38	579940.97
		D-A1-4	147182.08	579941.20			D-B5-2	147227.28	579940.84
		D-A1-5	147184.42	579948.85			D-B5-3	147227.17	579940.68
	A2	D-A2-1	147154.35	579950.53		B6	D-B6-1	147201.49	579950.56
		D-A2-2	147147.23	579953.41			D-B6-2	147201.39	579950.43
		D-A2-3	147147.27	579958.33			D-B6-3	147201.19	579950.55
		D-A2-4	147147.28	579954.25			D-B6-4	147201.19	579950.55
		D-A2-5	147140.34	579979.19			D-B6-5	147201.19	579950.55
	A3	D-A3-1	147133.51	579941.41		B7	D-B7-1	147201.19	579950.55
		D-A3-2	147133.50	579947.42			D-B7-2	147201.19	579950.55
		D-A3-3	147133.47	579956.24			D-B7-3	147201.19	579950.55
		D-A3-4	147136.70	579950.71		B8	D-B8-1	147201.19	579950.55
	A4	D-A4-1	147130.55	579952.00			D-B8-2	147201.19	579950.55
		D-A4-2	147130.55	579952.00			D-B8-3	147201.19	579950.55
		D-A4-3	147130.55	579952.00			D-B8-4	147201.19	579950.55
		D-A4-4	147130.55	579952.00			D-B8-5	147201.19	579950.55
		D-A4-5	147130.55	579952.00			D-B8-6	147201.19	579950.55
		D-A4-6	147130.55	579952.00			D-B8-7	147201.19	579950.55
		D-A4-7	147130.55	579952.00			D-B8-8	147201.19	579950.55
		D-A4-8	147130.55	579952.00			D-B8-9	147201.19	579950.55
		D-A4-9	147130.55	579952.00			D-B8-10	147201.19	579950.55
		D-A4-10	147130.55	579952.00			D-B8-11	147201.19	579950.55
		D-A4-11	147130.55	579952.00			D-B8-12	147201.19	579950.55
		D-A4-12	147130.55	579952.00			D-B8-13	147201.19	579950.55
		D-A4-13	147130.55	579952.00			D-B8-14	147201.19	579950.55
		D-A4-14	147130.55	579952.00			D-B8-15	147201.19	579950.55
		D-A4-15	147130.55	579952.00			D-B8-16	147201.19	579950.55
		D-A4-16	147130.55	579952.00			D-B8-17	147201.19	579950.55
		D-A4-17	147130.55	579952.00			D-B8-18	147201.19	579950.55
		D-A4-18	147130.55	579952.00			D-B8-19	147201.19	579950.55
		D-A4-19	147130.55	579952.00			D-B8-20	147201.19	579950.55
		D-A4-20	147130.55	579952.00			D-B8-21	147201.19	579950.55
		D-A4-21	147130.55	579952.00			D-B8-22	147201.19	579950.55
		D-A4-22	147130.55	579952.00			D-B8-23	147201.19	579950.55
		D-A4-23	147130.55	579952.00			D-B8-24	147201.19	579950.55
		D-A4-24	147130.55	579952.00			D-B8-25	147201.19	579950.55
		D-A4-25	147130.55	579952.00			D-B8-26	147201.19	579950.55
		D-A4-26	147130.55	579952.00			D-B8-27	147201.19	579950.55
		D-A4-27	147130.55	579952.00			D-B8-28	147201.19	579950.55
		D-A4-28	147130.55	579952.00			D-B8-29	147201.19	579950.55
		D-A4-29	147130.55	579952.00			D-B8-30	147201.19	579950.55
		D-A4-30	147130.55	579952.00			D-B8-31	147201.19	579950.55
		D-A4-31	147130.55	579952.00			D-B8-32	147201.19	579950.55
		D-A4-32	147130.55	579952.00			D-B8-33	147201.19	579950.55
		D-A4-33	147130.55	579952.00			D-B8-34	147201.19	579950.55
		D-A4-34	147130.55	579952.00			D-B8-35	147201.19	579950.55
		D-A4-35	147130.55	579952.00			D-B8-36	147201.19	579950.55
		D-A4-36	147130.55	579952.00			D-B8-37	147201.19	579950.55
		D-A4-37	147130.55	579952.00			D-B8-38	147201.19	579950.55
		D-A4-38	147130.55	579952.00			D-B8-39	147201.19	579950.55
		D-A4-39	147130.55	579952.00			D-B8-40	147201.19	579950.55
		D-A4-40	147130.55	579952.00			D-B8-41	147201.19	579950.55
		D-A4-41	147130.55	579952.00			D-B8-42	147201.19	579950.55
		D-A4-42	147130.55	579952.00			D-B8-43	147201.19	579950.55
		D-A4-43	147130.55	579952.00			D-B8-44	147201.19	579950.55
		D-A4-44	147130.55	579952.00			D-B8-45	147201.19	579950.55
		D-A4-45	147130.55	579952.00			D-B8-46	147201.19	579950.55
		D-A4-46	147130.55	579952.00			D-B8-47	147201.19	579950.55
		D-A4-47	147130.55	579952.00			D-B8-48	147201.19	579950.55
		D-A4-48	147130.55	579952.00			D-B8-49	147201.19	579950.55
		D-A4-49	147130.55	579952.00			D-B8-50	147201.19	579950.55
		D-A4-50	147130.55	579952.00			D-B8-51	147201.19	579950.55
		D-A4-51	147130.55	579952.00			D-B8-52	147201.19	579950.55
		D-A4-52	147130.55	579952.00			D-B8-53	147201.19	579950.55
		D-A4-53	147130.55	579952.00			D-B8-54	147201.19	579950.55
		D-A4-54	147130.55	579952.00			D-B8-55	147201.19	579950.55
		D-A4-55	147130.55	579952.00			D-B8-56	147201.19	579950.55
		D-A4-56	147130.55	579952.00			D-B8-57	147201.19	579950.55
		D-A4-57	147130.55	579952.00			D-B8-58	147201.19	579950.55
		D-A4-58	147130.55	579952.00			D-B8-59	147201.19	579950.55
		D-A4-59	147130.55	579952.00			D-B8-60	147201.19	579950.55
		D-A4-60	147130.55	579952.00			D-B8-61	147201.19	579950.55
		D-A4-61	147130.55	579952.00			D-B8-62	147201.19	579950.55
		D-A4-62	147130.55	579952.00			D-B8-63	147201.19	579950.55
		D-A4-63	147130.55	579952.00			D-B8-64	147201.19	579950.55
		D-A4-64	147130.55	579952.00			D-B8-65	147201.19	579950.55
		D-A4-65	147130.55	579952.00			D-B8-66	147201.19	579950.55
		D-A4-66	147130.55	579952.00			D-B8-67	147201.19	579950.55
		D-A4-67	147130.55	579952.00			D-B8-68	147201.19	579950.55
		D-A4-68	147130.55	579952.00			D-B8-69	147201.19	579950.55
		D-A4-69	147130.55	579952.00			D-B8-70	147201.19	579950.55
		D-A4-70	147130.55	579952.00			D-B8-71	147201.19	579950.55
		D-A4-71	147130.55	579952.00			D-B8-72	147201.19	579950.55
		D-A4-72	147130.55	579952.00			D-B8-73	147201.19	579950.55
		D-A4-73	147130.55	579952.00			D-B8-74	147201.19	579950.55
		D-A4-74	147130.55	579952.00			D-B8-75	147201.19	579950.55
		D-A4-75	147130.55	579952.00			D-B8-76	147201.19	579950.55
		D-A4-76	147130.55	579952.00			D-B8-77	147201.19	579950.55
		D-A4-77	147130.55	579952.00			D-B8-78	147201.19	579950.55
		D-A4-78	147130.55	579952.00			D-B8-79	147201.19	579950.55
		D-A4-79	147130.55	579952.00			D-B8-80	147201.19	579950.55
		D-A4-80	147130.55	579952.00			D-B8-81	147201.19	579950.55
		D-A4-81	147130.55	579952.00			D-B8-82	147201.19	579950.55
		D-A4-82	147130.55	579952.00			D-B8-83	147201.19	579950.55
		D-A4-83	147130.55	579952.00			D-B8-84	147201.19	579950.55
		D-A4-84	147130.55	579952.00			D-B8-85	147201.19	579950.55
		D-A4-85	147130.55	579952.00			D-B8-86	147201.19	579950.55
		D-A4-86	147130.55	579952.00			D-B8-87	147201.19	579950.55
		D-A4-87	147130.55	579952.00			D-B8-88	147201.19	579950.55
		D-A4-88	147130.55	579952.00			D-B8-89	147201.19	579950.55
		D-A4-89	147130.55	579952.00			D-B8-90	147201.19	579950.55
		D-A4-90	147130.55	579952.00			D-B8-91	147201.19	579950.55
		D-A4-91	147130.55	579952.00			D-B8-92	147201.19	579950.55
		D-A4-92	147130.55	579952.00			D-B8-93	147201.19	579950.55
		D-A4-93	147130.55	579952.00			D-B8-94	147201.19	579950.55
		D-A4-94	147130.55	579952.00			D-B8-95	147201.19	579950.55
		D-A4-95	147130.55	579952.00			D-B8-96	147201.19	579950.55
		D-A4-96	147130.55	579952.00			D-B8-97	147201.19	579950.55
		D-A4-97	147130.55	579952.00			D-B8-98	147201.19	579950.55
		D-A4-98	147130.55	579952.00			D-B8-99	147201.19	579950.55
		D-A4-99	147130.55	579952.00			D-B8-100	147201.19	579950.55

