Waste Site Reclassification Form

Date Submitted: 7/12/06 **Originator:** L. M. Dittmer **Phone:** 372-9664	**Operable Unit(s):** 100-FR-1 **Waste Site ID:** 100-F-33 **Type of Reclassification Action:** Rejected ☐ Closed Out ☐ Interim Closed Out ☒ No Action ☐	**Control Number:** 2006-021 **Lead Agency:** EPA

This form documents agreement among the parties listed below authorizing classification of the subject unit as rejected, closed out, interim closed out, or no action and authorizing backfill of the site, if appropriate. Final removal from the National Priorities List of no action, interim closed-out, or closed-out sites will occur at a future date.

Description of current waste site condition:

The 100-F-33, 146-F Aquatic Biology Fish Ponds waste site was an area with six small rectangular ponds and one large circular pond used to conduct tests on fish using various mixtures of river and reactor effluent water. Remedial action was performed in August 2005. Evaluation, remediation, and 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) sampling the site, (2) remediating the portions of the site containing contamination above cleanup goals, (3) demonstrating through verification sampling that cleanup goals have been met, and (4) proposing the site for reclassification as interim closed out.

Basis for reclassification:

The 100-F-33, 146-F Aquatic Biology Fish Ponds site meets the remedial action objectives specified in the Remaining Sites ROD. The results of verification and applicable confirmatory sampling demonstrate that residual contaminant concentrations support future unrestricted land uses that can be represented (or bounded) by a rural-residential scenario. These results also show that residual concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The site does not have a deep zone; therefore, no deep zone institutional controls are required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-F-33, 146-F Aquatic Biology Fish Ponds* (attached).

D. C. Smith DOE-RL Project Manager	Signature	8/6/06 Date
N/A Ecology Project Manager	Signature	Date
R. A. Lobos EPA Project Manager	Signature	8/25/2006 Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-33, 146-F AQUATIC BIOLOGY FISH PONDS

Attachment to Waste Site Reclassification Form 2006-021

August 2006

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-33, 146-F AQUATIC BIOLOGY FISH PONDS

EXECUTIVE SUMMARY

The 100-F-33 waste site is the former 146-F Aquatic Biology Fish Ponds, located approximately 640 m (2,100 ft) northwest of the 105-F Reactor Building. The fish ponds were located just east of the demolished 146-F Aquatic Biology Laboratory. The site is part of the 100-FR-1 Operable Unit and is listed in the Waste Information Data System database as an area where unplanned releases of reactor cooling water effluent may have occurred.

The 100-F-33 waste site was evaluated during 2004 confirmatory sampling efforts to decide if remedial action would be required at the site. Based on field observations during confirmatory sampling and the results of laboratory analysis of samples collected, it was decided that the northern portion of the site required remediation. The confirmatory sample results for the southern portion of the site, however, did not indicate that residual contaminants were present exceeding cleanup criteria; therefore, this portion of the site did not require remedial action. Remedial actions were performed so as to not preclude any future uses of the site (as bounded by the rural-residential scenario) and to allow unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). Remedial action for the northern portion of the site was initiated on August 5, 2005, and continued through August 8, 2005, with excavation of 2,024 metric tons (2,231 U.S. tons) of material disposed at the Environmental Restoration Disposal Facility.

Following remediation, verification sampling of the excavation and the waste staging area footprint was conducted on January 24, 2006. The results indicated that the waste removal action achieved compliance with the remedial action objectives for the 100-F-33 waste site. 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-33 site in accordance with the TPA-MP-14 (DOE-RL 1998) procedure.

In accordance with this evaluation, the verification sampling and applicable confirmatory 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). 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. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of concern, contaminants of potential concern, and other constituents. Screening levels were not exceeded for the site constituents, with the exception of boron, mercury, 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 vanadium are below site background levels and boron and mercury concentrations are consistent with those seen elsewhere at the Hanford Site (no established background value is available for boron). A baseline risk assessment for the river corridor portion of the Hanford Site began in 2004, which includes a more complete quantitative ecological risk assessment. That baseline risk assessment will be used as part of the final closeout decision for this site.

Table ES-1. Summary of Remedial Action Objectives for the 100-F-33 Site. (2 Pages)

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.	No radionuclide COPCs were detected above single radionuclide dose equivalent lookup values in confirmatory samples. No radionuclide COCs were identified for the 100-F-33 site verification sampling event.	Yes
Direct Exposure Nonradionuclides	Attain individual COC/COPC RAGs.	All individual COC/COPC concentrations are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	All individual hazard quotients are less than 1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotients for both sampling areas (2.9×10^{-1} and 4.7×10^{-2}) are less than 1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk values for individual carcinogens are less than 1×10^{-6}.	
	Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The total excess cancer risk values for both sampling areas (8.6×10^{-7} and 9.6×10^{-8}) are less than 1×10^{-5}.	
Groundwater/River Protection – Radionuclides	Attain single-COC groundwater and river protection RAGs.	No radionuclide COPCs were detected above soil lookup values for groundwater and river protection in confirmatory samples. No radionuclide COCs were identified for the 100-F-33 site verification sampling event.	Yes
	Attain national primary drinking water regulations:[a] 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.		
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide from DOE Order 5400.5.[b]		
	Meet total uranium standard of 21.2 pCi/L.[c]		

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Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Verification sample results for lead, zinc, and aroclor-1254 in the excavated area failed one or more parts of the WAC 173-340 3-part test. Additionally, mercury and aroclor-1254 in the staging pile footprint exceeded groundwater and river protection RAGs. However, RESRAD results (BHI 2005) indicate that these contaminants are not expected to migrate to groundwater or the river in 1,000 years, thus achieving RAOs for protection of groundwater and the river.	Yes

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).
[b] *Radiation Protection of the Public and Environment* (DOE Order 5400.5).
[c] Based on the isotopic distribution of uranium in the 100 Areas, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI 2001a).

COC = contaminant of concern
COPC = contaminant of potential concern
MCL = maximum contaminant level
RAG = remedial action goal
RAO = remedial action objective
RESRAD = RESidual RADioactivity (dose assessment model)
WAC = *Washington Administrative Code*

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-33, 146-F AQUATIC BIOLOGY FISH PONDS

STATEMENT OF PROTECTIVENESS

This report demonstrates that the 100-F-33, 146-F Aquatic Biology Fish Ponds waste site meets the objectives for interim closure as established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 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). 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. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

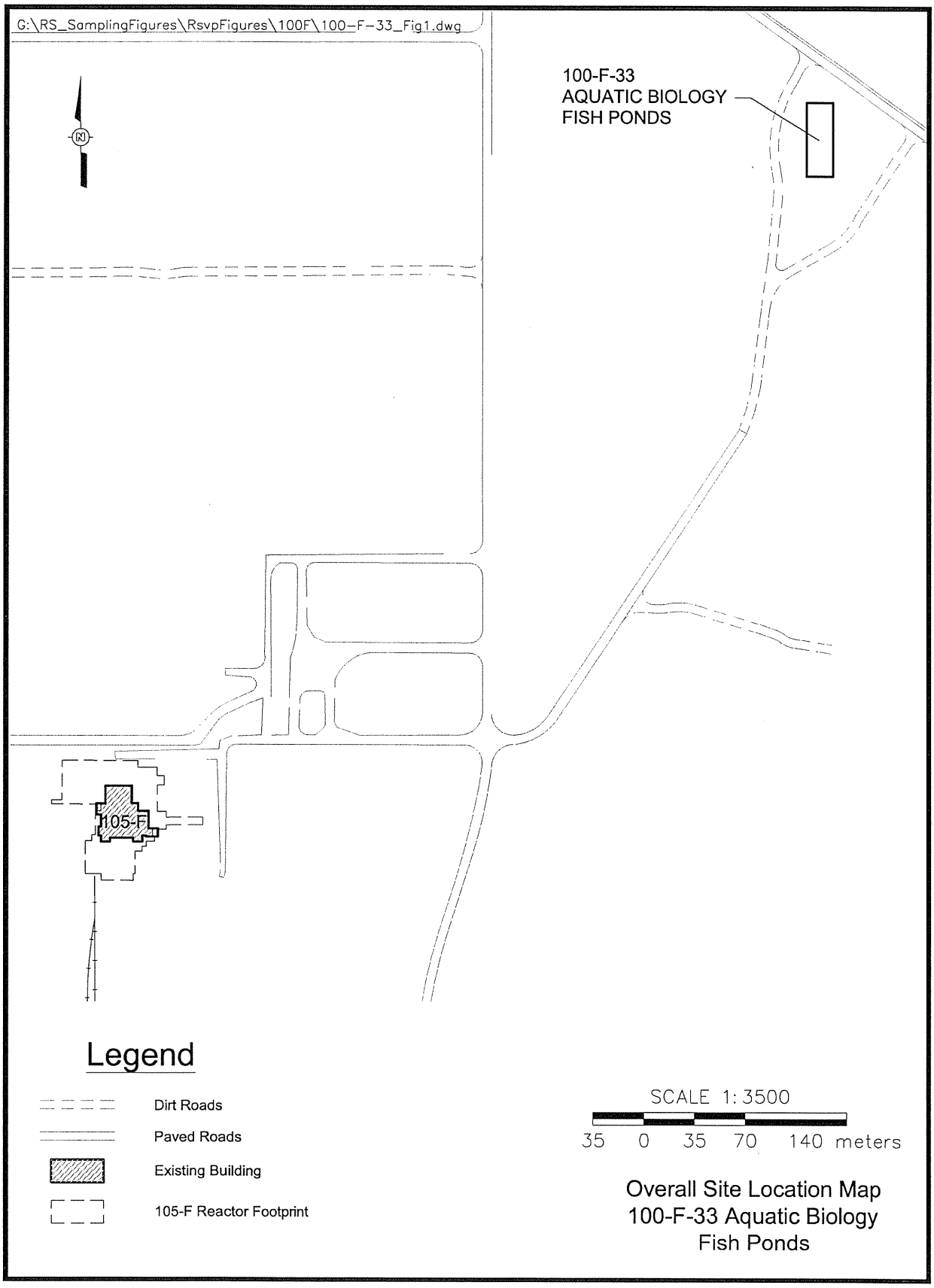
Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of concern, contaminants of potential concern, and other constituents. Screening levels were not exceeded for the site constituents, with the exception of boron, mercury, 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 vanadium are below site background levels and boron and mercury concentrations are consistent with those seen elsewhere at the Hanford Site (no established background value is available for boron). A baseline risk assessment for the river corridor portion of the Hanford Site began in 2004, which includes a more complete quantitative ecological risk assessment. That baseline risk assessment will be used as part of the final closeout decision for this site.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-F-33, 146-F Aquatic Biology Fish Ponds site was located approximately 640 m (2,100 ft) northwest of the 105-F Reactor Building (Figure 1). The site is recorded in the Waste Information Data System (WIDS) (WCH 2005) as an area where unplanned releases of reactor cooling water effluent may have occurred.

The WIDS database describes the configuration of the fish ponds as six small rectangular ponds in a two-by-three matrix, one large circular pond located due south of the smaller ponds, and possibly two larger rectangular ponds located between the six smaller ponds and the circular pond. However, site drawings and historical documentation describe the fish ponds as six small rectangular ponds in a two-by-three matrix, with each pond divided into two halves (each half numbered individually, 1 through 12), a large rectangular pond or trough located just west of the six smaller ponds (number 13), and one large circular pond located due south of the smaller ponds. There is no indication of the existence of the two larger rectangular ponds that are mentioned in the WIDS database text.

Figure 1. 100-F-33 Site Location Map.



Hanford drawing H-1-2898 (GE 1954) is referenced in the WIDS database as showing the addition of three ponds, and there is a note on the drawing commenting that these larger rectangular ponds were not built during 1951-1952 construction. The ponds may never have been constructed. This note likely refers to the two larger rectangular ponds mentioned in the WIDS database for which there is no evidence in site drawings and other historical literature.

The ponds were constructed of reinforced concrete. Each of the six smaller ponds was 3.35 by 2.90 m (11 by 9.5 ft), with a center divider separating the tank into two numbered tanks. The larger rectangular pond was located just to the west, alongside the six small ponds, and had dimensions of 15.5 by 1.83 m (51 by 6 ft). The circular pond, located just south of the others, had a diameter of 9.14 m (30 ft).

These ponds were used for experiments designed to determine the effects of effluent wastewater from the 100-F Area on native fish. The ponds may have at some time contained combinations of Columbia River water, reactor cooling water effluent, sludge from the water purification area, condenser water, refrigeration cooling water, floor drainage containing radioactive substances, and substances used to inhibit corrosion. Laboratory reports also mention the presence of "Calol™," a standard lubricating oil used in the charging/discharging process of the reactor piles, in the area effluent water that was pumped to the ponds. This oil was noted as being very toxic to fish and, although it was only present in the wastewater on days that charging or discharging occurred, it may have reached concentrations of 20 parts per million (GE 1946).

The outer walls of the ponds were removed and the ponds were backfilled in June 1975 (GE 1975). Most of the southern two-thirds of the 100-F-33 site was excavated during remediation of the 1607-F6 septic system (BHI 2001b).

CONFIRMATORY SAMPLING ACTIVITIES

Contaminants of Potential Concern

Contaminants of potential concern (COPCs) for confirmatory sampling were identified from historical information of the 146-F Aquatic Biology Fish Ponds. These contaminants are cobalt-60, cesium-137, europium-152, europium-154, europium-155, plutonium-238, plutonium-239/240, strontium-90, uranium-234, uranium-235, hexavalent chromium, mercury, lead, and polycyclic aromatic hydrocarbons (PAHs) (DOE-RL 2005a).

Based on further site-specific evaluation, arsenic, barium, cadmium, total chromium, selenium, silver, and polychlorinated biphenyls (PCBs) were included as COPCs. Additionally, carbon-14 and nickel-63 were identified as COPCs because of the presence of reactor process water, and petroleum hydrocarbons were added as a COPC because of the repeated mention in historical literature of the presence of "Calol" lubricating oil.

Confirmatory Sample Design

A focused sampling approach was selected for this site, biased toward the worst-case locations for potential contamination. These locations were selected based on historical information, process knowledge, geophysical investigation, and observations during site excavation. Additionally, the previous remediation performed within the southern portion of the site during excavation of the 1607-F6

septic system was taken into consideration to select sample locations. The sample locations are shown in Figure 2 and include the following:

1. Test Trench 1

The purpose of test trench 1 was to sample the soil and buried debris associated with the 12 small ponds and the larger rectangular pond. Several pipes were encountered within the top 1.2 m (4 ft) below ground surface (bgs). Most of these pipes appeared to be steel, with another vitrified clay pipe (most likely a drain line). Also found in test trench 1 were what appeared to be cinder blocks containing mastic material. It is possible that the walls of the fish ponds were made from these cinder blocks. In the western end of the trench, two long rectangular pieces of concrete were found that could have been part of a trough or long, narrow pond. Samples collected from test trench 1 include mastic from the cinder blocks (J01X23, J01VF0); pieces of a red vitrified clay pipe (J01X24, J01VV3); concrete scabbled from the smooth side of one of the long rectangular pieces of concrete (J01X25, J01VV4); soil from directly beneath a bundle of pipes (J01TH2); and native soil, homogenized from 15 aliquots distributed evenly across the trench bottom (J01TH1).

2. Test Trench 2

The purpose of test trench 2 was to allow for sampling of the pipes that brought reactor cooling water effluent to the ponds. The top 1.2 m (4 ft) of the soil profile contained a fill material composed of sand with gravel and some cobbles. Below this layer of fill, the native soil was sand with large, rounded gravel. Numerous pipes were encountered, ranging in diameter from 2.5 to 15.2 cm (1 to 6 in.) and at depths of 0.3 to 1.2 m (1 to 4 ft) bgs. Most of the pipes appeared to be galvanized steel, along with one vitrified clay pipe. Some of the pipes were coated with a black mastic material. Also, several pieces of concrete were encountered throughout the trench and appeared to be anchor blocks associated with the pipes. One large piece of concrete that resembled an over-poured slab or toppled wall was found near the western edge of the trench. Samples collected from test trench 2 include mastic coating from a 15.2-cm (6-in.) pipe (J01X22, J01VD8); pieces of a yellow vitrified clay pipe (J01VD6, J01VV2); a section of 7.6-cm (3-in.) metal pipe (J01XD7); soil from underneath what appeared to be distribution header pipes (J01TH0); a duplicate, for data quality purposes, of sample J01TH0 (J01TH3); and native soil, homogenized from 15 aliquots distributed evenly across the trench bottom (J01TF9).

3. Test Pit 3

The purpose of test pit 3 was to allow for sampling of the soil and buried debris that are believed to be the remains of the circular tank. The concrete bottom of the circular tank was found immediately at a depth of about 1.2 m (4 ft) bgs. A test pit was excavated to locate the edge of the slab, and then the excavation was widened to locate the drain hole at the center. A 15.2-cm (6-in.) drain pipe, about 0.9 m (3 ft) long and attached to a 0.3-m (1-ft) square base plate, was encountered loose in the soil over the slab and was assumed to be an overflow-type drain for the pond. Samples collected from test pit 3 include sediment/soil from within the drain hole (J01TF8), scabbled concrete from the top surface of the concrete slab (J01VD9, J01VV1), and native soil from just below the edge of the slab (J01TF7). Also, a field equipment blank (J01TH4) was also collected for data quality purposes.

Figure 2. Confirmatory Sampling Locations at the 100-F-33 Site.

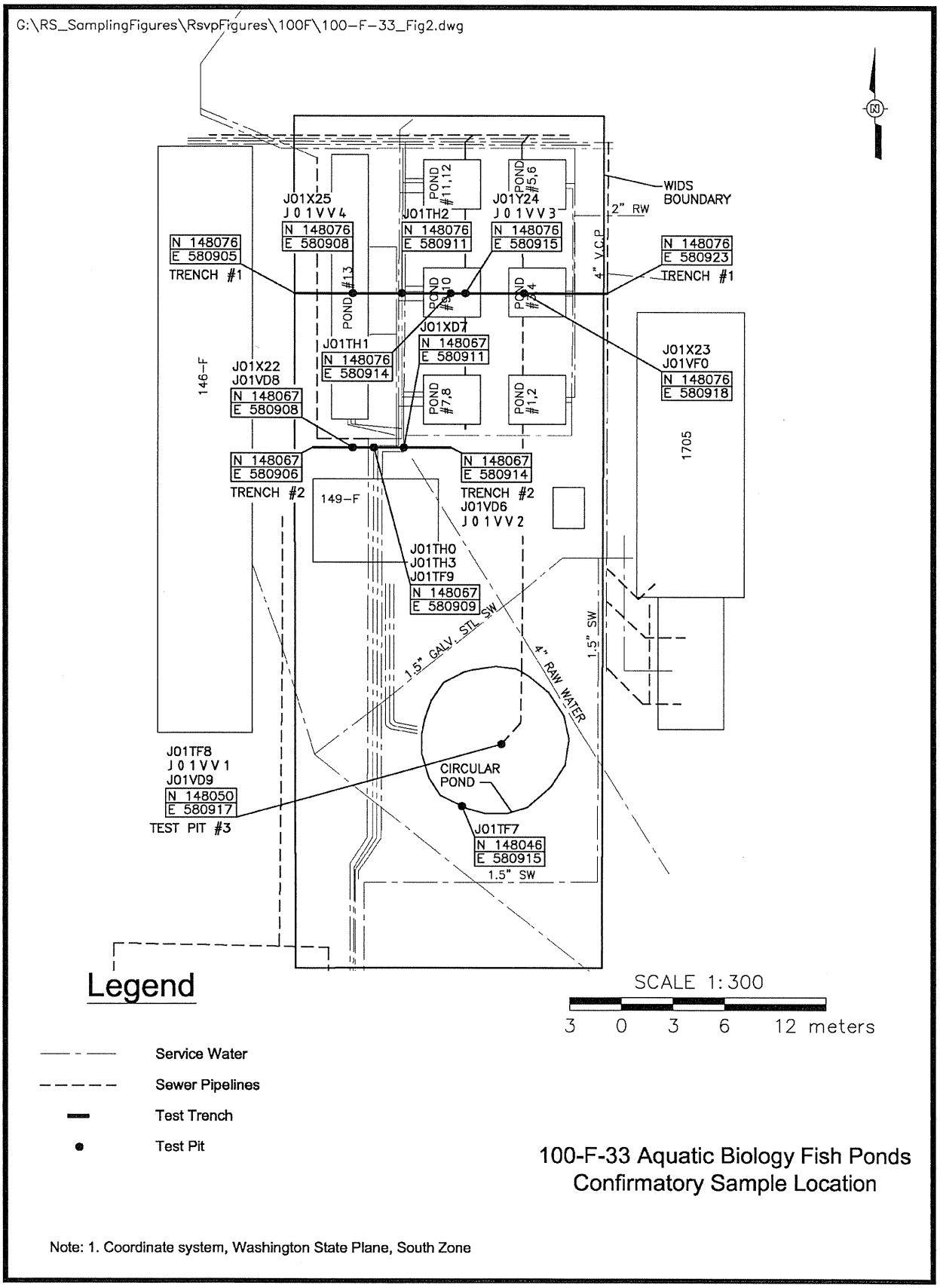


Table 1 provides a summary of the samples that were collected from each sampling location and the analyses that were requested for each sample. Figure 2 identifies the sample locations.

