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

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)	Stacy Charboneau Signature	1/29/08 Date
N/A Ecology Project Manager (printed)	Signature	Date
R. A. Lobos EPA Project Manager (printed)	Signature	3/18/08 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^3 (107 yd^3) 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 x 10^{-3}) is less than 1.	
	Attain an excess cancer risk of <1 x 10^{-6} for individual carcinogens.	The excess cancer risk for carcinogens is less than 1 x 10^{-6}.	
	Attain a cumulative excess cancer risk of <1 x 10^{-5} for carcinogens.	The total excess cancer risk (1.1 x 10^{-7}) is less than 1 x 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:[a] 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.[b]		
	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

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).
[b] *Radiation Protection of the Public and the Environment* (DOE Order 5400.5).
[c] *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.

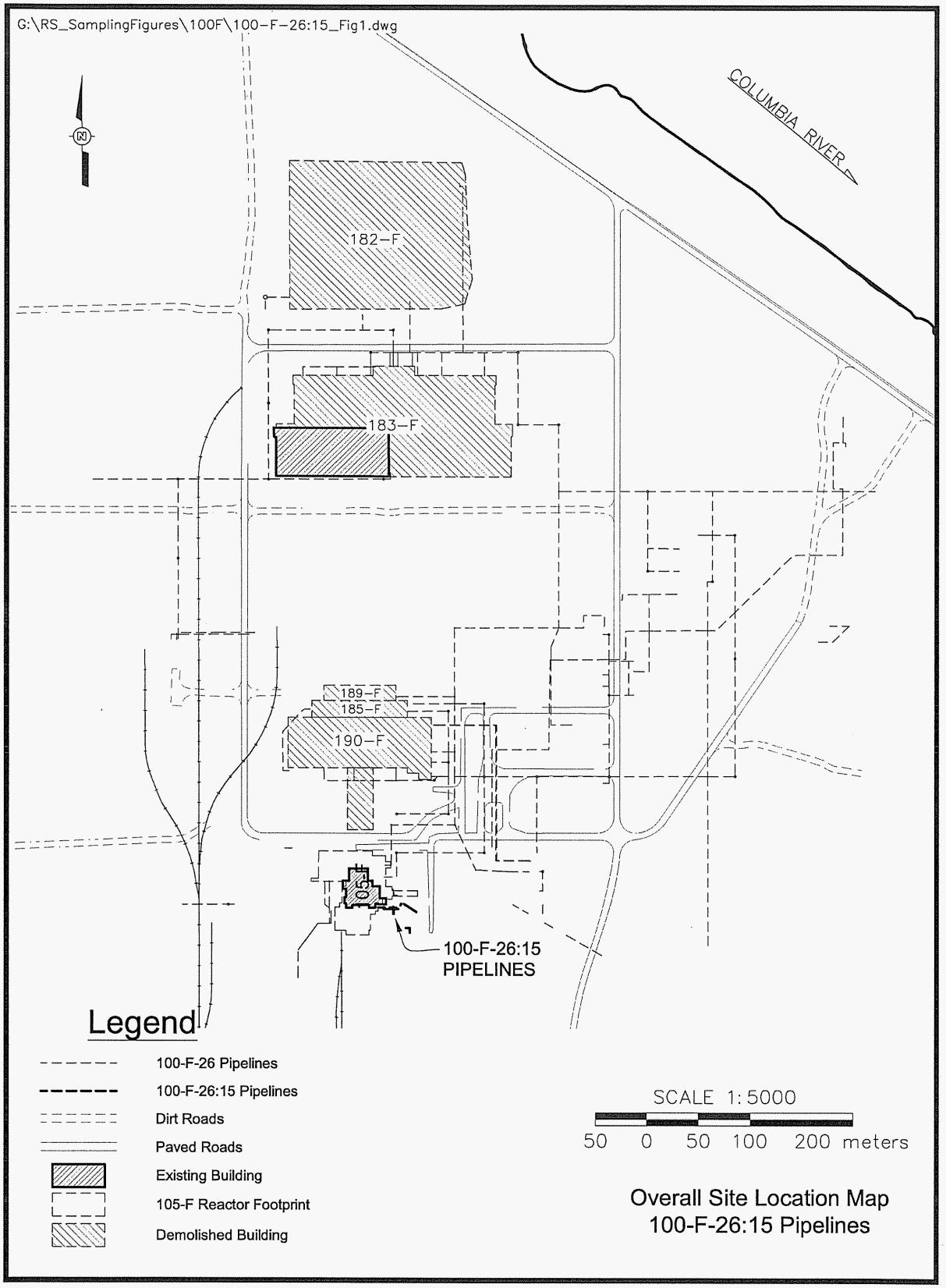
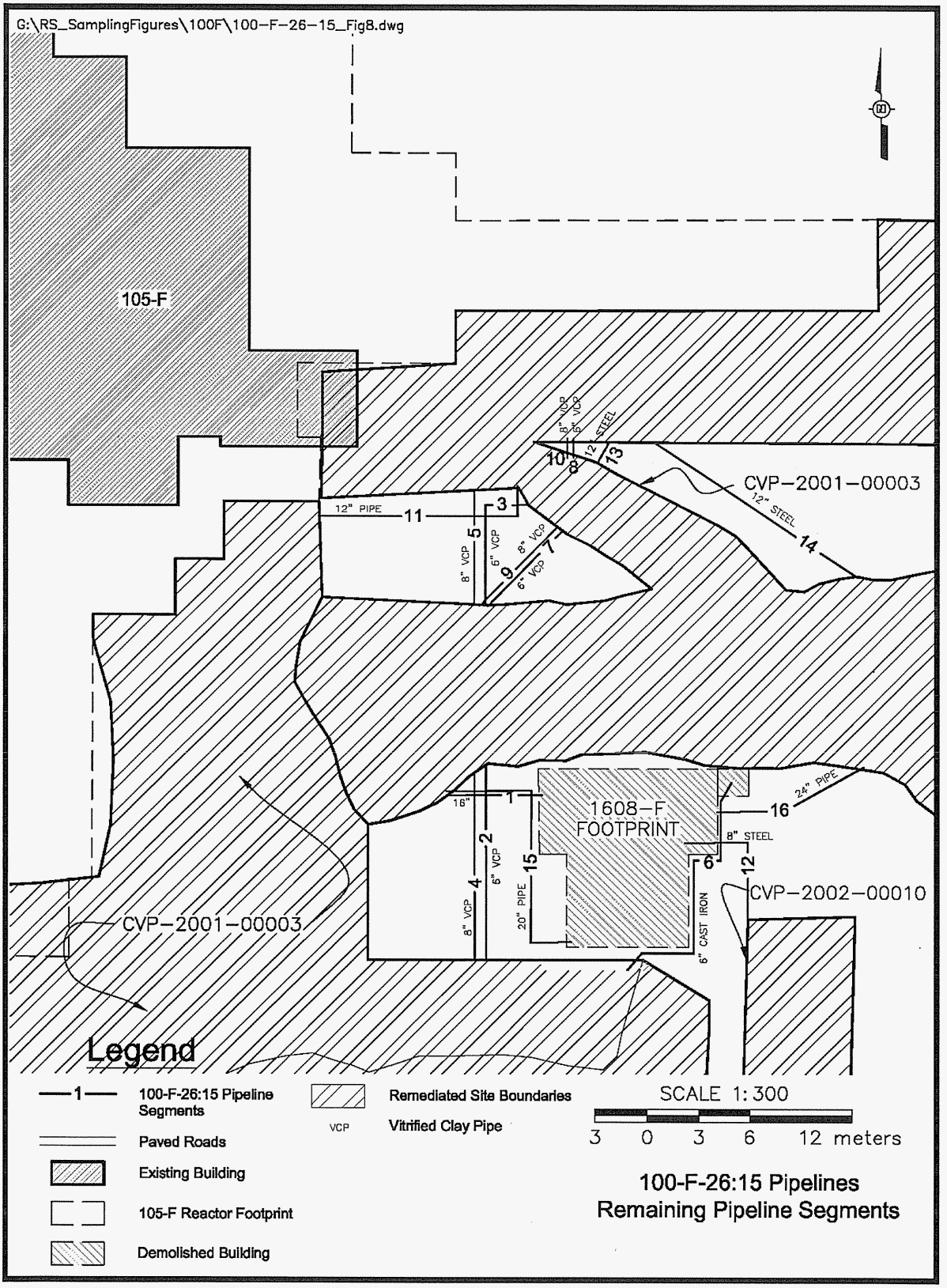


Table 1. Description of the 100-F-26:15 Pipeline Segments.

