

Date Submitted: <u>1/7/08</u>	WASTE SITE RECLASSIFICATION FORM Operable Unit(s): <u>100-FR-1</u>	Control Number: 2007-031
Originator: <u>L. M. Dittmer</u>	Waste Site Code: <u>100-F-26:15</u>	
Phone: <u>372-9227</u>	Type of Reclassification Action:  Closed Out <input type="checkbox"/> Interim Closed Out <input checked="" type="checkbox"/> No Action <input type="checkbox"/> RCRA Postclosure <input type="checkbox"/> Rejected <input type="checkbox"/> Consolidated <input type="checkbox"/>	

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:

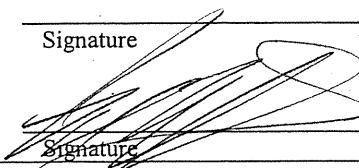
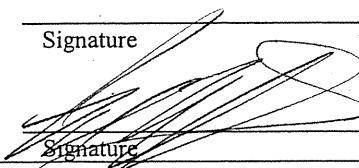
The 100-F-26:15 waste site consisted of the remnant portions of underground process effluent and floor drain pipelines that originated at the 105-F Reactor. The site has been remediated and presently exists as an open excavation. Remediation and verification sampling of this site have been performed in accordance with remedial action objectives and goals established by the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100 DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington. The selected action involved: (1) evaluating the site using available process information, (2) remediating the site, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification to 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 Remaining Sites ROD. The results of verification sampling show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow-zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Site contamination did not extend into the deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep-zone are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-F-26:15, Miscellaneous Pipelines Associated with the 1608-F Sump* (attached).

Waste Site Controls:

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

S. L. Charboneau DOE Federal Project Director (printed)	<u>Stacy Charboneau</u> Signature	<u>1/29/08</u> Date
N/A Ecology Project Manager (printed)	 Signature	<u>3/18/08</u> Date
R. A. Lobos EPA Project Manager (printed)	 Signature	<u>3/18/08</u> Date

**REMAINING SITES VERIFICATION PACKAGE FOR  
THE 100-F-26:15 MISCELLANEOUS PIPELINES ASSOCIATED WITH  
THE 132-F-6, 1608-F WASTE WATER PUMPING STATION**

**Attachment to Waste Site Reclassification Form 2007-031**

**January 2008**

**REMAINING SITES VERIFICATION PACKAGE FOR  
100-F-26:15 WASTE SITE, MISCELLANEOUS PIPELINES ASSOCIATED WITH THE  
132-F-6, 1608-F WASTE WATER PUMPING STATION**

**EXECUTIVE SUMMARY**

The 100-F-26 waste site is located within the 100-FR-1 Operable Unit on the Hanford Site and includes the underground process and sanitary sewer pipelines associated with the 100-F Area pre-reactor cooling water treatment facilities. The 100-F-26:15 subsite includes the miscellaneous pipelines associated with the 132-F-6, 1608-F waste water pumping station. The waste site is located east and southeast of the 105-F Reactor Building, within the former 105-F Exclusion Area fence.

The 100-F-26:15 waste site includes the remnant portions of underground process effluent and floor drain pipelines that originated at the 105-F Reactor. It was possible that these pipelines remained following removal of the large-diameter reactor cooling water effluent pipelines (100-F-19) (BHI 2003a) and the 116-F-6 influent pipeline (BHI 2003b), remediation of the 105-F Reactor fuel storage basin (as part of interim safe storage of the 105-F Reactor) (BHI 2004), and demolition of the 132-F-6, 1608-F waste water pumping station (BHI 2003c). However, the only pipelines encountered during remediation of the 100-F-26:15 subsite were to the immediate west of the former 132-F-6, 1608-F site. All of the other pipelines included in the 100-F-26:15 subsite are believed to have been removed during previous remediation activities (BHI 2003a, BHI 2003b, BHI 2004).

Confirmatory sampling was not performed because the presence of contamination related to the pipelines was already documented. Remedial action at the 100-F-26:15 pipeline site was performed from January 29 through January 31, 2007. Two distinct areas were excavated resulting in disposal of approximately 82 m<sup>3</sup> (107 yd<sup>3</sup>) of contaminated materials to the Environmental Restoration Disposal Facility (ERDF).

Verification sampling for the 100-F-26:15 subsite was performed in July 2007 to collect data to determine if the remedial action goals (RAGs) had been met. The contaminants of potential concern (COPCs) for verification sampling included inductively coupled plasma (ICP) metals, hexavalent chromium, and mercury (WCH 2007a). Gross alpha, gross beta, and gamma energy analysis (GEA) were used to screen for radioactivity to determine if additional isotopic specific analyses would be required for those samples with results greater than background.

A portion of the site that had required excavation up to the foundation wall of the 105-F Reactor was sampled for early backfill. It was necessary to backfill this portion of the excavation to secure the building foundation from damage due to undermining. The COPCs for these samples included tritium (H-3), nickel-63, total strontium, americium-241/curium, polychlorinated biphenyls in addition to the site COPCs.

A summary of the cleanup evaluation for the soil results against the applicable criteria is presented in Table ES-1. The results of the verification sampling are used to make reclassification decisions for the 100-F-26:15 subsite in accordance with the *Tri-Party Agreement Handbook Management Procedures*, TPA-MP-14 (DOE-RL 2007) procedure.

**Table ES-1. Summary of Remedial Action Goals for the 100-F-26:15 Site.**

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain 15-mrem/yr dose rate above background over 1,000 years.	Maximum dose rates based on generic dose-equivalence lookup values within the verification sampling area is 1.15 mrem/yr (Table 4) and 4.35 mrem/yr within the focus sampling area.	Yes
Direct Exposure – Nonradionuclides	Attain individual COPC RAGs.	All individual COPC concentrations are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	All hazard quotients are less than 1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient ( $2.6 \times 10^{-3}$ ) is less than 1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk for carcinogens is less than $1 \times 10^{-6}$ .	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The total excess cancer risk ( $1.1 \times 10^{-7}$ ) is less than $1 \times 10^{-5}$ .	
Groundwater/River Protection – Radionuclides	Attain single-COPC groundwater and river protection RAGs.	Residual concentrations of radionuclides were detected below direct exposure levels, which are lower than the limits for groundwater and river protection.	Yes
	Attain national primary drinking water standards: <sup>a</sup> 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.		
	Meet drinking water standards for alpha emitters: the most stringent of 15 pCi/L MCL or 1/25th of the derived concentration guides from DOE Order 5400.5. <sup>b</sup>		
	Meet total uranium standard of 30 µg/L (21.2 pCi/L).		
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Maximum detected results for nonradionuclides are below groundwater and river protection RAGs.	Yes

<sup>a</sup> "National Primary Drinking Water Regulations" (40 Code of Federal Regulations 141).

<sup>b</sup> *Radiation Protection of the Public and the Environment* (DOE Order 5400.5).

<sup>c</sup> *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b).

COPC = contaminant of potential concern

MCL = maximum contaminant level (drinking water standard)

RAG = remedial action goal

RESRAD = RESidual RADioactivity (dose model)

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 *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington (Remaining Sites ROD)* (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

Soil cleanup levels were established in the interim action ROD based on a limited ecological risk assessment. A baseline risk assessment for the river corridor portion of Hanford began in 2004, which includes a more complete quantitative ecological risk assessment. That baseline risk assessment will be used to support the final closeout decision for this site.

**REMAINING SITES VERIFICATION PACKAGE FOR  
100-F-26:15 WASTE SITE, MISCELLANEOUS PIPELINES ASSOCIATED  
WITH THE 132-F-6, 1608-F WASTE WATER PUMPING STATION**

**STATEMENT OF PROTECTIVENESS**

This report demonstrates that the 100-F-26:15 Waste Site, Miscellaneous Pipelines Associated with the 132-F-6, 1608-F waste water pumping station, 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 2005b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

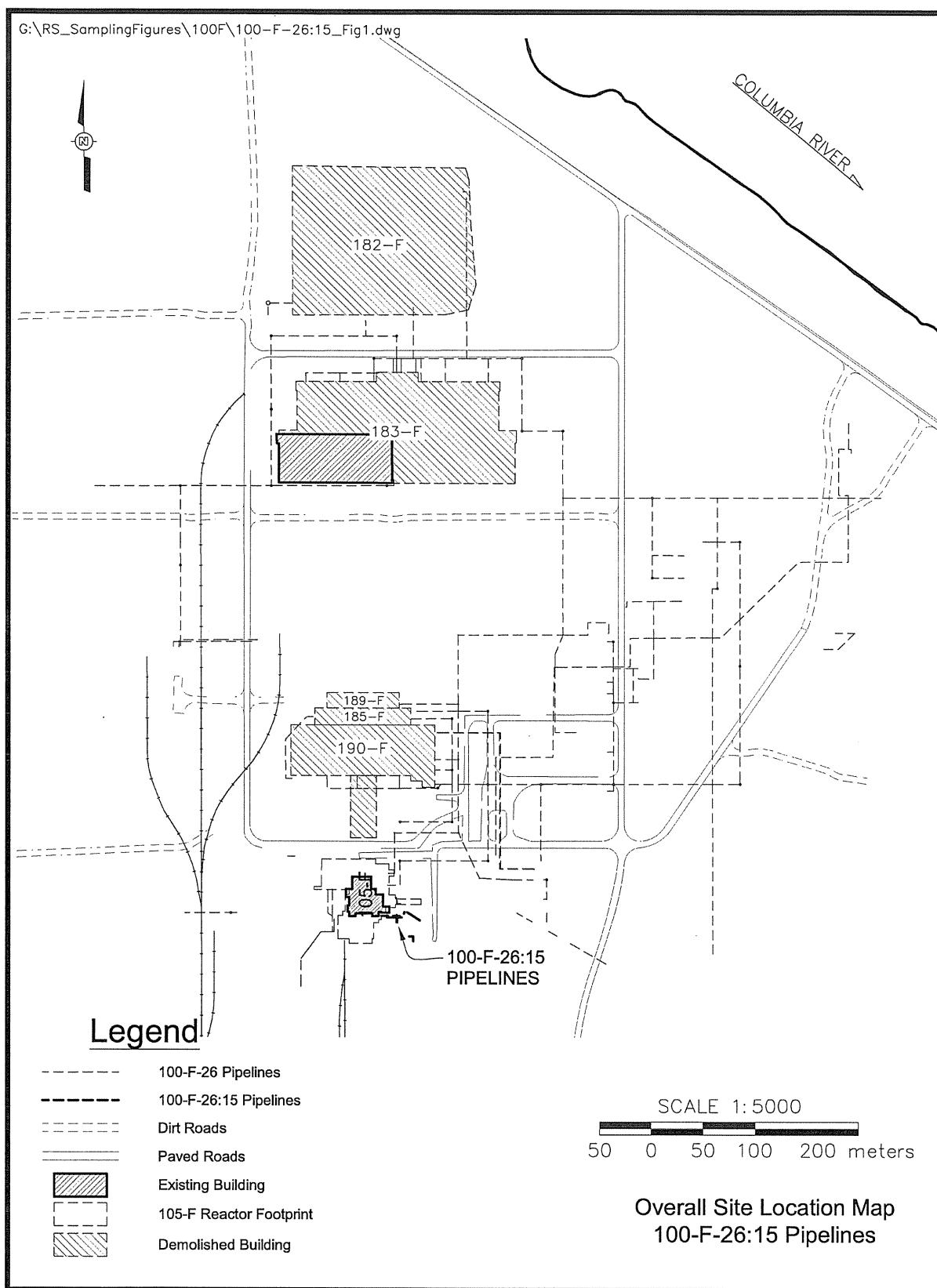
A comparison against ecological risk screening levels has been made for the site contaminants of concern and other constituents. Screening levels were not exceeded for the site constituents, with the exception of antimony, barium, boron, manganese, and vanadium. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. It is believed that the presence of these constituents does not pose a risk to ecological receptors because concentrations of antimony, manganese, and vanadium are below site background levels, and boron concentrations are consistent with those seen elsewhere at the Hanford Site (no established background value is available for boron). A single sample contained barium at a level greater than Hanford Site background. Additionally, the upper confidence limit (UCL) result for barium is below both Hanford Site background and the ecological screening levels. A more complete quantitative ecological risk assessment will be presented in the baseline risk assessment for the river corridor portion of the Hanford Site and will be used to support the final closeout decision for this site.

## GENERAL SITE INFORMATION AND BACKGROUND

The 100-F-26:15 subsite is part of the 100-F-26, 100-F Water Treatment Facility underground pipelines and is located near the 105-F Reactor (Figure 1). The 100-F-26 site encompassed the upstream (pre-reactor) process sewers for the 100-F Area, including all underground water lines used to transport reactor cooling water between water treatment facilities and the 105-F Reactor Building. This includes potentially contaminated underground lines running between buildings and those that run to drainage facilities. The site was divided into 16 subsites based on the intended use of the pipe (i.e., sanitary sewer or process water), expected sources of contamination, and potential remedial actions. The 16 subsites are as follows:

- 100-F-26:1 North process sewer collection pipelines
- 100-F-26:2 Process water pipelines to the aquatic biology and strontium gardens
- 100-F-26:3 184-F Powerhouse pipelines
- 100-F-26:4 South process pipelines
- 100-F-26:5 190-F bypass pipelines
- 100-F-26:6 190-F Reservoir pipelines
- 100-F-26:7 Sodium dichromate and sodium silicate pipelines
- 100-F-26:8 1607-F1 sanitary sewer pipelines
- 100-F-26:9 1607-F2 sanitary sewer pipelines
- 100-F-26:10 1607-F3 sanitary sewer pipelines
- 100-F-26:11 1607-F4 sanitary sewer pipelines
- 100-F-26:12 1.8 m (72 in.) main process sewer pipeline
- 100-F-26:13 108-F drain pipelines
- 100-F-26:14 116-F5 influent pipelines
- 100-F-26:15 Miscellaneous pipelines associated with the 132-F-6, 1608-F waste water pumping station
- 100-F-26:16 Reactor cooling water pipelines.

This remaining sites verification package only addresses areas within the 100-F-26:15 subsite (Miscellaneous Pipelines Associated with the 132-F-6, 1608-F waste water pumping station). The 100-F-26:15 subsite consists of the remnant portions of underground process effluent and floor drain pipelines that originated at the 105-F Reactor. These pipeline remnants are identified by segment number in Table 1 and shown in Figure 2. It was possible that these pipelines remained following several remediation efforts: 1) removal of the large-diameter reactor cooling water effluent pipelines (100-F-19) that were used to carry reactor cooling water effluent away from the 105-F Reactor to the 107-F retention basin (116-F-14) (BHI 2003a) and to the associated outfalls for final discharge to the Columbia River, 2) the 116-F-6 influent pipeline (BHI 2003b), 3) remediation of the 105-F Reactor fuel storage basin as part of interim safe storage of the 105-F Reactor, and 4) following demolition of the 132-F-6, 1608-F waste water pumping station building (BHI 2003c). A detailed description of the construction activities and pipeline leaks associated with the 100-F-26:15 waste site is found in the verification sampling work instruction (WCH 2007a).

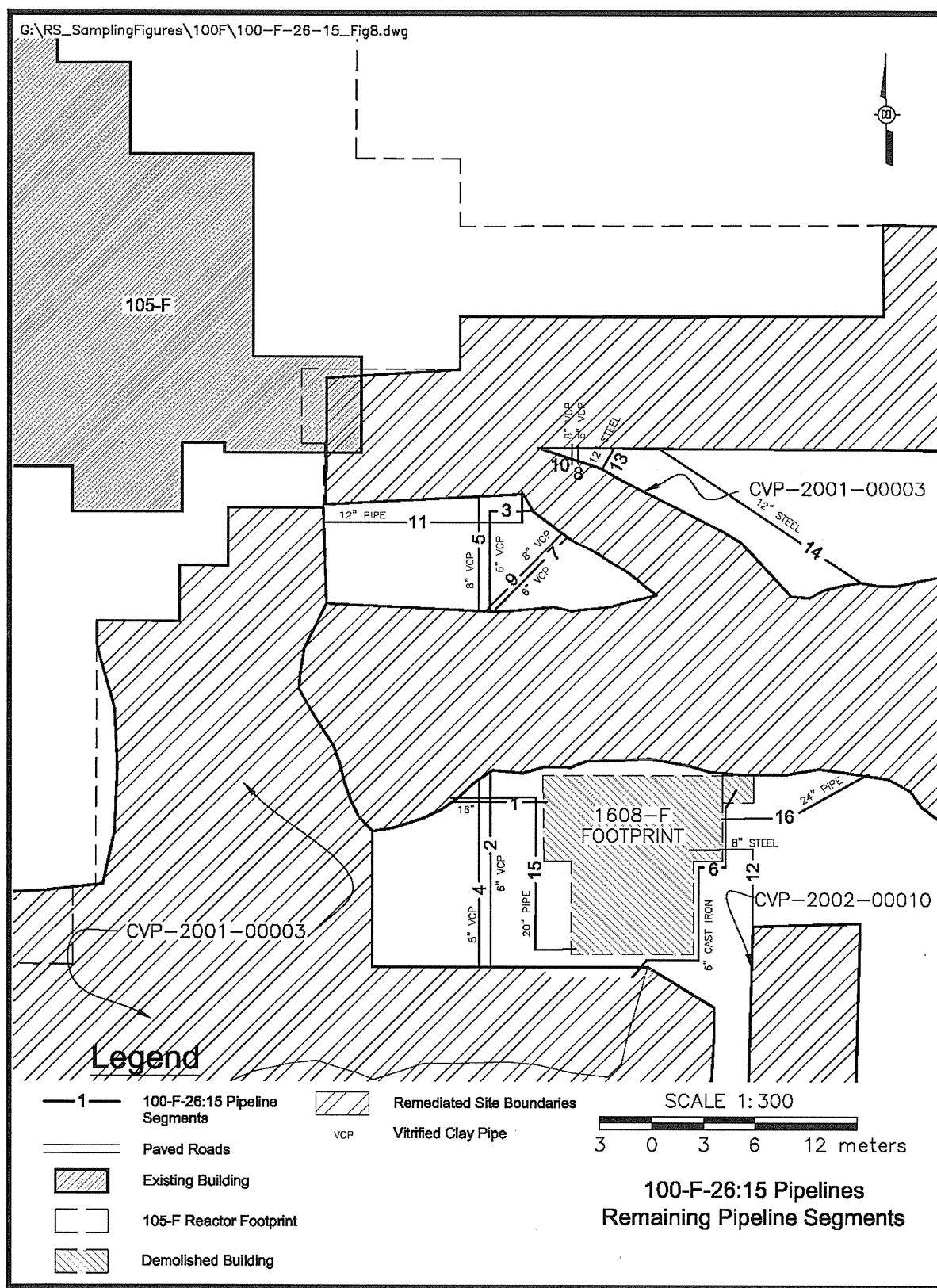
**Figure 1. 100-F-26:15 Waste Site Location Map.**

**Table 1. Description of the 100-F-26:15 Pipeline Segments.**

Segment	Discovery Site Number <sup>a</sup>	Size	Material	Length (estimated)	Service Date (estimated)
1	N/A	40.6 cm (16 in.)	Steel	4.0 m (13.1 ft)	1945 – 1957
2	DS-100F-006	15 cm (6 in.)	Vitrified clay	9.9 m (32.5 ft)	1945 – 1965
3	N/A	15 cm (6 in.)	Vitrified clay	5.0 m (16.4 ft)	1945 – 1949
4	N/A	20 cm (8 in.)	Vitrified clay	11.4 m (37.4 ft)	1945 – 1957
5	N/A	20 cm (8 in.)	Vitrified clay	5.0 m (16.4 ft)	1945 – 1949
6	DS-100F-016	15 cm (6 in.)	Cast iron	16.1 m (52.8 ft)	1945 – 1965
7	DS-100F-006	15 cm (6 in.)	Vitrified clay	6.3 m (20.7 ft)	1949 – 1957
8	DS-100F-006	15 cm (6 in.)	Vitrified clay	1.2 m (3.9 ft)	1949 – 1965
9	N/A	20 cm (8 in.)	Vitrified clay	6.3 m (20.7 ft)	1949 – 1957
10	N/A	20 cm (8 in.)	Vitrified clay	1.2 m (3.9 ft)	1949 – 1957
11	N/A	30 cm (12 in.)	Steel	13.8 m (45.3 ft)	1949 – 1965
12	N/A	20 cm (8 in.)	Steel	8.2 m (26.9 ft)	1952 – 1965
13	DS-100F-007	30 cm (12 in.)	Steel	1.5 m (4.9 ft)	1957 – 1965
14	DS-100F-007	30 cm (12 in.)	Steel	14.3 m (46.9 ft)	1957 – 1965
15	DS-100F-015	51 cm (20 in.)	K-21 (Sch. 30 Steel)	16.3 m (53.5 ft)	1961 – 1965
16	DS-100F-014	61 cm (24 in.)	K-21 (Sch. 30 Steel)	9.3 m (30.5 ft)	1961 – 1965

<sup>a</sup> Discovery Site Numbers are assigned to pipelines that are discovered during confirmatory sampling or during the Orphan Sites Task activities and have not been previously identified in the Waste Information Data System (WIDS) or been rejected as a waste site.

Figure 2. Pipeline Segments of the 100-F-26:15 Waste Site.