- NOTES
- SHALLOW ZONE NODE AREAS ARE APPROXIMATELY 37.07 SQUARE METERS.
 - SAMPLES ARE TAKEN FROM THE APPROXIMATE CENTER OF EACH NODE.
 - THE SHALLOW ZONE CONSISTS OF SAMPLING AREAS A1, A2, A3 AND A4 WITHIN DECISION SUBUNIT 1, AREAS B5, B6, B7, AND B8 WITHIN DECISION SUBUNIT 2, AREAS C9, C10, C11, AND C12 WITHIN DECISION SUBUNIT 3, AND AREAS D3, D4, D5, AND D6 WITHIN DECISION SUBUNIT 4.

LEGEND

① VERIFICATION SAMPLING NODE

SAMPLE LOCATION TABLE

Attachment 3
Originator: CAE Date: 1/23/08
Chk'd By: CAE Date: 1/23/08
Calc. No. 0001-CA-10390 Rev. No. 0

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

100-F AREA
118-F-6 BURIAL GROUND
OVERBURDEN SAMPLE DESIGN

ATTACHMENT 3

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-V0337

Subject: 118-F-6 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	Cover = 1 Summary = 5 Attn. = 10 Total = 16	M. J. Appel	J. M. Capron	NA	S. W. Callison	signed 1-21-2008
1	Cover = 1 Summary = 5 Attn. = 10 Total = 16	M. Sulloway	J. M. Capron	NA	J. D. Fancher	6/24/08

SUMMARY OF REVISION

1	Pages 1, 2, 3, and 4 replaced in their entirety. On page 1, lines 10 and 11 changed on page one to remove references to 118-F-6 Staging Pile Area Calculations and sheet 6. Sheet 5 is now referenced to the Split/Duplicate Analysis. On page 2, calculation results for plutonium-238 were added on line 25. On pages 3 and 4, calculations for plutonium-238 in the excavation and overburden/BCL areas were added.
---	--

CALCULATION SHEET

Washington Closure Hanford

Originator <u>H. M. Sulloway</u>	Date <u>06/24/08</u>	Calc. No. <u>0100F-CA-V0337</u>	Rev. No. <u>1</u>
Project <u>100-F Field Remediation</u>	Job No. <u>14655</u>	Checked <u>J. M. Capron</u>	Date <u>06/24/08</u>
Subject <u>118-F-6 Burial Ground Cleanup Verification 95% UCL Calculations</u>			Sheet No. <u>1 of 5</u>

Summary

Purpose:

Calculate the 95% upper confidence limit (UCL) values to evaluate compliance with cleanup standards for the subject site. Also, calculate the relative percent difference (RPD) for primary-duplicate and primary-split sample pairs, as necessary.

Table of Contents:

Sheets 1 to 2 - Summary
Sheet 3 - 118-F-6 Remediation Footprint Statistical Calculations
Sheet 4 - 118-F-6 Overburden/BCL Material Statistical Calculations
Sheet 5 - Split/Duplicate Analysis
Attachment 1 - 118-F-6 Verification Sampling Results (11 pages)

Given/References:

- 1) Sample Results (Attachment 1).
- 2) Background values and remedial action goals (RAGs) are taken from DOE-RL (2005), DOE-RL (2001), and Ecology (2005).
- 3) DOE-RL, 2001, 100 Area Burial Grounds Remedial Action Sampling and Analysis Plan (SAP), DOE/RL-2001-35, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- 5) DOE-RL, 2005, Remedial Design Report/Remedial Action Work Plan for the 100 Area (RDR/RAWP), DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- 8) Ecology, 2005, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <<https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>>.
- 9) EPA, 1994, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540/R-94/013. U.S. Environmental Protection Agency, Washington, D.C.

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. Duplicate and split RPD results are used in evaluation of data quality within the CVP for this site.

Methodology:

The COCs for the 118-F-6 waste site are: Cobalt-60, Cesium-137, Plutonium-239/240, Strontium-90, and Europium-152. 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. Calculations for radionuclide data sets are performed assuming non-parametric distribution, without further testing for distributional form. The 95% UCL values were not calculated for radium-226, radium-228, thorium-228, thorium-232, and potassium-40, as these isotopes are excluded from consideration as COCs based on natural occurrence and analogous site information.

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 (where direct evaluation of the attached data showed that a given analyte was undetected in both the primary and duplicate sample, no further calculations were performed). The RPD is calculated when both the primary value and the duplicate value for a given analyte 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 2005a). 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

CALCULATION SHEET

Washington Closure Hanford

Originator H. M. Sulloway

Date 06/24/08

Calc. No. 0100F-CA-V0337

Rev. No. 1

Project 100-F Field Remediation

Job No. 14655

Checked J. M. Capron

Date 06/24/08

Subject 118-F-6 Burial Ground Cleanup Verification 95% UCL Calculations

Sheet No. 2 of 5

Summary (continued)

For quality assurance/quality control (QA/QC) split and duplicate RPD calculations, a value less than 30% indicates the data compare favorably. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed. To assist in the identification of anomalous sample pairs, when an analyte is detected in the primary or duplicate/split sample, but was quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate/split results exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. Additional discussion is provided in the data quality assessment section of the applicable CVP, as necessary.

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

Results Summary^a

Analyte	Remediation Footprint		OB-BCL		Focused Samples ^b	Units
	Result	Qualifier	Result	Qualifier	Result	
Cesium-137	0.214		0.035		1.62	pCi/g
Cobalt-60	0.018	U	0.013	U	--	pCi/g
Europium-152	0.043	U	0.032	U	--	pCi/g
Plutonium-238	0.030	U	0.040	U	--	pCi/g
Plutonium-239/240	0.016	U	0.015	U	--	pCi/g
Strontium-90 -soils	2.701		0.286		0.462	pCi/g
Strontium-90 - groundwater	--		--		330	pCi/L
Tritium - groundwater	--		--		221	pCi/L
Uranium-233/234	--		--		0.397	pCi/g
Uranium-235	--		--		--	pCi/g
Uranium-238	--		--		0.391	pCi/g
bis(2-Ethylhexyl)phthalate	--		--		0.042	mg/kg

^aNo detections were reported in any data set for COCs/COPCs not listed in this table.

^bMaximum detected result from focused samples.

-- = not evaluated by laboratory analysis or not detected (for all samples in the data set)

BCL = below cleanup levels

U = not detected

COC = contaminant of concern

SPA = staging pile area

COPC = contaminant of potential concern

UCL = upper confidence limit

OB = overburden

Relative Percent Difference Results^a -

Analyte	Remediation Footprint ^b	
	Footprint ^b	OB-BCL
Potassium-40	--	0.8%
Radium-226	4.1%	--

^aRelative percent difference evaluation was not required for analytes not included in this table.

^bThe significance of relative percent difference values are discussed within the cleanup verification package for the subject site.