Segment	Discovery Site Number[a]	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

[a] 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

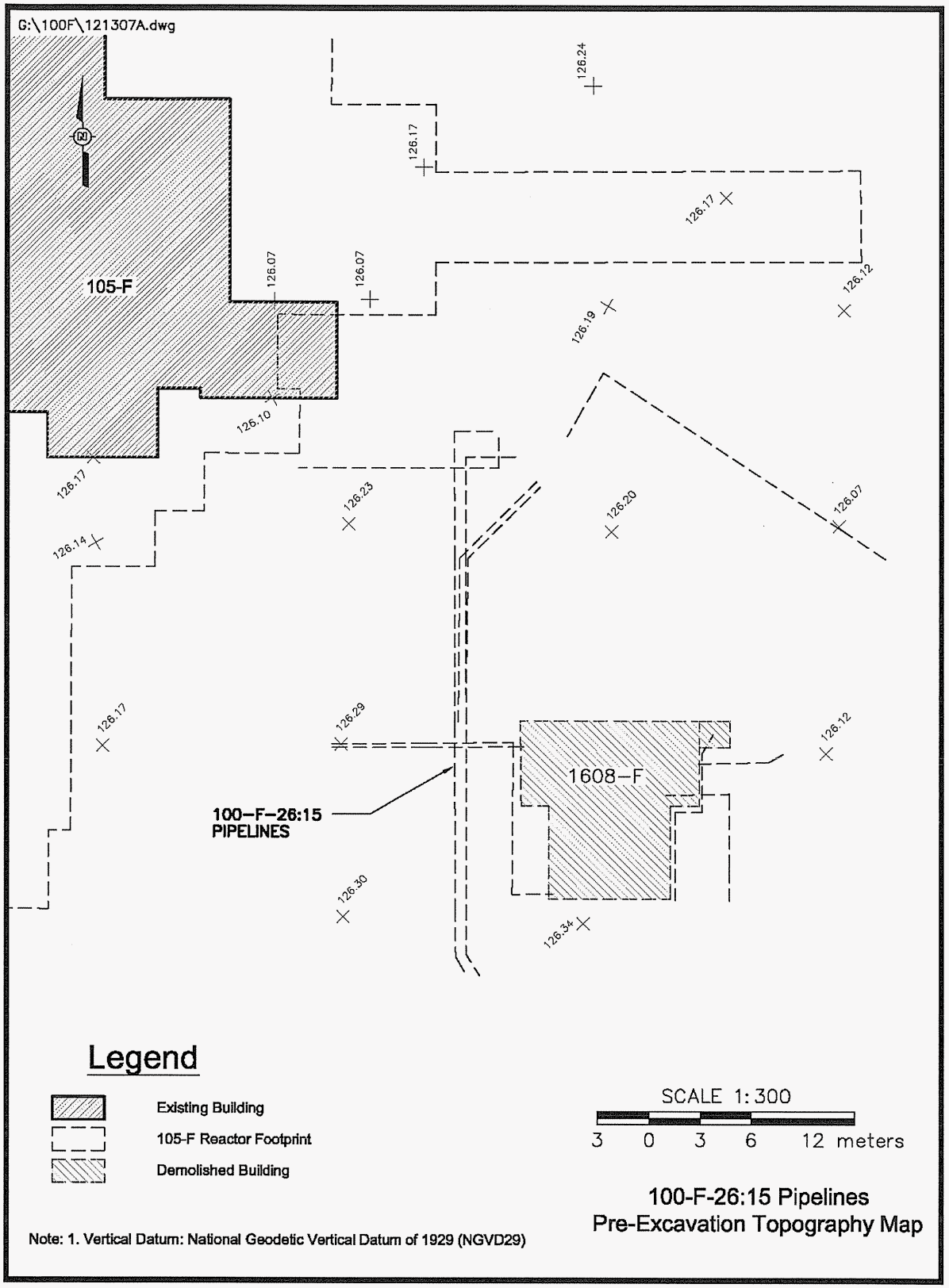
Nonintrusive Investigation Results

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^3 (107 yd^3) 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.

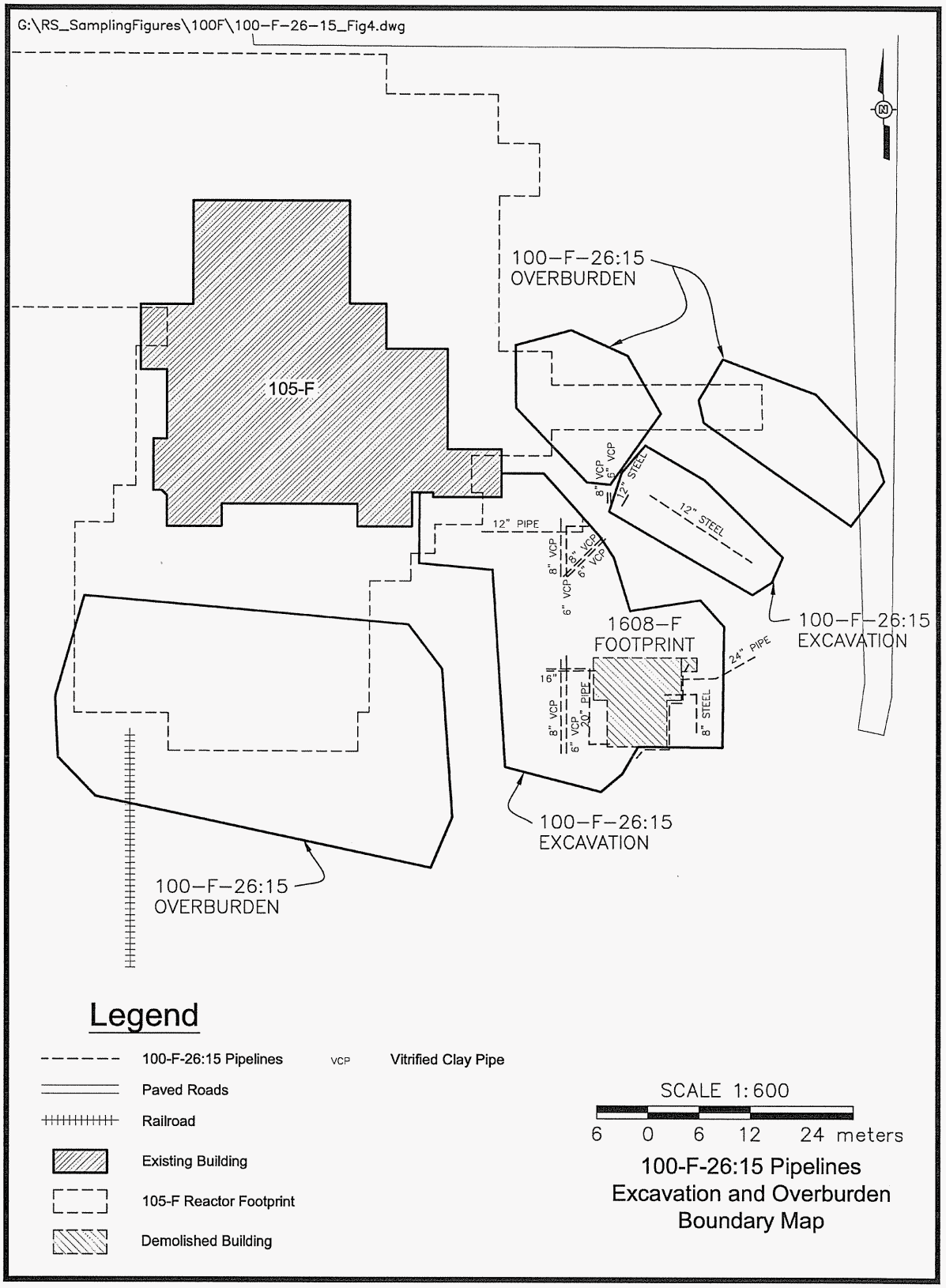


Figure 5. Radiological Survey of the 100-F-26:15 Waste Site.