## PRE-REMEDIATION ACTIVITIES

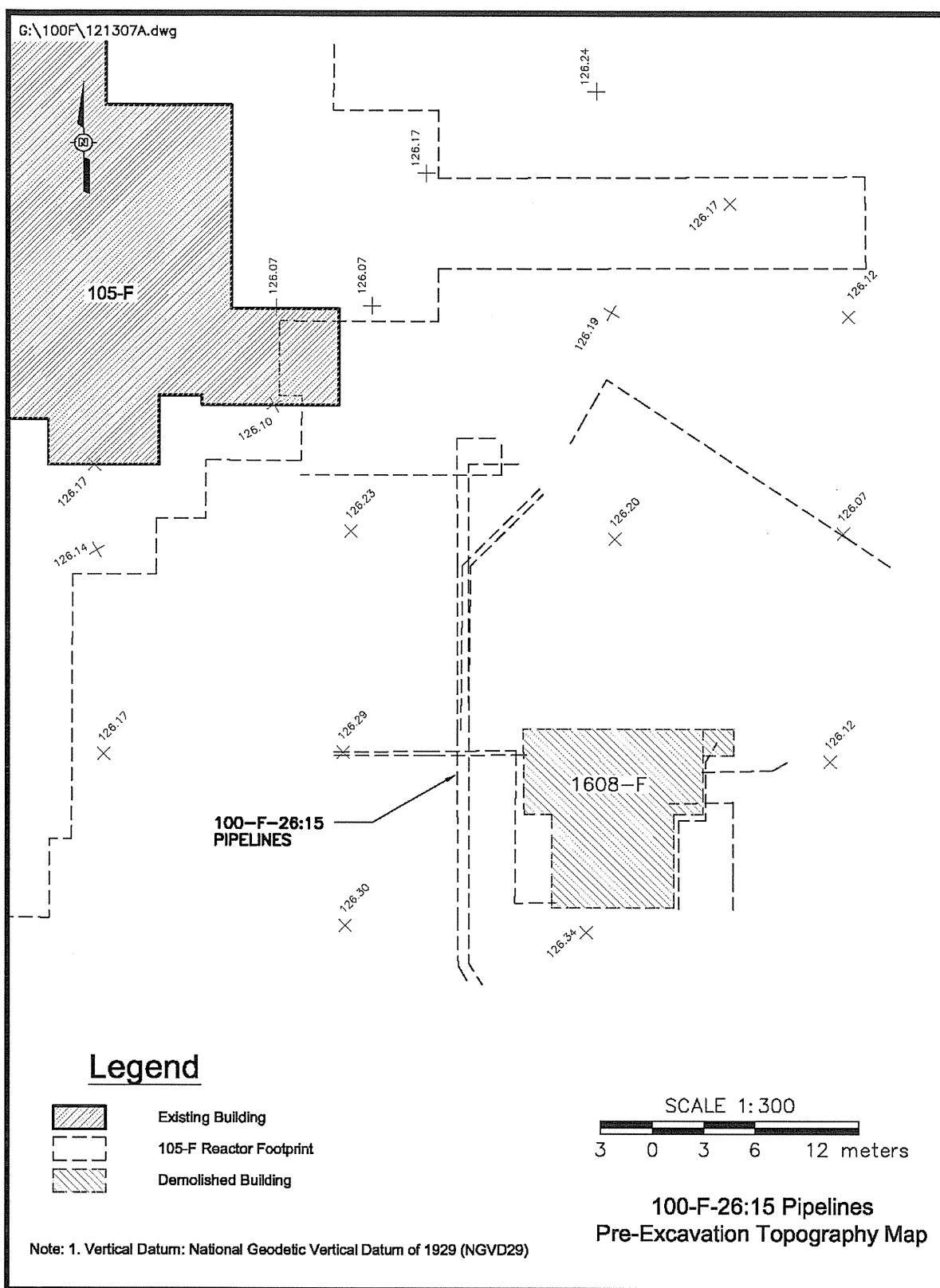
### Nonintrusive Investigation Results

A site walkdown was not conducted, given site conditions were known due to previous remediation activities. Ecological and cultural reviews were conducted for the entire 100-F-26 remediation project in December 2006 (WCH 2006). Terrestrial habitat in much of the location of the 100-F-26 had already been disturbed by previous demolition and decommissioning of reactor support structures. The primary ecological concern for remediation activities was to avoid disturbance of roosting bats in the 126-F-3 clearwells during the summer months. A geophysical investigation was performed at 100-F-26:15 with limited results from the ground penetrating radar due to the presence of disturbed soil and buried debris (WCH 2007b). Pre-remediation topography is shown in Figure 3.

### Confirmatory Sample Design

The 100-F-26:15 site was sent directly to remediation without confirmatory sampling based on process knowledge and historical information (BHI 2003a, BHI 2003b, BHI 2004). Due to the history of the site and the lack of information regarding the removal of the pipelines during previous demolition and decontamination (D&D) work, it was determined that the site required remedial action (Feist 2005).

Figure 3. Pre-remediation Topography of the 100-F-26:15 Waste Site.



## REMEDIAL ACTION SUMMARY

The 100-F-26:15 subsite was remediated from January 29 through January 31, 2007. Two distinct areas were excavated (Figure 4). The larger of the two excavations is referred to as the “primary excavation” in this document. Approximately 82 m<sup>3</sup> (107 yd<sup>3</sup>) of clay pipeline, steel pipeline, concrete encasement, and soil were removed from both excavation areas and disposed of at the Environmental Restoration Disposal Facility. A Global Positioning Environmental Radiological Surveyor (GPERS) with instrumentation specific to the detection of radiation associated with gamma emitting radionuclides was used to perform a final radiological survey of the site. The results of the post-excavation radiological survey are shown in Figure 5. The boundaries of the 100-F-26:15 remediation excavation and the overburden stockpiles are shown in Figure 4.

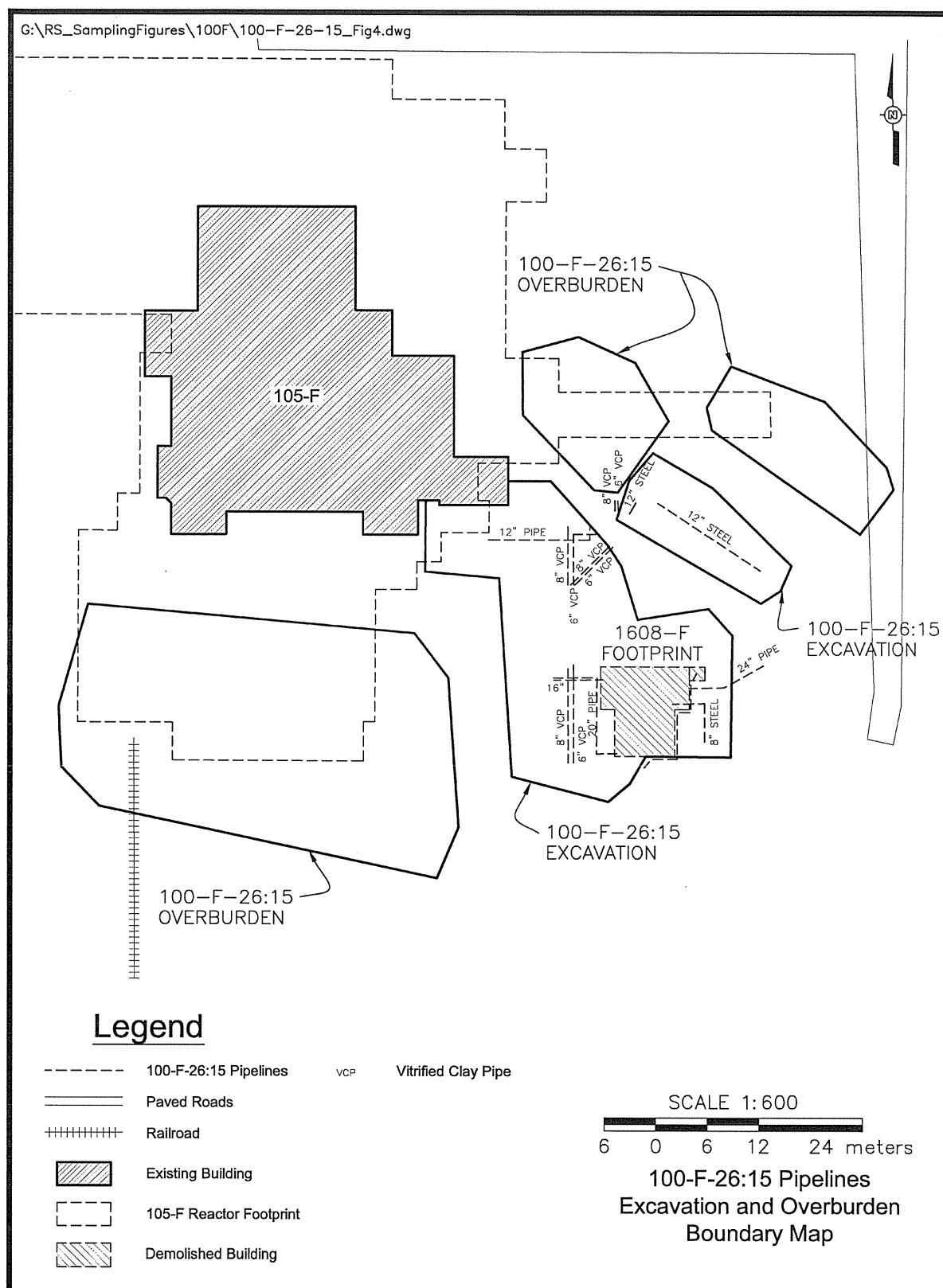
Only 3 of the 16 pipeline segments (numbers 2, 4, and 15) were found during excavation (Figure 6). The remaining pipeline segments were not located during this remedial action. Excavations for the remaining pipeline segments were performed to native soil to verify their previous removal. The topography of the site after remediation and the locations of the pipelines within the excavation are shown in Figure 7.

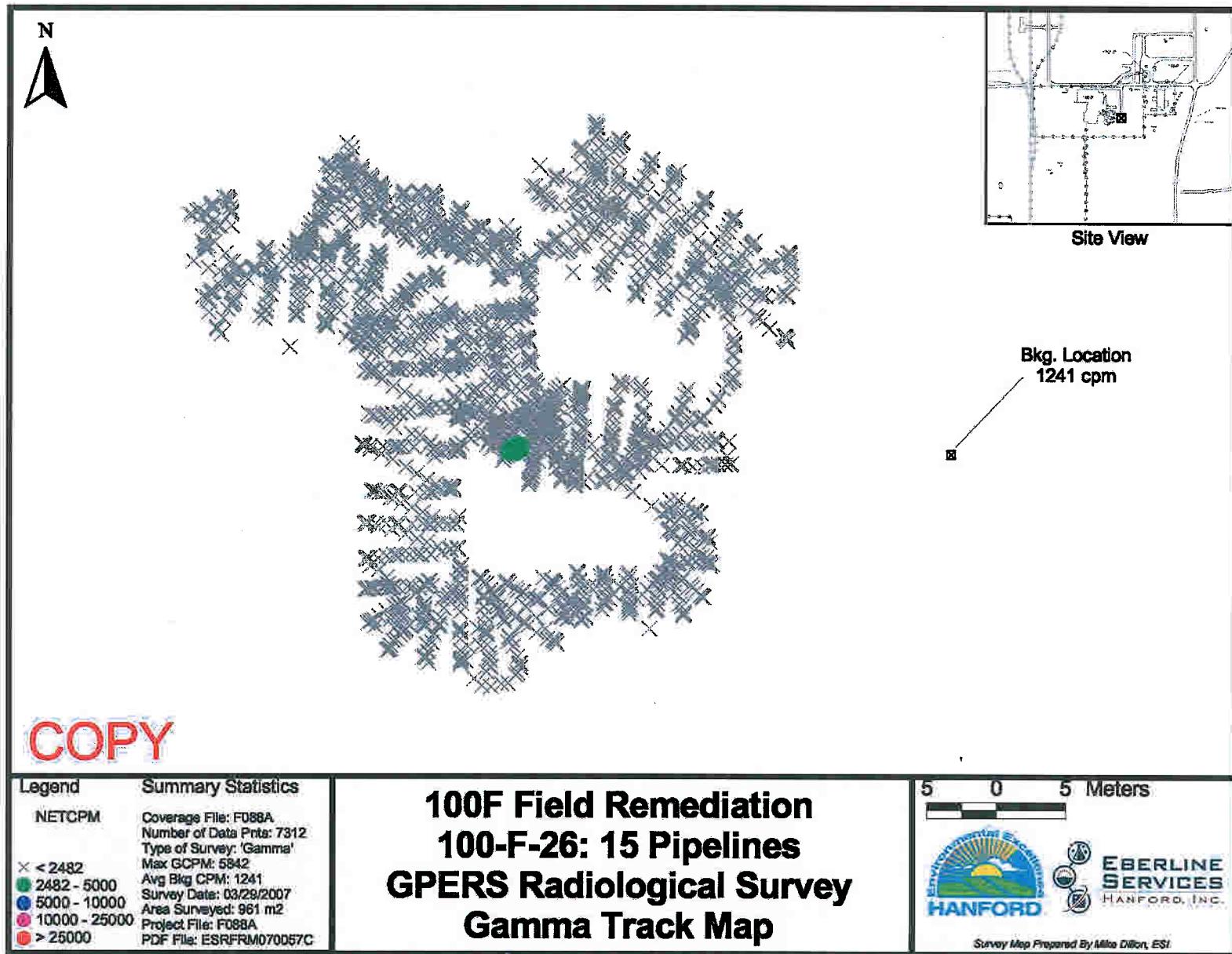
Eight of the pipeline segments (numbers 7, 8, 9, 10, 11, 12, 14 and 16) associated with the remediation of the 100-F-19:2, reactor cooling water effluent pipelines, in 2002 (BHI 2003a, Torres 2007).

The five remaining pipeline segments (numbers 1, 3, 5, 6, and 13) were not discovered during either of the pipeline removal activities in 2002 and 2007. These were most likely removed during previous D&D activities or historical pipeline replacement projects.

For the five pipeline segments that were not found during either remediation (numbers 1, 3, 5, 6, and 13), excavations at the locations shown on historical drawings were performed until native soil was encountered to verify their previous removal. Additional verification was available for pipeline segments 1 and 6 as these were associated with the 1608-F building. The below grade portion of the 1608-F building is present in the subsurface and was used as a guide to verify these pipeline segments were not present. Excavation was performed next to the 1608-F building for pipeline segments 1 and 6 continued until the bottom of the structure was reached, thereby verifying the pipeline segments were no longer present.

Two samples (J14D62 and J14D63) were collected on January 30, 2007, in the primary excavation adjacent to the 105-F Building foundation to allow for an early backfill. The early backfill was necessary to secure the foundation from damage due to undermining (Figures 8 and 9). These focused samples were analyzed for gross alpha, gross beta, carbon-14, gamma energy analysis (GEA), tritium (H-3), nickel-63, total strontium, americium-241/curium, polychlorinated biphenyls, total metals by inductively coupled plasma (ICP), mercury, and hexavalent chromium.

**Figure 4. Locations of 100-F-26:15 Waste Site Excavations and Overburden Stockpiles.**



**Figure 5. Radiological Survey of the 100-F-26:15 Waste Site.**

**Figure 6. Pipeline Segments Found and Removed during Remediation of the 100-F-26:15 Waste Site.**

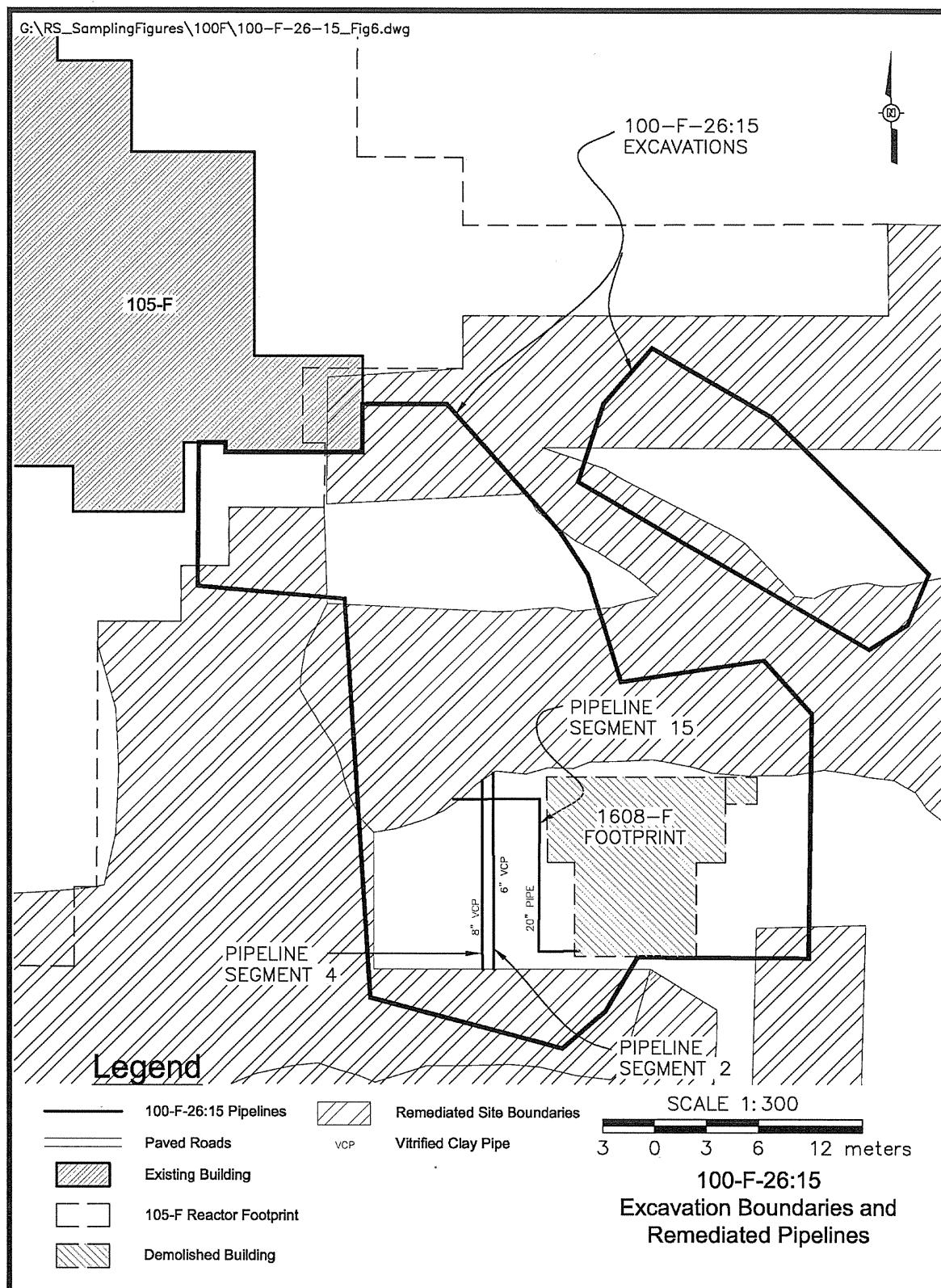
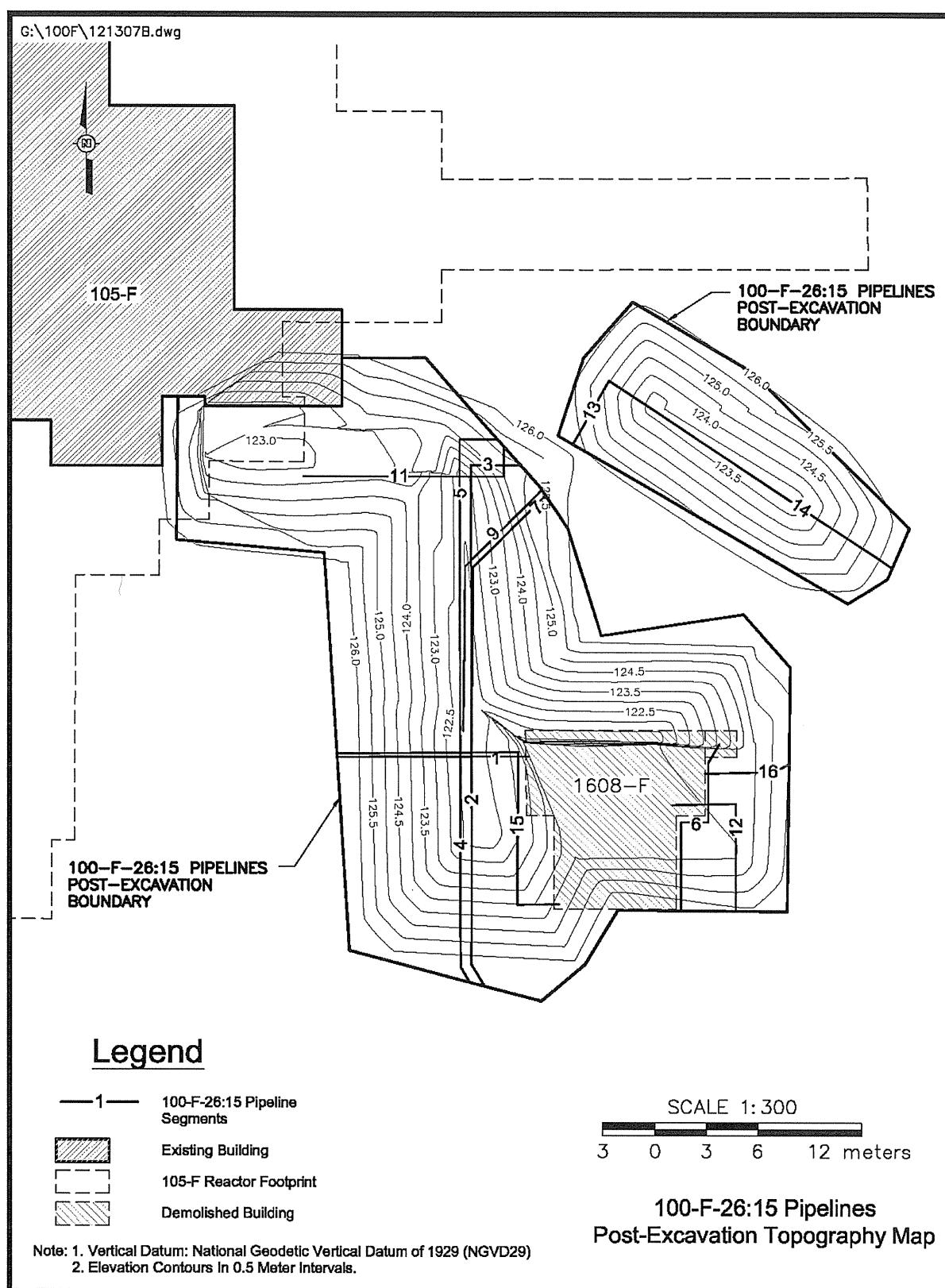


Figure 7. Post-remediation Topography of the 100-F-26:15 Waste Site.