-- = analysis not required

QA/QC = quality assurance/quality control

OB-BCL = Overburden/below contaminant level

Washington Closure Hanford

Originator H. M. Sulloway
 Project 100-F Field Remediation
 Subject 118-F-6 Burial Ground Cleanup Verification 95% UCL Calculations

CALCULATION SHEET

Date 06/24/08
 Job No. 14655

Calc. No. 0100F-CA-V0337
 Checked J. M. Capron

Rev. No. 1
 Date 06/24/08
 Sheet No. 3 of 5

1 118-F-6 Shallow Zone Statistical Calculations

2 Verification Data

Sample Area	Sample Number	Sample Date	Cesium-137			Cobalt-60			Europium-152			Plutonium-238			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	pCi/g	Q	MDA
A1	J163H7	12/6/2007	0.028	U	0.028	0.026	U	0.026	0.069	U	0.069	-0.024	U	0.228	0	U	0.182	0.519		0.2
A2	J163H8	12/6/2007	0.035	U	0.035	0.036	U	0.036	0.087	U	0.087	0.048	U	0.364	0.048	U	0.364	4.13		0.212
Duplicate of J163H8	J163H9	12/6/2007	0.036	U	0.036	0.042	U	0.042	0.102	U	0.102	-0.043	U	0.478	0	U	0.331	3.04		0.204
A3	J163J0	12/6/2007	0.029	U	0.029	0.028	U	0.028	0.066	U	0.066	0.049	U	0.302	-0.025	U	0.188	1.32		0.199
A4	J163J1	12/6/2007	0.316		0.029	0.029	U	0.029	0.067	U	0.067	-0.061	U	0.409	0	U	0.234	0.794		0.192

10 Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Cesium-137 pCi/g	Cobalt-60 pCi/g	Europium-152 pCi/g	Plutonium-238 pCi/g	Plutonium-239/240 pCi/g	Strontium-90 pCi/g
A1	J163H7	12/6/2007	0.014	0.013	0.035	-0.024	0	0.519
A2	J163H8/J163H9	12/6/2007	0.018	0.020	0.047	0.003	0.024	3.59
A3	J163J0	12/6/2007	0.015	0.014	0.033	0.049	-0.025	1.32
A4	J163J1	12/6/2007	0.316	0.015	0.034	-0.061	0	0.794

17 Statistical Computations

	Cesium-137	Cobalt-60	Europium-152	Plutonium-238	Plutonium-239/240	Strontium-90
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.	Radionuclide data set. Use nonparametric z-stat.
N	4	4	4	4	4	4
% < Detection limit	75%	100%	100%	100%	100%	0%
Mean	0.091	0.015	0.037	-0.008	0.000	1.555
Standard deviation	0.150	0.003	0.007	0.046	0.020	1.394
95% UCL on mean	0.214	0.018	0.043	0.030	0.016	2.701
Maximum detected value	0.316	0.0	0	0	0	4.13
Background	NA	NA	NA	NA	NA	NA
Statistical value above background	0.214	0.018	0.043	0.030	0.016	2.701

28 BG = background
 29 GW = groundwater
 30 MDA = minimum detectable activity
 31 NA = not applicable
 32 Q = qualifier
 RAG = remedial action goal
 U = undetected
 UCL = upper confidence limit

C-14

CVP-2008-00001
 Rev. 0

Washington Closure Hanford

Originator H. M. Sulloway
Project 100-F Field Remediation
Subject 118-F-6 Burial Ground Cleanup Verification 95% UCL Calculations

CALCULATION SHEET

Date 06/24/08
Job No. 14655

Calc. No. 0100F-CA-V0337
Checked J. M. Capron

Rev. No. 1
Date 06/24/08
Sheet No. 4 of 5

1 118-F-6 Overburden/BCL Statistical Calculations

2 Verification Data

Sample Area	Sample Number	Sample Date	Cesium-137			Cobalt-60			Europium-152			Plutonium-238			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	pCi/g	Q	MDA
A1	J163J3	12/5/2007	0.043		0.025	0.018	U	0.018	0.052	U	0.052	0.074	U	0.203	-0.018	U	0.141	0.048	U	0.27
A2	J163J4	12/5/2007	0.05		0.028	0.026	U	0.026	0.064	U	0.064	0.096	U	0.147	0.019	U	0.147	0.003	U	0.252
A3	J163J5	12/5/2007	0.07		0.03	0.028	U	0.028	0.072	U	0.072	-0.022	U	0.168	0	U	0.168	0.01	U	0.283
A4	J163J6	12/5/2007	0.043	U	0.043	0.026	U	0.026	0.064	U	0.064	0	U	0.155	0	U	0.155	0.026	U	0.267
B5	J163J7	12/5/2007	0.051		0.013	0.012	U	0.012	0.031	U	0.031	0	U	0.272	0	U	0.189	-0.045	U	0.317
B6	J163J8	12/5/2007	0.041		0.013	0.01	U	0.01	0.026	U	0.026	0.02	U	0.274	0.000	U	0.156	0.07	U	0.305
B7	J163J9	12/5/2007	0.042		0.037	0.035	U	0.035	0.089	U	0.089	0.038	U	0.254	-0.019	U	0.145	-0.005	U	0.248
Duplicate of J163J9	J163K0	12/5/2007	0.041		0.029	0.025	U	0.025	0.064	U	0.064	0	U	0.309	-0.04	U	0.309	0.597		0.366
B8	J163K1	12/5/2007	0.035	U	0.035	0.038	U	0.038	0.085	U	0.085	0.024	U	0.262	0.047	U	0.181	0.312		0.256
C9	J163K2	12/5/2007	0.034	U	0.034	0.027	U	0.027	0.076	U	0.076	0.056	U	0.214	0	U	0.214	0.114	U	0.244
C10	J163K3	12/5/2007	0.015	U	0.015	0.016	U	0.016	0.038	U	0.038	0	U	0.224	0.02	U	0.155	-0.013	U	0.291
C1	J163K4	12/5/2007	0.013	U	0.013	0.011	U	0.011	0.029	U	0.029	0.073	U	0.186	0	U	0.186	0.082	U	0.265
C2	J163K5	12/5/2007	0.021	U	0.021	0.022	U	0.022	0.042	U	0.042	-0.027	U	0.204	-0.027	U	0.204	1.32		0.289
D3	J163K6	12/5/2007	0.011	U	0.011	0.017	U	0.017	0.038	U	0.038	0	U	0.178	0	U	0.178	-0.001	U	0.39
D4	J163K7	12/5/2007	0.028	U	0.028	0.031	U	0.031	0.073	U	0.073	0.027	U	0.296	0.054	U	0.205	0.068	U	0.256
D5	J163K8	12/5/2007	0.03	U	0.03	0.025	U	0.025	0.052	U	0.052	0.061	U	0.251	0.02	U	0.156	0.125	U	0.227
D6	J163K9	12/5/2007	0.044	U	0.044	0.028	U	0.028	0.07	U	0.07	0	U	0.300	0	U	0.171	-0.001	U	0.224

22 Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Cesium-137 pCi/g	Cobalt-60 pCi/g	Europium-152 pCi/g	Plutonium-238 pCi/g	Plutonium-239/240 pCi/g	Strontium-90 pCi/g
A1	J163J3	12/5/2007	0.043	0.009	0.026	0.074	-0.018	0.048
A2	J163J4	12/5/2007	0.050	0.013	0.032	0.096	0.019	0.003
A3	J163J5	12/5/2007	0.072	0.014	0.036	-0.022	0.000	0.010
A4	J163J6	12/5/2007	0.022	0.013	0.032	0.000	0.000	0.026
B5	J163J7	12/5/2007	0.051	0.006	0.016	0.000	0.000	-0.045
B6	J163J8	12/5/2007	0.041	0.005	0.013	0.020	0.000	0.070
B7	J163J9/J163K0	12/5/2007	0.042	0.015	0.038	0.019	-0.030	0.296
B8	J163K1	12/5/2007	0.018	0.019	0.043	0.024	0.047	0.312
C9	J163K2	12/5/2007	0.017	0.014	0.038	0.056	0.000	0.114
C10	J163K3	12/5/2007	0.008	0.008	0.019	0.000	0.020	-0.013
C1	J163K4	12/5/2007	0.007	0.006	0.015	0.073	0.000	0.082
C2	J163K5	12/5/2007	0.011	0.011	0.021	-0.027	-0.027	1.320
D3	J163K6	12/5/2007	0.006	0.009	0.019	0.000	0.000	-0.001
D4	J163K7	12/5/2007	0.014	0.016	0.037	0.027	0.054	0.068
D5	J163K8	12/5/2007	0.015	0.013	0.026	0.061	0.020	0.125
D6	J163K9	12/5/2007	0.022	0.014	0.035	0.000	0.000	-0.001

41 Statistical Computations

	Cesium-137	Cobalt-60	Europium-152	Plutonium-238	Plutonium-239/240	Strontium-90
95% UCL value 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.	Radionuclide data set. Use nonparametric z-stat.
N	16	16	16	16	16	16
% < Detection limit	63%	100%	100%	100%	100%	81%
Mean	0.027	0.011	0.028	0.025	0.005	0.151
Standard deviation	0.020	0.004	0.010	0.037	0.023	0.328
95% UCL on mean	0.035	0.013	0.032	0.040	0.015	0.286
Maximum detected value	0.072	0.00	0.00	0.00	0.00	1.32
Background	NA	NA	NA	NA	NA	NA
Statistical value above background	0.035	0.013	0.032	0.040	0.015	0.286

52 BG = background

Q = qualifier

53 BCL = below contaminant level

U = undetected

54 MDA = minimum detectable activity

UCL = upper confidence limit

55 NA = not applicable

CALCULATION SHEET

Washington Closure Hanford

Originator M. J. Appel
Project 100-F Field Remediation
Subject 118-F-6 Burial Ground Cleanup Verification 95% UCL Calculations

Date 01/17/08
Job No. 14655

Calc. No. 0100F-CA-V08337
Checked J. M. Capron

Rev. No. 0
Date 1/17/08
Sheet No. 5 of 5

1 Split/Duplicate Analysis: Remediation Footprint

Sample Area	Sample Number	Sample Date	Radium-226			Radium-228			Thorium-228			Thorium-232			Strontium-90		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A2	J163H8	12/6/2007	16.8		0.29	0.425		0.056	0.667		0.04	0.586		0.137	4.13		0.212
A2 Duplicate	J163H9	12/6/2007	17.5		0.425	0.54		0.096	0.627		0.059	0.801		0.184	3.04		0.204
Split of J163H8	J163L2	12/6/2007	--		--	--		--	--		--	--		--	2.02		0.133

6 Analysis:

Duplicate Analysis	TDL		0.1	0.2	1	1	1
	Both > MDA?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
Duplicate Analysis	Both >5xTDL?	Yes (calc RPD)	No - evaluate difference	No - evaluate difference	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	4.1%					
	Difference >2xTDL?	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable
Split Analysis	Both > MDA?						
	Both >5xTDL?						
	RPD						
	Difference >2xTDL?						