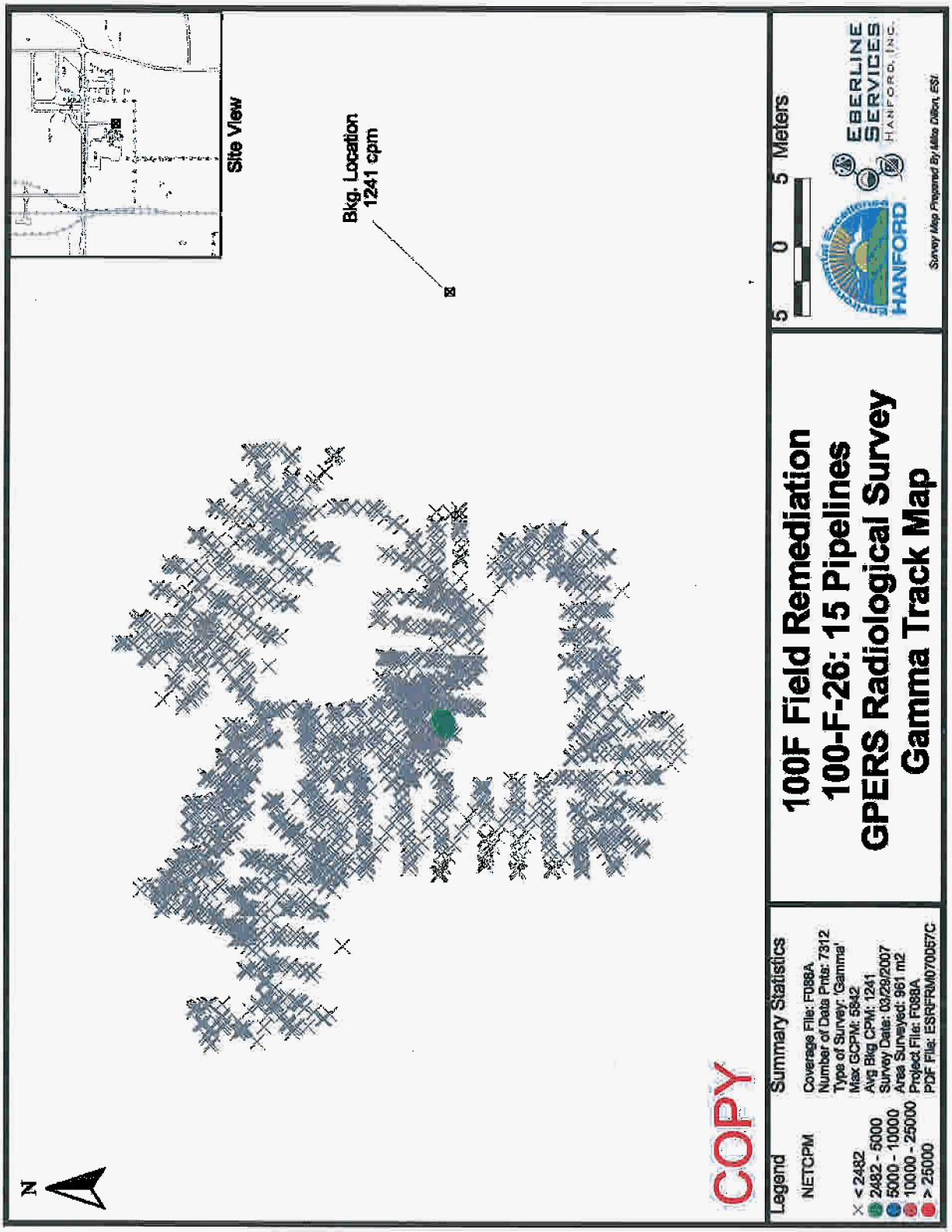


Figure 6. Pipeline Segments Found and Removed during Remediation of the 100-F-26:15 Waste Site.

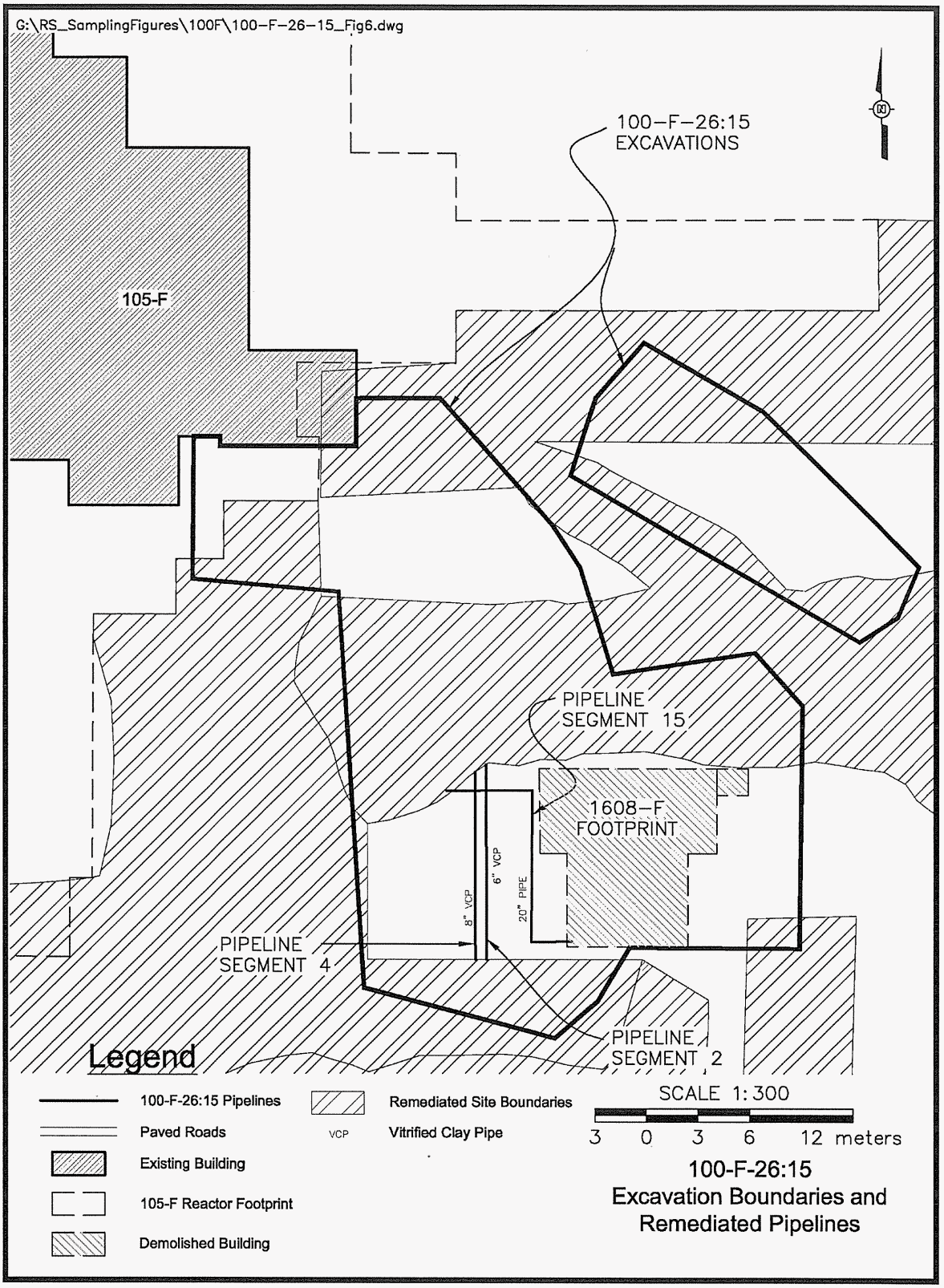


Figure 7. Post-remediation Topography of the 100-F-26:15 Waste Site.