**Figure 8. 100-F-26:15 Excavation Looking North to 105-F Reactor Building.**



**Figure 9. 105-F Reactor Building Foundation Exposed During Excavation.**



## VERIFICATION SAMPLING ACTIVITIES

Remedial action goals (RAGs) are the specific numeric goals against which the cleanup verification data are evaluated to demonstrate attainment of the remedial action objectives for the site. Verification sampling for the 100-F-26:15 pipeline site was performed on July 24 and 30, 2007 (WCH 2007c) to collect data to determine if the RAGs had been met. The following subsections provide additional discussion of the information used to develop the verification sampling design. The results of verification sampling are also summarized to support interim closure of the site.

### Contaminants of Potential Concern

The waste site contaminants of potential concern (COPCs) for the 100-F-26:15 waste site are described in the verification work instruction (WCH 2007a). COPCs for verification sampling included ICP metals, hexavalent chromium, and mercury. Gross alpha, gross beta, and gamma energy analysis (GEA) were used to detect radioactivity with isotope specific analyses performed for those samples with results greater than background. Americium-241, cesium-137, cobalt-60, europium-152, europium-154, and europium-155 were analyzed by gamma energy analysis (GEA). All analyses are discussed in the Data Evaluation portion of this Remaining Sites Verification Package.

### Verification Sample Design

This section describes the basis for selection of an appropriate sample design and determination of the number of verification samples that were collected. The 100-F-26:15 waste site was divided into three decision units for the purpose of verification sampling. The first decision unit consisted of the excavation footprint of the pipelines, the second decision unit consisted of the below cleanup level (BCL) stockpile, and the third decision unit consisted of the early backfill area adjacent to the 105-F Reactor.

### Verification Sampling – Excavation Footprint

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

Statistical parameters (i.e., standard deviation within the populations) for residual contaminant levels following remediation at the 100-F-26:15 waste site are unknown. Therefore, the standard deviation of the residual contaminant population was assumed to be less than 45% of the

corresponding decision thresholds for the population. This assumption will be verified using the resulting verification sampling data and will be considered in the data quality assessment for the data set.

The sampling area was delineated in Visual Sampling Plan<sup>1</sup> (PNNL 2002) and used as the basis for location of a random-start systematic grid for verification soil sample collection. The sampling area was restricted to a narrow segment of the excavation floor directly below the locations of the remediated pipelines as well as the areas from which pipelines had been previously removed. This was done to improve the chances for finding residual contamination should any still exist. Twenty-one samples were collected as shown in Figure 10. Triangular grids were selected for this investigation based on studies that indicate triangular grids are superior to square grids (Gilbert 1987). Additional discussion of the development of the statistical verification design is provided in the 100-F-26:15 verification work instruction (WCH 2007a).

### **Verification Sampling – BCL Stockpiles**

Verification sampling of the BCL stockpiles was performed to evaluate the suitability of the soil for use as clean backfill for the excavation. Because this material consists of overburden from the site and was not believed to have received discharges from the pipelines, a statistical sampling design was not warranted, and professional judgment was used to develop the sampling design. Sampling at the BCL stockpiles consisted of the collection of 25 aliquots of soil distributed across the surface of each existing pile and combining those into one sample for laboratory analysis.

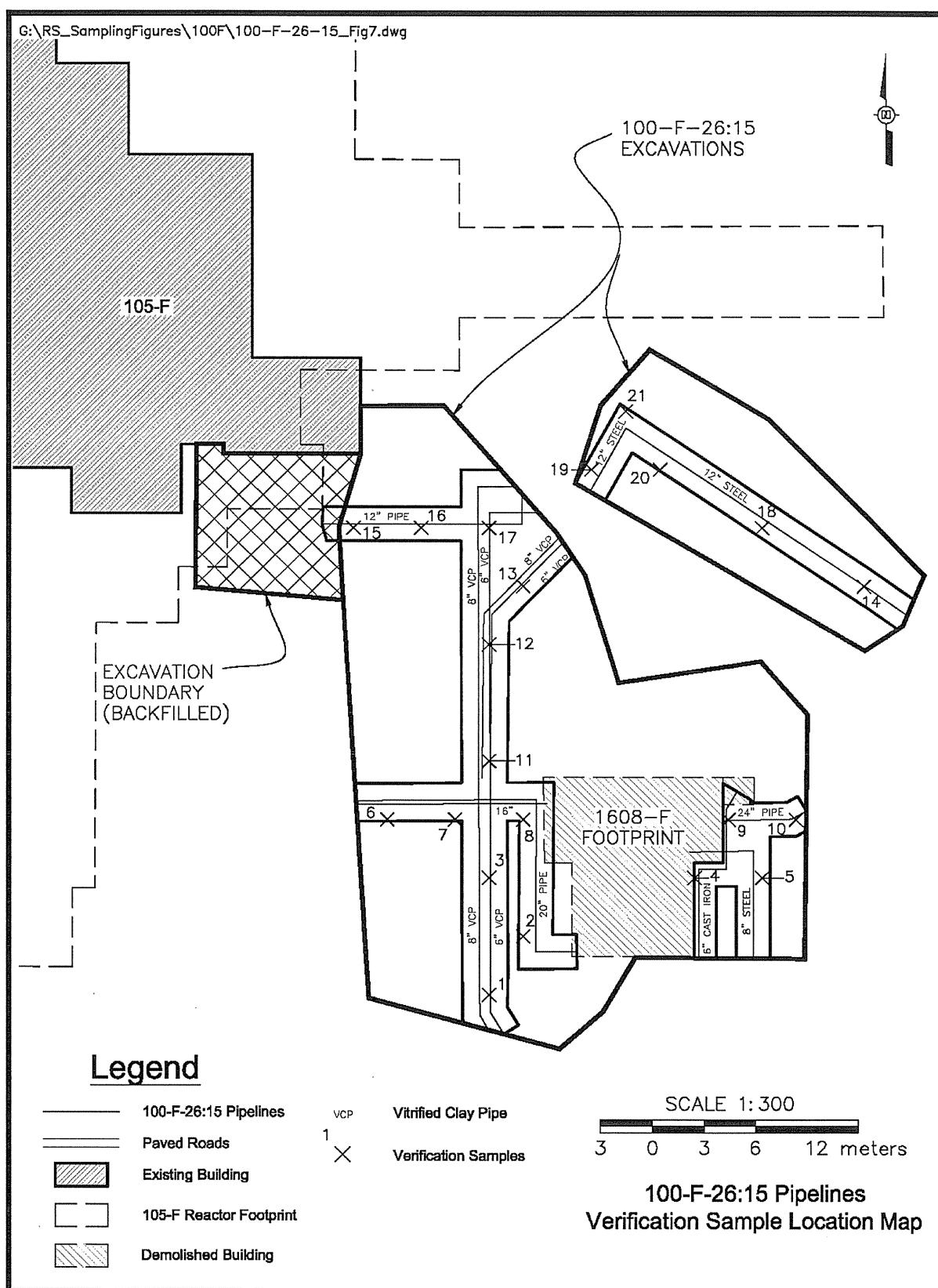
### **Verification Sampling – Early Backfill Area**

Verification sampling of the early backfill area was performed after excavation exposed the foundation of the 105-F Reactor and prior to backfilling this portion of the excavation (Figure 9). Because this segment of the excavation exposed the foundation wall of the 105-F Reactor, backfill was needed immediately to avoid undermining the support wall. Two soil samples were collected at the base of this portion of the excavation. Once the samples were collected, the excavation was backfilled.

Summaries of the samples collected and the analyses performed for the verification sampling event are presented in Table 2 and the locations are shown in Figure 10. All sampling was performed in accordance with ENV-1, *Environmental Monitoring & Management*, to fulfill the requirements of the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2005a).

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<sup>1</sup> Visual Sampling Plan is a site map-based user-interface program that may be downloaded at <http://dqa.pnl.gov>.

**Figure 10. 100-F-26:15 Verification Sample Locations.**

**Table 2. Verification Sample Summary for the 100-F-26:15 Waste Site.<sup>a</sup> (2 Pages)**

Sample Location	Sample Media	Actual Coordinates <sup>b</sup>	HEIS Number	Sample Analysis
		Northing Easting		
1	Soil	N 147551.6 E 580467.9	J15720	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
2	Soil	N 147555.0 E 582469.9	J15721	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
3	Soil	N 147558.4 E 580467.9	J15723	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
4	Soil	N 147558.4 E 580479.8	J15724	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
5	Soil	N 147558.4 E 580483.7	J15725	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
6	Soil	N 147561.9 E 580482.0	J15726	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
7	Soil	N 147561.9 E 580465.9	J15727	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
8	Soil	N 147561.9 E 580469.9	J15728	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
9	Soil	N 147561.9 E 580471.8	J15730	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
10	Soil	N 147561.9 E 580485.7	J15731	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
11	Soil	N 147565.3 E 580467.9	J15732	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
12	Soil	N 147572.2 E 580467.9	J15733	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
13	Soil	N 147575.6 E 580469.9	J15734	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
14	Soil	N 147575.6 E 580489.7	J15735	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
15	Soil	N 147579.0 E 580460.0	J15736	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
16	Soil	N 147579.0 E 580463.9	J15737	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
17	Soil	N 147579.0 E 580467.9	J15738	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
18	Soil	N 147579.0 E 580483.7	J15739	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.

**Table 2. Verification Sample Summary for the 100-F-26:15 Waste Site.<sup>a</sup> (2 Pages)**

19	Soil	N 147582.5 E 580473.8	J15740	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
20	Soil	N 147582.5 E 580477.8	J15741	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
21	Soil	N 147585.9 E 580475.8	J15742	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
Overburden Stockpiles	Soil	Composite	J15743	ICP metals, mercury, and hexavalent chromium.
Overburden Stockpiles	Soil	Composite	J15744	ICP metals, mercury, and hexavalent chromium.
Overburden Stockpiles	Soil	Composite	J15745	ICP metals, mercury, and hexavalent chromium.
Duplicate of J15721	Soil	N 147555.0 E 582469.9	J15722	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
Duplicate of J15728	Soil	N 147561.9 E 580469.9	J15729	GEA, gross alpha, gross beta, ICP metals, mercury, and hexavalent chromium.
Equipment Blank	Silica sand	NA	J15746	ICP metals, mercury, and hexavalent chromium.

<sup>a</sup> Source: Field logbooks EFL-1174-3 (WCH 2007c).<sup>b</sup> Washington State Plane (meters).

GEA = gamma spectroscopy

ICP = inductively coupled plasma

## Verification Sampling Results

Verification samples were analyzed using U.S. Environmental Protection Agency-approved analytical methods. 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 in Appendix A.

As noted earlier, the 100-F-26:15 waste site was divided into three decision units for verification sampling: (1) excavation footprint, (2) BCL stockpiles, and (3) early backfill area. Evaluation of the verification data from the excavation footprint was calculated using the 95% upper confidence limit on the true population mean for residual concentrations of COPCs as specified by the RDR/RAWP (DOE-RL 2005b). These calculations are provided in Appendix A. When a nonradionuclide COPC was detected in fewer than 50% of the verification samples collected, the maximum detected value was used for comparison against the RAGs. If no detections for a given COPC were reported in the data set, then no statistical evaluation or calculations were performed for that COPC. Evaluation of the verification data from the BCL stockpiles and early backfill area was performed by direct comparison of the sample results against cleanup criteria.

Comparisons of the statistical and maximum results for COPCs with the shallow zone RAGs for the excavation footprint, BCL stockpiles, and early backfill area are summarized in Tables 3a, 3b, and 3c, respectively. All three decision units are evaluated using the more restrictive shallow zone cleanup criteria. Contaminants that were not detected by laboratory analysis are excluded from these tables. Calculated cleanup levels are not presented in the *Cleanup Levels and Risk Calculations Database* (Ecology 2005) under Washington Administrative Code (WAC) 173-340-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium; therefore, these constituents are not considered site COPCs. Potassium-40, radium-226, radium-228, thorium-228, and thorium-232 were detected in samples collected at the site, but are not considered within statistical calculations or the following tables, as these isotopes are not related to the operational history of the site and were detected below background levels (based on an assumption of secular equilibrium, the background activities for radium-228 and thorium-228 are equal to the statistical background activity of 1.32 pCi/g for thorium-232 provided in DOE-RL [1996]).

**Table 3a. Comparison of Maximum or Statistical Contaminant Concentrations to Action Levels for the 100-F-26:15 Excavation Verification Sampling Event. (2 Pages)**

COPCs	Generic Site Lookup Values <sup>a</sup> (pCi/g)				Does the Statistical Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
	Maximum or Statistical Result (pCi/g)	Shallow Zone Lookup Value	Groundwater Protection Lookup Value	River Protection Lookup Value		
Cesium-137	0.092	6.2	-- <sup>b</sup>	-- <sup>b</sup>	No	--
Europium-152	0.205	3.3	-- <sup>b</sup>	-- <sup>b</sup>	No	--
COPC	Maximum or Statistical Result (mg/kg)	Remedial Action Goals <sup>a</sup> (mg/kg)			Does the Maximum Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Protective of Groundwater	Protective of the River		
Antimony	0.85 (<BG)	32	5	5	No	--
Arsenic	2.3 (<BG)	20	20	20	No	--
Barium	77.3 (<BG)	5,600	132	224	No	--
Beryllium	0.25 (<BG)	10.4	1.51	1.51	No	--
Boron	3.7	16,000	320	-- <sup>c</sup>	No	--
Cadmium	0.17 (<BG)	13.9	0.81	0.81	No	--
Chromium, Total	8.4 (<BG)	80,000	18.5	18.5	No	--
Cobalt	5.8 (<BG)	1,600	32	-- <sup>c</sup>	No	--
Copper	12.7 (<BG)	2,960	59.2	22.0	No	--

**Table 3a. Comparison of Maximum or Statistical Contaminant Concentrations to Action Levels for the 100-F-26:15 Excavation Verification Sampling Event. (2 Pages)**

Hexavalent chromium	0.24	2.1	4.8	2		--
Lead	4.1 (<BG)	353	10.2	10.2	No	--
Manganese	280 (<BG)	11,200	512	512	No	--
COPC	Maximum or Statistical Result (mg/kg)	Remedial Action Goals <sup>a</sup> (mg/kg)				
		Direct Exposure	Protective of Groundwater	Protective of the River	Does the Maximum Exceed RAGs?	Does the Result Pass RESRAD Modeling?
Mercury	0.13 (<BG)	24	0.33	0.33	No	--
Vanadium	34.5 (<BG)	560	85.1	-- <sup>c</sup>	No	--
Zinc	33.4 (<BG)	24,000	480	67.8	No	--

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

<sup>b</sup> The 100 Area RDR/RAWP (DOE-RL 2005) does not provide soil cleanup levels for this contaminant to be protective of groundwater and the Columbia River. Based on the lowest radionuclide soil partitioning distribution coefficient (for cesium-137 [50 mL/g]), no radionuclide contaminant is predicted to migrate more than 1 m (3.3 ft) vertically in 1,000 years (BHI 2005). The vadose zone underlying this waste site is approximately 7.8 m (25 ft) thick. Therefore, residual concentrations of this contaminant are predicted to be protective of groundwater and the Columbia River.

<sup>c</sup> No cleanup level is available from the *Cleanup Levels and Risk Calculations (CLARC) Database* (Ecology 2005), and no bioconcentration factor or ambient water quality criteria values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).

-- = not applicable

RAG = remedial action goal

BG = background

RESRAD = RESidual RADioactivity (dose assessment model)

COPC = contaminant of potential concern

RDL = required detection limit

EPA = Environmental Protection Agency

WAC = Washington Administrative Code

**Table 3b. Comparison of Maximum Contaminant Concentrations to Action Levels for the 100-F-26:15 Early Backfill Verification Sampling Event. (2 Pages)**

COPCs	Generic Site Lookup Values <sup>a</sup> (pCi/g)				Does the Maximum Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
	Maximum Result (mg/kg)	Shallow Zone Lookup Value	Groundwater Protection Lookup Value	River Protection Lookup Value		
Carbon-14	2.52	8.69	-- <sup>b</sup>	-- <sup>b</sup>	No	--
COPC	Maximum Result (mg/kg)	Soil Cleanup Levels, (mg/kg) <sup>a</sup>				Does the Maximum Result Pass RESRAD Modeling?
		Direct Exposure	Protective of Groundwater	Protective of the River	Does the Maximum Exceed RAGs?	
Arsenic	2.2 (<BG)	20	20	20	No	--
Barium	40.1 (<BG)	5,600	132	224	No	--
Beryllium	0.17 (<BG)	10.4	1.51	1.51	No	--
Boron <sup>e</sup>	1.4	16,000	320	-- <sup>c</sup>	No	--

**Table 3b. Comparison of Maximum Contaminant Concentrations to Action Levels for the 100-F-26:15 Early Backfill Verification Sampling Event. (2 Pages)**

COPC	Maximum Result (mg/kg)	Soil Cleanup Levels, (mg/kg) <sup>a</sup>			Does the Maximum Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Direct Exposure	Direct Exposure		
Cadmium <sup>g</sup>	0.12 (<BG)	13.9	0.81	0.81	No	--
Chromium, Total	8.2 (<BG)	80,000	18.5	18.5	No	--
Cobalt	5.1 (<BG)	1,600	32	-- <sup>c</sup>	No	--
Copper	13.7 (<BG)	2,960	59.2	22.0	No	--
Lead	3.2 (<BG)	353	10.2	10.2	No	--
Manganese	235 (<BG)	11,200	512	512	No	--
Nickel	9.4 (<BG)	1,600	19.1	27.4	No	--
Vanadium	31.3 (<BG)	560	85.1	-- <sup>c</sup>	No	--
Zinc	28.3 (<BG)	24,000	480	67.8	No	--

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

<sup>b</sup> The 100 Area RDR/RAWP (DOE-RL 2005) does not provide soil cleanup levels for this contaminant to be protective of groundwater and the Columbia River. Based on the lowest radionuclide soil partitioning distribution coefficient (for cesium-137 [50 mL/g]), no radionuclide contaminant is predicted to migrate more than 1 m (3.3 ft) vertically in 1,000 years (BHI 2005). The vadose zone underlying this waste site is approximately 7.8 m (25 ft) thick. Therefore, residual concentrations of this contaminant are predicted to be protective of groundwater and the Columbia River.

<sup>c</sup> No cleanup level is available from the *Cleanup Levels and Risk Calculations (CLARC) Database* (Ecology 2005), and no bioconcentration factor or ambient water quality criteria values are available to calculate cleanup levels (WAC 173-340730(3)(a)(iii), 1996 [Method B for surface waters]).

-- = not applicable

RESRAD = RESidual RADioactivity (dose assessment model)

BG = background

WAC = Washington Administrative Code

COPC = contaminant of potential concern

RDL = required detection limit

RAG = remedial action goal

**Table 3c. Comparison of Maximum Contaminant Concentrations to Action Levels for the 100-F-26:15 BCL Stockpile Verification Sampling Event. (2 Pages)**

COPC	Maximum Result (mg/kg)	Soil Cleanup Levels, (mg/kg) <sup>a</sup>			Does the Maximum Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Protective of Groundwater	Protective of the River		
Arsenic	2.5 (<BG)	20	20	20	No	--
Barium	66.9 (<BG)	5,600	132	224	No	--
Beryllium	0.29(<BG)	10.4	1.51	1.51	No	--
Boron	1.9	16,000	320	-- <sup>b</sup>	No	--
Chromium, Total	9.5 (<BG)	80,000	18.5	18.5	No	--
Cobalt	5.9 (<BG)	1,600	32	-- <sup>b</sup>	No	--
Copper	14.3 (<BG)	2,960	59.2	22.0	No	--
Lead	5.0 (<BG)	353	10.2	10.2	No	--
Manganese	277 (<BG)	11,200	512	512	No	--
Nickel	9.7 (<BG)	1,600	19.1	27.4	No	--

**Table 3c. Comparison of Maximum Contaminant Concentrations to Action Levels for the 100-F-26:15 BCL Stockpile Verification Sampling Event. (2 Pages)**

COPC	Maximum Result (mg/kg)	Soil Cleanup Levels, (mg/kg) <sup>a</sup>			Does the Maximum Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Protective of Groundwater	Protective of the River		
Vanadium	36.7 (<BG)	560	85.1	-- <sup>b</sup>	No	--
Zinc	34.8 (<BG)	24,000	480	67.8	No	--

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

<sup>b</sup> No cleanup level is available from the *Cleanup Levels and Risk Calculations (CLARC) Database* (Ecology 2005), and no bioconcentration factor or ambient water quality criteria values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).

-- = not applicable      RAG = remedial action goal  
 BCL = below cleanup level      RESRAD = RESidual RADioactivity (dose assessment model)  
 BG = background      RDL = required detection limit  
 COPC = contaminant of potential concern      WAC = Washington Administrative Code

## DATA EVALUATION

### Radionuclides

Table 4 compares the pipeline excavation radionuclide cleanup verification maximum results presented in Table 3a to direct exposure single radionuclide 15 mrem/yr dose-equivalence values and shows the sum of fractions evaluation for comparison of the total radionuclide dose to the RAG of 15 mrem/yr. The columns on the left side of Table 4 are the COPCs and maximum values, corrected for background, as appropriate. The fourth column of Table 4 presents the single radionuclide 15 mrem/yr dose-equivalence activity, and the last column presents the statistical values divided by the dose-equivalence activity. As demonstrated by the summation of these fractions, the total dose above background contributed by residual radionuclide populations will be significantly less than the 15 mrem/yr RAG. RESRAD evaluation of dose rates due to residual concentrations of cesium-137 and europium-152 shows that the maximum dose rate (1.15 mrem/yr) occurs at the present time and that the excess cancer risk associated with the radionuclide concentrations corresponds to a carcinogenic risk of  $1.04 \times 10^{-5}$  which is within the standard CERCLA risk range of  $10^{-4}$  to  $10^{-6}$ .

A similar calculation was prepared for one of the focus samples presented in Table 3b. This sample was taken in the early backfill area of 100-F-26:15. Carbon-14 was detected at 2.52 pCi/g in this sample. Using the methodology described above and a 15 mrem/yr direct exposure dose-equivalence value of 8.69 pCi/g (DOE-RL 2005b), the maximum dose rate for carbon-14 is 4.35 mrem/yr and occurs at the present time. The excess cancer risk associated with the radionuclide concentrations corresponds to a carcinogenic risk of  $5.3 \times 10^{-6}$  as determined by a RESRAD evaluation. This result is within the standard CERCLA risk range of  $10^{-4}$  to  $10^{-6}$ .