16

17 Split/Duplicate Analysis: Overburden/BCL

Sample Area	Sample Number	Sample Date	Cesium-137			Potassium-40			Radium-226			Radium-228			Thorium-228			Thorium-232			Strontium-90		
			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
SPA B7	J163J9	12/5/2007	0.042		0.037	12.9		0.355	0.411		0.059	0.62		0.132	0.712		0.042	0.62		0.132	-0.005	U	0.248
B7 Duplicate	J163K0	12/5/2007	0.041		0.029	13		0.268	0.466		0.048	0.64		0.109	0.631		0.035	0.640		0.109	0.597		0.366
Split of J163J9	J163L2	12/6/2007	0.0153		0.0129	--		--	--		--	--		--	--		--	--		--	0.112	U	0.163

22 Analysis:

23	Analysis:		TDL	0.1	0.5	0.1	0.2	1	1	1
24	Duplicate Analysis	Both > MDA?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)
25		Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
26		RPD		0.8%						
27		Difference >2xTDL?	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable
28	Split Analysis	Both > MDA?	Yes (continue)							No-Stop (acceptable)
29		Both >5xTDL?	No-Stop (acceptable)							
30		RPD								
31		Difference >2xTDL ?	No - acceptable							No - acceptable

-- = not reported

33 MDA = minimum detectable activity

34 PQL = practical quantitation limit

35

36

Q = qualifier

RPD = relative percent difference

U = undetected

C-16

Attachment 1. 118-F-6 Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Americium-241 GEA			Barium-133			Cesium-137			Cobalt-60			Europium-152			Europium-154			Europium-155		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
OB/BCL A1	J163J3	12/5/2007	0.128	U	0.128	0.02	U	0.02	0.043		0.025	0.018	U	0.018	0.052	U	0.052	0.063	U	0.063	0.123	U	0.123
OB/BCL A2	J163J4	12/5/2007	0.166	U	0.166	0.025	U	0.025	0.05		0.028	0.026	U	0.026	0.064	U	0.064	0.083	U	0.083	0.085	U	0.085
OB/BCL A3	J163J5	12/5/2007	0.03	U	0.03	0.03	U	0.03	0.072		0.03	0.028	U	0.028	0.072	U	0.072	0.095	U	0.095	0.066	U	0.066
OB/BCL A4	J163J6	12/5/2007	0.161	U	0.161	0.025	U	0.025	0.043	U	0.043	0.026	U	0.026	0.064	U	0.064	0.085	U	0.085	0.083	U	0.083
OB/BCL B5	J163J7	12/5/2007	0.013	U	0.013	0.013	U	0.013	0.051		0.013	0.012	U	0.012	0.031	U	0.031	0.042	U	0.042	0.046	U	0.046
OB/BCL B6	J163J8	12/5/2007	0.063	U	0.063	0.01	U	0.01	0.041		0.013	0.01	U	0.01	0.026	U	0.026	0.033	U	0.033	0.033	U	0.033
OB/BCL B7	J163J9	12/5/2007	0.038	U	0.038	0.038	U	0.038	0.042		0.037	0.035	U	0.035	0.089	U	0.089	0.117	U	0.117	0.079	U	0.079
OB/BCL B7 duplicate	J163K0	12/5/2007	0.155	U	0.155	0.023	U	0.023	0.041		0.029	0.025	U	0.025	0.064	U	0.064	0.077	U	0.077	0.081	U	0.081
OB/BCL B8	J163K1	12/5/2007	0.284	U	0.284	0.038	U	0.038	0.035	U	0.035	0.038	U	0.038	0.085	U	0.085	0.13	U	0.13	0.105	U	0.105
OB/BCL C9	J163K2	12/5/2007	0.042	U	0.042	0.045	U	0.045	0.034	U	0.034	0.027	U	0.027	0.076	U	0.076	0.108	U	0.108	0.09	U	0.09
OB/BCL C10	J163K3	12/5/2007	0.016	U	0.016	0.016	U	0.016	0.015	U	0.015	0.016	U	0.016	0.038	U	0.038	0.055	U	0.055	0.033	U	0.033
OB/BCL C1	J163K4	12/5/2007	0.073	U	0.073	0.012	U	0.012	0.013	U	0.013	0.011	U	0.011	0.029	U	0.029	0.041	U	0.041	0.037	U	0.037
OB/BCL C2	J163K5	12/5/2007	0.137	U	0.137	0.021	U	0.021	0.021	U	0.021	0.022	U	0.022	0.042	U	0.042	0.059	U	0.059	0.053	U	0.053
OB/BCL D3	J163K6	12/5/2007	0.02	U	0.02	0.024	U	0.024	0.011	U	0.011	0.017	U	0.017	0.038	U	0.038	0.046	U	0.046	0.03	U	0.03
OB/BCL D4	J163K7	12/5/2007	0.23	U	0.23	0.033	U	0.033	0.028	U	0.028	0.031	U	0.031	0.073	U	0.073	0.106	U	0.106	0.089	U	0.089
OB/BCL D5	J163K8	12/5/2007	0.037	U	0.037	0.021	U	0.021	0.03	U	0.03	0.025	U	0.025	0.052	U	0.052	0.073	U	0.073	0.055	U	0.055
OB/BCL D6	J163K9	12/5/2007	0.03	U	0.03	0.03	U	0.03	0.044	U	0.044	0.028	U	0.028	0.07	U	0.07	0.089	U	0.089	0.063	U	0.063
Equipment blank	J163L0	12/5/2007	0.069	U	0.069	0.011	U	0.011	0.011	U	0.011	0.011	U	0.011	0.029	U	0.029	0.036	U	0.036	0.035	U	0.035
OB/BCL B7 Split	J163L1	12/5/2007				0.0007	U	0.013	0.0153		0.0129	0.0001	U	0.014	-0.0179	U	0.029	0.0047	U	0.0439	0.00139	U	0.0406
A1	J163H7	12/6/2007	0.168	U	0.168	0.026	U	0.026	0.028	U	0.028	0.026	U	0.026	0.069	U	0.069	0.083	U	0.083	0.085	U	0.085
A2	J163H8	12/6/2007	0.04	U	0.04	0.039	U	0.039	0.035	U	0.035	0.036	U	0.036	0.087	U	0.087	0.12	U	0.12	0.078	U	0.078
A2 Duplicate	J163H9	12/6/2007	0.345	U	0.345	0.047	U	0.047	0.036	U	0.036	0.042	U	0.042	0.102	U	0.102	0.168	U	0.168	0.133	U	0.133
A3	J163J0	12/6/2007	0.174	U	0.174	0.028	U	0.028	0.029	U	0.029	0.028	U	0.028	0.066	U	0.066	0.101	U	0.101	0.09	U	0.09
A4	J163J1	12/6/2007	0.046	U	0.046	0.025	U	0.025	0.316		0.029	0.029	U	0.029	0.067	U	0.067	0.091	U	0.091	0.069	U	0.069
Equipment Blank	J163J2	12/6/2007	0.025	U	0.025	0.023	U	0.023	0.022	U	0.022	0.023	U	0.023	0.061	U	0.061	0.081	U	0.081	0.05	U	0.05
A2 Split	J163L2	12/6/2007				-0.0021	U	0.0141	-0.0059	U	0.0141	-0.00868	U	0.0158	-0.0202	U	0.0332	-0.00851	U	0.056	0.0281	U	0.0454