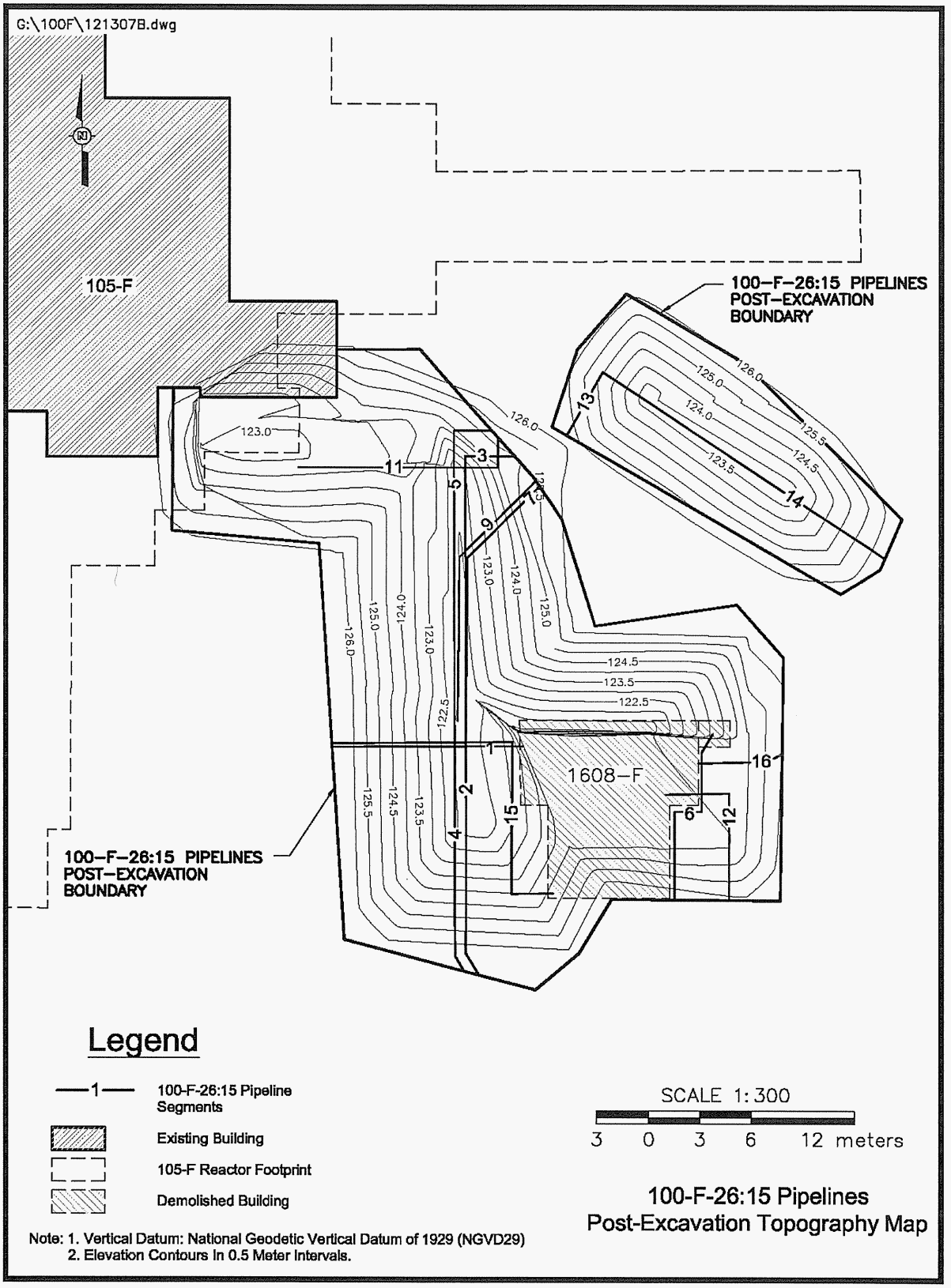


Figure 8. 100-F-26:15 Excavation Looking North to 105-F Reactor Building.

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[1] (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).

[1] Visual Sampling Plan is a site map-based user-interface program that may be downloaded at http://dqo.pnl.gov.

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

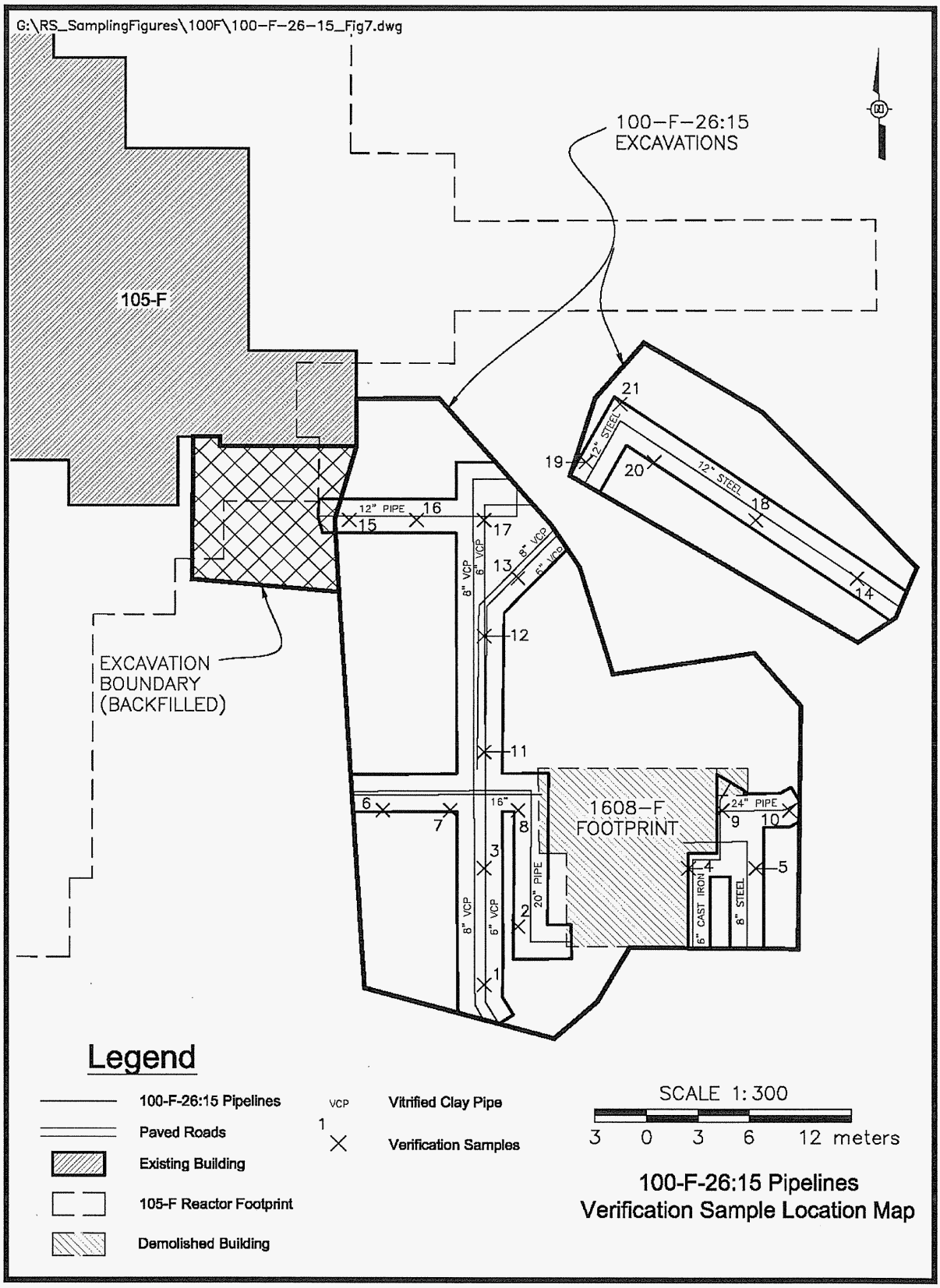


Table 2. Verification Sample Summary for the 100-F-26:15 Waste Site.[a] (2 Pages)

Sample Location	Sample Media	Actual Coordinates[b] Northing Easting	HEIS Number	Sample Analysis
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.[a] (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.

[a] Source: Field logbooks EFL-1174-3 (WCH 2007c).
[b] 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[a] (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	--[b]	--[b]	No	--
Europium-152	0.205	3.3	--[b]	--[b]	No	--
COPC	**Maximum or Statistical Result (mg/kg)**	**Remedial Action Goals[a] (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	--[c]	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	--[c]	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[a] (mg/kg)**			**Does the Maximum Exceed RAGs?**	**Does the Result Pass RESRAD Modeling?**
		Direct Exposure	**Protective of Groundwater**	**Protective of the River**		
Mercury	0.13 (<BG)	24	0.33	0.33	No	--
Vanadium	34.5 (<BG)	560	85.1	--[c]	No	--
Zinc	33.4 (<BG)	24,000	480	67.8	No	--

[a] 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.

[b] 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.

[c] 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
BG = background
COPC = contaminant of potential concern
EPA = Environmental Protection Agency
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose assessment model)
RDL = required detection limit
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[a] (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	--[b]	--[b]	No	--
COPC	**Maximum Result (mg/kg)**	**Soil Cleanup Levels, (mg/kg)[a]**			**Does the Maximum Exceed RAGs?**	**Does the Result Pass RESRAD Modeling?**
		Direct Exposure	**Protective of Groundwater**	**Protective of the River**		
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[e]	1.4	16,000	320	--[c]	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) [a]			Does the Maximum Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Direct Exposure	Direct Exposure		
Cadmium[g]	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	--[c]	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	--[c]	No	--
Zinc	28.3 (<BG)	24,000	480	67.8	No	--

[a] 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.

b 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.