Table 1. Sample Summary Table. (2 Pages)

Sample Location	Sample Media	Sample Number	Coordinate Locations	Depth (m bgs)	Sample Analysis
Test trench 1	Mastic on cinder block	J01X23	N 148076 E 580905 to N 148076 E 580923	0.6 – 1.2	Asbestos
		J01VF0			PAH
	Red VCP	J01X24		3	GEA, C-14, Ni-63, gross alpha, gross beta, ICP metals, mercury, PCB, PAH, TPH
		J01VV3			Hexavalent chromium
	Concrete	J01X25		0.5 – 1.5	GEA, C-14, Ni-63, gross alpha, gross beta, ICP metals, mercury, PCB, PAH, TPH
		J01VV4			Hexavalent chromium
	Soil under pipe distribution headers	J01TH2		1.3	GEA, C-14, Ni-63, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCB, PAH, TPH
	Native soil	J01TH1		1.2 – 3.9	GEA, C-14, Ni-63, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCB, PAH, TPH
Test trench 2	Mastic on 15.2-cm (6-in.) pipe	J01X22	N 148067 E 580906 to N 148067 E 580914	1	Asbestos
		J01VD8			PAH, PCB
	Yellow VCP	J01VD6		1.5	GEA, C-14, Ni-63, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCB, PAH, TPH
		J01VV2			Hexavalent chromium
	7.6-cm (3-in.) pipe section	J01XD7		1.5	GEA, gross alpha, gross beta
	Soil under pipe distribution headers	J01TH0		1.5	GEA, C-14, Ni-63, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCB, PAH, TPH
	Native soil	J01TF9		2	GEA, C-14, Ni-63, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCB, PAH, TPH

Table 1. Sample Summary Table. (2 Pages)

Sample Location	Sample Media	Sample Number	Coordinate Locations	Depth (m bgs)	Sample Analysis
Test pit 3	Soil/ sediment in drain	J01TF8	N 148050 E 580917	1.4	GEA, C-14, Ni-63, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCB, PAH, TPH
	Concrete	J0IVD9		1.2	GEA, C-14, Ni-63, gross alpha, gross beta, ICP metals, mercury, PCB, PAH, TPH
		J01VV1			Hexavalent chromium
	Native soil	J01TF7	N 148046 E 580915	1.5	GEA, C-14, Ni-63, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCB, PAH, TPH
Equipment blank	Silica sand	J01TH4	NA	NA	ICP metals, hexavalent chromium, mercury, PCB
Duplicate	Soil (duplicate of J01TH0)	J01TH3	N 148067 E 580906 to N 148067 E 580913	1.5	GEA, C-14, Ni-63, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCB, PAH, TPH

Source: 100-F Remaining Sites Field Logbook EL-1578-2 (BHI 2004a)

bgs = below ground surface
GEA = gamma energy analysis
ICP = inductively coupled plasma
NA = not applicable
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbon
VCP = vitrified clay pipe

Confirmatory sampling of the 100-F-33 site was conducted in September 2004 per the approved work instruction (BHI 2004b) and as described in the sampler's field logbook (BHI 2004a). Field screening for radioactivity (beta and gamma radiation) and for volatile organic compounds was conducted throughout the sampling activities, but no radioactivity above background or volatile organic compounds were detected at any time.

Confirmatory Sample Results

Confirmatory samples were analyzed using analytical methods approved by the U.S. Environmental Protection Agency (DOE-RL 2005a). The results are stored in the Environmental Restoration (ENRE) project-specific database prior to archiving in the Hanford Environmental Information System (HEIS) and are included in Appendix A.

Evaluation of the confirmatory sample results for each sample location indicated the presence of the following contaminants at concentrations exceeding remedial action goals (RAGs):

- Trench 1: The mastic coating found on the cinderblock debris contained asbestos. Benzo(b)fluoranthene (0.862 mg/kg) was also detected in the mastic at a concentration exceeding the

groundwater and river protection RAGs. Total petroleum hydrocarbons (1,260 mg/kg total) were detected in the soil at this location exceeding the RAGs for protection of groundwater and the Columbia River. Additionally, multiple metals (barium, cadmium, chromium, copper, lead, manganese, mercury, and zinc) and aroclor-1254 were detected in the concrete debris sample at levels slightly exceeding groundwater and/or river protection RAGs. No radionuclides were detected above background.

- Trench 2: The mastic coating found on the pipe in this location contained asbestos. Benzo(a)anthracene (4.92 mg/kg), benzo(a)pyrene (2.90 mg/kg), benzo(b)fluoranthene (6.83 mg/kg), and dibenzo(a,h)anthracene (2.47 mg/kg) were also present in the mastic at concentrations exceeding RAGs for direct exposure and groundwater and river protection. Total petroleum hydrocarbons (5,190 mg/kg total) were detected in the soil at this location exceeding the RAGs for protection of groundwater and the Columbia River. Additionally, lead (13.4 mg/kg), zinc (91 mg/kg), and aroclor-1254 (0.027 mg/kg) were detected in soil at concentrations slightly exceeding groundwater and/or river protection RAGs. No radionuclides were detected above background.

- Test pit 3: collected from the drain associated with the fish pond. Aroclor-1254 (0.094 mg/kg) and zinc (131 mg/kg) were detected in concrete above the groundwater and/or river protection RAGs. Petroleum hydrocarbons, hexavalent chromium, and PAHs were not detected above RAGs. No radionuclides were detected above background levels.

Based on field observations during confirmatory sampling and the results of laboratory analysis of samples collected from trench 1 and trench 2, it was decided that the northern portion of the site required remediation. However, the confirmatory sample results for the southern portion of the site, collected in the area of the circular fish pond (test pit 3), did not indicate that residual contaminants were present exceeding cleanup criteria, and, therefore, it was decided that this portion of the site did not require remedial action.

For the southern portion of the site, several contaminants were present that exceeded the RAGs for groundwater and river protection. However, based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005), a groundwater depth of 114 m (374 ft), a contaminant level of 123 m (404 ft), and an analyte-specific distribution coefficient, these contaminants are not predicted to migrate to groundwater within 1,000 years. Comparisons of the maximum results for COPCs and the site RAGs for samples collected from test pit 3 are summarized in Table 2. Contaminants that were not detected by laboratory analysis are excluded from these tables. Potassium-40, radium-226, radium-228, thorium-228, and thorium-232 were detected in the samples, but are not considered within Table 2. These isotopes are naturally occurring and were detected at levels below statistical background activities (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]). Calculated cleanup levels are not presented in the Model Toxics Control Act Cleanup Levels and Risk Calculations database 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. The laboratory-reported data results for all constituents are stored in the ENRE project-specific database prior to archiving in HEIS and are presented in Appendix A.

Table 2. Comparison of Maximum Values to Action Levels for the Southern Portion of the 100-F-33 Site. (2 Pages)

COPC	Maximum Result (pCi/g)	Generic Site Lookup Values (pCi/g)[a]			Does the Maximum Result Exceed Lookup Value?	Does the Maximum Result Pass RESRAD Modeling?
		Direct Exposure	Concentration in Soil Protective of Groundwater	Concentration in Soil Protective of Columbia River		
Cesium-137	0.597	6.2	1,465[b]	1,465[b]	No	--
Europium-152	0.095	3.3	--[c]	--[c]	No	--
COPC	**Maximum Result (mg/kg)**	**Remedial Action Goals (mg/kg[a])**			**Does the Maximum Result Exceed RAGs?**	**Does RESRAD Indicate Groundwater and River Protectiveness?**
		Direct Exposure	**Concentration in Soil Protective of Groundwater**	**Concentration in Soil Protective of Columbia River**		
Antimony[d]	1.1 (<BG)	32	5[e]	5[e]	No	--
Arsenic	6.4 (<BG)	20	20	20	No	--
Barium	106 (<BG)	5,600[f]	132[e,g]	224[h]	No	--
Beryllium	0.418 (<BG)	10.4[i]	1.51[e]	1.51[e]	No	--
Boron[j]	3.1	16,000	320	--[k]	No	--
Cadmium[d]	0.664 (<BG)	13.9[i]	0.81[e]	0.81[e]	No	--
Chromium, total	13.7 (<BG)	80,000[f]	18.5[e]	18.5[e]	No	--
Cobalt	8.2 (<BG)	1,600	32	--[k]	No	--
Copper	44.2	2,960	59.2	22.0[e]	Yes	Yes[l]
Chromium VI	0.277	2.1	4.8[m]	2	No	--
Lead	14.7	353	10.2[e]	10.2[e]	Yes	Yes[l]
Manganese	347 (<BG)	11,200	512[e]	512[e]	No	--
Mercury	0.034 (<BG)	24	0.33[e]	0.33[e]	No	--
Molybdenum[j]	1.4	400	8	--[k]	No	--
Nickel	11.8 (<BG)	1,600	19.1[e]	27.4	No	--
Vanadium	70.6 (<BG)	560	85.1[e]	--[k]	No	--
Zinc	131	24,000	480	67.8[e]	Yes	Yes[l]
Aroclor-1254	0.17	0.5	0.017[n]	0.017[n]	Yes	Yes[l]

Table 2. Comparison of Maximum Values to Action Levels for the Southern Portion of the 100-F-33 Site. (2 Pages)

COPC	Maximum Result (pCi/g)	Generic Site Lookup Values (pCi/g)[a]			Does the Maximum Result Exceed Lookup Value?	Does the Maximum Result Pass RESRAD Modeling?
		Direct Exposure	Concentration in Soil Protective of Groundwater	Concentration in Soil Protective of Columbia River		
Indeno (1,2,3-cd)pyrene	0.017	1.37	0.030[n]	0.030[n]	No	--
Phenanthrene[o]	0.014	24,000	240	1,920	No	--

[a] Lookup values and RAGs obtained from the RDR/RAWP (DOE-RL 2005b) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.
[b] Activity corresponding to a single radionuclide 15 mrem/yr exposure as calculated using a generic RESRAD model (DOE-RL 2005b).
[c] No value; RESRAD modeling predicts the contaminant will not reach groundwater within 1,000 years (BHI 2005).
[d] Hanford Site-specific background value is not available; not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[e] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996).
[f] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), 1996 (Method B for soils) (as presented in the RDR/RAWP [DOE-RL 2005b]). Updated oral reference dose values (as provided in IRIS) yield Method B direct exposure RAG values of 16,000 mg/kg and 120,000 mg/kg for barium and chromium, respectively.
[g] Barium soil cleanup level for groundwater protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule") and WAC 173-340-720(3), 1996 (Method B for groundwater) is 112 mg/kg (as presented in the RDR/RAWP [DOE-RL 2005b]). The updated oral reference dose value (as provided in IRIS) yields a Method B groundwater cleanup criteria of 7 mg/L, as compared to the more restrictive MCL of 2 mg/L (40 CFR 141). Per WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), the most restrictive updated soil cleanup level for groundwater protection would be 200 mg/kg.
[h] Barium soil cleanup level for river protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), a dilution attenuation factor of 2, and WAC 173-340-720(3), 1996 (Method B for groundwater) is 224 mg/kg (as presented in the RDR/RAWP [DOE-RL 2005b]). No surface water bioconcentration factor is available for barium and no AWQC value exists; therefore, no WAC 173-340-730(3), 1996 (Method B for surface waters) value can be determined.
[i] Carcinogenic cleanup level calculated based on the inhalation exposure pathway per WAC 173-340-750[3], 1996 (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m^3 (WDOH 1997).
[j] No Hanford Site-specific or Washington State background value available.
[k] No cleanup level is available from the Ecology Cleanup Levels and Risk Calculations database (Ecology 2005), and no bioconcentration factor or AWQC values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).
[l] Data were not collected on the vertical extent of contamination; however, based on *100 Area Analogous Site RESRAD Calculations* (BHI 2005), given the soil partitioning coefficient, this constituent would not be expected to migrate more than 1 m (3 ft) vertically in 1,000 years.
[m] Calculated cleanup level (per WAC 173-340-720(3), 1996 [Method B for groundwater] and WAC 173-340-740(3)(a)(ii)(A), 1996 ["100 times rule"]) presented is lower than that presented in the RDR/RAWP (DOE-RL 2005b), based on updated oral reference dose value (as provided in IRIS).
[n] Where cleanup levels are less than the RDL, cleanup levels default to the RDL (WAC 173-340-707[2], 1996 and DOE-RL 2005b).
[o] Toxicity data for this chemical are not available. Cleanup levels for phenathrene are based on the surrogate chemical anthracene.

--	= not applicable background	MCL	= maximum contaminant level (drinking water standard)
AWQC	= ambient water quality criteria	RAG	= remedial action goal
BG	= background	RDL	= required detection limit
CFR	= *Code of Federal Regulations*	RDR/RAWP	= Remedial Design Report/Remedial Action Work Plan
COPC	= contaminant of potential concern	RESRAD	= RESidual RADioactivity (dose assessment model)
IRIS	= Integrated Risk Information System	WAC	= *Washington Administrative Code*

REMEDIAL ACTION SUMMARY

Remedial action of the northern portion of the 100-F-33 was initiated on August 5, 2005, and continued through August 8, 2005, with excavation of 2,024 metric tons (2,231 U.S. tons) of material including concrete debris, piping, and soil. Excavated soil and debris were staged at the site until disposal of the

materials to the Environmental Restoration Disposal Facility (ERDF) occurred from September 19 to September 21, 2005. Radiological surveys were performed over the excavation and staging pile areas using a mobile sodium iodide detector (Figures 3 and 4). The pre- and post-excavation topographic surveys for the 100-F-33 site are provided in Figures 5 and 6, respectively.

As previously discussed, remediation of the southern portion was not performed because confirmatory sample results indicated that residual contaminant concentrations did not exceed RAGs. Additionally, much of the southern portion of the site was remediated during excavation and closeout performed for the 1607-F6 septic system (BHI 2001b). These previously remediated areas are shown in Figure 5.

During the remediation of the northern portion of the 100-F-33 site, in-process samples of excavated soils were collected as needed to support waste characterization and evaluation for disposal. The analytical results for these waste characterization samples are provided in Appendix A.

VERIFICATION SAMPLING ACTIVITIES

Verification sampling for the 100-F-33 site was performed on January 24, 2006, per the approved work instruction (WCH 2005), to collect data to evaluate if the remedial action objectives had been reached. Based on statistical evaluation of the resulting data, the residual contaminant concentrations meet the cleanup criteria specified in the RDR/RAWP (DOE-RL 2005b) and the Remaining Sites ROD (EPA 1999). 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 Concern and Contaminants of Potential Concern

Contaminants of concern (COCs) and COPCs for verification sampling were identified based on the results of confirmatory sampling and are listed in Table 3. These COCs include the constituents that were detected above direct exposure RAGs or dose-equivalence lookup values or above RAGs for the protection of groundwater and river water and that have the potential to migrate to groundwater (and thus the Columbia River) within a 1,000-year time frame based on the *100 Area Analogous Sites RESRAD Calculations* (WCH 2005).

Those metals, semivolatile organic compounds (SVOCs), and polychlorinated biphenyls that were detected above groundwater and/or river protection RAGs during confirmatory sampling but which are not predicted to migrate to groundwater based on the *100 Area Analogous Sites RESRAD Calculations* (WCH 2005) were retained as COPCs for verification sampling. Further, because the inductively coupled plasma (ICP) metals analysis results for confirmatory samples reported only the *Resource Conservation and Recovery Act of 1976*-listed metals, the additional metals from the expanded list of ICP metals (antimony, beryllium, boron, cobalt, copper, manganese, molybdenum, nickel, vanadium, and zinc) were considered as COPCs. SVOCs were also retained as COPCs where detected above the applicable RAGs in confirmatory sampling.

Table 3. Contaminants of Concern and Contaminants of Potential Concern for Verification Sampling at the 100-F-33 Site.

Contaminants of Concern	Contaminants of Potential Concern
Total petroleum hydrocarbons	ICP metals
Benzo(a)anthracene	PCBs
Benzo(a)pyrene	SVOC
Benzo(b)fluoranthene	Mercury
Dibenzo(a,h)anthracene	

ICP = inductively coupled plasma
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compounds

Figure 3. Results of Radiological Survey for the Excavation.

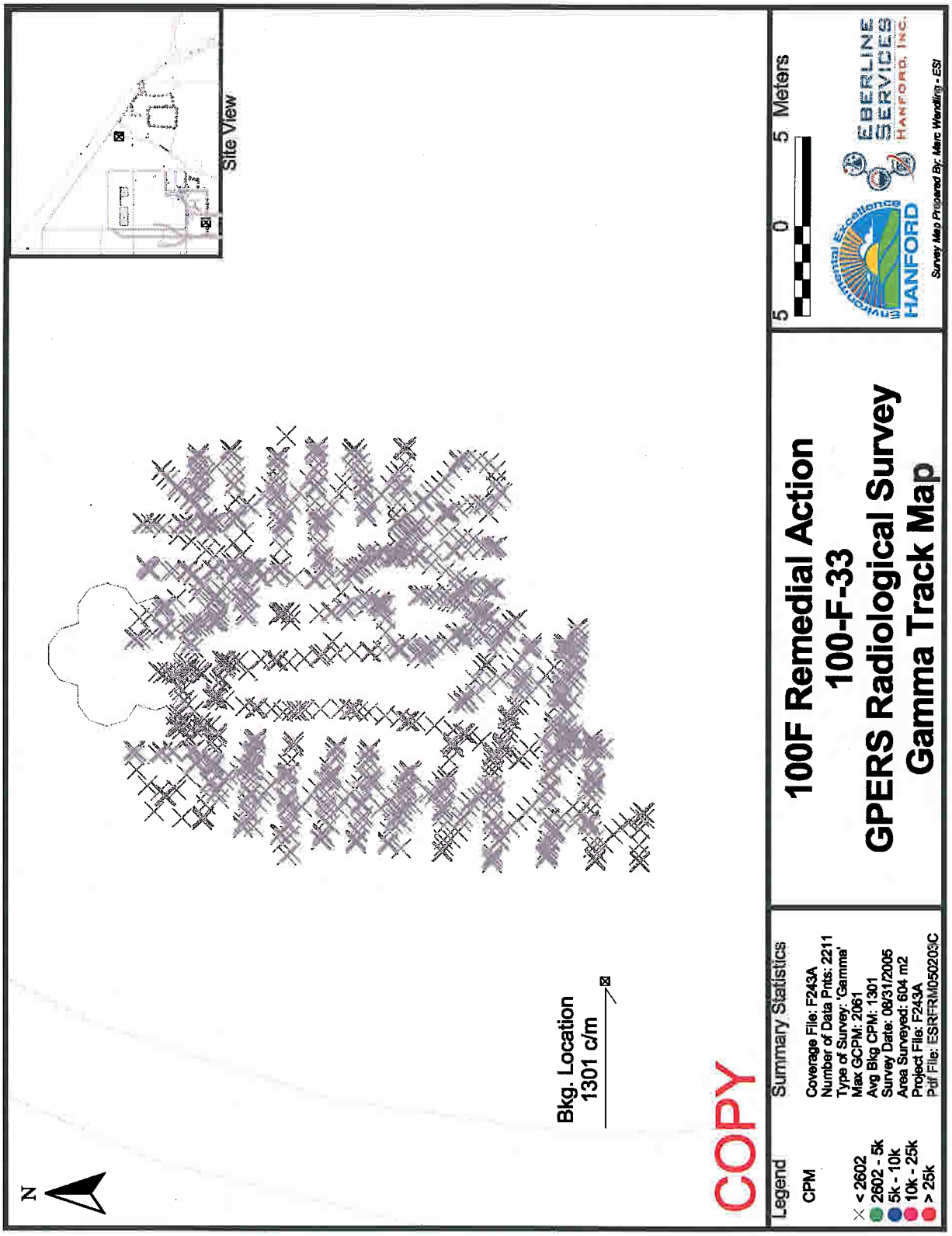


Figure 4. Results of Radiological Survey for the Staging Pile Footprint.

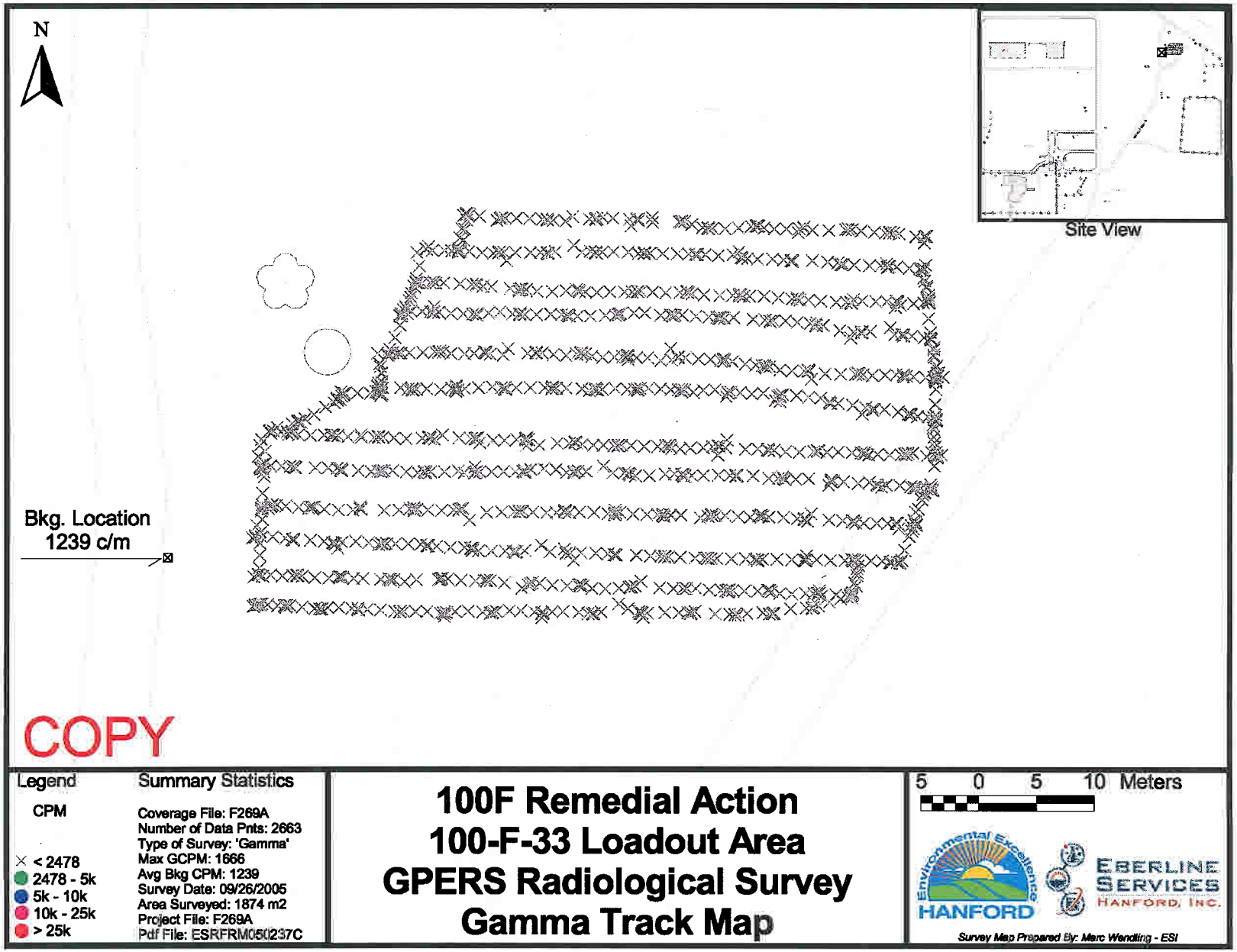

N
Bkg. Location
1239 c/m
Site View
COPY
Legend
CPM
< 2478
2478 - 5k
5k - 10k
10k - 25k
> 25k
Summary Statistics
Coverage File: F269A
Number of Data Pnts: 2663
Type of Survey: 'Gamma'
Max GCPM: 1666
Avg Bkg CPM: 1239
Survey Date: 09/26/2005
Area Surveyed: 1874 m2
Project File: F269A
Pdf File: ESRFRM050237C
100F Remedial Action
100-F-33 Loadout Area
GPERS Radiological Survey
Gamma Track Map
5 0 5 10 Meters
Environmental Excellence
HANFORD
EBERLINE SERVICES
HANFORD, INC.
Survey Map Prepared By: Marc Wendling - ESI

Figure 5. 100-F-33 Pre-Excavation Topographical Survey.