The 100 Area RDR/RAWP (DOE-RL 2005b) does not provide soil cleanup levels for cesium-137 and europium-152 to be protective of groundwater and the Columbia River. Based on the lowest radionuclide soil partitioning distribution coefficient (for cesium-137 [50 mL/g]), no radionuclide contaminant is predicted to migrate more than 1 m (3.3 ft) vertically in 1,000 years

(BHI 2005). The vadose zone underlying this waste site is approximately 7.8 m (25 ft) thick. Therefore, residual concentrations of the radionuclide contaminants are predicted to be protective of groundwater and the Columbia River.

**Table 4. Sum of Fractions Evaluation of Attainment of Radionuclide Direct Exposure RAGs for Verification Samples.**

COPCs	Maximum Values (pCi/g)	Activity Equivalent to 15 mrem/yr Dose <sup>a</sup> (pCi/g)	Fraction
Cesium-137	0.092	6.2	0.015
Europium-152	0.205	3.3	0.062
<b>Sum of Fractions</b>			0.077
<b>Equivalent Dose (mrem/yr)</b>			1.16

<sup>a</sup> Single radionuclide 15 mrem/yr dose-equivalence values and derivation methodology are presented in the *100 Area RDR/RAWP* (DOE-RL 2005b).

Similarly, the 100 Area RDR/RAWP (DOE-RL 2005b) does not provide soil cleanup levels for carbon-14 to be protective of groundwater and the Columbia River. Carbon-14 has a soil partitioning distribution coefficient of 200 ml/g (DOE 2005b) and is not predicted to migrate more than 1 m (3.3 ft) vertically in 1,000 years (BHI 2005). Therefore, the residual concentration of carbon-14 is predicted to be protective of groundwater and the Columbia River.

### Nonradionuclides

All verification sample nonradionuclide COPCs achieved compliance with direct exposure, groundwater, and river protection RAGs. When using a statistical sampling approach, a RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. The application of the three-part test for the 100-F-26:15 pipeline site is included in the statistical calculations (Appendix A). All residual COPC concentrations for the 100-F-26:15 pipeline site pass the three-part test.

Assessment of the risk requirements for the 100-F-26:15 waste site, Miscellaneous Pipelines Associated with the 132-F-6, 1608-F waste water pumping station, is determined by calculation of the hazard quotient and carcinogenic (excess cancer) risk values for nonradionuclides. These calculations are located in Appendix B. The requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than  $1 \times 10^{-6}$ , and a cumulative excess carcinogenic risk of less than  $1 \times 10^{-5}$ . These risk values were conservatively calculated for the entire waste site using the highest values from each of the decision units. Risk values were not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. The calculations indicated that all individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-F-26:15 waste site is  $2.6 \times 10^{-3}$ . All individual cumulative carcinogenic risk values are less than  $1 \times 10^{-6}$ . The cumulative carcinogenic risk value is  $1.1 \times 10^{-7}$ . Therefore, nonradionuclide risk requirements are met.

## 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 design (WCH 2007a). A review of the sample design (WCH 2007a), the field logbook (WCH 2007c), and applicable analytical data packages has been performed as part of this DQA. This DQA was performed in accordance with site specific data quality objectives found in the SAP (DOE-RL 2005a).

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 100-F-26:15, Miscellaneous Pipelines Associated with the 132-F-6, 1608-F waste water pumping station, included a sample design with multiple subunit areas. All samples were collected per the sample design.

Gross alpha and gross beta were required analyses for all samples. Gross alpha and/or gross beta analyses are screening methods used to evaluate if additional isotopic analyses are required. Verification sample data collected at the 100-F-26:15 waste site(s) were provided by the laboratories in two sample delivery groups (SDGs): SDG K0881 and SDG K0894. In the analytical data set, SDG K0881 had elevated results for gross alpha and/or gross beta for samples J15720, J15721, J15726, J15729, J15730, J15731, J15733, and J15734. SDG K0894 had elevated results for gross beta for sample J15739. The appropriate isotopic analyses were requested for these samples. Specifically, elevated gross alpha results prompt additional analyses for isotopic forms of plutonium, americium, and uranium, and elevated gross beta results lead to additional analyses for strontium.

Usually, the isotopic analyses determine if specific Hanford related contaminants are the source of the elevated gross alpha or gross beta results. However, in the analytical data set for 100-F-26:15, the data had inconsistent results between the gross alpha and the plutonium isotopic analysis, and/or gross beta and the strontium isotopic analyses. It is possible that variability in the background levels is responsible for these results. In instances without a clear explanation of the data, the laboratory is asked to rerun samples. The 100-F-26:15 gross alpha and/or gross beta analyses were rerun for the samples with inconsistent results.

Where two sets of data are created during the investigation of the elevated gross alpha/beta results, an examination of both sets of data is made in comparison to the isotopic analyses. Because they are specific, the isotopic results are more reliable than the screening methods. The data set most consistent with the isotopic analysis is considered more reliable. If the second data set is determined to be more reliable, the first data set is excluded and the second data set is used for decision-making purposes. If an evaluation of the two data sets is inconclusive, then the first (original) data set is retained and used for decision-making purposes, while the second data set is

excluded from the data set. Duplicated data are accepted or excluded in sets. Individual results from multiple data sets are not mixed to create a desired result. The two sets of data for 100-F-26:15 gross alpha and gross beta analyses are shown in Table 5.

**Table 5. 100-F-26:15 Gross Alpha and Gross Beta Results.**

SDG	Sample	Original Result	Re-run Result
Gross Alpha (pCi/g)			
K0881	J15726	46.6	8.55
K0881	J15730	69.8	-0.918
K0881	J15733	118	2.3
Gross Beta (pCi/g)			
K0881	J15720	37.8	20.7
K0881	J15721	78.9	10.7
K0881	J15729	51.4	16.9
K0881	J15730	40.2	-0.422
K0881	J15731	135	14.2
K0881	J15733	134	18.7
K0881	J15734	33	16.9
K0894	J15739	34.2	16.8

The results of the second gross alpha and gross beta analyses are consistent with the results from the more precise plutonium and strontium isotopic analyses. Therefore, the second data set is more reliable than the first data set, and is presented in Appendix A.

No major deficiencies were identified in the analytical data set. SDG K0894 was submitted for third-party validation. Minor deficiencies are discussed below.

### **SDG K0881**

This SDG comprises 15 field samples (J15720-J15734) and an equipment blank (J15746) collected from the 100-F-26:15 shallow zone excavations. Two field duplicate pairs are included in this SDG (J15721/ J15722 and J15728/J15729). These samples were analyzed for ICP metals, mercury, hexavalent chromium, gross alpha, gross beta, and by gamma spectroscopy. In addition, samples J15721, J15726, J15730, J15731, J15733 were analyzed for total strontium by beta counting, and samples J15726, J15730, J15731, J15733 were analyzed for plutonium isotopes by alpha spectroscopy. No major deficiencies were found in SDG K0881. Minor deficiencies are as follows:

All samples, with the exception of sample J15746 (the equipment blank), were reported with three-fold dilutions for ICP metals due to sample matrix.

In the initial digestion batch, sample J15720 indicated a high concentration of silver that wasn't supported by the replicate or matrix spike result. The sample was redigested in batch 07L0367, and was subsequently found to be free of silver contamination.

Also in the ICP metals analysis, the relative percent difference (RPD) for silicon is above the acceptance criteria at 44.6%. The silicon data for SDG K0881 may be considered estimated. Estimated data are useable for decision-making purposes.

Calcium, sodium, and zinc were reported in the MB at a concentration below the CRQL but not less than 1/5<sup>th</sup> of the concentration reported in the equipment blank, sample J15746 (i.e., the field sample concentration is low enough that the MB concentration is of similar magnitude). The calcium, sodium, and zinc result for sample J15746 may be considered estimated. Estimated data are acceptable for decision-making purposes.

The matrix spike (MS) recoveries for four ICP metals (aluminum, iron, antimony, and silicon) are out of project acceptance criteria. For aluminum, iron, and silicon, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. To confirm quantitation, post-digestion spikes and serial dilutions were prepared for each analyte with results ranging between 96.7-106.9%. Antimony did not have mismatched spike and native concentrations in the original MS. The original MS recovery for antimony was 69.8%. The antimony data for SDG K0881 may be considered estimated. Estimated data are useable for decision-making purposes.

#### **SDG K0894**

This SDG comprises 11 field samples: 8 statistical samples (J15735 – J15742) collected from the 100-F-26:15 shallow zone excavation, and 3 composites samples (J15743 – J15745) collected from the BCL stockpiles. These samples were analyzed for ICP metals, mercury, hexavalent chromium, gross alpha, gross beta, and by gamma spectroscopy. SDG K0894 also contains data from the 118-F-2 and 118-F-5 waste sites, this DQA discussion is limited to the sample results for 100-F-26:15. SDG K0894 was submitted for third-party validation. No major deficiencies were found in SDG K0894. Minor deficiencies are as follows:

In the radionuclide analyses, all gross beta results were qualified as estimated and flagged "J" by third-party validation, due to method blank contamination. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for four ICP metals (aluminum, iron, antimony, and silicon) are out of project acceptance criteria. For most of these analytes, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. To confirm quantitation, post-digestion spikes and serial dilutions were prepared for each analyte with results ranging between 100.5-110.7%. Antimony did not have mismatched spike and native concentrations in the original MS. The original MS recovery for antimony was 73.7%.

The antimony data for SDG K0894 were qualified as estimated with a "J" flag by third-party validation. The data are useable for decision-making purposes.

## FIELD QUALITY ASSURANCE/QUALITY CONTROL

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

Field quality assurance/quality control (QA/QC) measures are used to assess potential sources of error and cross contamination of samples that could bias results. The field QA/QC samples for the 100-F-26:15 waste site, listed in the field logbook (WCH 2007c), are two sets of primary and duplicate field samples from the excavation shallow zone (J15721/J15722 and J15727/J15728). The main and QA/QC sample results for the excavation shallow zone are presented in Appendix A of this document.

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 COPC. Only analytes with values above five times the detection limits for both the main and duplicate samples are compared. The 95% UCL calculation brief in Appendix A provides details on duplicate pair evaluation and RPD calculation. The data are suitable for the intended purpose of cleanup verification.

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

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

RPDs for the remaining radionuclides and nonradionuclide analytes are not calculated because an evaluation of the data shows that the analytes are not detected in both the main and duplicate sample at more than five times the target detection limit. RPDs of analytes detected at low concentrations (less than five times the detection limit) are not considered indicative of the analytical system performance. The data are useable for decision-making purposes.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than five times the target detection limit (TDL), including undetected analytes. In these cases, a control limit of  $\pm 2$  times the TDL is used (Appendix B) to indicate that a visual check of the data is required by the reviewer. None of the sample results required this check. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are useable for decision-making purposes.

## Data Quality Assessment Summary

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above, are a potential challenge 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 100-F-26:15 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 100-F-26:15 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 ENRE project-specific database prior to being submitted for inclusion in the HEIS database. The verification sample analytical data are also summarized in Appendix A.

## SUMMARY FOR INTERIM CLOSURE

The 100-F-26:15 subsite, Miscellaneous Pipelines Associated with the 132-F-6, 1608-F waste water pumping station, has been remediated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2005b). The site was remediated by removing approximately 82 m<sup>3</sup> (107 yd<sup>3</sup>) of material for disposal at the Environmental Restoration Disposal Facility. Statistical sampling to verify the completeness of remediation was performed, and analytical results for the decision units (excavation footprint, early backfill, and overburden) were shown to meet the cleanup objectives for direct exposure, groundwater protection, and river protection. Accordingly, an interim closure reclassification is supported for the 100-F-26:15 subsite. The site does not have a deep zone or residual contaminant concentrations that would require any institutional controls.

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## APPENDIX A

### **95% UCL CALCULATIONS AND VERIFICATION SAMPLING RESULTS**

## **APPENDIX A**

### **CALCULATION BRIEF**

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:

*100-F-26:15 Waste Site Cleanup Verification 95% UCL Calculations, 0100F-CA-V0288, Rev. 0,*  
Washington Closure Hanford, Richland, Washington.

#### **DISCLAIMER FOR CALCULATIONS**

The calculation that is provided in this appendix has been generated to document compliance with established cleanup levels. This calculation should be used in conjunction with other relevant documents in the administrative record.

## CALCULATION COVER SHEET

Project Title: 100-F Field RemediationJob No. 14655Area: 100-FDiscipline: Environmental \*Calculation No: 0100F-CA-V0288Subject: 100-F-26:15 Cleanup Verification 95% UCL CalculationComputer Program: Excel Program No: Excel 2003

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

Committed Calculation Preliminary Superseded Voided 

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 12 Attn. 1 = 11 Total = 24	H. M. Sulloway <i>H. M. Sulloway M. J. Appel</i>	M. J. Appel	NA	S. W. Callison <i>SW Callison</i>	12-5-07

### SUMMARY OF REVISION


Washington Closure Hanford**CALCULATION SHEET**

Originator H. M. Sulloway	<i>HMS</i>	Date 11/27/07	Calc. No. 0100F-CA-V0288	Rev. No. 0
Project 100-F Field Remediation		Job No. 14655	Checked M. J. Appel <i>MA</i>	Date 11/29/07
Subject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS				

1	<b>Summary</b>
2	<b>Purpose:</b> Calculate the 95% upper confidence limit (UCL) values to evaluate compliance with cleanup standards for the subject site. Also, perform the <i>Washington Administrative Code</i> (WAC) 173-340-740(7)(e) Model Toxics Control Act (MTCA) 3-part test for nonradionuclide analytes and calculate the relative percent difference (RPD) for primary-duplicate sample pairs for each contaminant of concern (COC) and contaminant of potential concern (COPC), as necessary.
3	<b>Table of Contents:</b> Sheets 1 to 3 - Calculation Sheet Summary Sheet 4 to 5 - Calculation Sheet Shallow Zone Verification Data Sheet 6 to 9 - Calculation Sheet Duplicate Analyses Sheet 10 to 12 - Ecology Software (MTCAStat) Results Attachment 1 - 100-F-26:15 Verification Sampling Results (11 sheets)
4	<b>Given/References:</b> 1) Sample Results (Attachment 1). 2) Background values and remedial action goals (RAGs) are taken from DOE-RL (2005b), DOE-RL (2001), and Ecology (1996). 3) DOE-RL, 2001, <i>Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes</i> , DOE/RL-92-24, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington. 4) DOE-RL, 2005a, <i>100 Area Remedial Action Sampling and Analysis Plan</i> (SAP), DOE/RL-96-22, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington. 5) DOE-RL, 2005b, <i>Remedial Design Report/Remedial Action Work Plan for the 100 Area</i> (RDR/RWP), DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington. 6) Ecology, 1992, <i>Statistical Guidance for Ecology Site Managers</i> , Publication #92-54, Washington Department of Ecology, Olympia, Washington. 7) Ecology, 1993, <i>Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-detection Limit or Below-PQL Values (Censored Data Sets)</i> , Publication #92-54, Washington Department of Ecology, Olympia, Washington. 8) Ecology, 1996, <i>Model Toxic Control Act Cleanup Levels and Risk Calculations (CLARC II)</i> , Publication #94-145, Washington State Department of Ecology, Olympia, Washington. 9) Ecology, 2005, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, < <a href="https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx">https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx</a> >. 10) EPA, 1994, <i>USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review</i> , EPA 540/R-4/013, U.S. Environmental Protection Agency, Washington, D.C. 11) WAC 173-340, 1996, "Model Toxic Control Act - Cleanup," <i>Washington Administrative Code</i> .
5	<b>Solution:</b> Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993), below, and in the RDR/RWP (DOE-RL 2005b). Use data from attached worksheets to perform the 95% UCL calculation for each analyte, the WAC 173-340-740(7)(e) 3-part test for nonradionuclides, and the RPD calculations for each COC/COPC. The hazard quotient and carcinogenic risk calculations are located in a separate calculation brief as an appendix to the Remaining Sites Verification Package (RSVP).
6	<b>Calculation Description:</b> The subject calculations were performed on data from soil verification samples (Attachment 1) from the 100-F-26:15 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/RWP (DOE-RL 2005b) is documented by this calculation. In addition to the statistical soil samples collected at this site, nonstatistical data were collected, and the results are also included in Attachment 1. As the maximum detected values for these data sets are used instead of the 95% UCL (additional discussion is provided in the RSVP), calculations on these data sets are not included herein. Duplicate RPD results are used in evaluation of data quality within the RSVP for this site.

Washington Closure Hanford

## CALCULATION SHEET

Originator H. M. Sulloway *H. M. Sulloway* Date 11/27/07 Calc. No. 0100F-CA-V0288 Rev. No. 0  
 Project 100-F Field Remediation Job No. 14655 Checked M. J. Appel *M. J. Appel* Date 11/29/07  
 Subject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS Sheet No. 2 of 12

1 **Summary (continued)**2 **Methodology:**

3 For nonradioactive analytes with ≤50% of the data below detection limits and all detected radionuclide analytes, the statistical value  
 4 calculated to evaluate the effectiveness of cleanup is the 95% UCL. For nonradioactive analytes with >50% of the data below detection  
 5 limits, as determined by direct inspection of the sample results (Attachment 1), the maximum detected value for the data set is used  
 6 instead of the 95% UCL, and no further calculations are performed for those data sets. For convenience, these maximum detected  
 7 values are included in the summary tables that follow. The 95% UCL was not calculated for data sets with no reported detections.  
 8 Calculated cleanup levels are not available in Ecology (2005) under WAC 173-340-740(3) for aluminum, calcium, iron, magnesium,  
 9 potassium, silicon, and sodium; therefore, these constituents are not considered site COCs/COPCs and are also not included in these  
 10 calculations. The 95% UCL values were also not calculated for radium-226, radium-228, thorium-228, thorium-232, and potassium-40,  
 11 as these isotopes are not related to the operational history of the site and thus not considered COCs/COPCs.  
 12

13  
 14 All nonradionuclide data reported as being undetected are set to ½ the detection limit value for calculation of the statistics (Ecology  
 15 1993). For radionuclide data, calculation of the statistics was done on the reported value. In cases where the laboratory does not  
 16 report a value below the minimal detectable activity (MDA), half of the MDA is used in the calculation. For the statistical evaluation of  
 17 duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as  
 18 described above.  
 19

20 For nonradionuclides, the WAC 173-340 statistical guidance suggests that a test for distributional form be performed on the data and  
 21 the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets ( $n < 10$ ) and all  
 22 radionuclide data sets, the calculations are performed assuming nonparametric distribution, so no tests for distribution are performed.  
 23 For nonradionuclide data sets of ten or greater, as for the subject site, distributional testing is done using Ecology's MTCASStat software  
 24 (Ecology 1993). Due to differences in addressing censored data between the RDR/RAWP (DOE-RL 2005b) and MTCASStat coding and  
 25 due to a limitation in the MTCASStat coding (no direct capability to address variable quantitation limits within a data set), substitutions for  
 26 censored data are performed before software input and the resulting data set treated as uncensored.  
 27

28  
 29 The WAC 173-340-740(7)(e) 3-part test is performed for nonradionuclide analytes only and determines if:  
 30 1) the 95% UCL exceeds the most stringent cleanup limit for each COPC/COC,  
 31 2) greater than 10% of the raw data exceed the most stringent cleanup limit for each COPC/COC,  
 32 3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each COPC/COC.  
 33

34 The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are  
 35 greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method  
 36 and is listed in Table II-1 of the SAP (DOE-RL 2005a). Where direct evaluation of the attached sample data showed that a given  
 37 analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD  
 38 calculations use the following formula:  
 39

$$40 \quad RPD = [ |M-S| / ((M+S)/2) ] * 100$$

41 where,  $M$  = Main Sample Value  $S$  = Split (or duplicate) Sample Value  
 42

43 For quality assurance/quality control (QA/QC) split and duplicate RPD calculations, a value less than 30% indicates the data compare  
 44 favorably. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split  
 45 data), further investigation regarding the usability of the data is performed. No split samples were collected for cleanup verification of  
 46 the subject site. Additional discussion as necessary is provided in the data quality assessment section of the applicable RSVP.  
 47

48 For quality assurance/quality control (QA/QC) split and duplicate RPD calculations, a value less than 30% indicates the data compare  
 49 favorably. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split  
 50 data), further investigation regarding the usability of the data is performed. No split samples were collected for cleanup verification of  
 51 the subject site. Additional discussion is provided in the data quality assessment section of the applicable RSVP, as necessary.  
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Washington Closure Hanford

## CALCULATION SHEET

Originator H. M. Sulloway *H. M. Sulloway* Date 11/27/07 Calc. No. 0100F-CA-V0288 Rev. No. 0  
 Project 100-F Field Remediation Job No. 14655 Checked M. J. Appel *MJA* Date 11/29/07  
 Subject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS Sheet No. 3 of 12

## 1 Summary (continued)

## 2 Results:

3 The results presented in the tables that follow include the summary of the results of the 95% UCL calculations for the shallow zone  
 4 excavation, the WAC 173-340-740(7)(e) 3-part test evaluation, and the RPD calculations, and are for use in risk analysis and the  
 5 RSVP for this site.

6

Results Summary - Shallow Zone Excavation			
Analyte	95% UCL Result <sup>a</sup>	Maximum Value <sup>a</sup>	Units
Cesium-137	0.092		mg/kg
Europium-152	0.205		mg/kg
Arsenic	2.3		mg/kg
Barium	77.3		mg/kg
Beryllium	0.25		mg/kg
Boron	3.7		mg/kg
Chromium	8.4		mg/kg
Cobalt	5.8		mg/kg
Copper	12.7		mg/kg
Hexavalent Chromium	0.24		mg/kg
Lead	4.1		mg/kg
Manganese	280		mg/kg
Molybdenum	0.56		mg/kg
Nickel	9.6		mg/kg
Vanadium	34.5		mg/kg
Zinc	33.4		mg/kg
Antimony		0.85	mg/kg
Cadmium		0.17	mg/kg
Mercury		0.13	mg/kg

28 WAC 173-340-740(7)(e) Evaluation:

30 WAC 173-340 3-Part Test for most stringent RAG:

31 95% UCL > Cleanup Limit? NO

32 > 10% above Cleanup Limit? NO

33 Any sample > 2x Cleanup Limit? NO

35 <sup>a</sup>The 95% UCL result or maximum value, depending on data censorship,  
 36 as described in the methodology section.  
 37 QA/QC = quality assurance/quality control  
 38 RSVP = remaining sites verification package

39

Relative Percent Difference Results, J15728 and J15729 <sup>b</sup> - QA/QC Analysis	
Analyte	Duplicate Analysis <sup>c</sup>
Potassium -40	13.0%
Aluminum	8.0%
Barium	20.5%
Boron	38.7%
Calcium	14.0%
Chromium	7.8%
Copper	12.2%
Iron	3.0%
Magnesium	10.2%
Manganese	18.2%
Silicon	9.1%
Vanadium	10.6%
Zinc	4.2%

56 <sup>b</sup>Relative percent difference evaluation was not  
 57 required for analytes not included in this table.