[c] 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
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose assessment model
WAC = *Washington Administrative Code*
RDL = required detection limit

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)[a]			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	--[b]	No	--
Chromium, Total	9.5 (<BG)	80,000	18.5	18.5	No	--
Cobalt	5.9 (<BG)	1,600	32	--[b]	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)[a]			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	--[b]	No	--
Zinc	34.8 (<BG)	24,000	480	67.8	No	--

[a] 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.

[b] 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
BCL = below cleanup level
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose assessment model)
RDL = required detection limit
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 1.04×10^{-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 5.3×10^{-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[a] (pCi/g)	Fraction
Cesium-137	0.092	6.2	0.015
Europium-152	0.205	3.3	0.062
		Sum of Fractions	0.077
		Equivalent Dose (mrem/yr)	1.16

[a] 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 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-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 2.6×10^{-3}. All individual cumulative carcinogenic risk values are less than 1×10^{-6}. The cumulative carcinogenic risk value is 1.1×10^{-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 1/5th 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 ± 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^3 (107 yd^3) 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.

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CALCULATION COVER SHEET

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

Area: 100-F

Discipline: Environmental *Calculation No: 0100F-CA-V0288

Subject: 100-F-26:15 Cleanup Verification 95% UCL Calculation

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

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

SUMMARY OF REVISION

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

Washington Closure Hanford CALCULATION SHEET

Originator 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 Date 11/29/07
Subject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS Sheet No. 1 of 12

Summary

Purpose:
Calculate the 95% upper confidence limit (UCL) values to evaluate compliance with cleanup standards for the subject site. Also, perform the *Washington Administrative Code* (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.

Table of Contents:

Given/References:

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, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, DOE/RL-92-24, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) DOE-RL, 2005a, *100 Area Remedial Action Sampling and Analysis Plan* (SAP), DOE/RL-96-22, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
5) DOE-RL, 2005b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
6) Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
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10) EPA, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-4/013. U.S. Environmental Protection Agency, Washington, D.C.
11) WAC 173-340, 1996, "Model Toxic Control Act - Cleanup," *Washington Administrative Code.*

Solution:
Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993), below, and in the RDR/RAWP (DOE-RL 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).

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

Summary (continued)

Methodology:

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

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

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

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

The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method 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 analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

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

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

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

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

Washington Closure Hanford **CALCULATION SHEET**

Originator 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 **Date** 11/29/07
Subject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS **Sheet No.** 3 of 12

Summary (continued)

Results:
The results presented in the tables that follow include the summary of the results of the 95% UCL calculations for the shallow zone 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 RSVP for this site.

Results Summary - Shallow Zone Excavation

Analyte	95% UCL Result[a]	Maximum Value[a]	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

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

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

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

[a]The 95% UCL result or maximum value, depending on data censorship, as described in the methodology section.
QA/QC = quality assurance/quality control
RSVP = remaining sites verification package

Relative Percent Difference Results, J15721 and J15722[b] - QA/QC Analysis

Analyte	Duplicate Analysis[c]
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%

[b]Relative percent difference evaluation was not required for analytes not included in this table.
[c]These values are discussed in the RSVP.

Relative Percent Difference Results, J15728 and J15729[b] - QA/QC Analysis

Analyte	Duplicate Analysis[c]
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%

[b]Relative percent difference evaluation was not required for analytes not included in this table.
[c]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

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Date 11/29/07
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Shallow Zone Verification Data

Sampling Area	HEIS Number	Sample Date	Cesium-137 pCi/g	Q	MDA	Europium-152 pCi/g	Q	MDA	Arsenic mg/kg	Q	PQL	Barium mg/kg	Q	PQL	Beryllium mg/kg	Q	PQL	Boron mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Cobalt pCi/g	Q	MDA
2	J15721	7/24/2007	0.099		0.05	0.45		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
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
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
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
1	J15720	7/24/2007	0.029	U	0.03	0.13	U	0.13	2.9	U	2.9	51.9	C	0.06	0.13		0.03	1.9		1.0	9.1	C	0.29	5.5		0.23
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
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
5	J15725	7/24/2007	0.112		0.04	0.11	U	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
6	J15726	7/24/2007	0.045	U	0.05	0.19	U	0.19	1.5		2	52.2	C	0.06	0.21		0.03	2.6		1.0	8.6	C	0.29	5.5		0.23
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
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
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
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
12	J15733	7/24/2007	0.076		0.04	0.10		0.09	2.1		2	49.3	C	0.06	0.22		0.03	1.8		1.0	8.9	C	0.29	5.7		0.23
13	J15734	7/30/2007	0.039		0.03	0.25	U	0.25	2.4		2	63.8	C	0.06	0.31		0.03	2.9		1.0	11.4	C	0.29	7.1		0.24
14	J15735	7/30/2007	0.124		0.04	0.41		0.09	3.1		2	58.2	C	0.06	0.19		0.03	1.9		1.0	9.5	C	0.29	5.9		0.23
15	J15736	7/30/2007	0.046		0.03	0.12	U	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
16	J15737	7/30/2007	0.035	U	0.04	0.09	U	0.09	2.1		2	46.5	C	0.06	0.21		0.03	1.1	U	1.1	7.5	C	0.30	5.0		0.24
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
18	J15739	7/30/2007	0.110		0.03	0.18		0.07	1.4		1.2	39.8	C	0.06	0.19		0.03	1.1	U	1.1	5.5	C	0.30	4.3		0.24
19	J15740	7/30/2007	0.079	U	0.08	0.18	U	0.18	2.3		1.2	70.8	C	0.06	0.25		0.03	1.0	U	1.0	7.0	C	0.29	5.5		0.23
20	J15741	7/30/2007	0.056		0.03	0.13	U	0.13	2.6		2	47.3	C	0.06	0.23		0.03	1.1	U	1.1	6.4	C	0.29	4.7		0.24
21	J15742	7/30/2007	0.072		0.04	0.23	U	0.23	2.3		1.2	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 pCi/g	Q	MDA	Europium-152 pCi/g	Q	MDA	Arsenic mg/kg	Q	PQL	Barium mg/kg	Q	PQL	Beryllium mg/kg	Q	PQL	Boron mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Cobalt pCi/g	Q	MDA
2	J15721/J15722	7/24/2007	0.105			0.450			2.1			56.7			0.11			3.1			7.7			5.4		
8	J15728/J15729	7/24/2007	0.193			0.281			2.5			60.1			0.26			2.5			8.2			5.5		
1	J15720	7/24/2007	0.029			0.066			1.5			51.9			0.13			1.9			9.1			5.5		
3	J15723	7/24/2007	0.078			0.142			1.3			64.7			0.22			2.9			7.1			5.6		
4	J15724	7/24/2007	0.149			0.076			1.6			56.0			0.19			4.4			5.3			4.6		
5	J15725	7/24/2007	0.112			0.056			1.8			206			0.27			12.9			6.5			4.7		
6	J15726	7/24/2007	0.023			0.093			1.5			52.2			0.21			2.6			8.6			5.5		
7	J15727	7/24/2007	0.084			0.124			2.2			60.4			0.26			2.7			8.5			6.2		
9	J15730	7/24/2007	0.080			0.254			1.5			50.4			0.22			1.7			7.2			4.6		
10	J15731	7/24/2007	0.058			0.156			1.9			49.2			0.22			2.3			7.9			5.0		
11	J15732	7/24/2007	0.051			0.322			2.4			86.1			0.34			2.5			8.9			7.2		
12	J15733	7/24/2007	0.076			0.098			2.1			49.3			0.22			1.8			8.9			5.7		
13	J15734	7/24/2007	0.039			0.126			2.4			63.8			0.31			2.9			11.4			7.1		
14	J15735	7/24/2007	0.124			0.411			3.1			58.2			0.19			1.9			9.5			5.9		
15	J15736	7/30/2007	0.046			0.061			2.6			72.2			0.23			3.7			7.2			5.6		
16	J15737	7/30/2007	0.078			0.046			2.1			46.5			0.21			0.6			7.5			5.0		
17	J15738	7/30/2007	0.051			0.217			2.6			63.6			0.26			5.2			8.2			6.1		
18	J15739	7/30/2007	0.110			0.176			1.4			39.8			0.19			0.6			5.5			4.3		
19	J15740	7/30/2007	0.040			0.088			2.3			70.8			0.25			0.5			7.0			5.5		
20	J15741	7/30/2007	0.056			0.064			2.6			47.3			0.23			0.6			6.4			4.7		
21	J15742	7/30/2007	0.072			0.113			2.3			63.2			0.27			0.5			8.2			5.7		