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

BCL = below contaminant level

BHC = hexachlorocyclohexane

C = blank contamination

D = diluted

FS = focused sample

GEA = gamma energy analysis

HEIS = Hanford Environmental Information System

I = interference

J = estimate

MDA = minimum detectable activity

OB = overburden

PQL = practical quantitation limit

Q = qualifier

U = undetected

Attachment	1	Sheet No.	1 of 10
Originator	M. J. Appel	Date	01/17/08
Checked	J. M. Capron	Date	1/17/08
Calc. No.	0100F-CA-V01637	Rev. No.	0

HMS
1/22/08

Attachment 1. 118-F-6 Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Plutonium-238			Plutonium-239/240			Potassium-40			Radium-226			Radium-228			Silver 108-metastable		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
OB/BCL A1	J163J3	12/5/2007	0.074	U	0.203	-0.018	U	0.141	13.6		0.212	0.468		0.039	0.728		0.085	0.015	U	0.015
OB/BCL A2	J163J4	12/5/2007	0.096	U	0.147	0.019	U	0.147	13.8		0.227	0.469		0.051	0.743		0.106	0.019	U	0.019
OB/BCL A3	J163J5	12/5/2007	-0.022	U	0.168	0	U	0.168	13.4		0.25	0.461		0.049	0.66		0.128	0.019	U	0.019
OB/BCL A4	J163J6	12/5/2007	0	U	0.155	0	U	0.155	13.4		0.282	0.486		0.049	0.706		0.097	0.019	U	0.019
OB/BCL B5	J163J7	12/5/2007	0	U	0.272	0	U	0.189	13.1		0.127	0.449		0.02	0.674		0.05	0.008	U	0.008
OB/BCL B6	J163J8	12/5/2007	0.02	U	0.274	0	U	0.156	14.1		0.109	0.475		0.021	0.68		0.042	0.008	U	0.008
OB/BCL B7	J163J9	12/5/2007	0.038	U	0.254	-0.019	U	0.145	12.9		0.355	0.411		0.059	0.62		0.132	0.024	U	0.024
OB/BCL B7 duplicate	J163K0	12/5/2007	0	U	0.309	-0.04	U	0.309	13		0.268	0.466		0.048	0.64		0.109	0.018	U	0.018
OB/BCL B8	J163K1	12/5/2007	0.024	U	0.262	0.047	U	0.181	12.7		0.36	0.465		0.07	0.64		0.167	0.025	U	0.025
OB/BCL C9	J163K2	12/5/2007	0.056	U	0.214	0	U	0.214	14.2		0.345	0.511		0.054	0.708		0.113	0.018	U	0.018
OB/BCL C10	J163K3	12/5/2007	0	U	0.224	0.02	U	0.155	1.23		0.138	0.032		0.023	0.094	U	0.094	0.011	U	0.011
OB/BCL C1	J163K4	12/5/2007	0.073	U	0.186	0	U	0.186	2.07		0.124	0.086		0.021	0.117		0.045	0.009	U	0.009
OB/BCL C2	J163K5	12/5/2007	-0.027	U	0.204	-0.027	U	0.204	3.3		0.141	0.127		0.037	0.181		0.073	0.012	U	0.012
OB/BCL D3	J163K6	12/5/2007	0	U	0.178	0	U	0.178	3.44		0.073	0.103		0.025	0.189		0.048	0.008	U	0.008
OB/BCL D4	J163K7	12/5/2007	0.027	U	0.296	0.054	U	0.205	13.4		0.329	0.499		0.062	0.724		0.136	0.021	U	0.021
OB/BCL D5	J163K8	12/5/2007	0.061	U	0.251	0.02	U	0.156	12.9		0.158	0.497		0.036	0.672		0.101	0.016	U	0.016
OB/BCL D6	J163K9	12/5/2007	0	U	0.3	0	U	0.171	14.7		0.306	0.506		0.052	0.655		0.123	0.019	U	0.019
Equipment blank	J163L0	12/5/2007	0.03	U	0.33	0	U	0.228	3.98		0.118	0.152		0.023	0.179		0.043	0.008	U	0.008
OB/BCL B7 Split	J163L1	12/5/2007	0.0115	U	0.0405	0.0043	U	0.0405									-0.00453	U	0.0091	
A1	J163H7	12/5/2007	-0.024	U	0.228	0	U	0.182	14.5		0.263	0.565		0.053	0.826		0.11	0.02	U	0.02
A2	J163H8	12/6/2007	0.048	U	0.364	0.048	U	0.364	16.8		0.29	0.425		0.056	0.586		0.137	0.024	U	0.024
A2 Duplicate	J163H9	12/6/2007	-0.043	U	0.478	0	U	0.331	17.5		0.425	0.54		0.096	0.801		0.184	0.033	U	0.033
A3	J163J0	12/6/2007	0.049	U	0.302	-0.025	U	0.188	17.1		0.293	0.406		0.049	0.68		0.117	0.021	U	0.021
A4	J163J1	12/6/2007	-0.061	U	0.409	0	U	0.234	12.7		0.261	0.491		0.048	0.698		0.078	0.021	U	0.021
Equipment Blank	J163J2	12/6/2007	-0.029	U	0.222	0	U	0.222	4.1		0.23	0.137		0.031	0.156		0.085	0.015	U	0.015
A2 Split	J163L2	12/6/2007	0.00869	U	0.0416	0.0052	U	0.0491									0.000498	U	0.0106	

Attachment 1
 Originator M. J. Appel
 Checked J. M. Capron
 Calc. No. 0100F-CA-V0833710

Sheet No. 2 of 10
 Date 01/17/08
 Date 1/17/08
 Rev. No. 0

HMS
 1/22/08

Attachment 1. 118-F-6 Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Thorium-228GEA			Thorium-232 GEA			Total beta radiostrontium			Uranium-235 GEA			Uranium-238 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
OB/BCL A1	J163J3	12/5/2007	0.668		0.029	0.728		0.085	0.048	U	0.27	0.09	U	0.09	2.32	U	2.32
OB/BCL A2	J163J4	12/5/2007	0.71		0.036	0.743		0.106	0.003	U	0.252	0.116	U	0.116	3.14	U	3.14
OB/BCL A3	J163J5	12/5/2007	0.756		0.034	0.66		0.128	0.01	U	0.283	0.11	U	0.11	3.31	U	3.31
OB/BCL A4	J163J6	12/5/2007	0.682		0.032	0.706		0.097	0.026	U	0.267	0.11	U	0.11	3.1	U	3.1
OB/BCL B5	J163J7	12/5/2007	0.678		0.015	0.674		0.05	-0.045	U	0.317	0.047	U	0.047	1.47	U	1.47
OB/BCL B6	J163J8	12/5/2007	0.693		0.013	0.68		0.042	0.07	U	0.305	0.045	U	0.045	1.2	U	1.2
OB/BCL B7	J163J9	12/5/2007	0.712		0.042	0.62		0.132	-0.005	U	0.248	0.135	U	0.135	4.2	U	4.2
OB/BCL B7 duplicate	J163K0	12/5/2007	0.631		0.035	0.64		0.109	0.597		0.366	0.104	U	0.104	2.86	U	2.86
OB/BCL B8	J163K1	12/5/2007	0.672		0.044	0.64		0.167	0.312		0.256	0.157	U	0.157	4.21	U	4.21
OB/BCL C9	J163K2	12/5/2007	0.691		0.034	0.708		0.113	0.114	U	0.244	0.106	U	0.106	3.18	U	3.18
OB/BCL C10	J163K3	12/5/2007	0.155		0.018	0.094	U	0.094	-0.013	U	0.291	0.058	U	0.058	1.92	U	1.92
OB/BCL C1	J163K4	12/5/2007	0.146		0.014	0.117		0.045	0.082	U	0.265	0.051	U	0.051	1.45	U	1.45
OB/BCL C2	J163K5	12/5/2007	0.155		0.022	0.181		0.073	1.32		0.269	0.084	U	0.084	2.56	U	2.56
OB/BCL D3	J163K6	12/5/2007	0.185		0.015	0.189		0.048	-0.001	U	0.39	0.05	U	0.05	1.64	U	1.64
OB/BCL D4	J163K7	12/5/2007	0.832		0.06	0.724		0.136	0.068	U	0.256	0.13	U	0.13	3.94	U	3.94
OB/BCL D5	J163K8	12/5/2007	0.709		0.028	0.672		0.101	0.125	U	0.227	0.095	U	0.095	4.04	U	4.04
OB/BCL D6	J163K9	12/5/2007	0.738		0.033	0.655		0.123	-0.001	U	0.224	0.104	U	0.104	3.24	U	3.24
Equipment blank	J163L0	12/5/2007	0.175		0.015	0.179		0.043	0.003	U	0.225	0.048	U	0.048	1.3	U	1.3
OB/BCL B7 Split	J163L1	12/5/2007							0.112	U	0.163						
A1	J163H7	12/6/2007	0.791		0.037	0.826		0.11	0.519		0.2	0.118	U	0.118	3.2	U	3.2
A2	J163H8	12/6/2007	0.667		0.04	0.586		0.137	4.13		0.212	0.132	U	0.132	4.02	U	4.02
A2 Duplicate	J163H9	12/6/2007	0.627		0.059	0.801		0.184	3.04		0.204	0.192	U	0.192	5.33	U	5.33
A3	J163J0	12/6/2007	0.614		0.04	0.68		0.117	1.32		0.199	0.125	U	0.125	3.24	U	3.24
A4	J163J1	12/6/2007	0.653		0.035	0.698		0.078	0.794		0.192	0.113	U	0.113	3.13	U	3.13
Equipment Blank	J163J2	12/6/2007	0.167		0.028	0.156		0.085	0.268		0.205	0.085	U	0.085	2.7	U	2.7
A2 Split	J163L2	12/6/2007							2.02		0.133						