58 <sup>c</sup>These values are discussed in the RSVP.

59

Relative Percent Difference Results, J15728 and J15729 <sup>b</sup> - QA/QC Analysis	
Analyte	Duplicate Analysis <sup>c</sup>
Potassium-40	7.1%
Aluminum	7.8%
Barium	12.0%
Boron	8.0%
Calcium	8.9%
Chromium	2.8%
Copper	4.8%
Iron	8.4%
Magnesium	5.6%
Manganese	9.2%
Silicon	0.3%
Vanadium	10.6%
Zinc	6.6%

<sup>b</sup>Relative percent difference evaluation was not required for analytes not included in this table.

<sup>c</sup>These values are discussed in the RSVP.

## Abbreviations/Acronyms:

The following abbreviations and/or acronyms are used in this calculation:

B = blank contamination (organics)

BG = background

C = blank contamination (inorganics)

COC = contaminant of concern

COPC = contaminant of potential concern

DE = direct exposure

GW = groundwater

J = estimate

MDA = minimal detectable activity

MTCA = Model Toxics Control Act

PQL = practical quantitation limit

Q = qualifier

QA/QC = quality assurance/quality control

RAG = remedial action goal

RDL = required detection limit

RDR/RAWP = remedial design report/remedial action work plan

RESRAD = RESidual RADioactivity (dose model)

RPD = relative percent difference

RSVP = remaining sites verification package

SAP = sampling and analysis plan

TDL = target detection limit

U = undetected

UCL = upper confidence limit

WAC = Washington Administrative Code

## Washington Closure Hanford

Originator H. M. Sulloway  
 Project 100-F Field Remediation  
 Subject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date 11/27/07  
 Job No. 14655

Calc. No. 0100F-CA-V0288  
 Checked M. J. Appel

Rev. No. 0  
 Date 11/29/07  
 Sheet No. 4 of 12

Shallow Zone Verification Data																												
Sampling Area	HEIS Number	Sample Date	Cesium-137			Europium-152			Arsenic			Barium			Beryllium			Boron			Chromium							
			pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA		
2	J15721	7/24/2007	0.099	0.05	0.45	0.08	0.10	1.9	2	50.9	C	0.06	0.08	0.03	3.7	1.1	7.4	C	0.29	5.0	0.24							
5	Duplicate of J15721	J15722	7/24/2007	0.110	0.04	0.45	0.08	2.3	2	62.5	C	0.06	0.14	0.03	2.5	1.0	8.0	C	0.29	5.8	0.23							
6	8	J15728	7/24/2007	0.208	0.03	0.28	0.07	2.4	2	63.7	C	0.06	0.26	0.03	2.6	1.0	11.0	C	0.29	6.4	0.23							
7	Duplicate of J15728	J15729	7/24/2007	0.178	0.03	0.28	0.07	2.6	2	56.5	C	0.06	0.25	0.03	2.4	1.1	5.3	C	0.30	4.6	0.24							
8	1	J15720	7/24/2007	0.029	U	0.03	0.13	U	0.13	2.9	51.9	C	0.06	0.13	0.03	1.9	1.0	9.1	C	0.29	5.5	0.23						
9	3	J15723	7/24/2007	0.078	0.04	0.14	0.08	1.3	2	64.7	C	0.06	0.22	0.03	2.9	1.1	7.1	C	0.30	5.6	0.24							
10	4	J15724	7/24/2007	0.149	0.04	0.08	0.07	1.6	2	56.0	C	0.06	0.19	0.03	4.4	1.1	5.3	C	0.30	4.6	0.24							
11	5	J15725	7/24/2007	0.112	0.04	0.11	0.11	1.8	2	206	C	0.06	0.27	0.03	12.9	1.0	6.5	C	0.29	4.7	0.23							
12	6	J15726	7/24/2007	0.045	U	0.05	0.19	U	0.19	2	52.2	C	0.06	0.21	0.03	2.6	1.0	8.6	C	0.29	5.5	0.23						
13	7	J15727	7/24/2007	0.084	0.04	0.12	0.07	2.2	2	60.4	C	0.06	0.26	0.03	2.7	1.1	8.5	C	0.30	6.2	0.24							
14	9	J15730	7/24/2007	0.080	0.04	0.25	0.08	1.5	2	50.4	C	0.06	0.22	0.03	1.7	1.0	7.2	C	0.29	4.6	0.23							
15	10	J15731	7/24/2007	0.058	0.03	0.16	0.07	1.9	2	49.2	C	0.06	0.22	0.03	2.3	1.1	7.9	C	0.30	5.0	0.24							
16	11	J15732	7/24/2007	0.051	0.03	0.32	0.06	2.4	2	86.1	C	0.06	0.34	0.03	2.5	1.0	8.9	C	0.29	7.2	0.23							
17	12	J15733	7/24/2007	0.076	0.04	0.10	0.09	2.1	2	19.3	C	0.06	0.22	0.03	1.8	1.0	8.9	C	0.29	5.7	0.23							
18	13	J15734	7/30/2007	0.039	0.03	0.25	U	0.25	2	63.8	C	0.06	0.31	0.03	2.9	1.0	11.4	C	0.29	7.1	0.24							
19	14	J15735	7/30/2007	0.124	0.04	0.41	0.09	3.1	2	50.2	C	0.06	0.19	0.03	1.9	1.0	9.5	C	0.29	5.9	0.23							
20	15	J15736	7/30/2007	0.046	0.03	0.12	0.12	2.6	2	72.2	C	0.06	0.23	0.03	3.7	1.0	7.2	C	0.29	5.6	0.23							
21	16	J15737	7/30/2007	0.035	U	0.04	0.09	U	0.09	2	46.5	C	0.06	0.21	0.03	1.1	U	1.1	7.5	C	0.30	5.0	0.24					
22	17	J15738	7/30/2007	0.051	0.03	0.22	0.06	2.6	2	63.6	C	0.06	0.26	0.03	5.2	1.0	8.2	C	0.29	6.1	0.23							
23	18	J15739	7/30/2007	0.110	0.03	0.18	0.07	1.4	2	39.8	C	0.06	0.19	0.03	1.1	U	1.1	5.5	C	0.30	4.3	0.24						
24	19	J15740	7/30/2007	0.079	U	0.08	0.18	U	0.18	2	70.8	C	0.06	0.25	0.03	1.0	U	1.0	7.0	C	0.29	5.5	0.23					
25	20	J15741	7/30/2007	0.056	0.03	0.13	U	0.13	2	47.3	C	0.06	0.23	0.03	1.1	U	1.1	6.4	C	0.29	4.7	0.24						
26	21	J15742	7/30/2007	0.072	0.04	0.23	U	0.23	2	63.2	C	0.06	0.27	0.03	1.0	U	1.0	8.2	C	0.29	5.7	0.23						
Statistical Computation Input Data																												
Sampling Area	HEIS Number	Sample Date	Cesium-137			Europium-152			Arsenic			Barium			Beryllium			Boron			Chromium			Cobalt				
			pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA		
2	J15721/J15722	7/24/2007	0.165		0.450			2.1		56.7		0.11		3.1			7.7			5.4								
3	8	J15728/J15729	7/24/2007	0.193		0.281			2.5		60.1		0.26		2.5			8.2			5.5							
32	1	J15720	7/24/2007	0.029		0.066			1.5		51.9		0.13		1.9			9.1			5.5							
33	3	J15723	7/24/2007	0.078		0.142			1.3		64.7		0.22		2.9			7.1			5.6							
34	4	J15724	7/24/2007	0.149		0.076			1.6		56.0		0.19		4.4			5.3			4.6							
35	5	J15725	7/24/2007	0.11																								

## Washington Closure Hanford

Originator H. M. Sulloway  
 Project 100-F Field Remediation  
 Subject 100-F-26:5 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date 11/27/07  
 Job No. 14655

Calc. No. 0100F-CA-V0268  
 Checked M. J. Appel

Rev. No. 0  
 Date 11/29/07  
 Sheet No. 5 of 12

1 Shallow Zone Verification Data			Copper Hexavalent Chromium Lead Manganese Molybdenum Nickel Vanadium Zinc																							
Sampling Area	HEIS Number	Sample Date	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
2	J15721	7/24/2007	10.8	C	0.26	0.25	0.20		3.7	0.97	230	0.21	0.71	0.47	8.1	0.79	33.8	0.24	32.3	C	0.12					
Duplicate of J15721	J15722	7/24/2007	12.2	C	0.26	0.26	0.20		4.1	0.95	276	0.2	0.51	0.46	8.9	0.78	30.4	0.23	33.7	C	0.12					
8	J15728	7/24/2007	12.9	C	0.26	0.20	U	0.20	3.9	0.95	256	0.2	0.65	0.46	10.5	0.78	41.6	0.12	37.3	C	0.12					
Duplicate of J15728	J15729	7/24/2007	12.3	C	0.27	0.20	U	0.20	3.7	0.98	270	0.21	0.68	0.48	9.9	0.8	37.4	0.24	34.9	C	0.12					
1	J15720	7/24/2007	13.4	C	0.26	0.27	0.20		3.5	0.96	266	0.2	0.47	U	0.47	9.8	0.79	37.7	0.23	33.0	C	0.12				
3	J15723	7/24/2007	12.2	C	0.26	0.20	U	0.20	3.8	0.99	279	0.21	0.71	0.48	8.9	0.81	29.4	0.24	31.3	C	0.12					
4	J15724	7/24/2007	12.5	C	0.27	0.32	0.20		3.4	0.98	211	0.21	0.79	0.48	7.6	0.8	24.8	0.24	28.7	C	0.12					
5	J15725	7/24/2007	12	C	0.27	0.35	0.20		4.5	0.94	219	0.2	0.73	0.46	7.9	0.77	33.8	0.23	29.5	C	0.11					
6	J15726	7/24/2007	14.6	C	0.26	0.31	0.20		3.7	0.94	254	0.2	0.54	0.46	10.0	0.88	36.6	0.23	31.6	C	0.11					
7	J15727	7/24/2007	11.6	C	0.26	0.26	0.20		4.0	0.99	296	0.21	0.56	0.48	9.4	0.81	35.8	0.24	34.8	C	0.12					
9	J15730	7/24/2007	14.6	C	0.26	0.20	U	0.20	3.4	0.95	248	0.2	0.66	0.46	8.8	0.78	26.0	0.23	27.7	C	0.12					
10	J15731	7/24/2007	11.6	C	0.26	0.22	0.20		2.9	0.98	243	0.21	0.57	0.48	8.8	0.8	33.1	0.24	32.8	C	0.12					
11	J15732	7/24/2007	13.1	C	0.27	0.27	0.20		4.4	0.94	355	0.2	0.75	0.46	10.2	0.77	36.1	0.23	37.6	C	0.11					
12	J15733	7/24/2007	12.9	C	0.25	0.31	0.20		3.4	0.94	262	0.2	0.81	0.46	9.1	0.77	36.2	0.23	33.2	C	0.11					
13	J15734	7/30/2007	12.3	C	0.27	0.24	0.20		4.4	0.97	317	0.21	0.61	0.47	11.7	0.79	43.1	0.24	39.4	C	0.12					
14	J15735	7/30/2007	11.9	C	0.26	0.20	U	0.20	4.6	0.91	268	0.2	0.46	U	0.46	9.5	0.77	32.0	0.23	31.9	C	0.11				
15	J15736	7/30/2007	13.6	C	0.27	0.20	U	0.20	4.8	0.94	279	0.2	0.46	U	0.46	9.6	0.77	30.6	0.23	31.8	C	0.11				
16	J15737	7/30/2007	11.5	C	0.28	0.20	U	0.20	3.5	0.98	234	0.21	0.48	U	0.48	8.8	0.8	27.2	0.24	27.0	C	0.12				
17	J15738	7/30/2007	11.2	C	0.25	0.20	U	0.20	4.4	0.94	292	0.2	0.46	U	0.46	10.0	0.77	33.0	0.23	32.8	C	0.11				
18	J15739	7/30/2007	12.7	C	0.25	0.20	U	0.20	3.5	0.95	195	0.21	0.48	U	0.48	6.8	0.8	19.6	0.24	22.7	C	0.12				
19	J15740	7/30/2007	12.3	C	0.23	0.21	0.20		4.2	0.95	301	0.2	0.46	U	0.46	8.4	0.78	27.8	0.23	34.6	C	0.12				
20	J15741	7/30/2007	12.7	C	0.23	0.21	0.20		4.1	0.97	226	0.21	0.47	U	0.47	8.2	0.79	23.5	0.23	25.4	C	0.12				
21	J15742	7/30/2007	12.2	C	0.27	0.23	0.20		4.2	0.96	275	0.2	0.47	U	0.47	9.7	0.79	32.4	0.23	32.2	C	0.12				

27 Statistical Computation Input Data			Copper Hexavalent Chromium Lead Manganese Molybdenum Nickel Vanadium Zinc																							
Sampling Area	HEIS Number	Sample Date	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL									
2	J15721/J15722	7/24/2007	11.5		0.26	3.9			253		0.61				8.5			32.1			33.0					
8	J15728/J15729	7/24/2007	12.6		0.10	3.8			283		0.67				10.2			39.5			36.1					
1	J15720	7/24/2007	13.4		0.27	3.5			266		0.24				9.8			37.7			33.0					
3	J15723	7/24/2007	12.2		0.10	3.8			279		0.71				8.9			29.4			31.3					
4	J15724	7/24/2007	12.5		0.32	3.4			211		0.79				7											

## CALCULATION SHEET

Washington Closure Hanford  
 Originator H. M. Sulloway *LMW*  
 Project 100-F Field Remediation

Subject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date 11/27/07  
 Job No. 14655

Calc. No. 0100F-CA-V0288  
 Checked M. J. Appel *MM*

Rev. No. 0  
 Date 11/29/07  
 Sheet No. 6 of 12

## 1 Duplicate Analysis

Sampling Area	Sample Number	Sample Date	Cesium-137			Europium-152			Potassium-40			Radium-226			Radium-228			Thorium-228 GEA			Thorium-232 GEA			Aluminum		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
2	J15721	7/24/2007	0.099		0.053	0.451		0.099	15.6		0.33	0.606		0.081	0.782		0.202	0.776		0.052	0.782		0.202	5020		4.9
Duplicate of J15721	J15722	7/24/2007	0.11		0.04	0.449		0.084	13.7		0.325	0.493		0.067	0.754		0.15	0.739		0.042	0.754		0.15	5440		4.8

## 6 Analysis:

Duplicate Analysis	TDL	0.1	0.1	0.5	0.1	0.2	1	1	5
	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD			13.0%					8.0%
Difference > 2 TDL?		No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable

12

Sampling Area	HEIS Number	Sample Date	Arsenic			Barium			Beryllium			Boron			Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
2	J15721	7/24/2007	1.9		1.2	50.9		0.06	0.08		0.03	3.7		1.1	3450		2.1	7.4		0.29	5		0.24	10.8		0.26
Duplicate of J15721	J15722	7/24/2007	2.3		1.2	62.5		0.06	0.14		0.03	2.5		1.0	3970		2.0	8		0.29	5.8		0.23	12.2		0.26

## 17 Analysis:

Duplicate Analysis	TDL	10	2	0.5	2	100	1	2	1
	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		20.5%			14.0%	7.8%		12.2%
Difference > 2 TDL?		No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	No - applicable	No - acceptable	Not applicable

## CALCULATION SHEET

Washington Closure Hanford

Originator H. M. Sulloway

Project 100-F Field Remediation

Subject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date 11/27/07  
Job No. 14655Calc. No. 0100F-CA-V0288  
Checked M. J. AppelRev. No. 0  
Date 11/29/07  
Sheet No. 7 of 12

## 1 Duplicate Analysis

Sampling Area	Sample Number	Sample Date	Hexavalent Chromium			Iron			Lead			Magnesium			Manganese			Molybdenum			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
2	J15721	7/24/2007	0.25		0.2	13100		7	3.7		0.97	3060	C	2.4	230		0.21	0.71		0.47	8.1		0.79	894		9.4
Duplicate of J15721	J15722	7/24/2007	0.26		0.2	13500		6.9	4.1		0.95	3390	C	2.3	276		0.2	0.51		0.46	8.9		0.78	1110		9.2

## 6 Analysis:

	TDL	0.5	5	5	75	5	2	4	400
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	3.0%		0.2%	18.2%				
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable

12

Sampling Area	HEIS Number	Sample Date	Silicon			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
2	J15721	7/24/2007	1670		2.5	137		2.1	33.8		0.24	32.3		0.12
Duplicate of J15721	J15722	7/24/2007	1830		2.5	124		2.0	30.4		0.23	33.7		0.12

## 17 Analysis:

	TDL	2	50	2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	9.1%		10.6%	4.2%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable

## CALCULATION SHEET

Washington Closure HanfordOriginator H. M. Sulloway *HMS*

Project 100-F Field Remediation

Subject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date 11/27/07  
Job No. 14655Calc. No. 0100F-CA-V0288  
Checked M. J. Appel *MJA*Rev. No. 0  
Date 11/29/07  
Sheet No. 8 of 12

## 1 Duplicate Analysis

Sampling Area	Sample Number	Sample Date	Cesium-137			Europium-152			Potassium-40			Radium-226			Radium-228			Thorium-228 GEA			Thorium-232 GEA			Aluminum		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
8	J15728	7/24/2007	0.208		0.028	0.284		0.07	14.6		0.284	0.555		0.051	0.863		0.111	0.762		0.039	0.863		0.111	6380		4.8
Duplicate of J15728	J15729	7/24/2007	0.178		0.029	0.278		0.071	13.6		0.233	0.499		0.052	0.736		0.116	0.865		0.055	0.736		0.116	5900		4.9

## 6 Analysis:

TDL		0.1	0.1	0.5	0.1	0.2	1	1	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD			7.1%					7.8%
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable

12

Sampling Area	HEIS Number	Sample Date	Arsenic			Barium			Beryllium			Boron			Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
8	J15728	7/24/2007	2.4		1.2	63.7		0.06	0.26		0.03	2.6		1	4010		2	11		0.29	6.4		0.23	12.9	C	0.26
Duplicate of J15728	J15729	7/24/2007	2.6		1.2	56.5		0.06	0.25		0.03	2.4		1.1	3670		2.1	10.7		0.3	5.9		0.24	12.3	C	0.27

17

TDL		10	2	0.5	2	100	1	2	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD		12.0%			8.9%		2.8%	
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable

Washington Closure HanfordOriginator H. M. Sulloway *HMS*

Project 100-F Field Remediation

Subject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS

## CALCULATION SHEET

Date 11/27/07  
Job No. 14655Calc. No. 0100F-CA-V0288  
Checked M. J. Appel *MJA*Rev. No. 0  
Date 11/29/07  
Sheet No. 9 of 12

## 1 Duplicate Analysis

Sampling Area	Sample Number	Sample Date	Iron			Lead			Magnesium			Manganese			Molybdenum			Nickel			Potassium			Silicon		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
8	J15728	7/24/2007	17300		6.9	3.9		0.95	3870		2.3	296		0.2	0.65		0.46	10.5		0.78	1070		9.2	649		2.5
Duplicate of J15728	J15729	7/24/2007	15900		7.1	3.7		0.98	3660		2.4	270		0.21	0.68		0.48	9.9		0.8	964		9.5	651		2.6

## 6 Analysis:

TDL		5	5	75	5	2	4	400	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD		8.4%		5.6%		9.2%		0.3%
	Difference > 2 TDL?	Not applicable	No - acceptable	No applicable	No applicable	No applicable	No - acceptable	No - acceptable	No applicable

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Sampling Area	HEIS Number	Sample Date	Sodium			Vanadium			Zinc		
mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL			

Washington Closure Hanford

Originator H. M. Sulloway *HMS*  
 Project 100-F Field Remediation  
 Subject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS

## CALCULATION SHEET

Date 11/27/07  
 Job No. 14655

Calc. No. 0100F-CA-V0288  
 Checked M. J. Appel *MJA*  
 Rev. No. 0  
 Date 11/27/07  
 Sheet No. 10 of 12