Statistical Computations

	Cesium-137	Europium-152	Arsenic	Barium	Beryllium	Boron	Chromium	Cobalt
95% UCL value based on	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Large data set (n >10), use MTCAStat lognormal distribution.	Large data set (n >10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n >10), use MTCAStat normal distribution.	Large data set (n >10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n >10), use MTCAStat lognormal distribution.	Large data set (n >10), use MTCAStat lognormal distribution.
N	21	21	21	21	21	21	21	21
% < Detection limit	19%	43%	5%	0%	0%	24%	0%	0%
Mean	0.076	0.163	2.1	65.2	0.23	2.7	7.8	5.5
Standard deviation	0.044	0.118	0.5	33.9	0.05	2.7	1.4	0.8
95% UCL on mean	0.092	0.205	2.3	77.3	0.25	3.7	8.4	5.8
Maximum detected value	0.208	0.451	3.1	206	0.34	12.9	11.4	7.2
Background	NA	NA	6.4	132	1.51	NA	18.5	15.7
Statistical value above background	0.092	0.205	2.3	77.3	0.25	3.7	8.4	5.8
Most Stringent Cleanup Limit for nonradionuclide and RAG type			20 DE/GW & River Protection	132 BG/GW Protection	1.51 BG/GW & River Protection	320 GW Protection	18.5 BG/GW & River Protection	32 GW Protection
WAC 173-340 3-PART TEST								
95% UCL > Cleanup Limit?			NA	NO	NA	NO	NA	NA
> 10% above Cleanup Limit?			NA	NO	NA	NO	NA	NA
Any sample > 2X Cleanup Limit?			NA	NO	NA	NO	NA	NA
WAC 173-340 Compliance? NO			Because all values are below background (6.5 mg/kg), the MTCA 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.	Because all values are below background (1.51 mg/kg), the MTCA 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.	Because all values are below background (18.5 mg/kg), the MTCA 3-part test is not required.	Because all values are below background (15.7 mg/kg), the MTCA 3-part test is not required.

BG = background
DE = direct exposure
GW = groundwater
HEIS = Hanford Environmental Information System
MDA = minimum detectable activity
MTCA = Model Toxics Control Act
PQL = practical quantitation 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-V0268
Checked M. J. Appel

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

Shallow Zone Verification Data

Sampling Area	HEIS Number	Sample Date	Copper pCi/g	Q	MDA	Hexavalent Chromium pCi/g	Q	MDA	Lead pCi/g	Q	MDA	Manganese pCi/g	Q	MDA	Molybdenum mg/kg	Q	PQL	Nickel mg/kg	Q	PQL	Vanadium mg/kg	Q	PQL	Zinc 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	296		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	0.26	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	11.3	C	0.26	0.20	U	0.20	4.6		0.94	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	0.26	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		3.5	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	0.25	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	0.25	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

Statistical Computation Input Data

Sampling Area	HEIS Number	Sample Date	Copper pCi/g	Q	MDA	Hexavalent Chromium pCi/g	Q	MDA	Lead pCi/g	Q	MDA	Manganese pCi/g	Q	MDA	Molybdenum mg/kg	Q	PQL	Nickel mg/kg	Q	PQL	Vanadium mg/kg	Q	PQL	Zinc 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	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			7.6			24.8			28.7		
5	J15725	7/24/2007	12.0			0.35			4.5			219			0.73			7.9			33.8			29.5		
6	J15726	7/24/2007	14.6			0.31			3.7			254			0.54			10.0			36.6			31.6		
7	J15727	7/24/2007	11.6			0.26			4.0			296			0.56			9.4			35.8			34.8		
9	J15730	7/24/2007	14.6			0.10			3.4			248			0.66			8.8			26.0			27.7		
10	J15731	7/24/2007	11.6			0.22			2.9			243			0.57			8.8			33.1			32.8		
11	J15732	7/24/2007	13.1			0.27			4.4			355			0.75			10.2			36.1			37.6		
12	J15733	7/24/2007	12.9			0.47			3.4			262			0.81			9.1			36.2			33.2		
13	J15734	7/24/2007	12.3			0.24			4.4			317			0.61			11.7			43.1			39.4		
14	J15735	7/24/2007	11.3			0.10			4.6			268			0.23			9.5			32.0			31.9		
15	J15736	7/30/2007	13.6			0.10			4.8			279			0.23			9.6			30.6			31.8		
16	J15737	7/30/2007	11.5			0.10			3.5			234			0.24			8.8			27.2			27.0		
17	J15738	7/30/2007	11.2			0.10			4.4			292			0.23			10.0			33.0			32.8		
18	J15739	7/30/2007	12.7			0.10			3.5			195			0.24			6.8			19.6			22.7		
19	J15740	7/30/2007	12.3			0.21			4.2			301			0.23			8.4			27.8			34.6		
20	J15741	7/30/2007	12.7			0.21			4.1			226			0.24			8.2			23.5			25.4		
21	J15742	7/30/2007	12.2			0.23			4.2			275			0.24			9.7			32.4			32.2		

Statistical Computations

	Copper	Hexavalent Chromium	Lead	Manganese	Molybdenum	Nickel	Vanadium	Zinc
95% UCL value based on	Large data set (n >10), use MTCAStat lognormal distribution.	Large data set (n >10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n >10), use MTCAStat lognormal distribution.	Large data set (n >10), use MTCAStat lognormal distribution.	Large data set (n >10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n >10), use MTCAStat lognormal distribution.	Large data set (n >10), use MTCAStat lognormal distribution.	Large data set (n >10), use MTCAStat lognormal distribution.
N	21	21	21	21	21	21	21	21
% < Detection limit	0%	38%	0%	0%	43%	0%	0%	0%
Mean	12.5	0.21	3.9	265	0.48	9.1	31.9	31.8
Standard deviation	1.0	0.10	0.5	37.5	0.23	1.1	5.7	4.0
95% UCL on mean	12.7	0.24	4.1	280	0.56	9.6	34.5	33.4
Maximum detected value	14.6	0.35	4.8	355	0.81	11.7	43.1	39.4
Background	22.0	NA	10.2	512	NA	19.1	85.1	67.8
Statistical value above background	12.7	0.24	4.1	280	0.56	9.6	34.5	33.4
Most Stringent Cleanup Limit for nonradionuclide and RAG type	22 BG & River Protection	2.0 River Protection	10.2 BG/GW & River Protection	512 BG/GW & River Protection	6 GW Protection	19.1 BG/GW Protection	85.1 BG/GW Protection	67.8 BG & River Protection
WAC 173-340 3-PART TEST								
95% UCL > Cleanup Limit?	NA	NO	NA	NA	NO	NA	NA	NA
> 10% above Cleanup Limit?	NA	NO	NA	NA	NO	NA	NA	NA
Any sample > 2X Cleanup Limit?	NA	NO	NA	NA	NO	NA	NA	NA
WAC 173-340 NO	Because all values are below background (22 mg/kg), the MTCA 3-part test is not required	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.	Because all values are below background (10.2 mg/kg), the MTCA 3-part test is not required.	Because all values are below background (512 mg/kg), the MTCA 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.	Because all values are below background (19.1 mg/kg), the MTCA 3-part test is not required.	Because all values are below background (85.1 mg/kg), the MTCA 3-part test is not required.	Because all values are below background (67.8 mg/kg), the MTCA 3-part test is not required.