Attachment	I	Sheet No.	3 of 10
Originator	M. J. Appel	Date	01/17/08
Checked	J. M. Capron	Date	
Calc. No.	0100F-CA-V00337	Rev. No.	0

1/22/08
HMS

Attachment 1. 118-F-6 Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Americium-241 GEA			Carbon-14			Cesium-137			Cobalt-60			Curium - 242			Curium - 243/244		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Trench 6, FS 7	J163X8	12/20/2007	0.088	U	0.088	2.7	U	3.28	0.052	U	0.052	0.032	U	0.032	0	U	0.442	-0.044	U	0.585
Trench 6, FS 8	J163X9	12/20/2007	0.186	U	0.186	2.44	U	3.64	1.62		0.036	0.027	U	0.027	-0.052	U	0.396	0.098	U	0.542
Trench 6, FS 9	J163Y0	12/20/2007	0.082	U	0.082	1.06	U	3.52	0.019		0.017	0.014	U	0.014	0	U	0.394	0	U	0.601
Sample Location	HEIS Number	Sample Date	Americium-241 GEA			Carbon-14			Cesium-137			Cobalt-60			Curium - 242			Curium - 243/244		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/g	Q	MDA	pCi/L	Q	MDA	pCi/g	Q	MDA
13	J163R0	1/7/2008	39.2	U	39.2				7.43	U	7.43	6.93	U	6.93						
Equipment blank	J163P9	1/7/2008	31.3	U	31.3				9.9	U	9.9	10.3	U	10.3						

Attachment	1	Sheet No.	4 of 10
Originator	M. J. Appel	Date	01/21/08
Checked	J. M. Capron	Date	
Calc. No.	0100F-CA-V01337	Rev. No.	0

1/22/08
Jms

Attachment 1. 118-F-6 Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Europium-152			Europium-154			Europium-155			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
Trench 6, FS 7	J163X8	12/20/2007	0.074	U	0.074	0.108	U	0.108	0.08	U	0.08	0.054	U	0.206	0.081	U	0.206	11.3		0.298
Trench 6, FS 8	J163X9	12/20/2007	0.083	U	0.083	0.094	U	0.094	0.095	U	0.095	-0.074	U	0.353	0	U	0.282	15.7		0.236
Trench 6, FS 9	J163Y0	12/20/2007	0.046	U	0.046	0.056	U	0.056	0.063	U	0.063	0.039	U	0.298	0	U	0.298	12		0.147
Sample Location	HEIS Number	Sample Date	Europium-152			Europium-154			Europium-155			Plutonium-238			Plutonium-239/240			Potassium-40		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA
Groundwater, FS 13	J163R0	1/7/2008	17.6	U	17.6	19.9	U	19.9	20.6	U	20.6	0.173	U	0.442	0	U	0.442	182	U	182
Equipment blank	J163P9	1/7/2008	25.4	U	25.4	33.1	U	33.1	25.6	U	25.6	0.088	U	0.424	0	U	0.338	270	U	270

Attachment	I	Sheet No.	5 of 10
Originator	M. J. Appel	Date	01/21/08
Checked	J. M. Capron	Date	
Calc. No.	0100F-CA-V00337	Rev. No.	0

1/22/08
HMS

Attachment 1. 118-F-6 Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Radium-226			Radium-228			Silver 108-metastable			Thorium-228GEA			Thorium-232 GEA			Total beta radioisotopes			Tritium		
			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
Trench 6, FS 10	J163P6	12/20/2007																			1.46	U	4.03
Trench 6, FS 11	J163P7	12/20/2007																			0.511	U	3.91
Trench 6, FS 12	J163P8	12/20/2007																			2.35	U	4.49
Trench 6, FS 7	J163X8	12/20/2007	0.416		0.049	0.567		0.12	0.02	U	0.02	0.539		0.033	0.567		0.12	0.017	U	0.225	0.882	U	4.04
Trench 6, FS 8	J163X9	12/20/2007	0.4		0.056	0.661		0.113	0.024	U	0.024	0.552		0.04	0.661		0.113	0.462		0.17	2.54	U	4.6
Trench 6, FS 9	J163Y0	12/20/2007	0.382		0.033	0.583		0.066	0.012	U	0.012	0.568		0.027	0.583		0.066	0.058	U	0.237	2.7	U	4.42
Sample Location	HEIS Number	Sample Date	Radium-226			Radium-228			Silver 108-metastable			Thorium-228GEA			Thorium-232 GEA			Total beta radioisotopes			Tritium		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA
Groundwater, FS 13	J163R0	1/7/2008	16.1	U	16.1	30.1	U	30.1	5.72	U	5.72	11.4	U	11.4	30.1	U	30.1	330		1.03	221		141
Equipment blank	J163P9	1/7/2008	23.4	U	23.4	48.2	U	48.2	7.58	U	7.58	15.2	U	15.2	48.2	U	48.2	0.034	U	0.75	76.2	U	141

Attachment	I	Sheet No.	6 of 10
Originator	M. J. Appel	Date	01/21/08
Checked	J. M. Capron	Date	
Calc. No.	0100F-CA-V00337	Rev. No.	0

1/22/08
Jms

Attachment 1. 118-F-6 Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Uranium-233/234			Uranium-235			Uranium-235 GEA			Uranium-238			Uranium-238 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Trench 6, FS 7	J163X8	12/20/2007	0.357		0.035	0.013	U	0.034	0.115	U	0.115	0.354		0.028	3.34	U	3.34
Trench 6, FS 8	J163X9	12/20/2007	0.356		0.038	0	U	0.046	0.135	U	0.135	0.391		0.038	2.94	U	2.94
Trench 6, FS 9	J163Y0	12/20/2007	0.397		0.036	0.02	U	0.03	0.082	U	0.082	0.361		0.025	2.42	U	2.42
			Uranium-233/234			Uranium-235			Uranium-235 GEA			Uranium-238			Uranium-238 GEA		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA
Groundwater, FS 13	J163R0	1/7/2008				29.4	U	29.4				780	U	780			
Equipment blank	J163P9	1/7/2008				38.4	U	38.4				1280	U	1280			

Attachment	I	Sheet No.	7 of 10
Originator	M. J. Appel	Date	01/21/08
Checked	J. M. Capron	Date	
Calc. No.	0100F-CA-V00337	Rev. No.	0

1/22/08
HMS

Attachment 1. 118-F-6 Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Total petroleum		
			mg/kg	Q	PQL
Trench 6, Focused sample 4	J163P3	12/20/2007	142	U	142
Trench 6, Focused sample 5	J163P4	12/20/2007	150	U	150
Trench 6, Focused sample 6	J163P5	12/20/2007	143	U	143

Attachment
Originator
Checked
Calc. No.

1
M. J. Appel
J. M. Capron
0100F-CA-V00337

Sheet No. 8 of 10
Date 01/17/08
Date
Rev. No. 0

4/22/08
HMS

Attachment 1. 118-F-6 Verification Sampling Results.