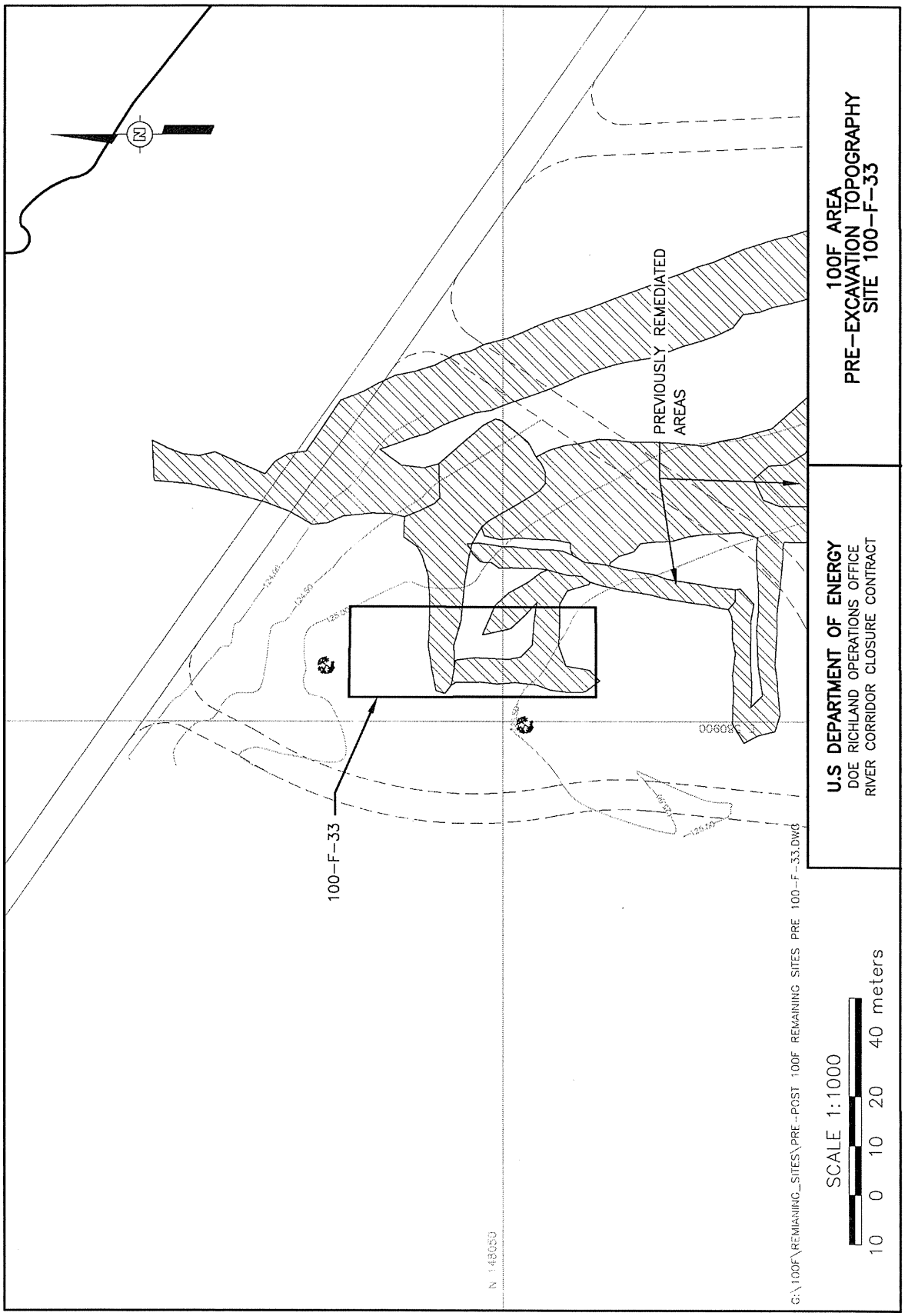
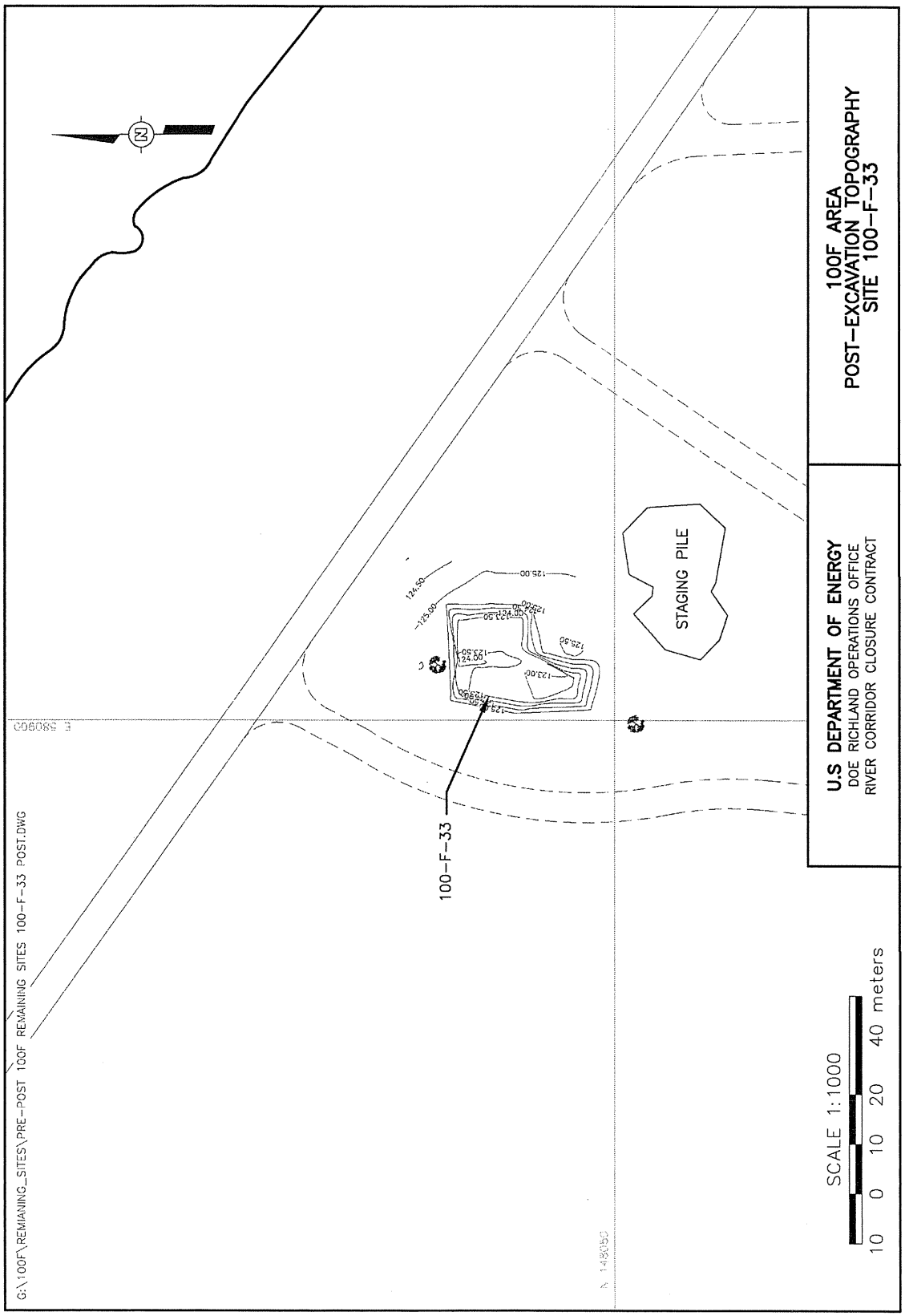


Figure 6. 100-F-33 Post-Excavation Topographical Survey.

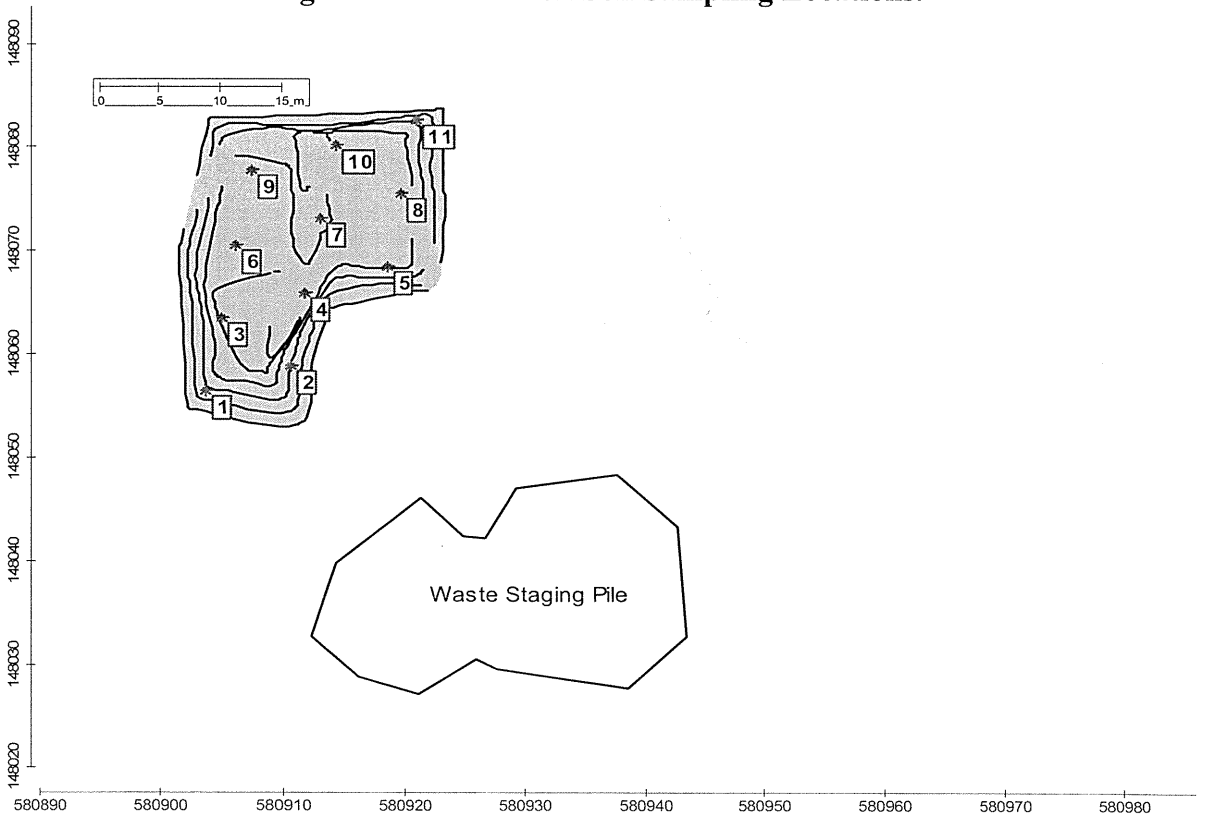


Verification Sampling Design – Excavated Area

The decision rule for demonstrating compliance with the cleanup criteria requires comparison of the true population mean, as estimated by the 95% upper confidence limit (UCL) on the sample mean, with the cleanup level. Therefore, a statistical sampling design was the preferred verification sampling approach for this site because the distribution of potential residual soil contamination over the study area (site) was uncertain. The Washington State Department of Ecology (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 known by Ecology as "area-wide sampling."

The post-excavation topographic survey drawing (Figure 6) was used to determine the area of the decision unit requiring soil verification sampling. The excavation area was delineated in Visual Sample Plan[1] and used as the basis for location of a random-start systematic grid for verification soil sample collection. A total of 11 soil samples were identified on the grid within the remediation footprint (Figure 7). A triangular grid was selected for this investigation based on studies that indicate triangular grids are superior to square grids (Gilbert 1987). A summary of the samples collected during verification sampling and the analysis performed is presented in Table 4. Additional discussion of development of the statistical verification sample design is provided in *Work Instruction for Verification Sampling of the 100-F-33, 146-F Aquatic Biology Fish Ponds* (WCH 2005).

Figure 7. Verification Soil Sampling Locations.



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

Table 4. Verification Sample Summary Table for the 100-F-33 Site.

Sample Location	Sample Media	Sample Coordinates	Depth	HEIS Number	Sample Analysis
1	Soil	N 148056.4 E 580903.7	Surface	J111T4	ICP metals, mercury, PCB, SVOA, TPH
2	Soil	N 148058.9 E 580910.5	Surface	J111T5	ICP metals, mercury, PCB, SVOA, TPH
3	Soil	N 148063.6 E 580904.9	Surface	J111T6	ICP metals, mercury, PCB, SVOA, TPH
4	Soil	N 148066.0 E 580911.7	Surface	J111T7	ICP metals, mercury, PCB, SVOA, TPH
5	Soil	N 148068.5 E 580918.5	Surface	J111T8	ICP metals, mercury, PCB, SVOA, TPH
6	Soil	N 148070.7 E 580906.2	Surface	J111T9	ICP metals, mercury, PCB, SVOA, TPH
7	Soil	N 148073.1 E 580912.9	Surface	J111V0	ICP metals, mercury, PCB, SVOA, TPH
8	Soil	N 148075.6 E 580919.7	Surface	J111V1	ICP metals, mercury, PCB, SVOA, TPH
9	Soil	N 148077.8 E 580907.4	Surface	J111V2	ICP metals, mercury, PCB, SVOA, TPH
10	Soil	N 148080.3 E 580914.2	Surface	J111V3	ICP metals, mercury, PCB, SVOA, TPH
11	Soil	N 148082.7 E 580921.0	Surface	J111V4	ICP metals, mercury, PCB, SVOA, TPH
Duplicate at location 3	Soil	N 148063.6 E 580904.9	Surface	J111V5	ICP metals, mercury, PCB, SVOA, TPH
Equipment blank	Silica sand	NA	NA	J111V6	ICP metals, mercury, SVOA

Source: *Remaining Site Field Sampling*, Logbook EL-1174 (WCH 2006a).
HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
TPH = total petroleum hydrocarbon

Verification Sample Design –Staging Pile Footprint

The excavated material staged on site during remedial activities consisted of soil and debris and was completely disposed at ERDF. There was no potential for contaminant migration into soils underlying the former staging pile; therefore, a statistical sampling design was not warranted for the staging pile footprint and professional judgment was used to develop the sampling design. The sampling consisted of collecting 30 aliquots of soil distributed across the surface of the staging pile footprint and combining into one sample for laboratory analysis.

Verification Sampling Results

Verification samples were analyzed using U.S. Environmental Protection Agency-approved analytical methods. The 95% UCL on the true population mean for residual concentrations of COCs and COPCs was calculated for the remediation footprint as specified by the RDR/RAWP (DOE-RL 2005b), with calculations provided in Appendix B. When a nonradionuclide COC or COPC was detected in fewer than 50% of the verification samples collected, the maximum detected value was used for comparison against RAGs. If no detection for a given COC/COPC was reported in the data set, no statistical evaluation or calculations were performed for that COC/COPC. Evaluation of the verification data from the staging pile footprint was performed by direct comparison of the sample result for each COC/COPC against the cleanup criteria.

Comparisons of the statistical and maximum results for COCs and COPCs and the site RAGs for the remediation footprint (excavation) and staging pile footprint area are summarized in Tables 5a and 5b, respectively. Contaminants that were not detected by laboratory analysis are excluded from these tables. Calculated cleanup levels are not presented in the Model Toxics Control Act Cleanup Levels and Risk Calculations database under WAC 173-340-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium; therefore, these constituents are not considered site COPCs. The laboratory-reported data results for all constituents are stored in the ENRE project-specific database prior to archiving in HEIS and are presented in Appendix B.

Table 5a. Comparison of Statistical Residual Contaminant Concentrations to Remedial Action Goals for the 100-F-33 Waste Site Excavated Area. (2 Pages)

Contaminant of Potential Concern	Statistical Result (mg/kg)	Remedial Action Goals (mg/kg)[a]			Does the Statistical Data Set Exceed RAGs?	Does the Statistical Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	4.5 (<BG)	20	20	20	No	--
Barium	68.3 (<BG)	5,600[b]	132[c,d]	224[e]	No	--
Beryllium	0.03 (<BG)	10.4[f]	1.51[c]	1.51[c]	No	--
Boron[g]	1.7	16,000	320	--[h]	No	--
Cadmium[i]	0.14 (<BG)	13.9[f]	0.81[c]	0.81[c]	No	--
Chromium (total)	9.5 (<BG)	80,000[b]	18.5[c]	18.5[c]	No	--
Cobalt	5.5 (<BG)	1,600	32	--[h]	No	--

Table 5a. Comparison of Statistical Residual Contaminant Concentrations to Remedial Action Goals for the 100-F-33 Waste Site Excavated Area. (2 Pages)

Contaminant of Potential Concern	Statistical Result (mg/kg)	Remedial Action Goals (mg/kg)[a]			Does the Statistical Data Set Exceed RAGs?	Does the Statistical Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Copper	11.6 (<BG)	2,960	59.2	22.0[c]	No	--
Lead	9.9 (<BG)	353	10.2[c]	10.2[c]	No	--
Manganese	258 (<BG)	11,200	512[c]	512[c]	No	--
Mercury	0.05 (<BG)	24	0.33[c]	0.33[c]	No	--
Molybdenum[g]	0.23	400	8	--[h]	No	--
Nickel	10.3 (<BG)	1,600	19.1[c]	27.4	No	--
Vanadium	33.8 (<BG)	560	85.1[c]	--[h]	No	--
Zinc	69	24,000	480	67.8[c]	Yes[j]	Yes[k]
Aroclor-1254	0.36	0.5	0.017[l]	0.017[l]	Yes[j]	Yes[k]
2-Methylnapthalene	0.031	320	3.2	--[h]	No	--
Di-n-butylphthalate	0.030	8,000	160	540	No	--
Napthalene	0.022	1,600	16.0	988	No	--

Table 5a. Comparison of Statistical Residual Contaminant Concentrations to Remedial Action Goals for the 100-F-33 Waste Site Excavated Area. (2 Pages)

Contaminant of Potential Concern	Statistical Result (mg/kg)	Remedial Action Goals (mg/kg)[a]			Does the Statistical Data Set Exceed RAGs?	Does the Statistical Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Phenol	0.019	24,000	960	4,200	No	--

[a] Lookup values and RAGs obtained from the RDR/RAWP (DOE-RL 2005b) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.

[b] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), 1996 (Method B for soils) (as presented in the RDR/RAWP [DOE-RL 2005b]). Updated oral reference dose values (as provided in IRIS) yield Method B direct exposure RAG values of 16,000 mg/kg and 120,000 mg/kg for barium and chromium, respectively.

[c] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996).

[d] Barium soil cleanup level for groundwater protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule") and WAC 173-340-720(3), 1996 (Method B for groundwater) is 112 mg/kg (as presented in the RDR/RAWP [DOE-RL 2005b]). The updated oral reference dose value (as provided in IRIS) yields a Method B groundwater cleanup criteria of 7 mg/L, as compared to the more restrictive MCL of 2 mg/L (40 CFR 141). Per WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), the most restrictive updated soil cleanup level for groundwater protection would be 200 mg/kg.

[e] Barium soil cleanup level for river protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), a dilution attenuation factor of 2, and WAC 173-340-720(3), 1996 (Method B for groundwater) is 224 mg/kg (as presented in the RDR/RAWP [DOE-RL 2005b]). No surface water bioconcentration factor is available for barium and no AWQC value exists; therefore, no WAC 173-340-730(3), 1996 (Method B for surface waters) value can be determined.

[f] Carcinogenic cleanup level calculated based on the inhalation exposure pathway per WAC 173-340-750[3], 1996 (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m^3 (WDOH 1997).

[g] No Hanford Site-specific or Washington State background value available.

[h] No cleanup level is available from the Ecology Cleanup Levels and Risk Calculations database (Ecology 2005), and no bioconcentration factor or AWQC values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).

[i] Hanford Site-specific background value is not available; not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

[j] Statistical data sets for zinc and aroclor-1254 fail one or more components of the WAC 173-340-740(7)(e) three-part test in comparison against soil RAGs for groundwater and/or river protection (Appendix B).

[k] Data were not collected on the vertical extent of contamination; however, based on *100 Area Analogous Site RESRAD Calculations* (BHI 2005) given the soil partitioning coefficient, this constituent would not be expected to migrate more than 3 m (10 ft) vertically in 1,000 years. The vadose zone beneath the 100-F-33 excavated area is approximately 9 m (29 ft) thick.

[l] Where cleanup levels are less than the RDL, cleanup levels default to the RDL (WAC 173-340-707[2], 1996 and DOE-RL 2005b).