BG = background
GW = groundwater
HEIS = Hanford Environmental Information System
MDA = minimum detectable activity
MTCA = Model Toxics Control Act
PQL = practical quantitation limit
U = uncetected
UCL = upper confidence limit
WAC = *Washington Administrative Code*

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. 14655

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

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

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

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			13.0%					8.0%
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable

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

Analysis:

	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)**	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	Not 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. 14655

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

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Sheet No. 7 of 12

Duplicate Analysis

Sampling Area	Sample Number	Sample Date	Hexavalent Chromium mg/kg	Q	PQL	Iron mg/kg	Q	PQL	Lead mg/kg	Q	PQL	Magnesium mg/kg	Q	PQL	Manganese mg/kg	Q	PQL	Molybdenum mg/kg	Q	PQL	Nickel mg/kg	Q	PQL	Potassium 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

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

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

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 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
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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

Analysis:

		Cesium-137	Europium-152	Potassium-40	Radium-226	Radium-228	Thorium-228 GEA	Thorium-232 GEA	Aluminum
	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

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

		Arsenic	Barium	Beryllium	Boron	Calcium	Chromium	Cobalt	Copper
	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)**	No-Stop (acceptable)	**Yes (calc RPD)**
	RPD		12.0%			8.9%	2.8%		4.8%
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not 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. 14655

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

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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

Analysis:

		Iron	Lead	Magnesium	Manganese	Molybdenum	Nickel	Potassium	Silicon
	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)**	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (calc RPD)**
	RPD	8.4%		5.6%	9.2%				0.3%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable

Sampling Area	HEIS Number	Sample Date	Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
8	J15728	7/24/2007	151		2.0	41.6		0.12	37.3		0.12
Duplicate of J15728	J15729	7/24/2007	149		2.1	37.4		0.24	34.9		0.12

Analysis:

		Sodium	Vanadium	Zinc
	TDL	50	2.5	1
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD		10.6%	6.6%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable

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CALCULATION SHEET

Originator H. M. Sulloway HMS Date 11/27/07 Calc. No. 0100F-CA-V0288 Rev. No. 0
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Subject 100-F-26:15 CLEANUP VERIFICATION 95% UCL CALCULATIONS Sheet No. 10 of 12

Ecology Software (MTCAStat) Results

Arsenic 95% UCL Calculation

DATA	ID
2.1	J15721/J15722
2.5	J15728/J15729
1.45	J15720
1.3	J15723
1.6	J15724
1.8	J15725
1.5	J15726
2.2	J15727
1.5	J15730
1.9	J15731
2.4	J15732
2.1	J15733
2.4	J15734
3.1	J15735
2.6	J15736
2.1	J15737
2.6	J15738
1.4	J15739
2.3	J15740
2.6	J15741
2.3	J15742

Number of samples
Uncensored 21
Censored
Detection limit or PQL
Method detection limit
TOTAL 21

Uncensored values
Mean 2.08
Lognormal mean 2.09
Std. devn. 0.49
Median 2.10
Min. 1.30
Max. 3.10

Lognormal distribution?
r-squared is: 0.95
Recommendations:
Use lognormal distribution.

Normal distribution?
r-squared is: 0.96

UCL (Land's method) is 2.31

Barium 95% UCL Calculation

DATA	ID
56.7	J15721/J15722
60.1	J15728/J15729
51.9	J15720
64.7	J15723
56.0	J15724
206	J15725
52.2	J15726
60.4	J15727
50.4	J15730
49.2	J15731
86.1	J15732
49.3	J15733
63.8	J15734
58.2	J15735
72.2	J15736
46.5	J15737
63.6	J15738
39.8	J15739
70.8	J15740
47.3	J15741
63.2	J15742

Number of samples
Uncensored 21
Censored
Detection limit or PQL
Method detection limit
TOTAL 21

Uncensored values
Mean 65.2
Lognormal mean 64.2
Std. devn. 33.9
Median 58.2
Min. 39.8
Max. 206

Lognormal distribution?
r-squared is: 0.715
Recommendations:

Normal distribution?
r-squared is: 0.48

Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 77.3

Beryllium 95% UCL Calculation

DATA	ID
0.11	J15721/J15722
0.26	J15728/J15729
0.13	J15720
0.22	J15723
0.19	J15724
0.27	J15725
0.21	J15726
0.26	J15727
0.22	J15730
0.22	J15731
0.34	J15732
0.22	J15733
0.31	J15734
0.19	J15735
0.23	J15736
0.21	J15737
0.26	J15738
0.19	J15739
0.25	J15740
0.23	J15741
0.27	J15742

Number of samples
Uncensored 21
Censored
Detection limit or PQL
Method detection limit
TOTAL 21

Uncensored values
Mean 0.23
Lognormal mean 0.23
Std. devn. 0.052
Median 0.22
Min. 0.11
Max. 0.34

Lognormal distribution?
r-squared is: 0.88
Recommendations:
Use normal distribution.

Normal distribution?
r-squared is: 0.95

UCL (based on t-statistic) is 0.25

Boron 95% UCL Calculation

DATA	ID
3.1	J15721/J15722
2.5	J15728/J15729
1.9	J15720
2.9	J15723
4.4	J15724
12.9	J15725
2.6	J15726
2.7	J15727
1.7	J15730
2.3	J15731
2.5	J15732
1.8	J15733
2.9	J15734
1.9	J15735
3.7	J15736
0.6	J15737
5.2	J15738
0.6	J15739
0.5	J15740
0.6	J15741
0.5	J15742

Number of samples
Uncensored 21
Censored
Detection limit or PQL
Method detection limit
TOTAL 21

Uncensored values
Mean 2.7
Lognormal mean 2.8
Std. devn. 2.7
Median 2.5
Min. 0.5
Max. 12.9

Lognormal distribution?
r-squared is: 0.90
Recommendations:

Normal distribution?
r-squared is: 0.65

Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) i 3.7

Chromium 95% UCL Calculation

DATA	ID
7.7	J15721/J15722
8.2	J15728/J15729
9.1	J15720
7.1	J15723
5.3	J15724
6.5	J15725
8.6	J15726
8.5	J15727
7.2	J15730
7.9	J15731
8.9	J15732
8.9	J15733
11.4	J15734
9.5	J15735
7.2	J15736
7.5	J15737
8.2	J15738
5.5	J15739
7.0	J15740
6.4	J15741
8.2	J15742

Number of samples
Uncensored 21
Censored
Detection limit or PQL
Method detection limit
TOTAL 21

Uncensored values
Mean 7.8
Lognormal mean 7.9
Std. devn. 1.4
Median 7.9
Min. 5.3
Max. 11.4

Lognormal distribution?
r-squared is: 0.97
Recommendations:
Use lognormal distribution.

Normal distribution?
r-squared is: 0.962

UCL (Land's method) is 8.4

Cobalt 95% UCL Calculation

DATA	ID
5.4	J15721/J15722
5.5	J15728/J15729
5.5	J15720
5.6	J15723
4.6	J15724
4.7	J15725
5.5	J15726
6.2	J15727
4.6	J15730
5.0	J15731
7.2	J15732
5.7	J15733
7.1	J15734
5.9	J15735
5.6	J15736
5.0	J15737
6.1	J15738
4.3	J15739
5.5	J15740
4.7	J15741
5.7	J15742

Number of samples
Uncensored 21
Censored
Detection limit or PQL
Method detection limit
TOTAL 21

Uncensored values
Mean 5.5
Lognormal mean 5.5
Std. devn. 0.8
Median 5.5
Min. 4.3
Max. 7.2

Lognormal distribution?
r-squared is: 0.95
Recommendations:
Use lognormal distribution.

Normal distribution?
r-squared is: 0.93

UCL (Land s method) is 5.8

Washington Closure Hanford

CALCULATION SHEET

Originator H. M. Sullowa
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
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Ecology Software (MTCAStat) Results

Copper 95% UCL Calculation

DATA	ID
11.5	J15721/J15722
12.5	J15728/J15729
13.4	J15720
12.5	J15723
12.0	J15724
14.6	J15725
11.6	J15726
13.1	J15727
11.3	J15730
13.6	J15731
11.5	J15732
11.2	J15733
12.7	J15734
12.3	J15735
12.7	J15736
12.2	J15737
12.6	J15738
9.8	J15739
11.7	J15740
12.6	J15741
12.7	J15742

Number of samples		Uncensored values	
Uncensored	21	Mean	12.3
Censored		Lognormal mean	12.3
Detection limit or PQL		Std. devn.	1.0
Method detection limit		Median	12.5
TOTAL	21	Min.	9.8
		Max.	14.6
Lognormal distribution?		Normal distribution?	
r-squared is:	0.94	r-squared is:	0.95
Recommendations:			
Use lognormal distribution.			
UCL (Land's method) is	12.7		

Hexavalent Chromium 95% UCL Calculation

DATA	ID
0.3	J15721/J15722
0.1	J15728/J15729
0.3	J15720
0.1	J15723
0.3	J15724
0.4	J15725
0.3	J15726
0.3	J15727
0.1	J15730
0.2	J15731
0.3	J15732
0.3	J15733
0.2	J15734
0.1	J15735
0.1	J15736
0.1	J15737
0.1	J15738
0.1	J15739
0.2	J15740
0.2	J15741
0.2	J15742

Number of samples		Uncensored values	
Uncensored	21	Mean	0.20
Censored		Lognormal mean	0.21
Detection limit or PQL		Std. devn.	0.09
Method detection limit		Median	0.22
TOTAL	21	Min.	0.10
		Max.	0.35
Lognormal distribution?		Normal distribution?	
r-squared is:	0.82	r-squared is:	0.87
Recommendations:			
Reject BOTH lognormal and normal distributions.			
UCL (based on Z-statistic) is	0.24		