Constituent	J163P3 Trench 6, Focused Sample Location 4 Sample Date 01/20/07			J163P4 Trench 6, Focused Sample Location 5 Sample Date 01/20/07			J163P5 Trench 6, Focused Sample Location 6 Sample Date 01/20/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Pesticides									
Aldrin									
Alpha-BHC									
alpha-Chlordane									
beta-1,2,3,4,5,6-									
Delta-BHC									
Dichlorodiphenyldichloroethane									
Dichlorodiphenyldichloroethylene									
Dichlorodiphenyltrichloroethane									
Dieldrin									
Endosulfan I									
Endosulfan II									
Endosulfan sulfate									
Endrin									
Endrin aldehyde									
Endrin ketone									
Gamma-BHC (Lindane)									
gamma-Chlordane									
Heptachlor									
Heptachlor epoxide									
Methoxychlor									
Toxaphene									
Semivolatile Organic Analytes									
1,2,4-Trichlorobenzene	360	U	360	360	U	360	360	U	360
1,2-Dichlorobenzene	360	U	360	360	U	360	360	U	360
1,3-Dichlorobenzene	360	U	360	360	U	360	360	U	360
1,4-Dichlorobenzene	360	U	360	360	U	360	360	U	360
2,4,5-Trichlorophenol	890	U	890	900	U	900	900	U	900
2,4,6-Trichlorophenol	360	U	360	360	U	360	360	U	360
2,4-Dichlorophenol	360	U	360	360	U	360	360	U	360
2,4-Dimethylphenol	360	U	360	360	U	360	360	U	360
2,4-Dinitrophenol	890	U	890	900	U	900	900	U	900
2,4-Dinitrotoluene	360	U	360	360	U	360	360	U	360
2,6-Dinitrotoluene	360	U	360	360	U	360	360	U	360
2-Chloronaphthalene	360	U	360	360	U	360	360	U	360
2-Chlorophenol	360	U	360	360	U	360	360	U	360
2-Methylnaphthalene	360	U	360	360	U	360	360	U	360
2-Methylphenol (cresol, o-)	360	U	360	360	U	360	360	U	360
2-Nitroaniline	890	U	890	900	U	900	900	U	900
2-Nitrophenol	360	U	360	360	U	360	360	U	360

Attachment 1. 118-F-6 Verification Sampling Results.

Constituent	J163P0 Sample Location 1 Sample Date 01/07/08			J163P1 Sample Location 2 Sample Date 01/07/08			J163P2 Sample Location 3 Sample Date 01/07/08		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Pesticides									
Aldrin	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Alpha-BHC	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
alpha-Chlordane	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
beta-1,2,3,4,5,6-	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Delta-BHC	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Dichlorodiphenyldichloroethane	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Dichlorodiphenyldichloroethylene	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Dichlorodiphenyltrichloroethane	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Dieldrin	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Endosulfan I	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Endosulfan II	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Endosulfan sulfate	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Endrin	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Endrin aldehyde	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Endrin ketone	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Gamma-BHC (Lindane)	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
gamma-Chlordane	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Heptachlor	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Heptachlor epoxide	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Methoxychlor	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4
Toxaphene	1.4	UD	1.4	1.4	UD	1.4	1.4	UD	1.4

Attachment 1
 Originator M. J. Appel
 Checked J. M. Capron
 Calc. No. 0100F-CA-V00337

Sheet No.

Date

Date

Rev. No.

9 of 10

01/17/08

0

1/22/08
 JMC

Attachment 1. 118-F-6 Verification Sampling Results.									
Constituent	J163P3 Sample Location 4 Sample Date 01/20/07			J163P4 Sample Location 5 Sample Date 01/20/07			J163P5 Sample Location 6 Sample Date 01/20/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Analytes (continued)									
3+4 Methylphenol (cresol, m+p)	360	U	360	360	U	360	360	U	360
3,3'-Dichlorobenzidine	360	U	360	360	U	360	360	U	360
3-Nitroaniline	890	U	890	900	U	900	900	U	900
4,6-Dinitro-2-methylphenol	890	U	890	900	U	900	900	U	900
4-Bromophenylphenyl ether	360	U	360	360	U	360	360	U	360
4-Chloro-3-methylphenol	360	U	360	360	U	360	360	U	360
4-Chloroaniline	360	U	360	360	U	360	360	U	360
4-Chlorophenylphenyl ether	360	U	360	360	U	360	360	U	360
4-Nitroaniline	890	U	890	900	U	900	900	U	900
4-Nitrophenol	890	U	890	900	U	900	900	U	900
Acenaphthene	360	U	360	360	U	360	360	U	360
Acenaphthylene	360	U	360	360	U	360	360	U	360
Anthracene	360	U	360	360	U	360	360	U	360
Benzo(a)anthracene	360	U	360	360	U	360	360	U	360
Benzo(a)pyrene	360	U	360	360	U	360	360	U	360
Benzo(b)fluoranthene	360	U	360	360	U	360	360	U	360
Benzo(ghi)perylene	360	U	360	360	U	360	360	U	360
Benzo(k)fluoranthene	360	U	360	360	U	360	360	U	360
Bis(2-chloro-1-methylethyl)ether	360	U	360	360	U	360	360	U	360
Bis(2-Chloroethoxy)methane	360	U	360	360	U	360	360	U	360
Bis(2-chloroethyl) ether	360	U	360	360	U	360	360	U	360
Bis(2-ethylhexyl) phthalate	37	JB	360	42	JB	360	19	JB	360
Butylbenzylphthalate	360	U	360	360	U	360	360	U	360
Carbazole	360	U	360	360	U	360	360	U	360
Chrysene	360	U	360	360	U	360	360	U	360
Di-n-butylphthalate	360	U	360	360	U	360	360	U	360
Di-n-octylphthalate	360	U	360	360	U	360	360	U	360
Dibenz[a,h]anthracene	360	U	360	360	U	360	360	U	360
Dibenzofuran	360	U	360	360	U	360	360	U	360
Diethylphthalate	360	U	360	360	U	360	360	U	360
Dimethyl phthalate	360	U	360	360	U	360	360	U	360
Fluoranthene	360	U	360	360	U	360	360	U	360
Fluorene	360	U	360	360	U	360	360	U	360
Hexachlorobenzene	360	U	360	360	U	360	360	U	360
Hexachlorobutadiene	360	U	360	360	U	360	360	U	360
Hexachlorocyclopentadiene	360	U	360	360	U	360	360	U	360
Hexachloroethane	360	U	360	360	U	360	360	U	360
Indeno(1,2,3-cd)pyrene	360	U	360	360	U	360	360	U	360
Isophorone	360	U	360	360	U	360	360	U	360
N-Nitroso-di-n-dipropylamine	360	U	360	360	U	360	360	U	360
N-Nitrosodiphenylamine	360	U	360	360	U	360	360	U	360
Naphthalene	360	U	360	360	U	360	360	U	360
Nitrobenzene	360	U	360	360	U	360	360	U	360
Pentachlorophenol	890	U	890	900	U	900	900	U	900
Phenanthrene	360	U	360	360	U	360	360	U	360
Phenol	360	U	360	360	U	360	360	U	360
Pyrene	360	U	360	360	U	360	360	U	360

Attachment 1
 Originator M. J. Appel
 Checked J. M. Capron
 Calc. No. 0100F-CA-V01337

Sheet No.
 Date
 Date
 Rev. No.

10 of 10
 01/17/08
 0

hms
 1/22/08

APPENDIX D
TRENCH 4 INFORMATIONAL SAMPLE RESULTS

Appendix D. 118-F-6 Trench 4 Informational Sampling Results.

Sample Location	HEIS Number	Sample Date	Americium-241 GEA			Cesium-137			Cobalt-60			Europium-152			Europium-154			Europium-155		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/g	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA
Groundwater, FS	J163R0	1/7/2008	39.2	U	39.2	7.43	U	7.43	6.93	U	6.93	17.6	U	17.6	19.9	U	19.9	20.6	U	20.6
Equipment blank	J163P9	1/7/2008	31.3	U	31.3	9.9	U	9.9	10.3	U	10.3	25.4	U	25.4	33.1	U	33.1	25.6	U	25.6

Sample Location	HEIS Number	Sample Date	Plutonium-238			Plutonium-239/240			Potassium-40			Radium-226			Radium-228			Silver 108-metastable		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA
Groundwater, FS 13	J163R0	1/7/2008	0.173	U	0.442	0	U	0.442	182	U	182	16.1	U	16.1	30.1	U	30.1	5.72	U	5.72
Equipment blank	J163P9	1/7/2008	0.088	U	0.424	0	U	0.338	270	U	270	23.4	U	23.4	48.2	U	48.2	7.58	U	7.58

Sample Location	HEIS Number	Sample Date	Thorium-228GEA			Thorium-232 GEA			Total beta radiostrontium			Tritium			Uranium-235			Uranium-238		
									pCi/g	Q	MDA									
Trench 4 Sr-90 GW/soil FS, 1	J169L6	2/5/2008							25.6		0.246									
Trench 4 Sr-90 GW/soil FS, 2	J169L7	2/5/2008							10.3		0.217									
Sample Location	HEIS Number	Sample Date	Thorium-228GEA			Thorium-232 GEA			Total beta radiostrontium			Tritium			Uranium-235			Uranium-238		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA
Groundwater, FS 13	J163R0	1/7/2008	11.4	U	11.4	30.1	U	30.1	330		1.03	221		141	29.4	U	29.4	780	U	780
Equipment blank	J163P9	1/7/2008	15.2	U	15.2	48.2	U	48.2	0.034	U	0.75	76.2	U	141	38.4	U	38.4	1280	U	1280
Trench 4 Sr-90 GW/soil FS, 1	J169L6-A	2/5/2008							970		1.14									
Trench 4 Sr-90 GW/soil FS, 2	J169L7-A	2/5/2008							409		1.02									
Trench 4 Sr-90 GW/soil FS, 1, filtered	J169L6-B	2/5/2008							1100		2.32									

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 2005b, WCH 2008). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan (SAP)* (DOE-RL 2005a).