## Ecology Software (MTCASStat) Results

Arsenic 95% UCL Calculation			Barium 95% UCL Calculation			Beryllium 95% UCL Calculation										
2.1	J15721/J15722		56.7	J15721/J15722		0.11	J15721/J15722									
2.5	J15728/J15729		60.1	J15728/J15729		0.26	J15728/J15729									
1.45	J15720	Number of samples	Uncensored values	51.9	J15720	Number of samples	Uncensored values	0.13								
1.3	J15723	Uncensored	21	Mean 2.08	64.7	J15723	Mean	0.22								
1.6	J15724	Censored		Lognormal mean 2.09	56.0	J15724	Lognormal mean	0.19								
1.8	J15725	Detection limit or PQL		Std. devn. 0.49	206	J15725	Std. devn.	0.27								
1.5	J15726	Method detection limit		Median 2.10	52.2	J15726	Median	0.21								
2.2	J15727	TOTAL	21	Min. 1.30	60.4	J15727	Min.	0.26								
1.5	J15730			Max. 3.10	50.4	J15730	Max.	0.22								
1.9	J15731				49.2	J15731		0.22								
2.1	J15732				86.1	J15732		0.34								
2.1	J15733				49.3	J15733		0.22								
2.4	J15734	Lognormal distribution?		Normal distribution?	63.8	J15734	Lognormal distribution?	Normal distribution?								
3.1	J15735	r-squared is: 0.95			58.2	J15735	r-squared is: 0.715	r-squared is: 0.48								
2.6	J15736	Recommendations:			72.2	J15736	Recommendations:									
2.1	J15737	Use lognormal distribution.			46.5	J15737										
2.6	J15738				63.6	J15738	Reject BOTH lognormal and normal distributions.									
1.4	J15739	UCL (Land's method) is 2.31			39.8	J15739										
2.3	J15740				70.8	J15740	UCL (based on Z-statistic) is 77.3									
2.6	J15741				47.3	J15741										
2.3	J15742				68.2	J15742										
27	DATA	ID	Boron 95% UCL Calculation			DATA	ID	Chromium 95% UCL Calculation			DATA	ID	Cobalt 95% UCL Calculation			
28	3.1	J15721/J15722		7.7	J15721/J15722		5.4	J15721/J15722								
29	2.5	J15728/J15729		8.2	J15728/J15729		5.5	J15728/J15729								
30	1.9	J15720	Number of samples	Uncensored values	9.1	J15720	Number of samples	Uncensored values	5.5	J15720	Number of samples	Uncensored values				
31	2.9	J15723	Uncensored	21	Mean 2.7	7.1	J15723	Uncensored	21	Mean 7.8	5.6	J15723	Uncensored	21	Mean 5.5	
32	4.4	J15724	Censored	Lognormal mean 2.8	5.3	J15724	Censored	Lognormal mean 7.9	4.6	J15724	Censored	Lognormal mean 5.5				
33	12.9	J15725	Detection limit or PQL	Std. devn. 2.7	6.5	J15725	Detection limit or PQL	Std. devn. 1.4	4.7	J15725	Detection limit or PQL	Std. devn. 0.8				
34	2.6	J15726	Method detection limit	Median 2.5	8.6	J15726	Method detection limit	Median 7.9	5.5	J15726	Method detection limit	Median 5.5				
35	2.7	J15727	TOTAL	21	Min. 0.5	8.5	J15727	TOTAL	21	Min. 5.3	6.2	J15727	TOTAL	21	Min. 4.3	
36	1.7	J15730			Max. 12.9	7.2	J15730			Max. 11.4	4.6	J15730			Max. 7.2	
37	2.3	J15731				7.9	J15731				5.0	J15731				
38	2.5	J15732				8.9	J15732				7.2	J15732				
39	1.8	J15733				8.9	J15733				5.7	J15733				
40	2.9	J15734	Lognormal distribution?	Normal distribution?	11.4	J15734	Lognormal distribution?	Normal distribution?	7.1	J15734	Lognormal distribution?	Normal distribution?				
41	1.9	J15735	r-squared is: 0.90	r-squared is: 0.65	9.5	J15735	r-squared is: 0.97	r-squared is: 0.962	5.9	J15735	r-squared is: 0.95	r-squared is: 0.93				
42	3.7	J15736	Recommendations:		7.2	J15736	Recommendations:		5.6	J15736	Recommendations:					
43	0.6	J15737	Reject BOTH lognormal and normal distributions.		7.5	J15737	Use lognormal distribution.		5.0	J15737	Use lognormal distribution.					
44	5.2	J15738			8.2	J15738			6.1	J15738						
45	0.6	J15739	UCL (based on Z-statistic) is 3.7		5.5	J15739	UCL (Land's method) is 8.4		4.3	J15739						
46	0.5	J15740			7.0	J15740			5.5	J15740	UCL (Land's method) is 5.8					
47	0.6	J15741			6.4	J15741			4.7	J15741						
48	0.5	J15742			8.2	J15742			5.7	J15742						

### Washington Closure Hanford

## CALCULATION SHEET

Originator H. M. Sulloway  
Project 100-F Field Remediation  
Subject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date 11/27/07 Calc. No. 0100F-CA-V0288  
Job No. 14655 Checked M. J. Appel

Rev. No. 0  
Date 11/13/96  
Sheet No. 11 of 12

Ecology Software (MTCASStat) Results

Copper 95% UCL Calculation										Hexavalent Chromium 95% UCL Calculation										Lead 95% UCL Calculation																								
DATA	ID	11.5	J15721/J15722	0.3	J15721/J15722	3.9	J15721/J15722	3.9	J15721/J15722	3.9	J15721/J15722	3.8	J15728/J15729	3.8	J15728/J15729	3.5	J15720	Number of samples	Uncensored values	Number of samples	Uncensored values	3.5	J15720	Number of samples	Uncensored values	3.8	J15723	Number of samples	Uncensored values	21	Mean	3.9												
3	12.5	J15728/J15729	12.5	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1	J15728/J15729	0.1									
4	13.4	J15720	Number of samples	Uncensored	21	Uncensored values	Mean	12.3	0.3	J15720	Number of samples	Uncensored	21	Uncensored values	Mean	0.20	3.5	J15720	Number of samples	Uncensored values	Number of samples	Uncensored values	3.5	J15720	Number of samples	Uncensored values	3.8	J15723	Number of samples	Uncensored values	21	Mean	3.9											
5	12.5	J15723	Uncensored	21	Uncensored values	Mean	12.3	0.1	J15723	Uncensored	21	Uncensored values	Mean	0.20	3.8	J15723	Uncensored	21	Uncensored values	Mean	3.9	3.8	J15728/J15729	Uncensored	21	Mean	3.9																	
6	12.0	J15724	Censored	Lognormal mean	12.3	0.3	J15724	Censored	Lognormal mean	0.21	3.4	J15724	Censored	Lognormal mean	0.21	3.4	J15724	Censored	Lognormal mean	0.21	3.4	J15724	Censored	Lognormal mean	0.21	3.4	J15724	Censored	Lognormal mean	0.21	3.4	J15724	Censored	Lognormal mean	0.21									
7	14.6	J15725	Detection limit or PQL	Std. devn.	1.0	0.4	J15725	Detection limit or PQL	Std. devn.	0.09	4.5	J15725	Detection limit or PQL	Std. devn.	0.09	4.5	J15725	Detection limit or PQL	Std. devn.	0.50	4.5	J15725	Detection limit or PQL	Std. devn.	0.50	4.5	J15725	Detection limit or PQL	Std. devn.	0.50	4.5	J15725	Detection limit or PQL	Std. devn.	0.50									
8	11.6	J15726	Method detection limit	Median	12.5	0.3	J15726	Method detection limit	Median	0.22	3.7	J15726	Method detection limit	Median	0.22	3.7	J15726	Method detection limit	Median	3.9	3.7	J15726	Method detection limit	Median	3.9	3.7	J15726	Method detection limit	Median	3.9	3.7	J15726	Method detection limit	Median	3.9									
9	13.1	J15727	TOTAL	21	Min.	9.8	0.3	J15727	TOTAL	21	Min.	0.10	4.0	J15727	TOTAL	21	Min.	2.9	4.0	J15727	TOTAL	21	Min.	2.9	4.0	J15727	TOTAL	21	Min.	2.9	4.0	J15727	TOTAL	21	Min.	2.9								
10	11.3	J15730	Max.	14.6	0.1	J15730	Max.	0.35	3.4	J15730	Max.	0.35	3.4	J15730	Max.	0.35	3.4	J15730	Max.	4.8	3.4	J15730	Max.	4.8	3.4	J15730	Max.	4.8	3.4	J15730	Max.	4.8	3.4	J15730	Max.	4.8								
11	13.6	J15731	0.2	J15731	0.2	4.4	J15731	0.2	4.4	4.4	J15731	0.2	4.4	4.4	J15731	0.2	4.4	4.4	J15731	0.2	4.4	4.4	J15731	0.2	4.4	4.4	J15731	0.2	4.4	4.4	J15731	0.2	4.4											
12	11.5	J15732	0.3	J15732	0.3	4.8	J15732	0.3	4.8	4.8	J15732	0.3	4.8	4.8	J15732	0.3	4.8	4.8	J15732	0.3	4.8	4.8	J15732	0.3	4.8	4.8	J15732	0.3	4.8	4.8	J15732	0.3	4.8											
13	11.2	J15733	0.3	J15733	0.3	3.4	J15733	0.3	3.4	3.4	J15733	0.3	3.4	3.4	J15733	0.3	3.4	3.4	J15733	0.3	3.4	3.4	J15733	0.3	3.4	3.4	J15733	0.3	3.4	3.4	J15733	0.3	3.4											
14	12.7	J15734	Lognormal distribution?	Normal distribution?	0.94	0.2	J15734	Lognormal distribution?	Normal distribution?	0.87	4.4	J15734	Lognormal distribution?	Normal distribution?	0.87	4.4	J15734	Lognormal distribution?	Normal distribution?	0.969	4.4	J15734	Lognormal distribution?	Normal distribution?	0.960	4.4	J15734	Lognormal distribution?	Normal distribution?	0.969	4.4	J15734	Lognormal distribution?	Normal distribution?	0.969									
15	12.3	J15735	r-squared is:	0.94	0.95	0.1	J15735	r-squared is:	0.82	0.87	4.6	J15735	r-squared is:	0.82	0.87	4.6	J15735	r-squared is:	0.960	0.969	4.6	J15735	r-squared is:	0.960	0.969	4.6	J15735	r-squared is:	0.960	0.969	4.6	J15735	r-squared is:	0.960	0.969									
16	12.7	J15736	Recommendations:	Use lognormal distribution.	0.1	J15736	Recommendations:	Reject BOTH lognormal and normal distributions.	0.1	J15736	Recommendations:	Reject BOTH lognormal and normal distributions.	0.1	J15736	Recommendations:	Reject BOTH lognormal and normal distributions.	0.1	J15736	Recommendations:	Use lognormal distribution.	0.1	J15736	Recommendations:	Use lognormal distribution.	0.1	J15736	Recommendations:	Use lognormal distribution.	0.1	J15736	Recommendations:	Use lognormal distribution.	0.1											
17	12.2	J15737	Use lognormal distribution.	0.1	J15737	Use lognormal distribution.	0.1	J15737	Use lognormal distribution.	0.1	J15737	Use lognormal distribution.	0.1	J15737	Use lognormal distribution.	0.1	J15737	Use lognormal distribution.	0.1	J15737	Use lognormal distribution.	0.1	J15737	Use lognormal distribution.	0.1	J15737	Use lognormal distribution.	0.1	J15737	Use lognormal distribution.	0.1													
18	12.6	J15738	0.1	J15738	0.1	4.4	J15738	0.1	4.4	4.4	J15738	0.1	4.4	4.4	J15738	0.1	4.4	4.4	J15738	0.1	4.4	4.4	J15738	0.1	4.4	4.4	J15738	0.1	4.4	4.4														
19	9.8	J15739	0.1	J15739	0.1	4.8	J15739	0.1	4.8	4.8	J15739	0.1	4.8	4.8	J15739	0.1	4.8	4.8	J15739	0.1	4.8	4.8	J15739	0.1	4.8	4.8	J15739	0.1	4.8	4.8														
20	11.7	J15740	UCL (Land's method) is	12.7	0.2	J15740	UCL (Land's method) is	0.24	0.2	J15740	UCL (Land's method) is	0.24	0.2	J15740	UCL (Land's method) is	0.24	0.2	J15740	UCL (Land's method) is	4.1	4.2	J15740	UCL (Land's method) is	4.1	4.2	J15740	UCL (Land's method) is	4.1	4.2	J15740	UCL (Land's method) is	4.1	4.2	J15740	UCL (Land's method) is	4.1								
21	12.6	J15741	0.2	J15741	0.2	4.1	J15741	0.2	4.1	4.1	J15741	0.2	4.1	4.1	J15741	0.2	4.1	4.1	J15741	0.2	4.1	4.1	J15741	0.2	4.1	4.1	J15741	0.2	4.1	4.1														
22	12.7	J15742	0.2	J15742	0.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2														
23	12.7	J15742	0.2	J15742	0.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2														
24	12.7	J15742	0.2	J15742	0.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2														
25	12.7	J15742	0.2	J15742	0.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2														
26	12.7	J15742	0.2	J15742	0.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2	J15742	0.2	4.2	4.2														
DATA	ID	Manganese 95% UCL Calculation										Molybdenum 95% UCL Calculation										Nickel 95% UCL Calculation																						
27	253	J15721/J15722	0.61	J15721/J15722	0.61	8.5	J15721/J15722	0.61	8.5	9.8	J15720	Number of samples	Uncensored values	Number of samples	Uncensored values	9.8	J15720	Number of samples	Uncensored values	9.1	9.8	J15723	Number of samples	Uncensored values	21	Mean	9.1																	
28	283	J15728/J15729	0.67	J15728/J15729	0.67	10.2	J15728/J15729	0.67	10.2	8.9	J15723	Uncensored	21	Mean	0.48	8.9	J15723	Uncensored	21	Mean	9.1	8.9	J15724	Censored	Lognormal mean	9.1	8.9	J15724	Censored	Lognormal mean	9.1	8.9	J15724	Censored	Lognormal mean	9.1								
29	266	J15720	Number of samples	Uncensored	21	Uncensored values	Mean	265	0.71	J15723	Number of samples	Uncensored	21	Uncensored values	Mean	0.48	7.6	J15724	Number of samples	Uncensored values	Lognormal mean	0.49	7.6	J15725	Number of samples	Uncensored values	Detection limit or PQL	Std. devn.	1.1	7.6	J15725	Number of samples	Uncensored values	Method detection limit	Median	9.1	7.6	J15725	Number of samples	Uncensored values	Method detection limit	Median	9.1	
30	279	J15723	Uncensored	21	Uncensored values	Mean	265	0.79	J15724	Uncensored	21	Uncensored values	Mean	0.49	7.9	J15725	Uncensored	21	Uncensored values	0.23	7.9	J15725	Uncensored	21	Uncensored values	0.23	7.9	J15725	Uncensored	21	Uncensored values	0.23	7.9	J15725	Uncensored	21	Uncensored values	0.23						
31	211	J15724	Censored	Lognormal mean	265	0.73	J15725	Detection limit or PQL	Std. devn.	0.23	0.23	J15735	Method detection limit	Median	0.56	10.0	J15726	Method detection limit	Median	0.56	10.0	J15726	Method detection limit	Median	0.56	10.0	J15726	Method detection limit	Median	0.56	10.0	J15726	Method detection limit	Median	0.56	10.0	J15726	Method detection limit	Median	0.56				
32	219	J15725	Detection limit or PQL	Std. devn.	37	0.73	J15726	Method detection limit	Median	0.56	0.56	J15727	TOTAL	21	Min.	0.23	9.4	J15727	TOTAL	21	Min.	0.23	9.4	J15727	TOTAL	21	Min.	0.23	9.4	J15727	TOTAL	21	Min.	0.23	9.4	J15727	TOTAL	21	Min.	0.23	9.4			
33	254	J15726	Method detection limit	Median	266	0.54	J15727	TOTAL	21	Min.	0.23	J15730	Min.	195	0.66	J15730	Max.	355	0.66	J15730	Max.	0.81	8.8	J15730	Max.	0.81	8.8	J15730	Max.	0.81	8.8	J15730	Max.	0.81	8.8	J15730	Max.	0.81	8.8	J15730	Max.	0.81		
34	296	J15727	TOTAL	21	Min.	195	0.56	J15727	TOTAL	21	Min.	0.56	J15731	Max.	355	0.57	J15731	Max.	0.57	8.8	J15731	Max.	0.57	8.8	10.2	J15732	Max.	0.57	10.2	10.2	J15732	Max.	0.57	10.2	10.2	J15732	Max.	0.57	10.2	10.2	J15732	Max.	0.57	10.2
35	248	J15730	Max.	J15730	Max.	0.66	J15730	Max.	0.66	0.57	J15731	Max.	0.57	0.75	J15732	Max.	0.75	0.81	J15733	Max.	0.81	0.81	J15733	Max.	0.81	0.81	J15733	Max.	0.81	0.81	J15733	Max.	0.81	0.81	J15733	Max.	0.81	0.81	J15733	Max.	0.81	0.81		
36	243	J15731	0.57	J15731	0.57	9.1	J15733	0.81	J15734	Lognormal distribution?	Normal distribution?	0.61	J15734	Lognormal distribution?	Normal distribution?	0.61	11.7	J15734	Lognormal distribution?	Normal distribution?	0.97	11.7	J15734	Lognormal distribution?	Normal distribution?	0.96	1																	

Washington Closure HanfordOriginator H. M. Su lowayProject 100-F Field RemediationSubject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS

## CALCULATION SHEET

Date 11/27/07  
Job No. 14655Calc. No. 0100F-CA-V0288  
Checked M. J. AppelRev. No. 0  
Date 11/27/07  
Sheet No. 12 of 2

## Ecology Software (MTCASStat) Results

1	DATA	ID	Vanadium 95% UCL Calculation					DATA	ID	Zinc 95% UCL Calculation				
2	32.1	J15721/J15722						33.0	5721/J15722					
3	39.5	J15728/J15729						36.1	5728/J15729					
4	37.7	J15720	Number of samples	21	Uncensored values			33.0	J15720	Number of samples	Uncensored values			
5	29.4	J15723	Uncensored		Mean	31.9		31.3	J15723	Uncensored	21	Mean	31.8	
6	24.8	J15724	Censored		Lognormal mean	32.0		28.7	J15724	Censored		Lognormal mean	31.8	
7	33.8	J15725	Detection limit or PQL		Std. devn.	5.7		29.5	J15725	Detection limit or PQL		Std. devn.	4.0	
8	36.6	J15726	Method detection limit		Median	32.4		31.6	J15726	Method detection limit		Median	32.2	
9	35.8	J15727	TOTAL	21	Min.	19.6		34.8	J15727	TOTAL	21	Min.	22.7	
10	26.0	J15730			Max.	43.1		27.7	J15730			Max.	39.4	
11	33.1	J15731						32.8	J15731					
12	36.1	J15732						37.6	J15732					
13	36.2	J15733						33.2	J15733					
14	43.1	J15734	Lognormal distribution?		Normal distribution?			39.4	J15734	Lognormal distribution?		Normal distribution?		
15	32.0	J15735	r-squared is: 0.96		r-squared is: 0.98			31.9	J15735	r-squared is: 0.94		squared is: 0.96		
16	30.6	J15736	Recommendations:					31.8	J15736	Recommendations:				
17	27.2	J15737	Use lognormal distribution.					27.0	J15737	Use lognormal distribution.				
18	33.0	J15738						32.8	J15738					
19	19.6	J15739	UCL (Land's method) is	34.5				22.7	J15739	UCL (Land's method) is	33.4			
20	27.8	J15740						34.6	J15740					
21	23.5	J15741						25.4	J15741					
22	32.4	J15742						32.2	J15742					
23														
24														
25														
26														
27														

## Attachment 1. 100-F-26:15 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Americium-241			Americium-241 GEA			Barium-133			Carbon-14			Cesium-137			Cobalt-60		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Early Backfill	J14D62	1/30/2007	0.051	U	0.2	1.3	U	1.3				1.99	U	2.2	0.25	U	0.25	0.13	U	0.13
Early Backfill	J14D63	1/30/2007	0.1	U	0.26	0.53	U	0.53				2.52		2.4	0.12	U	0.12	0.1	U	0.1
1	J15720	07/24/07				0.096	U	0.096	0.042	U	0.042				0.029	U	0.03	0.032	U	0.032
2	J15721	07/24/07				0.341	U	0.341	0.042	U	0.042				0.099		0.053	0.047	U	0.047
Duplicate of J15721	J15722	07/24/07				0.045	U	0.045	0.038	U	0.038				0.11		0.04	0.035	U	0.035
3	J15723	07/24/07				0.109	U	0.109	0.046	U	0.046				0.078		0.035	0.034	U	0.034
4	J15724	07/24/07				0.146	U	0.146	0.034	U	0.034				0.149		0.035	0.028	U	0.028
5	J15725	07/24/07				0.111	U	0.111	0.05	U	0.05				0.112		0.037	0.036	U	0.036
6	J15726	07/24/07				0.324	U	0.324	0.037	U	0.037				0.045	U	0.045	0.043	U	0.043
7	J15727	07/24/07				0.046	U	0.046	0.039	U	0.039				0.084		0.037	0.034	U	0.034
8	J15728	07/24/07				0.146	U	0.146	0.034	U	0.034				0.208		0.028	0.029	U	0.029
Duplicate of J15728	J15729	07/24/07				0.093	U	0.093	0.039	U	0.039				0.178		0.029	0.03	U	0.03
9	J15730	07/24/07				0.277	U	0.277	0.033	U	0.033				0.08		0.042	0.034	U	0.034
10	J15731	07/24/07				0.039	U	0.039	0.033	U	0.033				0.058		0.03	0.032	U	0.032
11	J15732	07/24/07				0.143	U	0.143	0.032	U	0.032				0.051		0.028	0.032	U	0.032
12	J15733	07/24/07				0.046	U	0.046	0.039	U	0.039				0.076		0.038	0.036	U	0.036
13	J15734	07/24/07				0.045	U	0.045	0.027	U	0.027				0.039		0.034	0.03	U	0.03
14	J15735	07/30/07				0.29	U	0.29	0.036	U	0.036				0.124		0.041	0.04	U	0.04
15	J15736	07/30/07				0.106	U	0.106	0.041	U	0.041				0.046		0.034	0.031	U	0.031
16	J15737	07/30/07				0.044	U	0.044	0.037	U	0.037				0.035	U	0.035	0.035	U	0.035
17	J15738	07/30/07				0.048	U	0.048	0.033	U	0.033				0.051		0.032	0.032	U	0.032
18	J15739	07/30/07				0.146	U	0.146	0.029	U	0.029				0.11		0.029	0.022	U	0.022
19	J15740	07/30/07				0.277	U	0.277	0.033	U	0.033				0.079	U	0.079	0.043	U	0.043
20	J15741	07/30/07				0.104	U	0.104	0.041	U	0.041				0.056		0.031	0.031	U	0.031
21	J15742	07/30/07				0.045	U	0.045	0.036	U	0.036				0.072		0.036	0.032	U	0.032
BCL 1	J15743	07/30/07				0.051	U	0.051	0.034	U	0.034				0.103		0.037	0.032	U	0.032
BCL 2	J15744	07/30/07				0.173	U	0.173	0.035	U	0.035				0.055		0.032	0.029	U	0.029
BCL 3	J15745	07/30/07				0.118	U	0.118	0.045	U	0.045				0.095		0.035	0.036	U	0.036
Equipment Blank	J15746	07/24/07																		

Acronyms and notes apply to all of the tables in this appendix.