Lead 95% UCL Calculation

DATA	ID
3.9	J15721/J15722
3.8	J15728/J15729
3.5	J15720
3.8	J15723
3.4	J15724
4.5	J15725
3.7	J15726
4.0	J15727
3.4	J15730
2.9	J15731
4.4	J15732
3.4	J15733
4.4	J15734
4.6	J15735
4.8	J15736
3.5	J15737
4.4	J15738
0.0	J15739
4.2	J15740
4.1	J15741
4.2	J15742

Number of samples		Uncensored values	
Uncensored	21	Mean	3.9
Censored		Lognormal mean	3.9
Detection limit or PQL		Std. devn.	0.50
Method detection limit		Median	3.9
TOTAL	21	Min.	2.9
		Max.	4.8
Lognormal distribution?		Normal distribution?	
r-squared is:	0.960	r-squared is:	0.969
Recommendations:			
Use lognormal distribution.			
UCL (Land's method) is	4.1		

Manganese 95% UCL Calculation

DATA	ID
253	J15721/J15722
283	J15728/J15729
266	J15720
279	J15723
211	J15724
219	J15725
254	J15726
296	J15727
248	J15730
243	J15731
355	J15732
262	J15733
317	J15734
268	J15735
279	J15736
234	J15737
292	J15738
195	J15739
301	J15740
226	J15741
275	J15742

Number of samples		Uncensored values	
Uncensored	21	Mean	265
Censored		Lognormal mean	265
Detection limit or PQL		Std. devn.	37
Method detection limit		Median	266
TOTAL	21	Min.	195
		Max.	355
Lognormal distribution?		Normal distribution?	
r-squared is:	0.99	r-squared is:	0.98
Recommendations:			
Use lognormal distribution.			
UCL (Land's method) is	280		

Molybdenum 95% UCL Calculation

DATA	ID
0.61	J15721/J15722
0.67	J15728/J15729
0.24	J15720
0.71	J15723
0.79	J15724
0.73	J15725
0.54	J15726
0.56	J15727
0.66	J15730
0.57	J15731
0.75	J15732
0.81	J15733
0.61	J15734
0.23	J15735
0.23	J15736
0.24	J15737
0.23	J15738
0.23	J15739
0.23	J15740
0.24	J15741
0.24	J15742

Number of samples		Uncensored values	
Uncensored	21	Mean	0.48
Censored		Lognormal mean	0.49
Detection limit or PQL		Std. devn.	0.23
Method detection limit		Median	0.56
TOTAL	21	Min.	0.23
		Max.	0.81
Lognormal distribution?		Normal distribution?	
r-squared is:	0.79	r-squared is:	0.83
Recommendations:			
Reject BOTH lognormal and normal distributions.			
UCL (based on Z-statistic) is	0.564		

Nickel 95% UCL Calculation

DATA	ID
8.5	J15721/J15722
10.2	J15728/J15729
9.8	J15720
8.9	J15723
7.6	J15724
7.9	J15725
10.0	J15726
9.4	J15727
8.8	J15730
8.8	J15731
10.2	J15732
9.1	J15733
11.7	J15734
9.5	J15735
9.6	J15736
8.8	J15737
10.0	J15738
6.8	J15739
8.4	J15740
8.2	J15741
9.7	J15742

Number of samples		Uncensored values	
Uncensored	21	Mean	9.1
Censored		Lognormal mean	9.1
Detection limit or PQL		Std. devn.	1.1
Method detection limit		Median	9.1
TOTAL	21	Min.	6.8
		Max.	11.7
Lognormal distribution?		Normal distribution?	
r-squared is:	0.96	r-squared is:	0.97
Recommendations:			
Use lognormal distribution.			
UCL (Land's method) is	9.6		

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 1?/27/07
Job No. 14655

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

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Ecology Software (MTCAStat) Results

DATA	ID	Vanadium 95% UCL Calculation			
32.1	J15721/J15722				
39.5	J15728/J15729				
37.7	J15720	Number of samples		Uncensored values	
29.4	J15723	Uncensored	21	Mean	31.9
24.8	J15724	Censored		Lognormal mean	32.0
33.8	J15725	Detection limit or PQL		Std. devn.	5.7
36.6	J15726	Method detection limit		Median	32.4
35.8	J15727	TOTAL	21	Min.	19.6
26.0	J15730			Max.	43.1
33.1	J15731				
36.1	J15732				
36.2	J15733				
43.1	J15734	Lognormal distribution?		Normal distribution?	
32.0	J15735	r-squared is:	0.96	r-squared is:	0.98
30.6	J15736	Recommendations:			
27.2	J15737	Use lognormal distribution.			
33.0	J15738				
19.6	J15739	UCL (Land's method) is	34.5		
27.8	J15740				
23.5	J15741				
32.4	J15742				

DATA	ID	Zinc 95% UCL Calculation			
33.0	5721/J15722				
36.1	5728/J15729				
33.0	J15720	Number of samples		Uncensored values	
31.3	J15723	Uncensored	21	Mean	31.8
28.7	J15724	Censored		Lognormal mean	31.8
29.5	J15725	Detection limit or PQL		Std. devn.	4.0
31.6	J15726	Method detection limit		Median	32.2
34.8	J15727	TOTAL	21	Min.	22.7
27.7	J15730			Max.	39.4
32.8	J15731				
37.6	J15732				
33.2	J15733				
39.4	J15734	Lognormal distribution?		Normal distribution?	
31.9	J15735	r-squared is:	0.94	squared is:	0.96
31.8	J15736	Recommendations:			
27.0	J15737	Use lognormal distribution.			
32.8	J15738				
22.7	J15739	UCL (Land's method) is	33.4		
34.6	J15740				
25.4	J15741				
32.2	J15742				

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	Date	11/27/07
Checked	M. J. Appel	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	Sheet No.	2 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	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	Sheet No.	4 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	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	1.1
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	1.1
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	1.0
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	1.1
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	1.0
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	1.0
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	1.1
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	1.0
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	0.34

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	Sheet No.	7 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	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	Sheet No.	8 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	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	BC	9.5	1.3	U	1.3	1320	C	2.6	0.27	U	0.27	193	BC	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.	0100F-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	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	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14
Early Backfill	J14D63	1/30/2007	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14	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.

Acrobat 8.0

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	M. J. Appel	NA	S. W. Callison	12-5-07

SUMMARY OF REVISION

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

Washington Closure Hanford, Inc. CALCULATION SHEET

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

PURPOSE:

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

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

GIVEN/REFERENCES:

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

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

3) WCH, 2007, *Remaining Sites Verification Package for the Miscellaneous Pipelines Associated with the 1608-F Sump (100-F-26:15)*, Attachment to Waste Site Reclassification Form 2007-031, Washington Closure Hanford, Inc., Richland, Washington.

SOLUTION:

1) Generate an HQ for each noncarcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL 2005).

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

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the excess cancer risk of $<1 \times 10^{-6}$ (DOE-RL 2005).

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	H. M. Sulloway	Date:	11/27/07	Calc. No.:	0100F-CA-V0328	Rev.:	0
Project:	100-F Area Field Remediation	Job No:	14655	Checked:	M. J. Appel	Date:	11/28/07
Subject:	100-F-26:15 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	2 of 3

METHODOLOGY:

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

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

1) For example, the maximum value for boron is 3.7 mg/kg, divided by the noncarcinogenic RAG value of 16,000 mg/kg (boron is identified as a noncarcinogen in WAC 173-340-740[3]), is 2.3×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criteria is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. The sum of the HQ values is 2.6×10^{-3}. Comparing this value to the requirement of <1.0, this criteria is met.

3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value, then multiplied by 1×10^{-6}. For example, the maximum value for hexavalent chromium is 0.24 mg/kg, divided by 2.1 mg/kg, and multiplied as indicated, is 1.1×10^{-7}. Comparing this value and all other individual values to the requirement of $<1 \times 10^{-6}$, this criteria is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk can be obtained by summing the individual values. The sum of the excess cancer risk values is 1.1×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

RESULTS:

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

Table 1 shows the results of the calculations.

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

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

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

Notes:

[a] = From WCH (2007).

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

[c] = Value for the carcinogen RAG calculated based on the inhalation exposure pathway WAC 173-340-750(3), 1996.

-- = not applicable

RAG = remedial action goal

CONCLUSION:

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).