A review of the sample design (WCH 2008), the field logbooks (WCH 2007), and applicable analytical data packages has been performed as part of this DQA. All samples were collected per the sample design. 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-6 Burial Ground included a sample design with multiple subunit areas. Verification sample data collected at the 118-F-6 waste site were provided by the laboratories in eight sample delivery groups (SDGs). For the below cleanup level (BCL) stockpiles, verification sample data were provided in two SDGs: SDG K1046 and SDG J00153. SDG K1046 was submitted for third-party validation. For the shallow zone excavation, verification sample data were provided in two SDGs: SDG K1051 and SDG J00154. The shallow zone focused sample data were provided in four SDGs: SDG K1064, SDG K1068, SDG K1074, and SDG K1078. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed below.

SDG K1046

This SDG comprises 18 field samples (J163J3-J163J9, J163K0-J163K9, and J163L0) collected from the BCL stockpiles. One field duplicate pair (J15786/ J15787) and one equipment blank (J163L0) are included in this SDG. These samples were analyzed by alpha spectroscopy, for total strontium by beta counting, and by gamma spectroscopy. SDG K1046 was submitted for formal third-party validation. No major deficiencies were found in SDG K1046. Minor deficiencies are as follows:

SDG J00153

This SDG comprises one field sample (J163L1) collected from the BCL stockpiles, a split of sample J163J9 from SDG K1046. This sample was analyzed at TestAmerica Laboratories, Inc., with the analyses including alpha spectroscopy, total strontium by beta counting, and gamma spectroscopy. No major or minor deficiencies were found in SDG J00153.

SDG K1051

This SDG comprises six field samples (J163H7 - J163H9 and J163J0 – J163J2) collected from the 118-F-6 shallow zone. One field duplicate pair (J163H2/J163H9) and one equipment blank (J163J2) are included in this SDG. These samples were analyzed by alpha spectroscopy, total strontium by beta counting, and gamma spectroscopy. No major deficiencies were found in SDG K1051. Minor deficiencies are as follows:

For the total strontium analysis, sample J163J2 (the equipment blank) was switched with another sample in the group during chemistry. All samples were reanalyzed for total strontium with new quality control (QC) samples. The data are useable for decision-making purposes.

SDG J00154

This SDG comprises one field sample (J163L2), a split of sample J163H8 from SDG K1051. This sample was analyzed at TestAmerica Laboratories, Inc., with the analyses including alpha spectroscopy, total strontium by beta counting, and gamma spectroscopy. No major deficiencies were found in SDG J00154. Minor deficiencies are as follows:

For the gamma spectroscopy, there was insufficient volume for a duplicate. Therefore, sample J163L2 was recounted on a different detector for the duplicate sample. The data are useable for decision-making purposes.

SDG K1064

This SDG comprises six focused samples (J163X8-J163X9, J163Y0, J163P6-J163P8) collected from the area of the shallow zone excavation where silver drums and cylinders were excavated. These samples were all analyzed for tritium by liquid scintillation counting (LSC). In addition, samples J163X8-J163X9 and J163Y0 were analyzed by alpha spectroscopy, total strontium by beta counting, by gamma spectroscopy, and for carbon-14 by LSC. No major deficiencies were found in SDG K1064. Minor deficiencies are as follows:

No matrix spike analysis was performed for tritium or for carbon-14. Also, the laboratory control sample (LCS) recovery for carbon-14 was below the acceptance criteria, at 81%. The tritium and carbon-14 results for SDG K1064 may be considered estimated. Estimated data are useable for decision-making purposes.

SDG K1068

This SDG comprises three focused samples (J163P3-J163P5) from the area of the shallow zone excavation where a buried railroad tank car used to dispose of and burn animal carcasses with diesel fuel was excavated. These samples were analyzed for

semivolatile organic compounds (SVOCs) and total petroleum hydrocarbons (TPH). No major deficiencies were found in SDG K1068. Minor deficiencies are as follows:

In the SVOC analysis, 12 of 128 matrix spike (MS) recoveries are below the acceptance criteria. The MS for 2,2'-oxybis(1-chloropropane) is 37%, and the matrix spike duplicate (MSD) recovery is 45%. The hexachloroethane MS and MSD are 38% and 44%, respectively. The 1,3-dichlorobenzene, 1,4-dichlorobenzene, and 1,2-dichlorobenzene MS recoveries are 42%, 44%, and 47%, respectively. The 4-nitrophenol MSD recovery is 37%, the n-nitrosodiphenylamine (1) MS recovery is 46%, and the 1,2,4-trichlorobenzene MS is 50%. The nitrobenzene MS recovery is 49%, and the bis(2-chloroethyl)ether MS is 43%. The data may be considered estimated. Estimated data are useable for decision-making purposes.

SDG K1074

This SDG comprises a focused water sample (J163R0) and an equipment blank (J163P9) collected from the area of the shallow zone that has been excavated to the groundwater soil interface. These samples were analyzed by alpha spectroscopy, total strontium by beta counting, by gamma spectroscopy, and for tritium by LSC. No major deficiencies were found in SDG K1074. Minor deficiencies are as follows:

The method blank and LCS results for tritium exceeded the RQL. The tritium results for SDG K1074 may be considered estimated. Estimated data are useable for decision-making purposes.

SDG K1078

This SDG comprises three focused samples (J163P0-J163P2) from the area of the shallow zone excavation where rusty soil staining and organic odor were observed. These samples were analyzed for pesticides. No major deficiencies were found in SDG K1078. Minor deficiencies are as follows:

All of the toxaphene data in SDG K1078 may be considered estimated due to lack of a MS, MSD, or LSC analysis for the analyte. Estimated data are considered acceptable for the intended use of the data.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

Relative percent difference (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 2007) are summarized in Table E-1. The main and QA/QC sample results are presented in Appendix C.

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

Sample Area	Main Sample	Duplicate Sample	Split Sample
BCL stockpile	J163J9	J163K0	J163L1
Shallow zone excavation	J163H8	J163H9	J163L2

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 contaminant of concern. Only analytes with values above five times the detection limits for both the main and duplicate samples are compared. The 95% upper confidence limit (UCL) calculation brief in Appendix C provides details on duplicate pair evaluation and RPD calculation. None of the RPDs calculated for radionuclides 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 the analytes are not detected in both the main and duplicate sample at more than five times the target detection limit (TDL). RPDs of analytes detected at low concentrations (less than five times the detection limit) are not considered to be indicative of the analytical system performance. The data are useable for decision-making purposes.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate or main and split) is less than five times the TDL, including undetected analytes. In these cases, a control limit of ± 2 times the TDL is used (Appendix C) to indicate that a visual check of the data is required by the reviewer. For the shallow zone excavation main and split sample, the strontium-90 results required this check. These results are attributed to heterogeneities in the sample matrix from which the samples were collected. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are useable for decision-making purposes.

SUMMARY

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 118-F-6 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-6 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 project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database. The verification sample analytical data are also summarized in the attachment to the 95% UCL in Appendix C.

REFERENCES

- BHI, 2000a, *Data Validation Procedure for Chemical Analysis*, BHI-01435, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- BHI, 2000b, *Data Validation Procedure for Radiochemical Analysis*, BHI-01433, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- DOE-RL, 2005a, *100 Area Remedial Action Sampling and Analysis Plan*, DOE/RL-96-22, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE-RL, 2005b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- EPA, 2000, *Guidance for Data Quality Assessment*, EPA QA/G-9, QA00 Update, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, D.C.
- WCH, 2007, *100-F Remedial Sampling*, Logbook EFL-1174-4, pp. 30-34 and 40-44, Washington Closure Hanford, Richland, Washington.
- WCH, 2008, *118-F-6 Burial Ground Shallow Zone and Overburden Sample Design*, Calculation No. 0100F-CA-V0340, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISTRIBUTION

U.S. Department of Energy
Richland Operations Office

D. C. Smith (5)	A3-04
DOE-RL Public Reading Room	H2-53

Fluor Hanford, Inc.

S. A. Christman (WIDS)	B6-06
------------------------	-------

Washington Closure Hanford

S. W. Callison	X2-07
J. M. Capron	H4-23
R. A. Carlson	X2-07
S. W. Clark	H4-23
L. A. Dietz	H4-22
J. D. Fancher	L6-06
M. T. Hughes	H4-23
H. M. Sulloway	H4-23

Document Control	H4-11
Hanford Technical Library	P8-55