-- = not applicable
AWQC = ambient water quality criteria
BG = background
CFR = *Code of Federal Regulations*
IRIS = Integrated Risk Information System
MCL = maximum contaminant level (drinking water standard)
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = *remedial design report/remedial action work plan*
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

Table 5b. Comparison of Maximum Residual Contaminant Concentrations to Remedial Action Goals for the 100-F-33 Staging Pile Area Footprint.

Contaminant of Potential Concern	Maximum Result (mg/kg)	Remedial Action Goals[a] (mg/kg)			Does the Maximum Result Exceed RAGs?	Does the Maximum Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Barium	77.4 (<BG)	5,600[b]	132[c,d]	224[e]	No	--
Boron[f]	2.0	16,000	320	--[g]	No	--
Chromium (total)	9.4 (<BG)	80,000[b]	18.5[c]	18.5[c]	No	--
Cobalt	5.4 (<BG)	1,600	32	--[g]	No	--
Copper	12.5 (<BG)	2,960	59.2	22.0[c]	No	--
Lead	7.3 (<BG)	353	10.2[c]	10.2[c]	No	--
Manganese	250 (<BG)	11,200	512[c]	512[c]	No	--
Mercury	0.38	24	0.33[c]	0.33[c]	Yes	Yes[h]
Molybdenum[f]	0.28	400	8	--[g]	No	--
Nickel	9.9 (<BG)	1,600	19.1[c]	27.4	No	--
Silver	0.17 (<BG)	400	8	0.73[c]	No	--
Vanadium	36.1 (<BG)	560	85.1[c]	--[g]	No	--
Zinc	49.0 (<BG)	24,000	480	67.8[c]	No	--
Aroclor-1254	0.048	0.5	0.017[i]	0.017[i]	Yes	Yes[h]
Di-n-butylphthalate	0.030	8,000	160	540	No	--

Table 5b. Comparison of Maximum Residual Contaminant Concentrations to Remedial Action Goals for the 100-F-33 Staging Pile Area Footprint.

Contaminant of Potential Concern	Maximum Result (mg/kg)	Remedial Action Goals[a] (mg/kg)			Does the Maximum Result Exceed RAGs?	Does the Maximum Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		

Lookup values and RAGs obtained from the RDR/RAWP (DOE-RL 2005b) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.

[b] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), 1996 (Method B for soils) (as presented in the RDR/RAWP [DOE-RL 2005b]). Updated oral reference dose values (as provided in IRIS) yield Method B direct exposure RAG values of 16,000 mg/kg and 120,000 mg/kg for barium and chromium, respectively.

[c] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996).

[d] Barium soil cleanup level for groundwater protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule") and WAC 173-340-720(3), 1996 (Method B for groundwater) is 112 mg/kg (as presented in the RDR/RAWP [DOE-RL 2005b]). The updated oral reference dose value (as provided in IRIS) yields a Method B groundwater cleanup criteria of 7 mg/L, as compared to the more restrictive MCL of 2 mg/L (40 CFR 141). Per WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), the most restrictive updated soil cleanup level for groundwater protection would be 200 mg/kg.

[e] Barium soil cleanup level for river protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), a dilution attenuation factor of 2, and WAC 173-340-720(3), 1996 (Method B for groundwater) is 224 mg/kg (as presented in the RDR/RAWP [DOE-RL 2005b]). No surface water bioconcentration factor is available for barium and no AWQC value exists; therefore no WAC 173-340-730(3), 1996 (Method B for surface waters) value can be determined.

[f] No Hanford Site-specific or Washington State background value available.

[g] No cleanup level is available from the Ecology Cleanup Levels and Risk Calculations database (Ecology 2005), and no bioconcentration factor or AWQC values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).

[h] Data were not collected on the vertical extent of contamination; however, based on *100 Area Analogous Site RESRAD Calculations* (BHI 2005), given the soil partitioning coefficient, this constituent would not be expected to migrate more than 1 m (3 ft) vertically in 1,000 years. The vadose zone beneath the 100-F-33 staging area is approximately 11 m (36 ft) thick.

[i] Where cleanup levels are less than the RDL, cleanup levels default to the RDL (WAC 173-340-707[2], 1996 and DOE-RL 2005b).

-- = not applicable
AWQC = ambient water quality criteria
BG = background
IRIS = Integrated Risk Information System
MCL = maximum contaminant level (drinking water standard)
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

DATA EVALUATION

When using a statistical sampling approach, a requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test, which consists of the following criteria: (1) the cleanup verification statistical value must be less than the cleanup level, (2) no single detection can exceed two times the cleanup criteria, and (3) the percentage of samples exceeding the cleanup criteria must be less than 10%. The results of the WAC 173-340 three-part test are documented in the 95% UCL calculation provided in Appendix B and in Table 5a. Where statistical values default to maximum values due to data censorship, as is the case for several analytes in the 100-F-33 verification data set, the three-part test is not performed, as direct comparison of the maximum values against RAGs is used as the compliance basis.

Statistical results for lead, zinc, and aroclor-1254 in the excavated area failed one or more parts of the WAC 173-340 three part test. Data were not collected on the vertical extent of contamination, but, given the soil-partitioning coefficient for lead (30 mL/g), zinc (30 mL/g), and aroclor-1254 (75.6 mL/g), these contaminants would not be expected to migrate more than 3 m (10 ft) vertically in 1,000 years, based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005). The vadose zone beneath the 100-F-33 excavated area is approximately 9 m (29 ft) thick.

Residual concentrations of mercury and aroclor-1254 in the staging pile footprint slightly exceed soil RAGs for groundwater and river protection. Data were also not collected on the vertical extent of contamination for the waste staging area, but, given the soil-partitioning coefficient of mercury and aroclor-1254 (30 mL/g and 75.6 mL/g, respectively), these contaminants would not be expected to migrate more than 3 m (10 ft) vertically in 1,000 years (BHI 2005). The vadose zone beneath the 100-F-33 staging pile footprint is approximately 11 m (36 ft) thick.

Nonradionuclide risk requirements for the 100-F-33 site 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 carcinogenic risk of less than 1×10^{-5}. These risk values were not calculated for constituents that were not detected. All individual hazard quotients for noncarcinogenic constituents were less than 1.0 (Appendix C). The cumulative hazard quotients for the noncarcinogenic constituents at the 100-F-33 site are 2.9×10^{-1} for the waste site footprint and 4.7×10^{-2} for the staging pile footprint. All individual carcinogen risk values for carcinogenic constituents in the waste site footprint were less than 1×10^{-6} (Appendix C), with a cumulative carcinogenic risk level of 8.6×10^{-7}, which satisfies the cumulative cancer risk limit of 1×10^{-5}. The individual carcinogenic risk value for aroclor-1254, the sole carcinogenic constituent in the staging pile footprint, is 9.6×10^{-8}, thus satisfying the individual cancer risk limit of 1×10^{-6} and cumulative cancer risk limit of 1×10^{-5}.

DATA QUALITY ASSESSMENT

Confirmatory Sampling Data Quality Assessment

A data quality assessment (DQA) was performed to compare the sampling approach and analytical data with the sampling and data requirements specified in the site-specific work instruction (BHI 2004b). This DQA was performed in accordance with ENV-1, *Environmental Monitoring and Management.* Specific data quality objectives for the site are found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2005a). A review of the work instruction, the field logbook

(BHI 2004a), and applicable analytical data packages has been performed as part of this DQA. 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 confirmatory sample design allowed for the collection of additional samples of potentially contaminated debris and stained soil if found during excavation to support site characterization. As a result, six additional samples were collected. All samples were collected per the sample design *Work Instruction for 100-F-33, 146-F Aquatic Biology Fish Ponds* (BHI 2004a). Data from samples collected at the 100-F-33 site were provided by the laboratories in sample delivery groups (SDGs) H2746, H2747, H2749, H2752, H2759, D00420, and W04400.

The work instruction for confirmatory sampling lists carbon-14, nickel-63, gamma spectroscopy (GEA), gross alpha, gross beta, hexavalent chromium, inductively coupled plasma (ICP) metals, mercury, TPH, PCBs, and PAHs as analytical constituents for the confirmatory sampling of 100-F-33. No major deficiencies were found in the data. Minor deficiencies in each SDG are discussed below.

SDG H2746:

SDG H2746 consisted of samples J01VD6, J01VD8, J01VD9, and J01VF0. Sample J01VF0, a sample of mastic on a cinder block, was analyzed for PAHs only. Samples J01VD6, J01VD8, and J01VD9 were of vitrified clay pipe, sediment, and concrete, respectively.

Post-digestion spikes and serial dilutions were performed in the ICP metals analysis on aluminum, calcium, iron, manganese, and silicon because the matrix spike (MS) result for these analytes did not fall within the acceptance criteria. The post-digestion spike and serial dilution results were all within criteria. The data are useable for decision-making purposes.

Matrix spike sample recovery results for three ICP metals (aluminum, calcium, silicon) were above the 70% to 130% range. The known additions, or spikes, in these samples are added before the native concentrations of these analytes are known. In the case of the three analytes listed above, the spike is small relative to the native concentration. The analytical variability and natural heterogeneity of the native sample overwhelmed the known additions, making the calculation of the percent recoveries misleading. Post-digestion spikes and serial digestions of these analytes, performed at meaningful concentrations, were within criteria. The laboratory control sample (LCS) recovery results were also within the accepted limits. The data are useable for decision-making purposes.

The relative percent differences (RPDs) for eight ICP metal analytes were above the 30% acceptance criteria (aluminum 40.3%, chromium 90.3%, iron 44.1%, magnesium 46.3%, magnesium 46%, manganese 41%, vanadium 32.9%, and zinc 46.6%). Elevated RPDs are attributed to natural heterogeneity in the sample matrixes. The data are useable for decision-making purposes.

The method detection limit (MDL) in the TPH analysis method blank (MB) was above the required detection limit (RDL) (5 mg/kg) at 33.3 mg/kg. Although the MDL is greater than the RDL, this result is acceptable because the RAG for TPH is much greater than the MDL or the RDL at 200 mg/kg. The data are useable for decision-making purposes.

Samples J01VF0 and J01VD8 in the PAH analysis required a 10- and 20-fold dilution, respectively. High concentrations of target analytes were cited by the laboratory as the cause for the dilutions. The dilutions resulted in MDLs for nondetected analytes that exceed the RDLs. The portion of the site from which these samples were collected was remediated, and PAHs were retained for verification sampling.

Dilutions were also required in the PCB analysis of sample J01VD8 and the MSs. The MDL results exceeded all the RDLs. PCBs were retained for verification sampling.

SDG H2747:

SDG H2747 consisted of samples J01TF7, J01TF8, J01TF9, J01TH0, J01TH1, J01TH3, and J01TH4. Sample J01TH3 is the field duplicate of sample J01TH0. Sample J01TH4 is the equipment blank. There were no issues with the equipment blank. An evaluation of sample J01TH0 and its duplicate, sample J01TH3, found elevated RPDs for most analytes. The field duplicate results are attributed to naturally occurring (unavoidable) heterogeneities in the sample matrixes. The data are useable for decision-making purposes.

In the gamma analysis, europium-152 and europium-154 had elevated minimum detectable activities (MDAs) in some of the samples such that the MDAs were greater than the RDLs. However, the MDAs remain less than one-fifth of the action levels and are, therefore, acceptable. The data are useable for decision-making purposes.

In the PAH analysis, 2 out of 10 surrogate recoveries were above the acceptance criteria. Elevated surrogate results may suggest a high bias in the sample data, which is acceptable for the intended purposes. The data are useable for decision-making purposes.

Calcium, sodium, silicon, and zinc were detected in the ICP metals MB. The analytical results for these analytes in sample J01TH4 (equipment blank) were less than 20 times greater than the MB results. In samples J01TF7, J01TF9, and J01TH0, the analytical results for silicon were less than the MB result. These results suggest a high bias in these samples for the analytes listed. A high bias in the sample is acceptable for the intended purpose of the data. The data are useable for decision-making purposes.

SDG H2749:

SDG H2749 consisted of samples J01X24 and J01X25. Samples J01X24 and J01X25 were of vitrified clay pipe and concrete, respectively.

In the ICP metals analysis, a continuing calibration verification (CCV) sample result for calcium was above the acceptance criteria (90% to 110%) at 111.1%. This CCV was associated only with the laboratory quality control samples. The CCVs associated with the field samples were within criteria. The data are useable for decision-making purposes.

MS sample recovery results for three ICP metals (aluminum, iron, and manganese) were above the acceptance criteria. Post-digestion spikes and serial digestions of these analytes, performed at meaningful concentrations, were within criteria. The LCS recovery results were also within the accepted limits. The data are useable for decision-making purposes.

Most of laboratory duplicate results in the ICP metals analysis were above the RPD criteria. The elevated RPDs generally fall in the range of 40% to 90%. This type of uniform increase in the RPDs is slightly different than the naturally occurring heterogeneity usually observed. Sample J01X24 (vitrified clay pipe) was used to prepare the laboratory duplicate. It is likely that either the sample or the duplicate had more essentially inert material than the other, causing a generally uniform difference in the analytical results. Most of the analytical results were also near the detection limit, which also causes an increase in the observed RPDs. The ICP metals sample data should be considered estimated but are still useable for decision-making purposes.

The MDL in the TPH analysis MB was above the RDL (5 mg/kg) at 33.3 mg/kg. Although the MDL is greater than the RDL, this result is acceptable because the RAG for TPH is still greater at 200 mg/kg. The data are useable for decision-making purposes.

SDG H2752:

SDG H2752 consisted of sample J01XD7, a pipe sample from trench 2, and analyzed for gross alpha, gross beta, and by GEA.

In the GEA, no laboratory duplicate sample was prepared because of a lack of sample volume. As an alternative, the laboratory analyzed the sample twice. The data are useable for decision-making purposes.

SDG H2759:

SDG H2759 consisted of sample J01TH2, a soil sample from trench 1.

In the PCB analysis, 2 out of 10 surrogate recoveries were above the acceptance criteria. Elevated surrogate results may suggest a high bias in the sample data. There were no detected analytes in the field samples, so a high bias has no effect on the sample data. The data are useable for decision-making purposes.

In the PCB analysis, four MS or MSD recoveries were outside of the acceptance range. In each case, either the MS or the MSD was within criteria. This result is attributed to natural heterogeneity in the sample matrix. The data are useable for decision-making purposes.

In the ICP metals analysis, a CCV sample result for calcium was above the acceptance criteria (90% to 110%) at 111.1%. This CCV was only associated with the LCSs. The CCVs associated with the field samples were within criteria. The data are useable for decision-making purposes.

MS sample recovery results for five ICP metal (aluminum, calcium, iron, antimony, and silicon) were outside of the acceptance criteria. Post-digestion spikes and serial digestions of these analytes, performed at meaningful concentrations, were within criteria. The LCS recovery results were also within the accepted limits. The data are useable for decision-making purposes.

The MS recovery in the TPH analysis was low at 1.4%. The TPH data for this data set are considered estimated, and TPH will be retained for verification sampling.

SDG D00420:

SDG D00420 consisted of sample J01X23, which was mastic on a cinder block that was analyzed for asbestos. There were no issues with the asbestos analysis.

SDG W04400:

SDG W04400 consisted of samples J01VV1, J01VV2, J01VV3, and J01VV4. Samples J01VV1 and J01VV4 were concrete, and the remaining two samples were vitrified clay pipe. These samples were all analyzed for hexavalent chromium.

SDG W04400 was analyzed in two batches. One of the two batches included samples J01VV1 and J01VV2. Sample J01VV1, a sample of concrete found in test pit 3, was used to prepare the MS and matrix spike duplicate for this batch. The MS and matrix spike duplicate were below acceptance criteria at 22.6% and 24.8%. A concrete sample is not an ideal matrix for hexavalent chromium spikes. Concrete is alkaline in nature with a primary component being lime. Under alkaline conditions, hexavalent chromium is known to undergo conversion to trivalent chromium and often precipitate as the hydroxide (Palmer and Puls 1994). Sample preparation would have involved crushing the concrete, making the surface area (and reactive potential) much higher than in the original sample. Therefore, low recoveries in this MS would be expected and do not indicate a problem with the analytical equipment or procedures. Under these reactive conditions, it is expected, and confirmed in the data, that hexavalent chromium would not be found in the native sample of concrete. The LCS is not prepared with the matrix and is within the acceptance criteria. The data are useable for decision-making purposes.

Several samples were analyzed within 48 hours past the holding time. The slightly exceeded holding time does not adversely affect the data. The data are useable for decision-making purposes.

The RPD was above acceptance criteria in the duplicate analysis of hexavalent chromium. High RPDs are the result of natural sample heterogeneity. These analyses were also performed near the MDL where analytical variability is highest. The data are useable for decision-making purposes.

Hexavalent chromium was detected in the MB. This suggests a high bias in the sample data. High biased data is acceptable for the intended purposes. The data are useable for decision-making purposes.

Conclusion:
Limited, random, or sample matrix-specific influenced batch quality control issues such as these are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses conducted. The confirmatory DQA review for the 100-F-33 site found the results to be accurate within the standard errors associated with the methods, including sampling and sample handling. It is therefore concluded that the 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 quality assurance and quality control deficiencies. All analytical data were found to be acceptable for decision-making purposes. The confirmatory sample analytical data are stored in the ENRE project-specific database prior to archiving in HEIS and are summarized in Appendix A.

Verification Sampling Data Quality Assessment

A DQA was performed to compare the sampling approach and analytical data with the sampling and data requirements specified in the site-specific work instruction (WCH 2005). This DQA was performed in accordance with ENV-1 Environmental Monitoring and Management. Specific data quality objectives for the site are found in the SAP (DOE-RL 2005a).

The statistical sample design in the verification sampling work instruction was partially based on assumptions about the standard deviation and distribution of residual contaminants (WCH 2005). Examination of the verification data set shows that the assumptions made were conservative; the sample design is, therefore, valid.

A review of the work instruction (WCH 2005), the field logbook (WCH 2006a), and applicable analytical data packages has been performed as part of this DQA. To ensure quality data, the SAP (DOE-RL 2005a) data assurance requirements as well as the 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 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).

All samples were collected per the sample design (WCH 2005). Data from samples collected at the 100-F-33 site were provided by the laboratory in SDG K0193, and third-party validation was performed on this SDG (WCH 2006b).

The work instruction lists ICP metals, mercury, TPH, PCBs, and semivolatile organic compounds as analytical constituents for the verification sampling of the 100-F-33 waste site. No major deficiencies were found in the data. Minor deficiencies are discussed below.

SDG K0193

SDG K0193 consisted of 14 samples from the 100-F-33 site: J111T4, J111T5, J111T6, J111T7, J111T8, J111T9, J111V0, J111V1, J111V2, J111V3, J111V4, J111V5, J111V6, and J111V7. Sample J111V5 is the field duplicate of sample J111T6. RPDs for the field duplicate pair were calculated, as needed, in the 95% UCL calculation presented in Appendix B. No issues were found with respect to the field duplicate pair. Sample J111V6 is the equipment (field) blank, of which no issues were found.

ICP metals analysis: The analytes barium, manganese, magnesium, lead, vanadium, and zinc were found at trace levels in the MB. There is no impact on the field sample data. No qualifiers were assigned by third-party validation. The MS recoveries for lead and antimony were 141.5% and 56.2%, respectively, and third-party validation qualified all of these samples as estimates with a "J."

TPH analysis: All of the samples were nondetect at a concentration above the required quantitation limit, but below the lowest RAG. No third-party qualifications were assigned.

PCB analysis: The MS/MSD results for aroclor-1260 were reported with no value, but flagged as "I." The "I" flag is assigned by the laboratory when an analyte had been interfered with. Third-party validation assigned a "J" qualifier to all of the PCB results in SDG K0193 except for the aroclor-1016 results, which had good MS/MSD recoveries.

SVOC analysis: The analyte 4,6-dinitro-2-methylphenol had low MS/MSD recoveries at 14% and 33%, respectively, and third-party validation qualified all of the samples as estimates with a "J". The analyte

bis(2-ethylhexyl)phthalate was found in all of the samples at values ranging from 0.037 mg/kg to 0.079 mg/kg. It was also found in the method blank at 0.041 mg/kg. All of the sample results were qualified "J" as estimates by the laboratory. These values are below the RAGs. Third-party validation requalified all of the samples as nondetects with a "U" flag and raised the reporting level to the required quantitation limit (i.e., 660 µg/kg).

Conclusion:
Limited, random, or sample matrix-specific influenced batch quality control issues such as these are a potential for any analysis. The number and types seen in these data sets were within expectations for the matrix types and analyses performed. The DQA review for the 100-F-33 site found the results to be accurate within the standard errors associated with the methods, including sampling and sample handling. It is therefore, concluded that the 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 quality assurance and quality control deficiencies. All analytical data were found acceptable for decision-making purposes. The verification sample analytical data are stored in the ENRE project-specific database prior to archiving in HEIS and are summarized in Appendix B.

SUMMARY FOR INTERIM CLOSURE

The 100-F-33 Aquatic Biology Fish Ponds waste site has been evaluated and remediated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2005b). The confirmatory sample results for the southern portion of the site did not indicate that residual contaminants were present exceeding cleanup criteria and, therefore, this portion of the site did not require remedial action. Because of the presence of ICP metals, mercury, PCBs, semivolatile organic compounds, and TPH at concentrations exceeding RAGs and visual observations of debris during confirmatory sampling in the northern portion of the site, approximately 2,024 metric tons (2,231 U.S. tons) of material was removed and disposed at ERDF. Sampling to verify the completeness of remediation was performed, and analytical results were shown to meet the cleanup objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the verification and confirmatory sampling results support a reclassification of the 100-F-33 site to interim closed out. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

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APPENDIX A

CONFIRMATORY, IN-PROCESS, AND WASTE CHARACTERIZATION SAMPLING RESULTS

Note: This appendix contains the sample results for the 100-F-33 waste site that led to a decision that remediation was necessary. Verification sampling results and calculations to support site closeout are provided in Appendix B.