Note: Data qualified with C, D, I, and/or J are considered acceptable values for decision-making purposes.

B = blank contamination (organics)

C = blank contamination (inorganic constituents)

D = diluted

GEA = gamma energy analysis

I = interference

J = estimate

MDA = minimum detectable activity

PQL = practical quantitation limit

Q = qualifier

U = undetected

Attachment 1 Sheet No. 1 of 11  
 Originator H. M. Sulloway /ms Date 11/27/07  
 Checked M. J. Appel /ma Date 11/29/07  
 Calc. No. 0100F-CA-V0288 Rev. No. 0

## Attachment 1. 100-F-26:15 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Curium-242			Curium-243/244			Europium-152			Europium-154			Europium-155			Gross alpha		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Early Backfill	J14D62	1/30/2007	0.027	U	0.2	0.026	U	0.28	0.45	U	0.45	0.56	U	0.56	0.47	U	0.47	6.21		6.1
Early Backfill	J14D63	1/30/2007	0.07	U	0.27	0.201	U	0.41	0.3	U	0.3	0.4	U	0.4	0.29	U	0.29	2.96	U	6
1	J15720	07/24/07							0.131	U	0.131	0.114	U	0.114	0.081	U	0.081	11.7		7.3
2	J15721	07/24/07							0.451		0.099	0.159	U	0.159	0.13	U	0.13	9.66		8.93
Duplicate of J15721	J15722	07/24/07							0.449		0.084	0.116	U	0.116	0.184	U	0.184	8.82	U	13.1
3	J15723	07/24/07							0.142		0.077	0.124	U	0.124	0.095	U	0.095	8.22	U	8.92
4	J15724	07/24/07							0.076		0.073	0.098	U	0.098				16.5		6.09
5	J15725	07/24/07							0.111	U	0.111	0.126	U	0.126	0.093	U	0.093	9.75		7.26
6	J15726	07/24/07							0.185	U	0.185	0.149	U	0.149	0.12	U	0.12	8.55		8.2
7	J15727	07/24/07							0.124		0.067	0.117	U	0.117	0.085	U	0.085	15.6		8.24
8	J15728	07/24/07							0.284		0.07	0.092	U	0.092	0.089	U	0.089	17.2		7.81
Duplicate of J15728	J15729	07/24/07							0.278		0.071	0.102	U	0.102	0.08	U	0.08	8.96		8.62
9	J15730	07/24/07							0.254		0.081	0.127	U	0.127	0.105	U	0.105	-0.918	U	8.68
10	J15731	07/24/07							0.156		0.072	0.107	U	0.107	0.074	U	0.074	17.4		7.9
11	J15732	07/24/07							0.322		0.063	0.086	U	0.086	0.086	U	0.086	11.1		7.76
12	J15733	07/24/07							0.098		0.091	0.124	U	0.124	0.086	U	0.086	2.3	U	12.2
13	J15734	07/24/07							0.251	U	0.251	0.102	U	0.102	0.077	U	0.077	11.1		8.48
14	J15735	07/30/07							0.411		0.091	0.139	U	0.139	0.11	U	0.11	6.51	U	11.9
15	J15736	07/30/07							0.121	U	0.121	0.111	U	0.111	0.084	U	0.084	16.6		7.75
16	J15737	07/30/07							0.091	U	0.091	0.116	U	0.116	0.08	U	0.08	10.7		6.77
17	J15738	07/30/07							0.217		0.064	0.103	U	0.103	0.075	U	0.075	17		8.33
18	J15739	07/30/07							0.176		0.069	0.076	U	0.076	0.085	U	0.085	7.81	U	7.87
19	J15740	07/30/07							0.176	U	0.176	0.135	U	0.135	0.102	U	0.102	12.1		7.88
20	J15741	07/30/07							0.127	U	0.127	0.115	U	0.115	0.078	U	0.078	7.24	U	10.4
21	J15742	07/30/07							0.225	U	0.225	0.114	U	0.114	0.078	U	0.078	11.1		9.4
BCL 1	J15743	07/30/07							0.215		0.073	0.106	U	0.106	0.124	U	0.124	16.3		8.95
BCL 2	J15744	07/30/07							0.086		0.065	0.085	U	0.085	0.099	U	0.099	14.4		9.7
BCL 3	J15745	07/30/07							0.309		0.072	0.119	U	0.119	0.087	U	0.087	14.4		7.06
Equipment Blank	J15746	07/24/07																		

Attachment 1  
 Originator H. M. Sulloway  
 Checked M. J. Appel  
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## Attachment 1. 100-F-26:15 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Gross beta			Nickel-63			Plutonium 238			Plutonium 239/240			Potassium-40			Radium-226		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Early Backfill	J14D62	1/30/2007	19.3		5.6	-0.455	U	4.2							28.6		1.2	1.06		0.3
Early Backfill	J14D63	1/30/2007	21		6	-0.14	U	3.8							15.9		1	0.536		0.15
1	J15720	07/24/07	20.7		6.12										14.7		0.293	0.486		0.053
2	J15721	07/24/07	10.7		9.28										15.6		0.33	0.606		0.081
Duplicate of J15721	J15722	07/24/07	22.4		6.08										13.7		0.325	0.493		0.067
3	J15723	07/24/07	16.6		9.36										14.3		0.329	0.564		0.057
4	J15724	07/24/07	16.6		6.43										16		0.304	0.497		0.057
5	J15725	07/24/07	18		5.73										13.6		0.322	0.569		0.05
6	J15726	07/24/07	27.4		6.38				0.029	U	0.223	0	U	0.223	15.2		0.405	0.483		0.078
7	J15727	07/24/07	19.3		5.45										14.6		0.345	0.491		0.061
8	J15728	07/24/07	26.3		5.68										14.6		0.284	0.555		0.051
Duplicate of J15728	J15729	07/24/07	16.9		5.68										13.6		0.233	0.499		0.052
9	J15730	07/24/07	-0.422	U	5.71				0.059	U	0.328	0	U	0.227	14.4		0.384	0.411		0.071
10	J15731	07/24/07	14.2		6.37				0.083	U	0.456	0	U	0.316	14.3		0.308	0.378		0.059
11	J15732	07/24/07	21		5.4										14.6		0.289	0.614		0.051
12	J15733	07/24/07	18.7		6.05				0.076	U	0.291	0	U	0.291	14.6		0.318	0.476		0.06
13	J15734	07/24/07	16.9		5.71										14.6		0.273	0.503		0.059
14	J15735	07/30/07	22	B	6.07										14.5		0.318	0.522		0.07
15	J15736	07/30/07	29.2		9.35										14.4		0.341	0.479		0.051
16	J15737	07/30/07	21.6	B	5.67										14.2		0.345	0.487		0.068
17	J15738	07/30/07	24.4	B	6.39										15.1		0.256	0.523		0.062
18	J15739	07/30/07	16.8		6.11										14.1		0.28	0.449		0.048
19	J15740	07/30/07	23.5	B	5.68										14.9		0.363	0.508		0.064
20	J15741	07/30/07	19.8	B	5.71										14		0.262	0.413		0.05
21	J15742	07/30/07	19.4	B	5.59										13.1		0.365	0.423		0.062
BCL 1	J15743	07/30/07	18.3		8.89										15.5		0.308	0.507		0.063
BCL 2	J15744	07/30/07	20.3		8.79										14.4		0.292	0.508		0.056
BCL 3	J15745	07/30/07	19.2	B	5.7										14.4		0.337	0.482		0.062
Equipment Blank	J15746	07/24/07																		

Attachment 1  
Sheet No. 3 of 11  
Originator H. M. Sulloway Date 11/27/07  
Checked M. J. Appel Date  
Calc. No. 0100F-CA-V0288 Rev. No. 0

## Attachment 1. 100-F-26:15 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Radium-228			Silver-108 metastable			Thorium-228 GEA			Thorium-232 GEA			Total beta radiostrontium			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	
Early Backfill	J14D62	1/30/2007	1.84	0.68	0.12	U	0.120	1.47	0.250	1.84	0.68	-0.052	U	0.350	0.729	U	2.20				
Early Backfill	J14D63	1/30/2007	0.77	0.46	0.073	U	0.073	0.962	0.170	0.77	0.46	-0.041	U	0.340	0.554	U	2.40				
1	J15720	07/24/07	0.798	0.113	0.023	U	0.023	0.876	0.056	0.798	0.113										
2	J15721	07/24/07	0.782	0.202	0.034	U	0.034	0.776	0.052	0.782	0.202	0.045	U	0.216							
Duplicate of J15721	J15722	07/24/07	0.754	0.150	0.026	U	0.026	0.739	0.042	0.754	0.150										
3	J15723	07/24/07	0.882	0.141	0.026	U	0.026	0.997	0.065	0.882	0.141										
4	J15724	07/24/07	0.698	0.127	0.021	U	0.021	0.628	0.040	0.698	0.127										
5	J15725	07/24/07	0.964	0.161	0.025	U	0.025	0.914	0.064	0.964	0.161										
6	J15726	07/24/07	0.744	0.192	0.03	U	0.030	0.752	0.085	0.744	0.192	0.020	U	0.223							
7	J15727	07/24/07	0.845	0.153	0.027	U	0.027	0.802	0.043	0.845	0.153										
8	J15728	07/24/07	0.863	0.111	0.02	U	0.020	0.762	0.039	0.863	0.111										
Duplicate of J15728	J15729	07/24/07	0.736	0.116	0.022	U	0.022	0.865	0.055	0.736	0.116										
9	J15730	07/24/07	0.71	0.172	0.027	U	0.027	0.699	0.069	0.710	0.172	0.105	U	0.243							
10	J15731	07/24/07	0.65	0.135	0.023	U	0.023	0.658	0.039	0.65	0.135	-0.093	U	0.306							
11	J15732	07/24/07	0.973	0.112	0.019	U	0.019	0.818	0.038	0.973	0.112										
12	J15733	07/24/07	0.74	0.167	0.028	U	0.028	0.677	0.043	0.74	0.167	-0.035	U	0.227							
13	J15734	07/24/07	0.772	0.110	0.02	U	0.020	0.792	0.037	0.772	0.110										
14	J15735	07/30/07	0.66	0.192	0.029	U	0.029	0.679	0.052	0.66	0.192										
15	J15736	07/30/07	0.694	0.121	0.023	U	0.023	0.920	0.059	0.694	0.121										
16	J15737	07/30/07	0.717	0.140	0.025	U	0.025	0.675	0.042	0.717	0.140										
17	J15738	07/30/07	0.907	0.114	0.022	U	0.022	0.798	0.035	0.907	0.114										
18	J15739	07/30/07	0.652	0.098	0.017	U	0.017	0.584	0.032	0.652	0.098										
19	J15740	07/30/07	0.736	0.152	0.024	U	0.024	0.866	0.074	0.736	0.152										
20	J15741	07/30/07	0.648	0.112	0.021	U	0.021	0.735	0.059	0.648	0.112										
21	J15742	07/30/07	0.625	0.150	0.024	U	0.024	0.693	0.044	0.625	0.150										
BCL 1	J15743	07/30/07	0.678	0.135	0.021	U	0.021	0.724	0.042	0.678	0.135										
BCL 2	J15744	07/30/07	0.857	0.118	0.02	U	0.020	0.747	0.038	0.857	0.118										
BCL 3	J15745	07/30/07	0.597	0.130	0.025	U	0.025	0.894	0.065	0.597	0.130										
Equipment Blank	J15746	07/24/07																			

Attachment 1  
 Originator H. M. Sulloway  
 Checked M. J. Appel  
 Calc. No. 0100F-CA-V0288  
 Sheet No. 4 of 11  
 Date 11/27/07  
 Rev. No. 0

## Attachment 1. 100-F-26:15 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Uranium-235 GEA			Uranium-238 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA
Early Backfill	J14D62	1/30/2007	0.660	U	0.660	21	U	21
Early Backfill	J14D63	1/30/2007	0.450	U	0.450	14	U	14
1	J15720	07/24/07	0.131	U	0.131			
2	J15721	07/24/07	0.19	U	0.19			
Duplicate of J15721	J15722	07/24/07	0.136	U	0.136			
3	J15723	07/24/07	0.147	U	0.147			
4	J15724	07/24/07	0.141	U	0.141			
5	J15725	07/24/07	0.208	U	0.208			
6	J15726	07/24/07	0.173	U	0.173			
7	J15727	07/24/07	0.144	U	0.144			
8	J15728	07/24/07	0.134	U	0.134			
Duplicate of J15728	J15729	07/24/07	0.123	U	0.123			
9	J15730	07/24/07	0.153	U	0.153			
10	J15731	07/24/07	0.12	U	0.12			
11	J15732	07/24/07	0.128	U	0.128			
12	J15733	07/24/07	0.144	U	0.144			
13	J15734	07/24/07	0.126	U	0.126			
14	J15735	07/30/07	0.163	U	0.163			
15	J15736	07/30/07	0.134	U	0.134			
16	J15737	07/30/07	0.13	U	0.13			
17	J15738	07/30/07	0.124	U	0.124			
18	J15739	07/30/07	0.114	U	0.114			
19	J15740	07/30/07	0.154	U	0.154			
20	J15741	07/30/07	0.124	U	0.124			
21	J15742	07/30/07	0.128	U	0.128			
BCL 1	J15743	07/30/07	0.13	U	0.13			
BCL 2	J15744	07/30/07	0.136	U	0.136			
BCL 3	J15745	07/30/07	0.139	U	0.139			
Equipment Blank	J15746	07/24/07						

Attachment 1 Sheet No. 5 of 11  
 Originator H. M. Sulloway Date 11/27/07  
 Checked M. J. Appel Date  
 Calc. No. 0100F-CA-V0288 Rev. No. 0

## Attachment 1. 100-F-26:15 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Early Backfill	J14D62	1/30/2007	4190		6.2	0.73	U	0.73	2.2		0.90	39.2		0.03	0.14		0.03	1.1	0.55	
Early Backfill	J14D63	1/30/2007	4720		6.3	0.74	U	0.74	2.1		0.92	40.1		0.03	0.17		0.03	1.4	0.56	
1	J15720	07/24/07	5930		4.8	0.64	U	0.64	2.9	U	2.9	51.9	C	0.06	0.13		0.03	1.9	1.0	
2	J15721	07/24/07	5020		4.9	0.65	U	0.65	1.9		1.2	50.9	C	0.06	0.08		0.03	3.7	1.1	
Duplicate of J15721	J15722	07/24/07	5440		4.8	0.63	U	0.63	2.3		1.2	62.5	C	0.06	0.14		0.03	2.5	1.0	
3	J15723	07/24/07	5090		5.0	0.66	U	0.66	1.3		1.2	64.7	C	0.06	0.22		0.03	2.9	1.1	
4	J15724	07/24/07	3760		4.9	0.65	U	0.65	1.6		1.2	56.0	C	0.06	0.19		0.03	4.4	1.1	
5	J15725	07/24/07	5320		4.8	0.63	U	0.63	1.8		1.2	206	C	0.06	0.27		0.03	12.9	1.0	
6	J15726	07/24/07	5530		4.7	0.63	U	0.63	1.5		1.2	52.2	C	0.06	0.21		0.03	2.6	1.0	
7	J15727	07/24/07	6010		5.0	0.66	U	0.66	2.2		1.2	60.4	C	0.06	0.26		0.03	2.7	1.1	
8	J15728	07/24/07	6380		4.8	0.63	U	0.63	2.4		1.2	63.7	C	0.06	0.26		0.03	2.6	1.0	
Duplicate of J15728	J15729	07/24/07	5900		4.9	0.65	U	0.65	2.6		1.2	56.5	C	0.06	0.25		0.03	2.4	1.1	
9	J15730	07/24/07	4100		4.8	0.63	U	0.63	1.5		1.2	50.4	C	0.06	0.22		0.03	1.7	1.0	
10	J15731	07/24/07	4630		4.9	0.65	U	0.65	1.9		1.2	49.2	C	0.06	0.22		0.03	2.3	1.1	
11	J15732	07/24/07	6720		4.7	0.63	U	0.63	2.4		1.2	86.1	C	0.06	0.34		0.03	2.5	1.0	
12	J15733	07/24/07	5320		4.7	0.63	U	0.63	2.1		1.2	49.3	C	0.06	0.22		0.03	1.8	1.0	
13	J15734	07/24/07	6870		4.9	0.65	U	0.65	2.4		1.2	63.8	C	0.06	0.31		0.03	2.9	1.0	
14	J15735	07/30/07	4920	C	4.7	0.63	U	0.63	3.1		1.2	58.2	C	0.06	0.19		0.03	1.9	1.0	
15	J15736	07/30/07	4860	C	4.7	0.63	U	0.63	2.6		1.2	72.2	C	0.06	0.23		0.03	3.7	1.0	
16	J15737	07/30/07	4410	C	4.9	0.65	U	0.65	2.1		1.2	46.5	C	0.06	0.21		0.03	1.1	U	
17	J15738	07/30/07	5410	C	4.7	0.63	U	0.63	2.6		1.2	63.6	C	0.06	0.26		0.03	5.2	1.0	
18	J15739	07/30/07	3070	C	4.9	0.65	U	0.65	1.4		1.2	39.8	C	0.06	0.19		0.03	1.1	U	
19	J15740	07/30/07	4500	C	4.8	0.85		0.63	2.3		1.2	70.8	C	0.06	0.25		0.03	1.0	U	
20	J15741	07/30/07	3910	C	4.9	0.65	U	0.65	2.6		1.2	47.3	C	0.06	0.23		0.03	1.1	U	
21	J15742	07/30/07	5330	C	4.8	0.64	U	0.64	2.3		1.2	63.2	C	0.06	0.27		0.03	1.0	U	
BCL 1	J15743	07/30/07	3800	C	4.8	0.64	U	0.64	1.2		1.2	45.3	C	0.06	0.22		0.03	1.0	U	
BCL 2	J15744	07/30/07	5770	C	4.9	0.65	U	0.65	2.3	B	1.2	66.9	C	0.06	0.29	B	0.03	1.9	B	
BCL 3	J15745	07/30/07	3650	C	4.8	0.64	U	0.64	2.5		1.2	53.2	C	0.06	0.24		0.03	1.0	U	
Equipment Blank	J15746	07/24/07	48.0		1.6	0.21	U	0.21	0.39	U	0.39	1.1	C	0.03	0.02		0.01	0.34	U	

Attachment 1 Sheet No. 6 of 11  
 Originator H. M. Sulloway Date 11/27/07  
 Checked M. J. Appel Date \_\_\_\_\_  
 Calc. No. 0100F-CA-V0288 Rev. No. 0

## Attachment 1. 100-F-26:15 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper			Hexavalent Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Early Backfill	J14D62	1/30/2007	0.12		0.09	3670	C	3.6	6.9		0.35	4.8	0.15	12.3		0.20	0.21	U	0.21	
Early Backfill	J14D63	1/30/2007	0.10		0.09	4230	C	3.7	8.2		0.36	5.1	0.15	13.7		0.21	0.21	U	0.21	
1	J15720	07/24/07	0.15	U	0.15	4850	C	2.1	9.1	C	0.29	5.5	0.23	13.4	C	0.26	0.27		0.20	
2	J15721	07/24/07	0.15	U	0.15	3450	C	2.1	7.4	C	0.29	5.0	0.24	10.8	C	0.26	0.25		0.20	
Duplicate of J15721	J15722	07/24/07	0.14	U	0.14	3970	C	2.0	8.0	C	0.29	5.8	0.23	12.2	C	0.26	0.26		0.20	
3	J15723	07/24/07	0.15	U	0.15	3440	C	2.1	7.1	C	0.30	5.6	0.24	12.5	C	0.27	0.20	U	0.20	
4	J15724	07/24/07	0.15	U	0.15	5550	C	2.1	5.3	C	0.30	4.6	0.24	12.0	C	0.27	0.32		0.20	
5	J15725	07/24/07	0.14	U	0.14	6820	C	2.0	6.5	C	0.29	4.7	0.23	14.6	C	0.26	0.35		0.20	
6	J15726	07/24/07	0.14	U	0.14	4650	C	2.0	8.6	C	0.29	5.5	0.23	11.6	C	0.26	0.31		0.20	
7	J15727	07/24/07	0.15	U	0.15	4100	C	2.1	8.5	C	0.30	6.2	0.24	13.1	C	0.27	0.26		0.20	
8	J15728	07/24/07	0.14	U	0.14	4010	C	2.0	11.0	C	0.29	6.4	0.23	12.9	C	0.26	0.20	U	0.20	
Duplicate of J15728	J15729	07/24/07	0.15	U	0.25	3670	C	2.1	10.7	C	0.30	5.9	0.24	12.3	C	0.27	0.20	U	0.20	
9	J15730	07/24/07	0.14	U	0.14	4440	C	2.0	7.2	C	0.29	4.6	0.23	11.3	C	0.26	0.20	U	0.20	
10	J15731	07/24/07	0.15	U	0.15	4380	C	2.1	7.9	C	0.30	5.0	0.24	13.6	C	0.27	0.22		0.20	
11	J15732	07/24/07	0.14	U	0.14	3370	C	2.0	8.9	C	0.29	7.2	0.23	11.5	C	0.26	0.27		0.20	
12	J15733	07/24/07	0.14	U	0.14	4700	C	2.0	8.9	C	0.29	5.7	0.23	11.2	C	0.26	0.31		0.20	
13	J15734	07/24/07	0.15	U	0.15	5000	C	2.1	11.4	C	0.29	7.1	0.24	12.7	C	0.26	0.24		0.20	
14	J15735	07/30/07	0.14	U	0.14	4340	C	2.0	9.5	C	0.29	5.9	0.23	12.3	C	0.26	0.20	U	0.20	
15	J15736	07/30/07	0.14	U	0.14	5230	C	2.0	7.2	C	0.29	5.6	0.23	12.7	C	0.26	0.20	U	0.20	
16	J15737	07/30/07	0.15	U	0.15	5640	C	2.1	7.5	C	0.30	5.0	0.24	12.2	C	0.27	0.20	U	0.20	
17	J15738	07/30/07	0.17		0.14	4230	C	2.0	8.2	C	0.29	6.1	0.23	12.6	C	0.26	0.20	U	0.20	
18	J15739	07/30/07	0.15	U	0.15	3810	C	2.1	5.5	C	0.30	4.3	0.24	9.8	C	0.27	0.20	U	0.20	
19	J15740	07/30/07	0.14	U	0.14	3960	C	2.0	7.0	C	0.29	5.5	0.23	11.7	C	0.26	0.21		0.20	
20	J15741	07/30/07	0.15	U	0.15	4100	C	2.1	6.4	C	0.29	4.7	0.24	12.6	C	0.26	0.21		0.20	
21	J15742	07/30/07	0.15	U	0.04	4290	C	2.1	8.2	C	0.29	5.7	0.23	12.7	C	0.26	0.23		0.20	
BCL 1	J15743	07/30/07	0.15	U	0.15	3610	C	2.1	5.6	C	0.29	4.8	0.23	11.1	C	0.26	0.20	U	0.20	
BCL 2	J15744	07/30/07	0.15	U	0.15	5240	C	2.1	9.5	C	0.30	5.9	B	0.24	14.3	C	0.27	0.20	U	0.20
BCL 3	J15745	07/30/07	0.15	U	0.15	3600	C	2.1	5.2	C	0.29	4.7	0.23	10.8	C	0.26	0.20	U	0.20	
Equipment Blank	J15746	07/24/07	0.05	U	0.05	25.8	C	0.68	0.1	U	0.10	0.08	U	0.08	0.31	C	0.09			