Table A-1. 100-F-33 Confirmatory Sample Results. (6 Pages)

Sample Location	HEIS Number	Sample Date	Americium-241 GEA			Carbon-14			Cesium-137			Cobalt-60			Europium-152			Europium-154		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Test Pit 3 Soil	J01TF7	09/23/04	0.12	U	0.12	-1.18	UJ	3.4	0.187		0.037	0.037	U	0.037	0.095		0.069	0.13	U	0.13
Test Pit 3 Soil	J01TF8	09/23/04	0.04	U	0.04	-0.803	UJ	3.2	0.01	U	0.01	0.015	U	0.015	0.018	U	0.018	0.044	U	0.044
Test Trench 2 Soil	J01TF9	09/24/04	0.041	U	0.041	-0.416	UJ	3.4	0.037	U	0.037	0.04	U	0.04	0.099	U	0.099	0.14	U	0.14
Test Trench 2 Soil	J01TH0	09/24/04	0.29	U	0.29	-1.28	UJ	2.8	0.063	U	0.063	0.038	U	0.038	0.099	U	0.099	0.12	U	0.12
Test Trench 1 Soil	J01TH1	09/24/04	0.055	U	0.055	-0.962	UJ	3.4	0.014	U	0.014	0.016	U	0.016	0.035	U	0.035	0.057	U	0.057
Test Trench 1 Soil	J01TH2	09/28/04	0.24	U	0.24	-2.54	U	3.9	0.03	U	0.03	0.029	U	0.029	0.072	U	0.072	0.11	U	0.11
Duplicate of J01TH0	J01TH3	09/24/04	0.044	U	0.044	-0.21	UJ	3	0.06		0.039	0.044	U	0.044	0.11	U	0.11	0.15	U	0.15
Test Trench 2 Pipe	J01VD6	09/24/04	0.27	U	0.27	-0.171	U	3.8	0.09	U	0.09	0.11	U	0.11	0.22	U	0.22	0.32	U	0.32
Test Pit 3 Concrete	J01VD9	09/24/04	0.1	U	0.1	-1.07	U	3.3	0.597		0.03	0.034	U	0.034	0.063	U	0.063	0.071	U	0.071
Test Trench 1 Pipe	J01X24	09/27/04	0.37	U	0.37	0.702	U	3.2	0.079	U	0.079	0.071	U	0.071	0.19	U	0.19	0.21	U	0.21
Test Trench 1 Concrete	J01X25	09/27/04	0.087	U	0.087	0.974	U	2.5	0.036	U	0.036	0.038	U	0.038	0.093	U	0.093	0.15	U	0.15

Notes and acronyms apply to all tables in this appendix.

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

C = blank contamination

GEA = gamma energy analysis

HEIS = Hanford Environmental Information System

J = estimate

MDA = minimum detectable activity

PQL = practical quantitation limit

Q = qualifier

TPH = total petroleum hydrocarbon

U = undetected

Table A-1. 100-F-33 Confirmatory Sample Results. (6 Pages)

Sample Location	HEIS Number	Sample Date	Europium-155			Gross alpha			Gross beta			Nickel-63			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
Test Pit 3 Soil	J01TF7	09/23/04	0.087	U	0.087	9.09		3.3	21.2		6.9	-0.474	UJ	3.9	14.7		0.26	0.559		0.053
Test Pit 3 Soil	J01TF8	09/23/04	0.26	U	0.26	8.67		4.5	17.8		6.1	0.595	UJ	3.5	0.15	U	0.15	0.016	U	0.016
Test Trench 2 Soil	J01TF9	09/24/04	0.071	U	0.071	6.4		2.8	20.9		5.6	-0.611	UJ	3.9	10.8		0.35	0.091	U	0.091
Test Trench 2 Soil	J01TH0	09/24/04	0.13	U	0.13	4.69		2.7	23.6		5.4	-0.41	UJ	3.8	14.8		0.41	0.579		0.073
Test Trench 1 Soil	J01TH1	09/24/04	0.045	U	0.045	8.06		3.2	20.9		5.8	0.887	UJ	4.3	15.2		0.13	0.493		0.026
Test Trench 1 Soil	J01TH2	09/28/04	0.11	U	0.11	4.51		2.7	21.4		5.5	2.25	U	3.4	15.5		0.32	0.504		0.052
Duplicate of J01TH0	J01TH3	09/24/04	0.076	U	0.076	7.45		3.6	19.5		6.5	-0.078	UJ	6.5	11.4		0.37	0.097	U	0.097
Test Trench 2 Pipe	J01VD6	09/24/04	0.24	U	0.24	25.4		2.7	29.2		5.5	-0.316	U	4.2	13.8		1	1.63		0.22
Test Trench 2 Pipe	J01XD7	09/24/04	0.031	U	0.031	0.062	U	0.31	0.055	U	0.54				0.560		0.11	0.039	U	0.018
Test Pit 3 Concrete	J01VD9	09/24/04	0.063	U	0.063	9.49		2.8	15.4		5.4	1.32	U	3.6	6.84		0.23	0.335		0.046
Test Trench 1 Pipe	J01X24	09/27/04	0.2	U	0.2	13.8		2.4	24		5.1	-0.709	U	5.4	10.7		0.6	1.38		0.14
Test Trench 1 Concrete	J01X25	09/27/04	0.086	U	0.086	6.45		2.9	14		5.4	0.471	U	4.9	8.89		0.35	0.43		0.078

Sample Location	HEIS Number	Sample Date	Radium-228			Thorium-228 GEA			Thorium-232 GEA			Uranium-235 GEA			Uranium-238 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Test Pit 3 Soil	J01TF7	09/23/04	0.768		0.13	0.654		0.036	0.768		0.13	0.11	U	0.11	4.1	U	4.1
Test Pit 3 Soil	J01TF8	09/23/04	0.044	U	0.044	0.007	U	0.007	0.044	U	0.044	0.019	U	0.019	1.4	U	1.4
Test Trench 2 Soil	J01TF9	09/24/04	0.2	U	0.2	0.662		0.054	0.2	U	0.2	0.12	U	0.12	4.6	U	4.6
Test Trench 2 Soil	J01TH0	09/24/04	0.888		0.16	0.69		0.041	0.888		0.16	0.15	U	0.15	4.7	U	4.7
Test Trench 1 Soil	J01TH1	09/24/04	0.736		0.07	0.616		0.018	0.736		0.07	0.042	U	0.058	1.9	U	1.9
Test Trench 1 Soil	J01TH2	09/28/04	0.786		0.14	0.648		0.034	0.786		0.14	0.12	U	0.12	3.8	U	3.8
Duplicate of J01TH0	J01TH3	09/24/04	0.26	U	0.26	0.701		0.06	0.26	U	0.26	0.13	U	0.13	4.7	U	4.7
Test Trench 2 Pipe	J01VD6	09/24/04	2.25		0.49	1.78		0.1	2.25		0.49	0.37	U	0.37	12	U	12
Test Trench 2 Pipe	J01XD7	09/24/04	0.046	U	0.048	0.016	U	0.017	0.046	U	0.048	0.047	U	0.047	1.3	U	1.3
Test Pit 3 Concrete	J01VD9	09/24/04	0.402		0.089	0.306		0.029	0.402		0.089	0.082	U	0.082	2.6	U	2.6
Test Trench 1 Pipe	J01X24	09/27/04	1.3		0.32	1.41		0.083	1.3		0.32	0.26	U	0.26	8.6	U	8.6
Test Trench 1 Concrete	J01X25	09/27/04	0.529		0.15	0.406		0.041	0.529		0.15	0.26	U	0.26	5.1	U	5.1

100-F-33 Asbestos Data Results.

Sample Area	HEIS	Sample	Asbestos Result
Cinderblock	J01X23	09/24/04	Between 10% and 20% total asbestos.
Pipe Mastic	J01X22	09/24/04	None detected

Table A-1. 100-F-33 Confirmatory Sample Results. (6 Pages)

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 3 Soil	J01TF7	09/23/04	7640		0.89	0.329		0.33	3		0.4	68.2		0.02	0.361		0.01	2.7		0.56
Test Pit 3 Soil	J01TF8	09/23/04	6800	J	0.86	0.347	J	0.32	2.8	J	0.38	63.8	J	0.02	0.408	J	0.01	1.8	J	0.54
Test Trench 2 Soil	J01TF9	09/24/04	7840		0.78	0.291		0.29	3		0.35	66.8		0.02	0.392		0.01	2.6		0.49
Test Trench 2 Soil	J01TH0	09/24/04	8350		0.83	0.383		0.31	3.6		0.37	79.7		0.02	0.407		0.01	4.2		0.53
Test Trench 1 Soil	J01TH1	09/24/04	6950		0.84	0.311	U	0.31	2.8		0.37	64		0.02	0.356		0.01	2.4		0.53
Test Trench 1 Soil	J01TH2	09/28/04	5240		0.72	0.304		0.27	2.8		0.32	69		0.02	0.302		0.01	1.7		0.45
Duplicate of J01TH0	J01TH3	09/24/04	8120		0.82	0.422		0.3	3.1		0.36	83.3		0.02	0.416		0.01	3		0.52
Equipment Blank	J01TH4	09/23/04	89.2		0.81	0.3	U	0.3	0.36	U	0.36	1		0.02	0.01	U	0.01	0.617		0.51
Test Trench 2 Pipe	J01VD6	09/24/04	84.8		0.79	0.293	U	0.29	0.352	U	0.35	4.2		0.02	0.01	U	0.01	0.771		0.5
Test Pit 3 Concrete	J01VD9	09/24/04	7180		0.77	1.1		0.29	6.4		0.34	106		0.02	0.418		0.01	3.1		0.49
Test Trench 1 Pipe	J01X24	09/27/04	519		0.8	0.296	U	0.3	0.587		0.35	10.5		0.02	0.029		0.01	4.3		0.5
Test Trench 1 Concrete	J01X25	09/27/04	12500		0.78	0.591		0.29	5.3		0.35	199		0.02	0.571		0.01	6.9		0.49

Sample Location	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper			Hexavalent Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 3 Soil	J01TF7	09/23/04	0.171		0.03	6480	C	0.76	13.4	C	0.07	6.4		0.09	13		0.05	0.222	U	0.222
Test Pit 3 Soil	J01TF8	09/23/04	0.121	J	0.03	6140	J	0.73	11.2	J	0.06	6.5	J	0.08	44.2	J	0.05	0.277	J	0.23
Test Trench 2 Soil	J01TF9	09/24/04	0.135		0.03	5400	C	0.67	13.4	C	0.06	6.9		0.08	12.8		0.05	0.205	U	0.2
Test Trench 2 Soil	J01TH0	09/24/04	0.182		0.03	5620	C	0.71	14.9	C	0.06	7.1		0.08	14.1		0.05	0.224		0.21
Test Trench 1 Soil	J01TH1	09/24/04	0.052		0.03	4000	C	0.71	11.6	C	0.06	5.7		0.08	9.8		0.05	0.209	U	0.21
Test Trench 1 Soil	J01TH2	09/28/04	0.027	U	0.03	3670	C	0.61	9	C	0.05	5.7		0.07	10.4		0.05	0.254		0.25
Duplicate of J01TH0	J01TH3	09/24/04	0.207		0.03	5220	C	0.7	16.4	C	0.06	7.4		0.08	14.5		0.05	0.702		0.2
Equipment Blank	J01TH4	09/23/04	0.03	U	0.03	26.8	C	0.69	0.205	J	0.06	0.08	U	0.08	0.05	U	0.05	0.2	U	0.2
Test Trench 2 Pipe	J01VD6	09/24/04	0.029	U	0.03	129	C	0.67	0.332	C	0.06	0.078	U	0.08	0.187		0.05			
Test Pit 3 Concrete	J01VD9	09/24/04	0.664		0.03	30800	C	0.66	13.7	C	0.06	8.2		0.08	18.5		0.05			
Test Pit 3 Concrete	J01VV1*	09/24/04																0.35	U	0.35
Test Trench 2 Pipe	J01VV2*	09/24/04																0.35	U	0.35
Test Trench 1 Pipe	J01VV3*	09/27/04																0.35	U	0.35
Test Trench 1 Concrete	J01VV4*	09/27/04																1.31		0.35
Test Trench 1 Pipe	J01X24	09/27/04	0.03	U	0.03	899	C	0.68	0.798	C	0.06	0.316		0.08	0.927		0.05			
Test Trench 1 Concrete	J01X25	09/27/04	1.6		0.03	60400	C	8	43.6		0.06	8.8		0.08	24.3		0.05			

*Only analyte was hexavalent chromium.

Table A-1. 100-F-33 Confirmatory Sample Results. (6 Pages)

Sample Location	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese			Mercury			Molybdenum		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 3 Soil	J01TF7	09/23/04	20500		2.5	7		0.21	4470	C	0.72	307	C	0.01	0.017	U	0.017	0.266		0.14
Test Pit 3 Soil	J01TF8	09/23/04	19400	J	2.4	14.7	J	0.2	4130	J	0.7	312	J	0.01	0.017	UJ	0.017	0.144	J	0.14
Test Trench 2 Soil	J01TF9	09/24/04	21700		2.2	9.6		0.18	4800	C	0.64	314	C	0.01	0.014	U	0.014	0.195		0.13
Test Trench 2 Soil	J01TH0	09/24/04	22500		2.3	13.4		0.2	4860	C	0.68	324	C	0.01	0.083		0.02	0.352		0.13
Test Trench 1 Soil	J01TH1	09/24/04	18600		2.4	3.9		0.2	4100	C	0.68	266	C	0.01	0.017	U	0.017	0.293		0.13
Test Trench 1 Soil	J01TH2	09/28/04	17000		2	5.2		0.17	3690	C	0.58	248	C	0.01	0.017	U	0.017	0.252		0.12
Duplicate of J01TH0	J01TH3	09/24/04	23100		2.3	16.6		0.19	4890	C	0.67	504	C	0.01	0.016	U	0.016	0.256		0.13
Equipment Blank	J01TH4	09/23/04	141		2.3	0.296		0.19	9.9	C	0.66	2.3	C	0.01	0.016	U	0.016	0.13	U	0.13
Test Trench 2 Pipe	J01VD6	09/24/04	156		2.2	0.227		0.19	35.7	C	0.65	3.1		0.01	0.016	U	0.016	0.127	U	0.13
Test Pit 3 Concrete	J01VD9	09/24/04	24800		2.2	7.6		0.18	8190	C	0.63	347		0.01	0.034		0.02	1.4		0.12
Test Trench 1 Pipe	J01X24	09/27/04	730		2.2	0.538		0.19	128	C	0.65	22.9	C	0.01	0.096		0.02	0.155		0.13
Test Trench 1 Concrete	J01X25	09/27/04	24600		2.2	34.7		0.18	9280	C	0.64	518	C	0.01	6.94		0.17	0.801		0.13

Sample Location	HEIS 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
Test Pit 3 Soil	J01TF7	09/23/04	11.7		0.13	1260	C	3.8	0.428	U	0.428	103	C	0.55	0.099	U	0.099	213	C	0.25
Test Pit 3 Soil	J01TF8	09/23/04	11.8	J	0.13	1310	J	3.7	0.414	UJ	0.414	414	J	0.53	0.096	UJ	0.096	183	J	0.24
Test Trench 2 Soil	J01TF9	09/24/04	12.9		0.12	1270	C	3.4	0.377	U	0.377	135	C	0.48	0.087	U	0.087	227	C	0.22
Test Trench 2 Soil	J01TH0	09/24/04	12.5		0.12	1350	C	3.6	0.402	U	0.402	42.2	C	0.52	0.093	U	0.093	222	C	0.24
Test Trench 1 Soil	J01TH1	09/24/04	11.1		0.12	1240	C	3.6	0.404	U	0.404	64.4	C	0.52	0.093	U	0.093	199	C	0.24
Test Trench 1 Soil	J01TH2	09/28/04	9.2		0.11	995		3.1	0.345	U	0.345	359		0.44	0.08	U	0.08	114		0.2
Duplicate of J01TH0	J01TH3	09/24/04	13.2		0.12	1240	C	3.5	0.394	U	0.394	142	C	0.5	0.091	U	0.091	304	C	0.23
Equipment Blank	J01TH4	09/23/04	0.12	U	0.12	28.4	C	3.5	0.39	U	0.39	81.6	C	0.5	0.09	U	0.09	12.4	C	0.23
Test Trench 2 Pipe	J01VD6	09/24/04	0.117	U	0.12	35.4	C	3.4	0.381	U	0.381	60.5		0.49	0.088	U	0.088	15.4		0.22
Test Pit 3 Concrete	J01VD9	09/24/04	10.6		0.11	1190	C	3.3	0.373	U	0.373	372		0.48	0.086	U	0.086	629		0.22
Test Trench 1 Pipe	J01X24	09/27/04	0.44		0.12	65.4		3.4	0.385		0.38	126		0.49	0.089	U	0.089	96.8		0.23
Test Trench 1 Concrete	J01X25	09/27/04	14		0.12	3570		3.4	0.376	U	0.376	991		0.48	0.087	U	0.087	1730		0.22

Sample Location	HEIS Number	Sample Date	Vanadium			Zinc			TPH		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 3 Soil	J01TF7	09/23/04	50.4		0.07	58.2	C	0.04	36.9	U	39.6
Test Pit 3 Soil	J01TF8	09/23/04	43.2	J	0.06	45.4	J	0.04	38.1	UJ	38.1
Test Trench 2 Soil	J01TF9	09/24/04	52.6		0.06	79.2	C	0.04	5190		852
Test Trench 2 Soil	J01TH0	09/24/04	51		0.06	91	C	0.04	41.6		34.2
Test Trench 1 Soil	J01TH1	09/24/04	44.3		0.06	43.8	C	0.04	1260		346
Test Trench 1 Soil	J01TH2	09/28/04	38.5		0.05	40.3		0.04	160		35.3
Duplicate of J01TH0	J01TH3	09/24/04	56.1		0.06	91.6	C	0.04	44.7		3..9
Equipment Blank	J01TH4	09/23/04	0.06	U	0.06	3.3	J	0.04			
Test Trench 2 Pipe	J01VD6	09/24/04	0.685		0.06	14.3		0.04	32.9		32.5
Test Pit 3 Concrete	J01VD9	09/24/04	70.6		0.06	131		0.04			
Test Trench 1 Pipe	J01X24	09/27/04	1.6		0.06	4.5		0.04	33.6	U	33.6
Test Trench 1 Concrete	J01X25	09/27/04	48.7		0.06	436		0.04	95.9		36.2

Table A-1. 100-F-33 Confirmatory Sample Results. (6 Pages)

Constituent	J01TF7 Test Pit 3 Soil Sample Date 9/23/04			J01TF8 Test Pit 3 Soil Sample Date 9/23/04			J01TF9 Test Trench 2 Soil Sample Date 9/24/04			J01TH0 Test Trench 2 Soil Sample Date 9/24/04			J01TH1 Test Trench 1 Soil Sample Date 9/24/04			J01TH2 Test Trench 1 Soil Sample Date 9/28/04			J01TH3 Duplicate of J01TH0 Sample Date 9/24/04		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
PCBs (polychlorinated biphenyls)																					
Aroclor-1016	15	U	15	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14
Aroclor-1221	15	U	15	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14
Aroclor-1232	15	U	15	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14
Aroclor-1242	15	U	15	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14
Aroclor-1248	15	U	15	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14
Aroclor-1254	14	J	15	94		14	24		14	16		14	14	U	14	23		23	27		27
Aroclor-1260	15	U	15	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14
PAH (polycyclic aromatic hydrocarbon)																					
Acenaphthene	200	U	200	232	U	232	222	U	222	206	U	206	209	U	209	0.4	U	0.4	340.813	J	204
Acenaphthylene	200	U	200	232	U	232	222	U	222	206	U	206	209	U	209	0.4	U	0.4	204	U	204
Anthracene	10	U	10	11.6	U	11.6	11.1	U	11.1	10.3	U	10.3	10.5	U	10.5	0.02	U	0.02	10.2	U	10.2
Benzo(a)anthracene	10	U	10	11.6	U	11.6	11.1	U	11.1	20.081		10.3	10.5	U	10.5	0.02	U	0.02	18.367	J	10.2
Benzo(a)pyrene	10	U	10	11.6	U	11.6	11.1	U	11.1	12.358		10.3	10.5	U	10.5	0.02	U	0.02	10.714		10.2
Benzo(b)fluoranthene	10	U	10	11.6	U	11.6	27.7		11.1	35.013		10.3	10.5	U	10.5	18.843		0.02	43.877	J	10.2
Benzo(ghi)perylene	10	U	10	11.6	U	11.6	11.1	U	11.1	10.3	U	10.3	10.5	U	10.5	0.02	U	0.02	10.2	U	10.2
Benzo(k)fluoranthene	10	U	10	11.6	U	11.6	11.1	U	11.1	10.3	U	10.3	10.5	U	10.5	0.02	U	0.02	10.2	U	10.2
Chrysene	10	U	10	11.6	U	11.6	11.1	U	11.1	10.3	U	10.3	10.5	U	10.5	0.02	U	0.02	12.245	J	10.2
Dibenz[a,h]anthracene	10	U	10	11.6	U	11.6	11.1	U	11.1	10.3	U	10.3	10.5	U	10.5	0.02	U	0.02	10.2	U	10.2
Fluoranthene	20	U	20	23.2	U	23.2	42.689		22.2	38.617		20.6	20.9	U	20.9	0.04	U	0.04	57.653	J	20.4
Fluorene	10	U	10	11.6	U	11.6	11.1	U	11.1	10.3	U	10.3	10.5	U	10.5	6.9		0.02	10.2	U	10.2
Indeno(1,2,3-cd)pyrene	17.007		10	11.6	U	11.6	59.875		11.1	13.748		10.3	10.5	U	10.5	31.052		0.02	158.672		10.2
Naphthalene	200	U	200	232	U	232	222	U	222	206	U	206	209	U	209	0.4	U	0.4	204	U	204
Phenanthrene	10	U	10	11.6	U	11.6	23.285		11.1	37.073		10.3	10.5	U	10.5	13.005		0.02	45.408	J	10.2
Pyrene	20	U	20	23.2	U	23.2	24.948		22.2	20.6	U	20.6	20.9	U	20.9	0.04	U	0.04	20.4	U	20.4

Table A-1. 100-F-33 Confirmatory Sample Results. (6 Pages)

Constituent	J01TH4* Equipment Blank Sample Date 9/23/04			J01VD6 Test Trench 2 Pipe Sample Date 9/24/04			J01VD8 Test Trench 2 Mastic Sample Date 9/24/04			J01VD9 Test Pit 3 Concrete Sample Date 9/24/04			J01VF0** Test Trench 1 Mastic Sample Date 9/24/04			J01X24 Test Trench 1 Pipe Sample Date 9/27/04			J01X25 Test Trench 1 Concrete Sample Date 9/27/04		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
PCBs (polychlorinated biphenyls)																					
Aroclor-1016	13	U	13	13	U	13	380	U	380	14	U	14				14	U	14	15	U	15
Aroclor-1221	13	U	13	13	U	13	380	U	380	14	U	14				14	U	14	15	U	15
Aroclor-1232	13	U	13	13	U	13	380	U	380	14	U	14				14	U	14	15	U	15
Aroclor-1242	13	U	13	13	U	13	380	U	380	14	U	14				14	U	14	15	U	15
Aroclor-1248	13	U	13	13	U	13	380	U	380	14	U	14				14	U	14	15	U	15
Aroclor-1254	13	U	13	13	U	13	380	U	380	170		14				14	U	14	15	U	15
Aroclor-1260	13	U	13	13	U	13	380	U	380	14	U	14				14	U	14	15	U	15
PAH (polycyclic aromatic hydrocarbon)																					
Acenaphthene				201	U	201	4320	U	4320	204	U	204	2040	U	2040	104	U	104	109	U	109
Acenaphthylene				201	U	201	4320	U	4320	204	U	204	2040	U	2040	104	U	104	109	U	109
Anthracene				10.1	U	10.1	240		211	10.2	U	10.2	102	U	102	5.22	U	5.22	5.45	U	5.45
Benzo(a)anthracene				10.1	U	10.1	4922.195		211	10.2	U	10.2	102	U	102	5.22	U	5.22	5.45	U	5.45
Benzo(a)pyrene				10.1	U	10.1	2896.218		211	10.2	U	10.2	200.116		102	5.22	U	5.22	5.45	U	5.45
Benzo(b)fluoranthene				10.1	U	10.1	6827.633		211	10.2	U	10.2	861.566		102	5.22	U	5.22	5.45	U	5.45
Benzo(ghi)perylene				10.1	U	10.1	211	U	211	10.2	U	10.2	102	U	102	5.22	U	5.22	5.45	U	5.45
Benzo(k)fluoranthene				10.1	U	10.1	211	U	211	10.2	U	10.2	102	U	102	5.22	U	5.22	5.45	U	5.45
Chrysene				10.1	U	10.1	5708.902		211	10.2	U	10.2	102	U	102	5.22	U	5.22	5.45	U	5.45
Dibenz[a,h]anthracene				10.1	U	10.1	2474.844		211	10.2	U	10.2	225.576		102	5.22	U	5.22	5.45	U	5.45
Fluoranthene				20.1	U	20.1	423	U	423	20.4	U	20.4	204	U	204	10.4	U	10.4	15		10.9
Fluorene				10.1	U	10.1	211	U	211	10.2	U	10.2	102	U	102	5.22	U	5.22	5.45	U	5.45
Indeno(1,2,3-cd)pyrene				10.1	U	10.1	211	U	211	10.2	U	10.2	102	U	102	5.22	U	5.22	5.45	U	5.45
Naphthalene				201	U	201	2600		4320	204	U	204	2040	U	2040	104	U	104	109	U	109
Phenanthrene				10.1	U	10.1	680		211	14.314		10.2	102	U	102	5.22	U	5.22	5.45	U	5.45
Pyrene				20.1	U	20.1	41587.54		423	20.4	U	20.4	204	U	204	10.4	U	10.4	10.9	U	10.9

*Analyzed for PCBs only.

** Analyzed for PAHs only.

Table A-2. 100-F-33 Waste Characterization Data Results. (3 Pages)

Sample Location	HEIS Number	Sample Date	Americium-241 GEA			Cesium-137			Cobalt-60			Europium-152			Europium-154			Europium-155		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Waste Sample	J03W90	08/08/05	0.17	U	0.17	0.05	U	0.054	0.049	U	0.049	0.11	U	0.11	0.19	U	0.19	0.11	U	0.11
Waste Sample	J03W91	08/08/05	0.19	U	0.19	0.039	U	0.039	0.036	U	0.036	0.12	U	0.12	0.13	U	0.13	0.13	U	0.13

Sample Location	HEIS Number	Sample Date	Nickel-63			Plutonium-238			Plutonium-239/240			Potassium-40			Radium-226			Radium-228		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Waste Sample	J03W90	08/08/05	-0.109	U	3.3	0.026	U	0.2	0	U	0.2	14.4		0.53	0.595		0.084	0.816		0.21
Waste Sample	J03W91	08/08/05	1.7	U	3.4	0	U	0.21	0.027	U	0.21	8.47		0.33	0.387		0.065	0.674		0.15

Sample Location	HEIS Number	Sample Date	Thorium-228 GEA			Thorium-232 GEA			Total beta			Uranium-235 GEA			Uranium-238		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Waste Sample	J03W90	08/08/05	0.77		0.086	0.816		0.21	-0.003	U	0.29	0.17	U	0.17	6.2	U	6.2
Waste Sample	J03W91	08/08/05	0.74		0.065	0.674		0.15	0.045	U	0.28	0.18	U	0.18	4.5	U	4.5

Table A-2. 100-F-33 Waste Characterization Data Results. (3 Pages)

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium		
			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
Waste Sample	J03W90	8/8/05	4280		2.2	0.37	U	0.37	2.5		0.42	61.2	C	0.02	0.77	C	0.009	1.1		0.21	0.09		0.03
Waste Sample	J03W91	8/8/05	4610		2.3	0.39	U	0.39	2		0.43	103	C	0.02	0.86	C	0.01	3.1		0.22	0.06		0.03

Sample Location	HEIS Number	Sample Date	Calcium			Chromium			Cobalt			Copper			Hexavalent Chromium			Iron			Lead		
			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
Waste Sample	J03W90	8/8/05	3250	C	1.7	8.3		0.07	4.5		0.08	9.5		0.27	0.26		0.21	11600	C	0.35	7.4		0.37
Waste Sample	J03W91	8/8/05	4180	C	1.7	7		0.07	4.8		0.09	11.2		0.28	0.22	U	0.22	12800	C	0.37	8.1		0.39

Sample Location	HEIS Number	Sample Date	Magnesium			Manganese			Mercury			Molybdenum			Nickel			Potassium			Selenium		
			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
Waste Sample	J03W90	8/8/05	3130		0.62	228	C	0.02	0.02	U	0.02	0.29		0.15	9.6		0.2	961		2.9	0.46	U	0.46
Waste Sample	J03W91	8/8/05	3150		0.65	231	C	0.02	0.06		0.02	0.4		0.15	8.7		0.21	886		3	0.47	U	0.47

Sample Location	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium			Zinc			Total Petroleum Hydrocarbons		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Waste Sample	J03W90	8/8/05	507		0.63	0.08	U	0.08	110	C	0.14	27.5		0.06	46.4	C	0.05	141	U	141
Waste Sample	J03W91	8/8/05	583		0.65	0.09	U	0.09	145	C	0.15	30.7		0.06	46.8	C	0.05	145	U	145

Table A-2. 100-F-33 Waste Characterization Data Results. (3 Pages)

Constituents	J03W90 Waste Sample Sample Date 8/8/05			J03W91 Waste Sample Sample Date 8/8/05		
	µg/kg	Q	PQL	µg/kg	Q	PQL
Polycyclic Aromatic Hydrocarbons (PAHs)						
Acenaphthene	47	J	53.5	96		54.4
Acenaphthylene	53.5	U	53.5	59		54.4
Anthracene	5.35	U	5.35	5.44	U	5.44
Benzo(a)anthracene	5.35	U	5.35	5.44	U	5.44
Benzo(a)pyrene	5.35	U	5.35	5.44	U	5.44
Benzo(b)fluoranthene	9.2		5.35	27		5.44
Benzo(ghi)perylene	5.35	U	5.35	5.44	U	5.44
Benzo(k)fluoranthene	5.35	U	5.35	5.44	U	5.44
Chrysene	42		5.35	73		5.44
Dibenz[a,h]anthracene	5.35	U	5.35	5.44	U	5.44
Fluoranthene	25		10.7	28		10.8
Fluorene	5.35	U	5.35	5.44	U	5.44
Indeno(1,2,3-cd)pyrene	5.35	U	5.35	74		5.44
Naphthalene	53.5	U	53.5	54.4	U	54.4
Phenanthrene	9.1		5.35	19		5.44
Pyrene	10.7	U	10.7	16		10.8

APPENDIX B

95% UCL CALCULATIONS AND VERIFICATION SAMPLING RESULTS

CALCULATION COVER SHEET

Project Title:	100-F Area Field Remediation	**Job No.**	14655
Area	100-F		
Discipline	Environmental	***Calc. No.**	0100F-CA-V0244
Subject	100-F-33 Fish Ponds Verification 95% UCL Calculations		
Computer Program	Excel	**Program No.**	Excel 2003

The attached calculations have been generated to document compliance with established cleanup levels. These documents 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 = 10 Attm. 1 = 10 Total = 21	J. M. Capron B. S. Wiegman 4/10/06	T. M. Blakley 4-11-06	L. M. Dittmer 4/11/06	S. W. Callison 4-13-06	

SUMMARY OF REVISIONS

* Obtain calc no. from DIS

DE01437.03 (12/09/2004)

CALCULATION SHEET

Washington Closure Hanford

Originator J. M. Capron B. S. Wiegman Date 04/10/06 Calc. No. 0100F-CA-V0244 Rev. No. 0
Project 100-F Area Field Remediation Job No. 14655 Checked T. M. Blakley Date 4-11-06
Subject 100-F-33 Fish Ponds Verification 95% UCL Calculations Sheet No. 1 of 10

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.
7) Ecology, 1993, *Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-detection Limit or Below-PQL Values (Censored Data Sets),* Publication #92-54, Washington Department of Ecology, Olympia, Washington.
8) Ecology, 1996, *Model Toxic Control Act Cleanup Levels and Risk Calculations (CLARC II),* Publication #94-145, Washington State Department of Ecology, Olympia, Washington.
9) EPA, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013. U.S. Environmental Protection Agency, Washington, D.C.
10) 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 from the subject waste site. The data were entered into an EXCEL 2003 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2005b) is documented by this calculation. Duplicate RPD results are used in evaluation of data quality within the RSVP for this site.

CALCULATION SHEET

Washington Closure Hanford

Originator J. M. Capron / B. S. Wiegman Date 04/10/06 Calc. No. 0100F-CA-V0244 Rev. No. 0
Project 100-F Area Field Remediation Job No. 14655 Checked T. M. Blakley Date 4-11-06
Subject 100-F-33 Fish Ponds Verification 95% UCL Calculations Sheet No. 2 of 10

Summary

Methodology:

For nonradioactive analytes with <50% of the data below detection limits and all radionuclide analytes, the statistical value calculated to evaluate the effectiveness of cleanup is the 95% UCL. For nonradioactive analytes with >50% of the data below detection limits, the maximum detected value for the data set is used instead of the 95% UCL. The evaluation of the portion of the data set below detection limits was performed by direct inspection of the attached sample results. All nonradionuclide data reported as being undetected are set to ½ the detection limit value for calculation of the statistics (Ecology 1993). No radionuclide COCs/COPCs were identified for this site.

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).

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 WAC 173-340-740(7)(e) 3-part test is not performed for data sets where the statistical value defaults to the maximum value, as direct comparison of the maximum against site RAGs is more conservative.

The RPD is calculated when both the primary value and the duplicate are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method, listed in Table II-1 of the SAP (DOE-RL 2005a). The RPD calculations use the following formula:

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

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

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.

CALCULATION SHEET

Washington Closure Hanford

Originator J. M. Capron / B. S. Wiegman Date 04/10/06 Calc. No. 0100F-CA-V0244 Rev. No. 0
Project 100-F Area Field Remediation Job No. 14655 Checked T. M. Blakley Date 4-11-06
Subject 100-F-33 Fish Ponds Verification 95% UCL Calculations Sheet No. 3 of 10

Summary (continued)

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

Results Summary

Analyte	95% UCL[a]	Maximum[b]	Units
Arsenic	4.5		mg/kg
Barium	68.3		mg/kg
Beryllium	0.03		mg/kg
Boron	1.7		mg/kg
Cadmium		0.14	mg/kg
Chromium (total)	9.5		mg/kg
Cobalt	5.5		mg/kg
Copper	11.6		mg/kg
Lead	9.9		mg/kg
Manganese	258		mg/kg
Mercury		0.05	mg/kg
Molybdenum	0.23		mg/kg
Nickel	10.3		mg/kg
Vanadium	33.8		mg/kg
Zinc	69		mg/kg
Aroclor-1254	0.36		mg/kg
2-Methylnaphthalene		0.031	mg/kg
Di-n-butylphthalate		0.030	mg/kg
Naphthalene		0.022	mg/kg
Phenol		0.019	mg/kg

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

WAC 3-Part Test for most stringent cleanup limit:

95% UCL > Cleanup Limit?	YES
> 10% above Cleanup Limit?	YES
Any sample > 2x Cleanup Limit?	YES

Because of the "yes" answers to the MTCA 3-part test for lead, zinc, and aroclor-1254, detailed assessments using RESRAD will be performed. All data sets meet the 3-part test criteria when compared to direct exposure cleanup levels.

[a]For nonradionuclides, where ≤ 50% of a data set is censored (below detection limits), the 95% UCL value is used for a given analyte.
[b]Where > 50% of a data set is censored, the statistical value defaults to the maximum detected value in the data set (Attachment 1).
MTCA = *Model Toxic Control Act*
RESRAD = RESidual RADioactivity (dose assessment model)
UCL = upper confidence level
WAC = *Washington Adminstrative Code*

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

Analyte	Duplicate Analysis[b]
Barium	3.0%
Chromium (total)	8.6%
Copper	1.1%
Manganese	2.7%
Vanadium	1.0%
Zinc	5.6%

[a]Relative percent difference evaluation was not required for analytes not included in this table.
[b]The significance of relative percent difference values ar
QA/QC = quality assurance/quality control
RSVP = remaining sites verification package

Washington Closure Hanford

CALCULATION SHEET

Originator J. M. Capron / B. S. Wiegman — Date 04/10/06 — Calc. No. 0100F-CA-V0244 — Rev. No. 0
Project 100-F Area Field Remediation — Job No. 14655 — Checked T. M. Blakley — Date 4-11-06
Subject 100-F-33 Fish Ponds Verification 95% UCL Calculations — Sheet No. 4 of 10

Shallow Zone Verification Data

Sampling Area	HEIS Number	Sample Date	Arsenic mg/kg	Q	PQL	Barium mg/kg	Q	PQL	Beryllium mg/kg	Q	PQL	Boron mg/kg	Q	PQL	Chromium (total) mg/kg	Q	PQL	Cobalt mg/kg	Q	PQL	Copper mg/kg	Q	PQL
3	J111T6	1/24/2006	4.2		3.6	57.8		0.02	0.06		0.01	1.0		0.27	9.7		0.16	5.0		0.12	9.3		0.12
Duplicate of J111T6	J111V5	1/24/2006	3.6	U	3.6	56.1		0.02	0.04		0.01	0.75		0.27	8.9		0.16	4.9		0.12	9.4		0.12
1	J111T4	1/24/2006	3.8	U	3.8	69.8		0.02	0.05		0.01	1.9		0.29	8.4		0.17	5.4		0.13	12.2		0.13
2	J111T5	1/24/2006	3.8	U	3.8	66.9		0.02	0.05		0.01	1.6		0.28	9.4		0.17	5.8		0.13	12.7		0.13
4	J111T7	1/24/2006	3.8		3.6	71.1		0.02	0.02		0.01	1.4		0.27	10.2		0.16	6.1		0.12	12.1		0.12
5	J111T8	1/24/2006	5.4		3.8	65.5		0.02	0.01	U	0.01	1.8		0.29	8.9		0.17	5.4		0.13	11.5		0.13
6	J111T9	1/24/2006	7.3		3.7	75.4		0.02	0.05		0.01	1.5		0.28	10.1		0.17	5.8		0.12	13.5		0.12
7	J111V0	1/24/2006	4.8		3.5	61.2		0.02	0.01	U	0.01	0.55		0.27	8.2		0.16	5.0		0.12	8.9		0.12
8	J111V1	1/24/2006	3.7	U	3.7	64.2		0.02	0.01		0.01	1.2		0.28	8.7		0.16	5.1		0.12	9.7		0.12
9	J111V2	1/24/2006	5.2		3.5	56.5		0.02	0.01	U	0.01	0.77		0.26	9.2		0.16	4.8		0.12	9.5		0.12
10	J111V3	1/24/2006	3.7	U	3.7	66.5		0.02	0.01	U	0.01	1.5		0.28	6.8		0.16	4.4		0.12	9.1		0.12
11	J111V4	1/24/2006	3.5	U	3.5	59.4		0.02	0.01		0.01	0.66		0.26	8.3		0.16	5.0		0.12	9.7		0.12

Statistical Computation Input Data

Sampling Area	HEIS Number	Sample Date	Arsenic mg/kg	Q	PQL	Barium mg/kg	Q	PQL	Beryllium mg/kg	Q	PQL	Boron mg/kg	Q	PQL	Chromium (total) mg/kg	Q	PQL	Cobalt mg/kg	Q	PQL	Copper mg/kg	Q	PQL
3	J111T6/J111V5	1/24/2006	3.0			57.0			0.05			0.88			9.3			5.0			9.4		
1	J111T4	1/24/2006	1.9			69.8			0.05			1.9			8.4			5.4			12.2		
2	J111T5	1/24/2006	1.9			66.9			0.05			1.6			9.4			5.8			12.7		
4	J111T7	1/24/2006	3.8			71.1			0.02			1.4			10.2			6.1			12.1		
5	J111T8	1/24/2006	5.4			65.5			0.005			1.8			8.9			5.4			11.5		
6	J111T9	1/24/2006	7.3			75.4			0.05			1.5			10.1			5.8			13.5		
7	J111V0	1/24/2006	4.8			61.2			0.005			0.55			8.2			5.0			8.9		
8	J111V1	1/24/2006	1.9			64.2			0.01			1.2			8.7			5.1			9.7		
9	J111V2	1/24/2006	5.2			56.5			0.005			0.77			9.2			4.8			9.5		
10	J111V3	1/24/2006	1.9			66.5			0.005			1.5			6.8			4.4			9.1		
11	J111V4	1/24/2006	1.8			59.4			0.01			0.66			8.3			5.0			9.7		

Statistical Computations

	Arsenic	Barium	Beryllium	Boron	Chromium (total)	Cobalt	Copper
Statistical value based on	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), 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.	Large data set (n ≥10), lognormal and normal distribution rejected, use z-statistic.
N	11	11	11	11	11	11	11
% < Detection limit	45%	0%	36%	0%	0%	0%	0%
mean	3.5	64.9	0.02	1.3	8.9	5.3	10.8
standard deviation	1.9	6.0	0.02	0.5	1.0	0.5	1.7
95% UCL on mean	4.5	68.3	0.03	1.7	9.5	5.5	11.6
maximum value	7.3	75.4	0.06	1.9	10.2	6.1	13.5
Statistical value	4.5	68.3	0.03	1.7	9.5	5.5	11.6
Most Stringent Cleanup Limit for nonradionuclide and RAG type	20 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	22.0 BG/River Protection
WAC 173-340 3-PART TEST							
95% UCL > Cleanup Limit?	NA	NA	NA	NO	NA	NA	NA
> 10% above Cleanup Limit?	NA	NA	NA	NO	NA	NA	NA
Any sample > 2X Cleanup Limit?	NA	NA	NA	NO	NA	NA	NA
WAC 173-340 Compliance? YES	Because all values are below background (20 mg/kg), the MTCA 3-part test is not required.	Because all values are below background (132 mg/kg), the MTCA 3-part test is not required.	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.	Because all values are below background (22.0 mg/kg), the MTCA 3-part test is not required.