Attachment 1  
 Originator: H. M. Sulloway  
 Checked: M. J. Appel  
 Calc. No.: 0100F-CA-V0288  
 Sheet No. 1 of 11  
 Date 11/27/07  
 Rev. No. 0

## Attachment 1. 100-F-26:15 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Iron			Lead			Magnesium			Manganese			Mercury			Molybdenum		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Early Backfill	J14D62	1/30/2007	11900	C	1.8	3.1		0.47	3010		1.3	235		0.12	0.02	U	0.03	0.47	U	0.47
Early Backfill	J14D63	1/30/2007	13200	C	1.8	3.2		0.47	3360		1.4	231		0.12	0.02	U	0.02	0.47	U	0.47
1	J15720	07/24/07	15600		7.0	3.5		0.96	3790	C	2.4	266		0.20	0.02	U	0.02	0.47	U	0.47
2	J15721	07/24/07	13100		7.0	3.7		0.97	3060	C	2.4	230		0.21	0.02	U	0.02	0.71		0.47
Duplicate of J15721	J15722	07/24/07	13500		6.9	4.1		0.95	3390	C	2.3	276		0.20	0.01	U	0.01	0.51		0.46
3	J15723	07/24/07	13000		7.2	3.8		0.99	3270	C	2.4	279		0.21	0.01	U	0.01	0.71		0.48
4	J15724	07/24/07	10800		7.2	3.4		0.98	2730	C	2.5	211		0.21	0.04		0.01	0.79		0.48
5	J15725	07/24/07	13100		6.8	4.5		0.94	3130	C	2.3	219		0.20	0.13		0.02	0.73		0.46
6	J15726	07/24/07	15000		6.8	3.7		0.94	3670	C	2.3	254		0.20	0.01	U	0.01	0.54		0.46
7	J15727	07/24/07	15700		7.2	4.0		0.99	3650	C	2.4	296		0.21	0.02	U	0.02	0.56		0.48
8	J15728	07/24/07	17300		6.9	3.9		0.95	3870	C	2.3	296		0.20	0.02	U	0.02	0.65		0.46
Duplicate of J15728	J15729	07/24/07	15900		7.1	3.7		0.98	3660	C	2.4	270		0.21	0.01	U	0.01	0.68		0.48
9	J15730	07/24/07	10900		9.6	3.4		0.95	3040	C	2.3	248		0.20	0.02	U	0.2	0.66		0.46
10	J15731	07/24/07	13200		7.1	2.9		0.98	3290	C	2.4	243		0.21	0.02	U	0.02	0.57		0.48
11	J15732	07/24/07	17200		6.8	4.4		0.94	3750	C	2.3	355		0.20	0.02	U	0.02	0.75		0.46
12	J15733	07/24/07	15300		6.8	3.4		0.94	3600	C	2.3	262		0.20	0.01	U	0.01	0.81		0.46
13	J15734	07/24/07	18700		7.0	4.4		0.97	4130	C	2.4	317		0.21	0.01	U	0.01	0.61		0.47
14	J15735	07/30/07	14400	C	6.8	4.6		0.94	3430	C	2.3	268		0.20	0.01	U	0.01	0.46	U	0.46
15	J15736	07/30/07	13000	C	6.8	4.8		0.94	3420	C	2.3	279		0.20	0.01	U	0.01	0.46	U	0.46
16	J15737	07/30/07	11800	C	7.1	3.5		0.98	3180	C	2.4	234		0.21	0.01	U	0.01	0.48	U	0.48
17	J15738	07/30/07	14900	C	6.8	4.4		0.94	3600	C	2.3	292		0.20	0.01	U	0.01	0.46	U	0.46
18	J15739	07/30/07	8960	C	7.1	3.5		0.98	2330	C	2.4	195		0.21	0.01	U	0.01	0.48	U	0.48
19	J15740	07/30/07	12000	C	6.9	4.2		0.95	3030	C	2.3	301		0.20	0.02	U	0.02	0.46	U	0.46
20	J15741	07/30/07	10400	C	7.0	4.1		0.97	2820	C	2.4	226		0.21	0.01	U	0.01	0.47	U	0.47
21	J15742	07/30/07	13900	C	7.0	4.2		0.96	3570	C	2.4	275		0.20	0.01	U	0.01	0.47	U	0.47
BCL 1	J15743	07/30/07	11300	C	7.0	3.7		0.96	2790	C	2.4	225		0.20	0.01	U	0.01	0.47	U	0.47
BCL 2	J15744	07/30/07	15600	C	7.1	5.0		0.98	3630	C	2.4	277		0.21	0.01	U	0.01	0.48	U	0.48
BCL 3	J15745	07/30/07	9960	C	7.0	4.2		0.96	2530	C	2.4	234		0.20	0.02	U	0.02	0.47	U	0.47
QC Equipment Blank	J15746	07/24/07	91.5		2.3	0.36		0.31	7.5	C	0.77	3		0.07	0.01	U	0.01	0.24		0.15

Attachment 1  
 Originator H. M. Sulloway Date 11/27/07  
 Checked M. J. Appel Date \_\_\_\_\_  
 Calc. No. 0100F-CA-V0288 Rev. No. 0

Sheet No. 8 of 11

## Attachment 1. 100-F-26:15 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Nickel			Potassium			Selenium			Silicon			Silver			Sodium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Early Backfill	J14D62	1/30/2007	8.2		0.64	698		6.2	1.3	U	1.3	414		3.2	0.15	U	0.15	99.5	C	0.82
Early Backfill	J14D63	1/30/2007	9.4		0.65	710		6.3	1.3	U	1.3	446		3.3	0.15	U	0.15	114	C	0.74
1	J15720	07/24/07	9.8		0.79	975		9.3	1.3	U	1.3	721	C	2.5	0.26	U	0.26	140	C	2.0
2	J15721	07/24/07	8.1		0.79	894		9.4	1.3	U	1.2	1670	C	2.5	0.26	U	0.26	137	C	2.1
Duplicate of J15721	J15722	07/24/07	8.9		0.78	1110		9.2	1.2	U	1.2	1830	C	2.5	0.26	U	0.26	124	C	2.0
3	J15723	07/24/07	8.9		0.81	1060		9.6	1.3	U	1.3	1300	C	2.6	0.27	U	0.27	119	C	2.1
4	J15724	07/24/07	7.6		0.80	657		9.5	1.3	U	1.2	1180	C	2.6	0.27	U	0.27	146	C	2.1
5	J15725	07/24/07	7.9		0.77	758		9.1	1.2	U	1.2	1120	C	2.5	0.26	U	0.26	216	C	2.0
6	J15726	07/24/07	10.0		0.88	884		9.1	1.2	U	1.2	912	C	2.5	0.26	U	0.26	137	C	2.0
7	J15727	07/24/07	9.4		0.81	1060		9.6	1.3	U	1.3	1790	C	2.6	0.27	U	0.27	148	C	2.1
8	J15728	07/24/07	10.5		0.78	1070		9.2	1.2	U	1.2	649	C	2.5	0.26	U	0.26	151	C	2.0
Duplicate of J15728	J15729	07/24/07	9.9		0.80	964		9.5	1.3	U	1.3	651	C	2.6	0.27	U	0.27	149	C	2.1
9	J15730	07/24/07	8.8		0.78	670		9.2	1.2	U	1.2	1340	C	2.5	0.26	U	0.26	105	C	2.0
10	J15731	07/24/07	8.8		0.80	698		9.5	1.3	U	1.2	1380	C	2.6	0.27	U	0.27	114	C	2.1
11	J15732	07/24/07	10.2		0.77	1570		9.1	1.2	U	1.2	1360	C	2.5	0.26	U	0.26	134	C	2.0
12	J15733	07/24/07	9.1		0.77	820		9.1	1.2	U	1.2	937	C	2.5	0.26	U	0.26	124	C	2.0
13	J15734	07/24/07	11.7		0.79	1210		6.4	1.3	U	1.3	762	C	2.5	0.26	U	0.26	164	C	2.1
14	J15735	07/30/07	9.5		0.77	992	C	9.1	1.2	U	1.2	1760	C	2.5	0.26	U	0.26	118	C	2.0
15	J15736	07/30/07	9.6		0.77	926	C	9.1	1.2	U	1.2	1620	C	2.5	0.26	U	0.26	131	C	2.0
16	J15737	07/30/07	8.8		0.80	801	C	9.5	1.3	U	1.2	1750	C	2.6	0.27	U	0.27	110	C	2.1
17	J15738	07/30/07	10.0		0.77	1140	C	9.1	1.2	U	1.2	1770	C	2.5	0.26	U	0.26	116	C	2.0
18	J15739	07/30/07	6.8		0.80	589	C	9.5	1.3	U	1.3	1480	C	2.6	0.27	U	0.27	91.1	C	2.1
19	J15740	07/30/07	8.4		0.78	1060	C	9.2	1.2	U	1.2	1570	C	2.5	0.26	U	0.26	98.3	C	2.0
20	J15741	07/30/07	8.2		0.79	798	C	9.4	1.3	U	1.3	1840	C	2.5	0.26	U	0.26	101	C	2.1
21	J15742	07/30/07	9.7		0.79	1130	C	9.3	1.3	U	1.3	1580	C	2.5	0.26	U	0.26	118	C	2.0
BCL 1	J15743	07/30/07	7.6		0.79	687	C	9.5	1.3	U	1.3	1690	C	2.5	0.26	U	0.26	94.3	C	2.0
BCL 2	J15744	07/30/07	9.7	B	0.80	1050	B C	9.5	1.3	U	1.3	1320	C	2.6	0.27	U	0.27	193	C	0.2
BCL 3	J15745	07/30/07	6.7		0.79	867	C	9.3	1.3	U	1.3	1650	C	2.5	0.26	U	0.26	83.8	C	2.0
QC Equipment Blank	J15746	07/24/07	0.26	U	0.26	23.9		3.0	0.41	U	0.41	67.1	C	0.82	0.09	U	0.09	11.9	C	0.67

Attachment	1	Sheet No.	9 of 11
Originator	H. M. Sulloway	Date	11/27/07
Checked	M. J. Appel	Date	
Calc. No.	0100F-CA-V0288	Rev. No.	0

## Attachment 1. 100-F-26:15 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL
Early Backfill	J14D62	1/30/2007	28.5		0.17	26.6		0.64
Early Backfill	J14D63	1/30/2007	31.3		0.18	28.3		0.65
1	J15720	07/24/07	37.7		0.23	33.0	C	0.12
2	J15721	07/24/07	33.8		0.24	32.3	C	0.12
Duplicate of J15721	J15722	07/24/07	30.4		0.23	33.7	C	0.12
3	J15723	07/24/07	29.4		0.24	31.3	C	0.12
4	J15724	07/24/07	24.8		0.24	28.7	C	0.12
5	J15725	07/24/07	33.8		0.23	29.5	C	0.11
6	J15726	07/24/07	36.6		0.23	31.6	C	0.11
7	J15727	07/24/07	35.8		0.24	34.8	C	0.12
8	J15728	07/24/07	41.6		0.12	37.3	C	0.12
Duplicate of J15728	J15729	07/24/07	37.4		0.24	34.9	C	0.12
9	J15730	07/24/07	26.0		0.23	27.7	C	0.12
10	J15731	07/24/07	33.1		0.24	32.8	C	0.12
11	J15732	07/24/07	36.1		0.23	37.6	C	0.11
12	J15733	07/24/07	36.2		0.23	33.2	C	0.11
13	J15734	07/24/07	43.1		0.24	39.4	C	0.12
14	J15735	07/30/07	32.0		0.23	31.9	C	0.11
15	J15736	07/30/07	30.6		0.23	31.8	C	0.11
16	J15737	07/30/07	27.2		0.24	27.0	C	0.12
17	J15738	07/30/07	33.0		0.23	32.8	C	0.11
18	J15739	07/30/07	19.6		0.24	22.7	C	0.12
19	J15740	07/30/07	27.8		0.23	34.6	C	0.12
20	J15741	07/30/07	23.5		0.23	25.4	C	0.12
21	J15742	07/30/07	32.4		0.23	32.2	C	0.12
BCL 1	J15743	07/30/07	27.2		0.23	27.9	C	0.12
BCL 2	J15744	07/30/07	36.7		0.24	34.8	C	0.12
BCL 3	J15745	07/30/07	22.2		0.23	26.0	C	0.12
QC Equipment Blank	J15746	07/24/07	0.08	U	0.08	2.6	C	0.04

Attachment 1 Sheet No. 10 of 11  
 Originator H. M. Sulloway Date 11/27/07  
 Checked M. J. Appel Date  
 Calc. No. 100F-CA-V0288 Rev. No. 0

## Attachment 1. 100-F-26:15 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Aroclor-1016			Aroclor-1221			Aroclor-1232			Aroclor-1242			Aroclor-1248			Aroclor-1254		
			mg/kg	Q	PQL															
Early Backfill	J14D62	1/30/2007	14	U	14															
Early Backfill	J14D63	1/30/2007	14	U	14															

Sample Location	Sample Number	Sample Date	Aroclor-1260		
			mg/kg	Q	PQL
Early Backfill	J14D62	1/30/2007	14	U	14
Early Backfill	J14D63	1/30/2007	14	U	14

Attachment 1 Sheet No. 11 of 11  
 Originator H. M. Sulloway Date 11/27/07  
 Checked M. J. Appel Date  
 Calc. No. 0100F-CA-V0288 Rev. No. 0

## **APPENDIX B**

### **HAZARD QUOTIENT AND CARCINOGENIC RISK CALCULATIONS**

**APPENDIX B**  
**HAZARD QUOTIENT AND**  
**CARCINOGENIC RISK 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:

*100-F-26:15 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation*, 0100F-CA-V0328, Rev. 0, Washington Closure Hanford, Richland, Washington.

**DISCLAIMER FOR CALCULATIONS**

The calculation provided in this appendix has been generated to document compliance with established cleanup levels. This calculation should be used in conjunction with other relevant documents in the administrative record.

## CALCULATION COVER SHEET

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

Area: 100-F

Discipline: Environmental \*Calculation No: 0100F-CA-V0328

Subject: 100-F-26:15 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation  Preliminary  Superseded  Voided

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 3 Total = 4	H. M. Sulloway <i>H. M. Sulloway</i>	M. J. Appel <i>M. J. Appel</i>	NA	S. W. Callison <i>SW Call</i>	12-5-07

### SUMMARY OF REVISION


Washington Closure Hanford, Inc.		CALCULATION SHEET					
Originator:	H. M. Sulloway <i>HMS</i>	Date:	11/27/07	Calc. No.:	0100F-CA-V0328	Rev.:	0
Project:	100-F Area Field Remediation	Job No.:	14655	Checked:	M. J. Appel <i>MJA</i>	Date:	11/28/07
Subject:	100-F-26:15 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	1 of 3

1      **PURPOSE:**

2  
3      Provide documentation to support the calculation of the hazard quotient (HQ) and carcinogenic (excess  
4      cancer) risk for the 100-F-26:15 waste site. In accordance with the remedial action goals (RAGs) in the  
5      remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2005), the following criteria  
6      must be met:

7  
8      1) An HQ of <1.0 for all individual noncarcinogens  
9      2) A cumulative HQ of <1.0 for noncarcinogens  
10     3) An excess cancer risk of <1 x 10<sup>-6</sup> for individual carcinogens  
11     4) A cumulative excess cancer risk of <1 x 10<sup>-5</sup> for carcinogens.

12  
13     **GIVEN/REFERENCES:**

14  
15     1) DOE-RL, 2005, *Remedial Design Report/Remedial Action Work Plan for the 100 Areas*,  
16        DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland,  
17        Washington.  
18  
19     2) WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, 1996.  
20  
21     3) WCH, 2007, *Remaining Sites Verification Package for the Miscellaneous Pipelines Associated with*  
22        *the 1608-F Sump (100-F-26:15)*, Attachment to Waste Site Reclassification Form 2007-031,  
23        Washington Closure Hanford, Inc., Richland, Washington.  
24  
25  
26

27     **SOLUTION:**

28  
29     1) Generate an HQ for each noncarcinogenic constituent detected above background or required  
30        detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL  
31        2005).  
32  
33     2) Sum the HQs and compare this value to the cumulative HQ of <1.0.  
34  
35     3) Generate an excess cancer risk value for each carcinogenic constituent detected above background or  
36        required detection limit/practical quantitation limit and compare it to the excess cancer risk of  
37        <1 x 10<sup>-6</sup> (DOE-RL 2005).  
38  
39     4) Sum the excess cancer risk value(s) and compare it to the cumulative cancer risk of <1 x 10<sup>-5</sup>.

Washington Closure Hanford, Inc.,		CALCULATION SHEET					
Originator:	H. M. Sulloway <i>HMS</i>	Date:	11/27/07	Calc. No.:	0100F-CA-V0328	Rev.:	0
Project:	100-F Area Field Remediation	Job No.:	14655	Checked:	M. J. Appel <i>MJA</i>	Date:	11/27/07
Subject:	100-F-26:15 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	2 of 3

1   **METHODOLOGY:**

2

3   The 100-F-26:15 waste site was divided into three areas for the purpose of verification sampling. The  
4   first area consisted of the excavation footprint of the 100-F-28:15 pipelines, the second area consisted of  
5   the Early Backfill excavation footprint, and the third area consisted of the BCL stockpiles. The Early  
6   Backfill footprint consists of an irregular shaped area approximately 8 by 9 m (26 by 30 ft) area at the  
7   southeast corner of the 105-F reactor that required immediate backfill to prevent damage to the building  
8   foundation due to undermining.

9

10   Hazard quotient and carcinogenic risk calculations for the 100-F-26:15 waste site were conservatively  
11   calculated using the highest of the focused and statistically calculated results from these four areas for  
12   each analyte (WCH 2007). Boron, molybdenum, and hexavalent chromium require HQ and risk  
13   calculations because these analytes were detected and a Washington State or Hanford Site background  
14   value is not available. All other site nonradionuclide COCs were not detected or were quantified below  
15   background levels. An example of the HQ and risk calculations is presented below:

16

- 17   1) For example, the maximum value for boron is 3.7 mg/kg, divided by the noncarcinogenic RAG  
18   value of 16,000 mg/kg (boron is identified as a noncarcinogen in WAC 173-340-740[3]), is  
19    $2.3 \times 10^{-4}$ . Comparing this value, and all other individual values, to the requirement of <1.0, this  
20   criteria is met.
- 21   2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be  
22   obtained by summing the individual values. The sum of the HQ values is  $2.6 \times 10^{-3}$ . Comparing this  
23   value to the requirement of <1.0, this criteria is met.
- 24   3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value,  
25   then multiplied by  $1 \times 10^{-6}$ . For example, the maximum value for hexavalent chromium is  
26   0.24 mg/kg, divided by 2.1 mg/kg, and multiplied as indicated, is  $1.1 \times 10^{-7}$ . Comparing this value  
27   and all other individual values to the requirement of  $<1 \times 10^{-6}$ , this criteria is met.
- 28   4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer  
29   risk can be obtained by summing the individual values. The sum of the excess cancer risk values is  
30    $1.1 \times 10^{-7}$ . Comparing this value to the requirement of  $<1 \times 10^{-5}$ , this criterion is met.

31

32

33   **RESULTS:**

34

35

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

40

41

42   43   Table 1 shows the results of the calculations.

Washington Closure Hanford, Inc.		CALCULATION SHEET				
Originator:	H. M. Sulloway <i>HMS</i>	Date:	11/27/07	Calc. No.:	0100F-CA-V0328	Rev.:
Project:	100-F Area Field Remediation	Job No.:	14655	Checked:	M. J. Appel <i>MA</i>	Date: <i>11/25/07</i>
Subject:	100-F-26:15 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation				Sheet No.	3 of 3

1      **Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-F-26:15 Waste Site.**  
2

Contaminants of Concern <sup>a</sup>	Maximum Value <sup>a</sup> (mg/kg)	Noncarcinogen RAG <sup>b</sup> (mg/kg)	Hazard Quotient	Carcinogen RAG <sup>b</sup> (mg/kg)	Carcinogen Risk
<b>Metals</b>					
Boron	3.7	16,000	2.3E-04	--	--
Chromium, hexavalent <sup>c</sup>	0.24	240	1.0E-03	2.1	1.1E-07
Molybdenum	0.56	400	1.4E-03	--	--
<b>Totals</b>					
<b>Cumulative Hazard Quotient:</b>			<b>2.6E-03</b>		
<b>Cumulative Excess Cancer Risk:</b>					<b>1.1E-07</b>

12      Notes:

13      <sup>a</sup> = From WCH (2007).14      <sup>b</sup> = Value obtained from the RDR/RAWP (DOE-RL 2005) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.15      <sup>c</sup> = Value for the carcinogen RAG calculated based on the inhalation exposure pathway WAC 173-340-750(3), 1996.  
16      -- = not applicable  
17      RAG = remedial action goal20      **CONCLUSION:**

21      This calculation demonstrates that the 100-F-26:15 waste site meets the requirements for the hazard quotients and carcinogenic (excess cancer) risk as identified in the RDR/RAWP (DOE-RL 2005).