BG = background
GW = groundwater
HEIS = Hanford Environmental Information System
MTCA = *Model Toxic Control Act*
NA = not applicable
PQL = practical quantitation limit
Q = qualifier
RAG = remedial action goal
U = undetected
UCL = upper confidence limit
WAC = *Washington Administrative Code*

Washington Closure Hanford

CALCULATION SHEET

Originator J. M. Capron /for/ B. S. Wiegman **Date** 04/10/06 **Calc. No.** 0100F-CA-V0244 **Rev. No.** 0
Project 100-F Area Field Remediation **Job No.** 14655 **Checked** T. M. Blakley **Date** 4-11-06
Subject 100-F-33 Fish Ponds Verification 95% UCL Calculations **Sheet No.** 5 of 10

Shallow Zone Verification Data

Sampling Area	HEIS Number	Sample Date	Lead			Manganese			Molybdenum			Nickel			Vanadium			Zinc			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	mg/kg	Q	PQL
3	J111T6	1/24/2006	3.2	J	0.31	229	C	0.02	0.23		0.13	10.4		0.13	30.2		0.09	31.2		0.05	0.0050	J	0.014
Duplicate of J111T6	J111V5	1/24/2006	4.2	J	0.31	223	C	0.02	0.20		0.13	11.2		0.13	30.5		0.09	33.0		0.05	0.10	J	0.014
1	J111T4	1/24/2006	12.4	J	0.33	254	C	0.02	0.41		0.14	9.0		0.14	31.6		0.1	61.7		0.05	0.26	J	0.015
2	J111T5	1/24/2006	7.4	J	0.33	265	C	0.02	0.31		0.14	10.1		0.14	34.6		0.09	51.9		0.05	0.21	J	0.015
4	J111T7	1/24/2006	6.5	J	0.32	287	C	0.02	0.13	U	0.13	11.2		0.13	39.7		0.09	147		0.05	0.013	J	0.015
5	J111T8	1/24/2006	12.9	J	0.33	254	C	0.02	0.15		0.14	9.5		0.14	36.2		0.1	55.3		0.05	0.016	J	0.015
6	J111T9	1/24/2006	10.3	J	0.32	266	C	0.02	0.16		0.13	10.6		0.13	31.1		0.09	65.9		0.05	0.11	J	0.015
7	J111V0	1/24/2006	3.1	J	0.32	237	C	0.02	0.13	U	0.13	9.4		0.13	29.4		0.09	29.5		0.05	0.014	UJ	0.014
8	J111V1	1/24/2006	4.2	J	0.32	241	C	0.02	0.13	U	0.13	9.3		0.13	32.3		0.09	37.2		0.05	0.0061	J	0.014
9	J111V2	1/24/2006	3.9	J	0.30	217	C	0.02	0.13	U	0.13	9.8		0.13	29.6		0.09	34.9		0.05	0.024	J	0.014
10	J111V3	1/24/2006	2.7	J	0.32	205	C	0.02	0.20		0.13	8.8		0.13	28.8		0.09	29.5		0.05	0.021	J	0.015
11	J111V4	1/24/2006	2.9	J	0.30	224	C	0.02	0.19		0.13	9.7		0.13	30.1		0.09	29.4		0.05	0.014	UJ	0.014

Statistical Computation Input Data

Sampling Area	HEIS Number	Sample Date	Lead mg/kg	Manganese mg/kg	Molybdenum mg/kg	Nickel mg/kg	Vanadium mg/kg	Zinc mg/kg	Aroclor-1254 mg/kg
3	J111T6/J111V5	1/24/2006	3.7	226	0.22	10.8	30.4	32.1	0.053
1	J111T4	1/24/2006	12.4	254	0.41	9.0	31.6	61.7	0.26
2	J111T5	1/24/2006	7.4	265	0.31	10.1	34.6	51.9	0.21
4	J111T7	1/24/2006	6.5	287	0.065	11.2	39.7	147	0.013
5	J111T8	1/24/2006	12.9	254	0.15	9.5	36.2	55.3	0.016
6	J111T9	1/24/2006	10.3	266	0.16	10.6	31.1	65.9	0.11
7	J111V0	1/24/2006	3.1	237	0.065	9.4	29.4	29.5	0.0070
8	J111V1	1/24/2006	4.2	241	0.065	9.3	32.3	37.2	0.0061
9	J111V2	1/24/2006	3.9	217	0.065	9.8	29.6	34.9	0.024
10	J111V3	1/24/2006	2.7	205	0.20	8.8	28.8	29.5	0.021
11	J111V4	1/24/2006	2.9	224	0.19	9.7	30.1	29.4	0.0070

Statistical Computations

	Lead	Manganese	Molybdenum	Nickel	Vanadium	Zinc	Aroclor-1254
Statistical value based on	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), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥10), use MTCAStat lognormal distribution.
N	11	11	11	11	11	11	11
% < Detection limit	0%	0%	36%	0%	0%	0%	18%
mean	6.4	243	0.17	9.8	32.2	52	0.07
standard deviation	3.9	24	0.11	0.8	3.4	34	0.09
95% UCL on mean	9.9	258	0.23	10.3	33.8	69	0.36
maximum value	12.9	287	0.41	11.2	39.7	147	0.26
Statistical value	9.9	258	0.23	10.3	33.8	69	0.36
Most Stringent Cleanup Limit for nonradionuclide and RAG type	10.2 BG/GW & River Protection	512 BG/GW Protection	8 GW Protection	19.1 BG/GW Protection	85.1 BG/GW Protection	67.8 BG/River Protection	0.017 GW/River Protection
WAC 173-340 3-PART TEST							
95% UCL > Cleanup Limit?	NO	NA	NO	NA	NA	YES	YES
> 10% above Cleanup Limit?	YES	NA	NO	NA	NA	NO	YES
Any sample > 2X Cleanup Limit?	NO	NA	NO	NA	NA	YES	YES
WAC 173-340 Compliance? NO	Because of the "yes" answer to the MTCA 3-part test, a detailed assessment using RESRAD will be performed. The data set meets the 3-part test criteria when compared to direct exposure cleanup levels.	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 of the "yes" answers to the MTCA 3-part test, a detailed assessment using RESRAD will be performed. The data set meets the 3-part test criteria when compared to direct exposure cleanup levels.	Because of the "yes" answers to the MTCA 3-part test, a detailed assessment using RESRAD will be performed. The data set meets the 3-part test criteria when compared to direct exposure cleanup levels.

BG = background
C = blank contamination
GW = groundwater
HEIS = Hanford Environmental Information System
J = estimate
MTCA = *Model Toxic Control Act*
NA = not applicable
PQL = practical quantitation limit
Q = qualifier
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose assessment model)
U = undetected
UCL = upper confidence limit
WAC = *Washington Administrative Code*

CALCULATION SHEET

Washington Closure Hanford

Originator J. M. Capron B. S. Wiegman **Date** 04/10/06 **Calc. No.** 0100F-CA-V0244 **Rev. No.** 0
Project 100-F Area Field Remediation **Job No.** 14655 **Checked** T. M. Blakley **Date** 4-11-06
Subject 100-F-33 Fish Ponds Verification 95% UCL Calculations **Sheet No.** 6 of 10

Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Arsenic			Barium			Beryllium			Boron			Chromium (total)		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
3	J111T6	1/24/2006	4.2		3.6	57.8		0.02	0.06		0.01	1.0		0.27	9.7		0.16
Duplicate of J111T6	J111V5	1/24/2006	3.6	U	3.6	56.1		0.02	0.04		0.01	0.75		0.27	8.9		0.16

Analysis:

		Arsenic	Barium	Beryllium	Boron	Chromium (total)
(TDL)		10	2	0.5	2	1
Duplicate Analysis	Both > PQL?	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?		**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (calc RPD)**
	RPD		3.0%			8.6%

Sampling Area	HEIS Number	Sample Date	Cobalt			Copper			Lead			Manganese			Molybdenum		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
3	J111T6	1/24/2006	5.0		0.12	9.3		0.12	3.2	J	0.31	229	C	0.02	0.23		0.13
Duplicate of J111T6	J111V5	1/24/2006	4.9		0.12	9.4		0.12	4.2	J	0.31	223	C	0.02	0.20		0.13

Analysis:

		Cobalt	Copper	Lead	Manganese	Molybdenum
(TDL)		2	1	5	5	2
Duplicate Analysis	Both > PQL/MDA?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)
	RPD		1.1%		2.7%	

Sampling Area	HEIS Number	Sample Date	Nickel			Vanadium			Zinc			Aroclor-1254		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
3	J111T6	1/24/2006	10.4		0.13	30.2		0.09	31.2		0.05	0.0050	J	0.014
Duplicate of J111T6	J111V5	1/24/2006	11.2		0.13	30.5		0.09	33.0		0.05	0.10	J	0.014

Analysis:

		Nickel	Vanadium	Zinc	Aroclor-1254
(TDL)		4	2.5	1	0.017
Duplicate Analysis	Both > PQL/MDA?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)
	Both >5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	
	RPD		1.0%	5.6%	

C = blank contamination
HEIS = Hanford Environmental Information System
J = estimate
PQL = practical quantitation limit
Q = qualifier
RPD = relative percent difference
TDL = target detection limit
U = undetected

Washington Closure Hanford

CALCULATION SHEET

Originator J. M. Capron / B. S. Wiegman — Date 04/10/06 — Calc. No. 0100F-CA-V0244 — Rev. No. 0

Project 100-F Area Field Remediation — Job No. 14655 — Checked T. M. Blakley — Date 4-11-06

Subject 100-F-33 Fish Ponds Verification 95% UCL Calculations — Sheet No. 7 of 10

Ecology Software (MTCAStat) Results

Arsenic 95% UCL Calculation

DATA	ID
3.0	J111T6/J111V5
1.9	J111T4
1.9	J111T5
3.8	J111T7
5.4	J111T8
7.3	J111T9
4.8	J111V0
1.9	J111V1
5.2	J111V2
1.9	J111V3
1.8	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	3.5
Censored		Lognormal mean	3.6
Detection limit or PQL		Std. devn.	1.9
Method detection limit		Median	3.0
TOTAL	11	Min.	1.8
		Max.	7.3

Lognormal distribution? — Normal distribution?

r-squared is: 0.877 — r-squared is: 0.867

Recommendations:

Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 4.5

Barium 95% UCL Calculation

DATA	ID
57.0	J111T6/J111V5
69.8	J111T4
66.9	J111T5
71.1	J111T7
65.5	J111T8
75.4	J111T9
61.2	J111V0
64.2	J111V1
56.5	J111V2
66.5	J111V3
59.4	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	64.9
Censored		Lognormal mean	64.9
Detection limit or PQL		Std. devn.	6.0
Method detection limit		Median	65.5
TOTAL	11	Min.	56.5
		Max.	75.4

Lognormal distribution? — Normal distribution?

r-squared is: 0.978 — r-squared is: 0.978

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 68.3

Beryllium 95% UCL Calculation

DATA	ID
0.05	J111T6/J111V5
0.05	J111T4
0.05	J111T5
0.02	J111T7
0.005	J111T8
0.05	J111T9
0.005	J111V0
0.01	J111V1
0.005	J111V2
0.005	J111V3
0.01	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	0.02
Censored		Lognormal mean	0.03
Detection limit or PQL		Std. devn.	0.02
Method detection limit		Median	0.01
TOTAL	11	Min.	0.005
		Max.	0.05

Lognormal distribution? — Normal distribution?

r-squared is: 0.824 — r-squared is: 0.756

Recommendations:

Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.03

Boron 95% UCL Calculation

DATA	ID
0.88	J111T6/J111V5
1.9	J111T4
1.6	J111T5
1.4	J111T7
1.8	J111T8
1.5	J111T9
0.55	J111V0
1.2	J111V1
0.77	J111V2
1.5	J111V3
0.66	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	1.3
Censored		Lognormal mean	1.3
Detection limit or PQL		Std. devn.	0.5
Method detection limit		Median	1.4
TOTAL	11	Min.	0.55
		Max.	1.9

Lognormal distribution? — Normal distribution?

r-squared is: 0.918 — r-squared is: 0.949

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 1.7

Washington Closure Hanford

CALCULATION SHEET

Originator J. M. Capron / B. S. Wiegman **Date** 04/10/06 **Calc. No.** 0100F-CA-V0244 **Rev. No.** 0

Project 100-F Area Field Remediation **Job No.** 14655 **Checked** T. M. Blakley **Date** 4-11-06

Subject 100-F-33 Fish Ponds Verification 95% UCL Calculations **Sheet No.** 8 of 10

Ecology Software (MTCAStat) Results

Chromium (total) 95% UCL Calculation

DATA	ID
9.3	J111T6/J111V5
8.4	J111T4
9.4	J111T5
10.2	J111T7
8.9	J111T8
10.1	J111T9
8.2	J111V0
8.7	J111V1
9.2	J111V2
6.8	J111V3
8.3	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	8.9
Censored		Lognormal mean	8.9
Detection limit or PQL		Std. devn.	1.0
Method detection limit		Median	8.9
TOTAL	11	Min.	6.8
		Max.	10.2

Lognormal distribution? Normal distribution?

r-squared is: 0.911 r-squared is: 0.939

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 9.5

Cobalt 95% UCL Calculation

DATA	ID
5.0	J111T6/J111V5
5.4	J111T4
5.8	J111T5
6.1	J111T7
5.4	J111T8
5.8	J111T9
5.0	J111V0
5.1	J111V1
4.8	J111V2
4.4	J111V3
5.0	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	5.3
Censored		Lognormal mean	5.3
Detection limit or PQL		Std. devn.	0.5
Method detection limit		Median	5.1
TOTAL	11	Min.	4.4
		Max.	6.1

Lognormal distribution? Normal distribution?

r-squared is: 0.964 r-squared is: 0.962

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 5.5

Copper 95% UCL Calculation

DATA	ID
9.4	J111T6/J111V5
12.2	J111T4
12.7	J111T5
12.1	J111T7
11.5	J111T8
13.5	J111T9
8.9	J111V0
9.7	J111V1
9.5	J111V2
9.1	J111V3
9.7	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	10.8
Censored		Lognormal mean	10.8
Detection limit or PQL		Std. devn.	1.7
Method detection limit		Median	9.7
TOTAL	11	Min.	8.9
		Max.	13.5

Lognormal distribution? Normal distribution?

r-squared is: 0.895 r-squared is: 0.889

Recommendations:

Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 11.6

Lead 95% UCL Calculation

DATA	ID
3.7	J111T6/J111V5
12.4	J111T4
7.4	J111T5
6.5	J111T7
12.9	J111T8
10.3	J111T9
3.1	J111V0
4.2	J111V1
3.9	J111V2
2.7	J111V3
2.9	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	6.4
Censored		Lognormal mean	6.4
Detection limit or PQL		Std. devn.	3.9
Method detection limit		Median	4.2
TOTAL	11	Min.	2.7
		Max.	12.9

Lognormal distribution? Normal distribution?

r-squared is: 0.918 r-squared is: 0.859

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 9.9

Washington Closure Hanford

CALCULATION SHEET

Originator J. M. Capron B. S. Wiegman
Project 100-F Area Field Remediation
Subject 100-F-33 Fish Ponds Verification 95% UCL Calculations

Date 04/10/06
Job No. 14655

Calc. No. 0100F-CA-V0244
Checked T. M. Blakley

Rev. No. 0
Date 4-11-06
Sheet No. 9 of 10

Ecology Software (MTCAStat) Results

Manganese 95% UCL Calculation

DATA	ID
226	J111T6/J111V5
254	J111T4
265	J111T5
287	J111T7
254	J111T8
266	J111T9
237	J111V0
241	J111V1
217	J111V2
205	J111V3
224	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	243
Censored		Lognormal mean	243
Detection limit or PQL		Std. devn.	24
Method detection limit		Median	241
TOTAL	11	Min.	205
		Max.	287

Lognormal distribution? Normal distribution?
r-squared is: 0.985 r-squared is: 0.982

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 258

Molybdenum 95% UCL Calculation

DATA	ID
0.22	J111T6/J111V5
0.41	J111T4
0.31	J111T5
0.065	J111T7
0.15	J111T8
0.16	J111T9
0.065	J111V0
0.065	J111V1
0.065	J111V2
0.20	J111V3
0.19	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	0.17
Censored		Lognormal mean	0.16
Detection limit or PQL		Std. devn.	0.11
Method detection limit		Median	0.16
TOTAL	11	Min.	0.065
		Max.	0.41

Lognormal distribution? Normal distribution?
r-squared is: 0.894 r-squared is: 0.879

Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.23

Nickel 95% UCL Calculation

DATA	ID
10.8	J111T6/J111V5
9.0	J111T4
10.1	J111T5
11.2	J111T7
9.5	J111T8
10.6	J111T9
9.4	J111V0
9.3	J111V1
9.8	J111V2
8.8	J111V3
9.7	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	9.8
Censored		Lognormal mean	9.8
Detection limit or PQL		Std. devn.	0.8
Method detection limit		Median	9.7
TOTAL	11	Min.	8.8
		Max.	11.2

Lognormal distribution? Normal distribution?
r-squared is: 0.971 r-squared is: 0.963

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 10.3

Vanadium 95% UCL Calculation

DATA	ID
30.4	J111T6/J111V5
31.6	J111T4
34.6	J111T5
39.7	J111T7
36.2	J111T8
31.1	J111T9
29.4	J111V0
32.3	J111V1
29.6	J111V2
28.8	J111V3
30.1	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	32.2
Censored		Lognormal mean	32.2
Detection limit or PQL		Std. devn.	3.4
Method detection limit		Median	31.1
TOTAL	11	Min.	28.8
		Max.	39.7

Lognormal distribution? Normal distribution?
r-squared is: 0.885 r-squared is: 0.861

Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 33.8

Washington Closure Hanford

CALCULATION SHEET

Originator J. M. Capron JMC B. S. Wiegman BSW
Project 100-F Area Field Remediation
Subject 100-F-33 Fish Ponds Verification 95% UCL Calculations

Date 04/10/06
Job No. 14655

Calc. No. 0100F-CA-V0244
Checked T. M. Blakley JMB

Rev. No. 0
Date 4-11-06
Sheet No. 10 of 10

Ecology Software (MTCAStat) Results

Zinc 95% UCL Calculation

DATA	ID
32.1	J111T6/J111V5
61.7	J111T4
51.9	J111T5
147	J111T7
55.3	J111T8
65.9	J111T9
29.5	J111V0
37.2	J111V1
34.9	J111V2
29.5	J111V3
29.4	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	52
Censored		Lognormal mean	52
Detection limit or PQL		Std. devn.	34
Method detection limit		Median	37
TOTAL	11	Min.	29.4
		Max.	147

Lognormal distribution? Normal distribution?
r-squared is: 0.841 r-squared is: 0.865

Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 69

Aroclor-1254 95% UCL Calculation

DATA	ID
0.053	J111T6/J111V5
0.26	J111T4
0.21	J111T5
0.013	J111T7
0.016	J111T8
0.11	J111T9
0.0070	J111V0
0.0061	J111V1
0.024	J111V2
0.021	J111V3
0.0070	J111V4

Number of samples		Uncensored values	
Uncensored	11	Mean	0.07
Censored		Lognormal mean	0.07
Detection limit or PQL		Std. devn.	0.09
Method detection limit		Median	0.02
TOTAL	11	Min.	0.0061
		Max.	0.26

Lognormal distribution? Normal distribution?
r-squared is: 0.923 r-squared is: 0.715

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.36

Attachment 1. 100-F-33 Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium			Chromium (total)		
			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
1	J111T4	1/24/06	0.43	UJ	0.43	3.8	U	3.8	69.8		0.02	0.05		0.01	1.9		0.29	0.08	U	0.08	8.4		0.17
2	J111T5	1/24/06	0.42	UJ	0.42	3.8	U	3.8	66.9		0.02	0.05		0.01	1.6		0.28	0.07	U	0.07	9.4		0.17
3	J111T6	1/24/06	0.40	UJ	0.41	4.2		3.6	57.8		0.02	0.06		0.01	1.0		0.27	0.07	U	0.07	9.7		0.16
Duplicate of J111T6	J111V5	1/24/06	0.40	UJ	0.40	3.6	U	3.6	56.1		0.02	0.04		0.01	0.75		0.27	0.07	U	0.07	8.9		0.16
4	J111T7	1/24/06	0.41	UJ	0.41	3.8		3.6	71.1		0.02	0.02		0.01	1.4		0.27	0.07	U	0.07	10.2		0.16
5	J111T8	1/24/06	0.43	UJ	0.43	5.4		3.8	65.5		0.02	0.01	U	0.01	1.8		0.29	0.14		0.07	8.9		0.17
6	J111T9	1/24/06	0.41	UJ	0.41	7.3		3.7	75.4		0.02	0.05		0.01	1.5		0.28	0.08		0.07	10.1		0.17
7	J111V0	1/24/06	0.39	UJ	0.39	4.8		3.5	61.2		0.02	0.01	U	0.01	0.55		0.27	0.07	U	0.07	8.2		0.16
8	J111V1	1/24/06	0.41	UJ	0.41	3.7	U	3.7	64.2		0.02	0.01		0.01	1.2		0.28	0.07	U	0.07	8.7		0.16
9	J111V2	1/24/06	0.39	UJ	0.39	5.2		3.5	56.5		0.02	0.01	U	0.01	0.77		0.26	0.07	U	0.07	9.2		0.16
10	J111V3	1/24/06	0.41	UJ	0.41	3.7	U	3.7	66.5		0.02	0.01	U	0.01	1.5		0.28	0.07	U	0.07	6.8		0.16
11	J111V4	1/24/06	0.39	UJ	0.39	3.5	U	3.5	59.4		0.02	0.01		0.01	0.66		0.26	0.07	U	0.07	8.3		0.16
Waste Staging Pile	J111V7	1/24/06	0.41	UJ	0.41	3.7	U	3.7	77.4		0.02	0.01	U	0.01	2.0		0.28	0.07	U	0.07	9.4		0.16
Equipment Blank	J111V6	1/24/06	0.37	UJ	0.37	3.4	U	3.4	0.99		0.02	0.009	U	0.009	0.25	U	0.25	0.07	U	0.07	0.15	U	0.15

Sample Location	HEIS Number	Sample Date	Cobalt			Copper			Lead			Manganese			Mercury			Molybdenum			Nickel		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J111T4	1/24/06	5.4		0.13	12.2		0.13	12.4	J	0.33	254	C	0.02	0.05		0.02	0.41		0.14	9.0		0.14
2	J111T5	1/24/06	5.8		0.13	12.7		0.13	7.4	J	0.33	265	C	0.02	0.04		0.01	0.31		0.14	10.1		0.14
3	J111T6	1/24/06	5.0		0.12	9.3		0.12	3.2	J	0.31	229	C	0.02	0.01	U	0.01	0.23		0.13	10.4		0.13
Duplicate of J111T6	J111V5	1/24/06	4.9		0.12	9.4		0.12	4.2	J	0.31	223	C	0.02	0.02	U	0.02	0.20		0.13	11.2		0.13
4	J111T7	1/24/06	6.1		0.12	12.1		0.12	6.5	J	0.32	287	C	0.02	0.02	U	0.02	0.13	U	0.13	11.2		0.13
5	J111T8	1/24/06	5.4		0.13	11.5		0.13	12.9	J	0.33	254	C	0.02	0.02	U	0.02	0.15		0.14	9.5		0.14
6	J111T9	1/24/06	5.8		0.12	13.5		0.12	10.3	J	0.32	266	C	0.02	0.04		0.02	0.16		0.13	10.6		0.13
7	J111V0	1/24/06	5.0		0.12	8.9		0.12	3.1	J	0.32	237	C	0.02	0.01	U	0.01	0.13	U	0.13	9.4		0.13
8	J111V1	1/24/06	5.1		0.12	9.7		0.12	4.2	J	0.32	241	C	0.02	0.01	U	0.01	0.13	U	0.13	9.3		0.13
9	J111V2	1/24/06	4.8		0.12	9.5		0.12	3.9	J	0.30	217	C	0.02	0.02	U	0.02	0.13	U	0.13	9.8		0.13
10	J111V3	1/24/06	4.4		0.12	9.1		0.12	2.7	J	0.32	205	C	0.02	0.02	U	0.02	0.20		0.13	8.8		0.13
11	J111V4	1/24/06	5.0		0.12	9.7		0.12	2.9	J	0.30	224	C	0.02	0.01	U	0.01	0.19		0.13	9.7		0.13
Waste Staging Pile	J111V7	1/24/06	5.4		0.12	12.5		0.12	7.3	J	0.32	250	C	0.02	0.38		0.02	0.28		0.13	9.9		0.13
Equipment Blank	J111V6	1/24/06	0.11	U	0.11	0.11	U	0.11	0.30	J	0.29	2.7	C	0.02	0.02	U	0.02	0.12	U	0.12	0.12	U	0.12

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

Note: Data qualified with C or J are considered acceptable values.

C = blank contamination (inorganic constituents)

HEIS = Hanford Environmental Information System

J = estimated

PQL = practical quantitation limit

Q = qualifier

TPH = total petroleum hydrocarbons

U = undetected

Attachment	1	Sheet No.	1 of 10
Originator	J. M. Capron B. S. Wiegman	Date	04/10/06
Checked	T. M. Blakley	Date	4-11-06
Calc. No.	0100F-CA-V0244	Rev. No.	0

Attachment 1. 100-F-33 Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Selenium			Silver			Vanadium			Zinc			TPH		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J111T4	1/24/06	0.39	U	0.39	0.15	U	0.15	31.6		0.1	61.7		0.05	152	U	152
2	J111T5	1/24/06	0.38	U	0.38	0.15	U	0.15	34.6		0.09	51.9		0.05	146	U	146
3	J111T6	1/24/06	0.36	U	0.36	0.14	U	0.14	30.2		0.09	31.2		0.05	142	U	142
Duplicate of J111T6	J111V5	1/24/06	0.36	U	0.36	0.14	U	0.14	30.5		0.09	33.0		0.05	139	U	139
4	J111T7	1/24/06	0.37	U	0.37	0.14	U	0.14	39.7		0.09	147		0.05	144	U	144
5	J111T8	1/24/06	0.38	U	0.38	0.15	U	0.15	36.2		0.1	55.3		0.05	151	U	151
6	J111T9	1/24/06	0.37	U	0.37	0.15	U	0.15	31.1		0.09	65.9		0.05	146	U	146
7	J111V0	1/24/06	0.35	U	0.35	0.14	U	0.14	29.4		0.09	29.5		0.05	139	U	139
8	J111V1	1/24/06	0.37	U	0.37	0.14	U	0.14	32.3		0.09	37.2		0.05	143	U	143
9	J111V2	1/24/06	0.35	U	0.35	0.14	U	0.14	29.6		0.09	34.9		0.05	139	U	139
10	J111V3	1/24/06	0.37	U	0.37	0.14	U	0.14	28.8		0.09	29.5		0.05	146	U	146
11	J111V4	1/24/06	0.35	U	0.35	0.14	U	0.14	30.1		0.09	29.4		0.05	141	U	141
Waste Staging Pile	J111V7	1/24/06	0.37	U	0.37	0.17		0.14	36.1		0.09	49.0		0.05	133	U	133
Equipment Blank	J111V6	1/24/06	0.34	U	0.34	0.13	U	0.13	0.09		0.08	1.0		0.05			

Attachment	1	Sheet No.	2 of 10
Originator	J. M. Capron B. S. Wiegman	Date	04/10/06
Checked	T. M. Blakley	Date	
Calc. No.	0100F-CA-V0244	Rev. No.	0

Attachment 1. 100-F-33 Verification Sampling Results.*

Constituent	J111V6 Equipment Blank Sample Date 1/24/06			J111T4 Sample Location 1 Sample Date 1/24/06			J111T5 Sample Location 2 Sample Date 1/24/06			J111T6 Sample Location 3 Sample Date 1/24/06		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls												
Aroclor-1016				15	U	15	15	U	15	14	U	14
Aroclor-1221				15	UJ	15	15	UJ	15	14	UJ	14
Aroclor-1232				15	UJ	15	15	UJ	15	14	UJ	14
Aroclor-1242				15	UJ	15	15	UJ	15	14	UJ	14
Aroclor-1248				15	UJ	15	15	UJ	15	14	UJ	14
Aroclor-1254				260	J	15	210	J	15	5.0	J	14
Aroclor-1260				15	UJ	15	15	UJ	15	14	UJ	14
Semivolatile Organic Compounds												
1,2,4-Trichlorobenzene	330	U	330	380	U	380	370	U	370	350	U	350
1,2-Dichlorobenzene	330	U	330	380	U	380	370	U	370	350	U	350
1,3-Dichlorobenzene	330	U	330	380	U	380	370	U	370	350	U	350
1,4-Dichlorobenzene	330	U	330	380	U	380	370	U	370	350	U	350
2,4,5-Trichlorophenol	830	U	830	950	U	950	920	U	920	890	U	890
2,4,6-Trichlorophenol	330	U	330	380	U	380	370	U	370	350	U	350
2,4-Dichlorophenol	330	U	330	380	U	380	370	U	370	350	UJ	350
2,4-Dimethylphenol	330	U	330	380	U	380	370	U	370	350	U	350
2,4-Dinitrophenol	830	UJ	830	950	UJ	950	920	UJ	920	890	UJ	890
2,4-Dinitrotoluene	330	U	330	380	U	380	370	U	370	350	U	350
2,6-Dinitrotoluene	330	U	330	380	UJ	380	370	UJ	370	350	UJ	350
2-Chloronaphthalene	330	U	330	380	U	380	370	U	370	350	U	350
2-Chlorophenol	330	U	330	380	UJ	380	370	UJ	370	350	UJ	350
2-Methylnaphthalene	330	U	330	380	U	380	370	U	370	350	U	350
2-Methylphenol (cresol, o-)	330	U	330	380	U	380	370	U	370	350	U	350
2-Nitroaniline	830	U	830	950	U	950	920	U	920	890	UJ	890
2-Nitrophenol	330	U	330	380	U	380	370	U	370	350	UJ	350
3,3'-Dichlorobenzidine	330	U	330	380	U	380	370	U	370	350	U	350
4-Methylphenol (p-cresol)	330	U	330	380	U	380	370	U	370	350	U	350
3-Nitroaniline	830	U	830	950	U	950	920	U	920	890	UJ	890
4,6-Dinitro-2-methylphenol	830	UJ	830	950	UJ	950	920	UJ	920	890	UJ	890
4-Bromophenyl-phenylether	330	U	330	380	U	380	370	U	370	350	U	350
4-Chloro-3-methylphenol	330	U	330	380	U	380	370	U	370	350	UJ	350
4-Chloroaniline	330	U	330	380	U	380	370	U	370	350	UJ	350
4-Chlorophenyl-phenylether	330	U	330	380	U	380	370	U	370	350	U	350
4-Nitroaniline	830	U	830	950	U	950	920	U	920	890	UJ	890
4-Nitrophenol	830	U	830	950	U	950	920	U	920	890	U	890
Acenaphthene	330	U	330	380	U	380	370	U	370	350	U	350
Acenaphthylene	330	U	330	380	U	380	370	U	370	350	U	350
Anthracene	330	U	330	380	U	380	370	U	370	350	U	350
Benzo(a)anthracene	330	U	330	380	U	380	370	U	370	350	U	350
Benzo(a)pyrene	330	U	330	380	U	380	370	U	370	350	U	350
Benzo(b)fluoranthene	330	U	330	380	U	380	370	U	370	350	U	350
Benzo(g,h,i)perylene	330	U	330	380	U	380	370	U	370	350	U	350
Benzo(k)fluoranthene	330	U	330	380	U	380	370	U	370	350	U	350
bis(2-Chloro-1-methylethyl)ether	330	U	330	380	U	380	370	U	370	350	U	350
bis(2-Chloroethoxy)methane	330	U	330	380	U	380	370	U	370	350	U	350
bis(2-Chloroethyl) ether	330	U	330	380	U	380	370	U	370	350	U	350
bis(2-Ethylhexyl) phthalate	660	U	660	660	U	660	660	U	660	660	U	660

*TPH data are located with the inorganic data.

Attachment	1	Sheet No.	3 of 10
Originator	J. M. Capron B. S. Wiegman	Date	04/10/06
Checked	T. M. Blakley	Date	
Calc. No.	0100F-CA-V0244	Rev. No.	0

Attachment 1. 100-F-33 Verification Sampling Results.

Constituent	J111V6 Equipment Blank Sample Date 1/24/06			J111T4 Sample Location 1 Sample Date 1/24/06			J111T5 Sample Location 2 Sample Date 1/24/06			J111T6 Sample Location 3 Sample Date 1/24/06		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Compounds (continued)												
Butylbenzylphthalate	330	U	330	380	U	380	370	U	370	350	U	350
Carbazole	330	U	330	380	U	380	370	U	370	350	U	350
Chrysene	330	U	330	380	U	380	370	U	370	350	U	350
Dibenz(a,h)anthracene	330	U	330	380	U	380	370	U	370	350	U	350
Dibenzofuran	330	U	330	380	U	380	370	U	370	350	U	350
Diethylphthalate	330	U	330	380	U	380	370	U	370	350	U	350
Dimethylphthalate	330	U	330	380	U	380	370	U	370	350	U	350
Di-n-butylphthalate	330	U	330	30	J	380	20	J	370	350	U	350
Di-n-octylphthalate	330	U	330	380	U	380	370	U	370	350	U	350
Fluoranthene	330	U	330	380	U	380	370	U	370	350	U	350
Fluorene	330	U	330	380	U	380	370	U	370	350	U	350
Hexachlorobenzene	330	U	330	380	U	380	370	U	370	350	U	350
Hexachlorobutadiene	330	U	330	380	U	380	370	U	370	350	U	350
Hexachlorocyclopentadiene	330	U	330	380	U	380	370	U	370	350	U	350
Hexachloroethane	330	U	330	380	U	380	370	U	370	350	U	350
Indeno(1,2,3-cd)pyrene	330	U	330	380	U	380	370	U	370	350	U	350
Isophorone	330	U	330	380	U	380	370	U	370	350	U	350
Naphthalene	330	U	330	380	U	380	370	U	370	350	U	350
Nitrobenzene	330	U	330	380	U	380	370	U	370	350	UJ	350
N-Nitroso-di-n-dipropylamine	330	U	330	380	U	380	370	U	370	350	UJ	350
N-Nitrosodiphenylamine	330	U	330	380	U	380	370	U	370	350	UJ	350
Pentachlorophenol	830	U	830	950	U	950	920	U	920	890	U	890
Phenanthrene	330	U	330	380	U	380	370	U	370	350	U	350
Phenol	330	U	330	380	U	380	370	U	370	350	U	350
Pyrene	330	U	330	380	U	380	370	U	370	350	U	350

Attachment	1	Sheet No.	4 of 10
Originator	J. M. Capron B. S. Wiegman	Date	04/10/06
Checked	T. M. Blakley	Date	
Calc. No.	0100F-CA-V0244	Rev. No.	0

Attachment 1. 100-F-33 Verification Sampling Results.

Constituent	J111V5 Duplicate of J111T6 Sample Date 1/24/06			J111T7 Sample Location 4 Sample Date1/24/06			J111T8 Sample Location 5 Sample Date 1/24/06			J111T9 Sample Location 6 Sample Date 1/24/06		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls												
Aroclor-1016	14	U	14	15	U	15	15	U	15	15	U	15
Aroclor-1221	14	UJ	14	15	UJ	15	15	UJ	15	15	UJ	15
Aroclor-1232	14	UJ	14	15	UJ	15	15	UJ	15	15	UJ	15
Aroclor-1242	14	UJ	14	15	UJ	15	15	UJ	15	15	UJ	15
Aroclor-1248	14	UJ	14	15	UJ	15	15	UJ	15	15	UJ	15
Aroclor-1254	100	J	14	13	J	15	16	J	15	110	J	15
Aroclor-1260	14	UJ	14	15	UJ	15	15	UJ	15	15	UJ	15
Semivolatile Organic Compounds												
1,2,4-Trichlorobenzene	350	U	350	360	U	360	380	U	380	370	U	370
1,2-Dichlorobenzene	350	U	350	360	U	360	380	U	380	370	U	370
1,3-Dichlorobenzene	350	U	350	360	U	360	380	U	380	370	U	370
1,4-Dichlorobenzene	350	U	350	360	U	360	380	U	380	370	U	370
2,4,5-Trichlorophenol	880	U	880	910	U	910	950	U	950	910	U	910
2,4,6-Trichlorophenol	350	U	350	360	U	360	380	U	380	370	U	370
2,4-Dichlorophenol	350	U	350	360	U	360	380	U	380	370	U	370
2,4-Dimethylphenol	350	U	350	360	U	360	380	U	380	370	U	370
2,4-Dinitrophenol	880	UJ	880	910	UJ	910	950	UJ	950	910	UJ	910
2,4-Dinitrotoluene	350	U	350	360	U	360	380	U	380	370	U	370
2,6-Dinitrotoluene	350	U	350	360	U	360	380	U	380	370	U	370
2-Chloronaphthalene	350	U	350	360	U	360	380	U	380	370	U	370
2-Chlorophenol	350	U	350	360	U	360	380	U	380	370	U	370
2-Methylnaphthalene	350	U	350	360	U	360	380	U	380	31	J	370
2-Methylphenol (cresol, o-)	350	U	350	360	U	360	380	U	380	370	U	370
2-Nitroaniline	880	U	880	910	U	910	950	U	950	910	U	910
2-Nitrophenol	350	U	350	360	U	360	380	U	380	370	U	370
3,3'-Dichlorobenzidine	350	U	350	360	U	360	380	U	380	370	U	370
4-Methylphenol (p-cresol)	350	U	350	360	U	360	380	U	380	370	U	370
3-Nitroaniline	880	U	880	910	U	910	950	U	950	910	U	910
4,6-Dinitro-2-methylphenol	880	UJ	880	910	UJ	910	950	UJ	950	910	UJ	910
4-Bromophenyl-phenylether	350	U	350	360	U	360	380	U	380	370	U	370
4-Chloro-3-methylphenol	350	U	350	360	U	360	380	U	380	370	U	370
4-Chloroaniline	350	U	350	360	U	360	380	U	380	370	U	370
4-Chlorophenyl-phenylether	350	U	350	360	U	360	380	U	380	370	U	370
4-Nitroaniline	880	U	880	910	U	910	950	U	950	910	U	910
4-Nitrophenol	880	U	880	910	U	910	950	U	950	910	U	910
Acenaphthene	350	U	350	360	U	360	380	U	380	370	U	370
Acenaphthylene	350	U	350	360	U	360	380	U	380	370	U	370
Anthracene	350	U	350	360	U	360	380	U	380	370	U	370
Benzo(a)anthracene	350	U	350	360	U	360	380	U	380	370	U	370
Benzo(a)pyrene	350	U	350	360	U	360	380	U	380	370	U	370
Benzo(b)fluoranthene	350	U	350	360	U	360	380	U	380	370	U	370
Benzo(g,h,i)perylene	350	U	350	360	U	360	380	U	380	370	U	370
Benzo(k)fluoranthene	350	U	350	360	U	360	380	U	380	370	U	370
bis(2-Chloro-1-methylethyl)ether	350	U	350	360	U	360	380	U	380	370	U	370
bis(2-Chloroethoxy)methane	350	U	350	360	U	360	380	U	380	370	U	370
bis(2-Chloroethyl) ether	350	U	350	360	U	360	380	U	380	370	U	370
bis(2-Ethylhexyl) phthalate	660	U	660	660	U	660	660	U	660	660	U	660

Attachment	1	Sheet No.	5 of 10
Originator	J. M. Capron B. S. Wiegman	Date	04/10/06
Checked	T. M. Blakley	Date	
Calc. No.	0100F-CA-V0244	Rev. No.	0

Attachment 1. 100-F-33 Verification Sampling Results.

Constituent	J111V5 Duplicate of J111T6 Sample Date 1/24/06			J111T7 Sample Location 4 Sample Date1/24/06			J111T8 Sample Location 5 Sample Date 1/24/06			J111T9 Sample Location 6 Sample Date 1/24/06		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Compounds (continued)												
Butylbenzylphthalate	350	U	350	360	U	360	380	U	380	370	U	370
Carbazole	350	U	350	360	U	360	380	U	380	370	U	370
Chrysene	350	U	350	360	U	360	380	U	380	370	U	370
Dibenz(a,h)anthracene	350	U	350	360	U	360	380	U	380	370	U	370
Dibenzofuran	350	U	350	360	U	360	380	U	380	370	U	370
Diethylphthalate	350	U	350	360	U	360	380	U	380	370	U	370
Dimethylphthalate	350	U	350	360	U	360	380	U	380	370	U	370
Di-n-butylphthalate	350	U	350	360	U	360	380	U	380	22	J	370
Di-n-octylphthalate	350	U	350	360	U	360	380	U	380	370	U	370
Fluoranthene	350	U	350	360	U	360	380	U	380	370	U	370
Fluorene	350	U	350	360	U	360	380	U	380	370	U	370
Hexachlorobenzene	350	U	350	360	U	360	380	U	380	370	U	370
Hexachlorobutadiene	350	U	350	360	U	360	380	U	380	370	U	370
Hexachlorocyclopentadiene	350	U	350	360	U	360	380	U	380	370	U	370
Hexachloroethane	350	U	350	360	U	360	380	U	380	370	U	370
Indeno(1,2,3-cd)pyrene	350	U	350	360	U	360	380	U	380	370	U	370
Isophorone	350	U	350	360	U	360	380	U	380	370	U	370
Naphthalene	350	U	350	360	U	360	380	U	380	22	J	370
Nitrobenzene	350	U	350	360	U	360	380	U	380	370	U	370
N-Nitroso-di-n-dipropylamine	350	U	350	360	U	360	380	U	380	370	U	370
N-Nitrosodiphenylamine	350	U	350	360	U	360	380	U	380	370	U	370
Pentachlorophenol	880	U	880	910	U	910	950	U	950	910	U	910
Phenanthrene	350	U	350	360	U	360	380	U	380	370	U	370
Phenol	350	U	350	360	U	360	380	U	380	19	J	370
Pyrene	350	U	350	360	U	360	380	U	380	370	U	370

Attachment	1	Sheet No.	6 of 10
Originator	J. M. Capron B. S. Wiegman	Date	04/10/06
Checked	T. M. Blakley	Date	
Calc. No.	0100F-CA-V0244	Rev. No.	0

Attachment 1. 100-F-33 Verification Sampling Results.

Constituent	J111V0 Sample Location 7 Sample Date 1/24/06			J111V1 Sample Location 8 Sample Date 1/24/06			J111V2 Sample Location 9 Sample Date 1/24/06			J111V3 Sample Location 10 Sample Date 1/24/06		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls												
Aroclor-1016	14	U	14	14	U	14	14	U	14	15	U	15
Aroclor-1221	14	UJ	14	14	UJ	14	14	UJ	14	15	UJ	15
Aroclor-1232	14	UJ	14	14	UJ	14	14	UJ	14	15	UJ	15
Aroclor-1242	14	UJ	14	14	UJ	14	14	UJ	14	15	UJ	15
Aroclor-1248	14	UJ	14	14	UJ	14	14	UJ	14	15	UJ	15
Aroclor-1254	14	UJ	14	6.1	J	14	24	J	14	21	J	15
Aroclor-1260	14	UJ	14	14	UJ	14	14	UJ	14	15	UJ	15
Semivolatile Organic Compounds												
1,2,4-Trichlorobenzene	350	U	350	360	U	360	350	U	350	370	U	370
1,2-Dichlorobenzene	350	U	350	360	U	360	350	U	350	370	U	370
1,3-Dichlorobenzene	350	U	350	360	U	360	350	U	350	370	U	370
1,4-Dichlorobenzene	350	U	350	360	U	360	350	U	350	370	U	370
2,4,5-Trichlorophenol	870	U	870	900	U	900	870	U	870	920	U	920
2,4,6-Trichlorophenol	350	U	350	360	U	360	350	U	350	370	U	370
2,4-Dichlorophenol	350	U	350	360	U	360	350	U	350	370	U	370
2,4-Dimethylphenol	350	U	350	360	U	360	350	U	350	370	U	370
2,4-Dinitrophenol	870	UJ	870	900	UJ	900	870	UJ	870	920	UJ	920
2,4-Dinitrotoluene	350	U	350	360	U	360	350	U	350	370	U	370
2,6-Dinitrotoluene	350	U	350	360	U	360	350	U	350	370	U	370
2-Chloronaphthalene	350	U	350	360	U	360	350	U	350	370	U	370
2-Chlorophenol	350	U	350	360	U	360	350	U	350	370	U	370
2-Methylnaphthalene	350	U	350	360	U	360	350	U	350	370	U	370
2-Methylphenol (cresol, o-)	350	U	350	360	U	360	350	U	350	370	U	370
2-Nitroaniline	870	U	870	900	U	900	870	U	870	920	U	920
2-Nitrophenol	350	U	350	360	U	360	350	U	350	370	U	370
3,3'-Dichlorobenzidine	350	U	350	360	U	360	350	U	350	370	U	370
4-Methylphenol (p-cresol)	350	U	350	360	U	360	350	U	350	370	U	370
3-Nitroaniline	870	U	870	900	U	900	870	U	870	920	U	920
4,6-Dinitro-2-methylphenol	870	UJ	870	900	UJ	900	870	UJ	870	920	UJ	920
4-Bromophenyl-phenylether	350	U	350	360	U	360	350	U	350	370	U	370
4-Chloro-3-methylphenol	350	U	350	360	U	360	350	U	350	370	U	370
4-Chloroaniline	350	U	350	360	U	360	350	U	350	370	U	370
4-Chlorophenyl-phenylether	350	U	350	360	U	360	350	U	350	370	U	370
4-Nitroaniline	870	U	870	900	U	900	870	U	870	920	U	920
4-Nitrophenol	870	U	870	900	U	900	870	U	870	920	U	920
Acenaphthene	350	U	350	360	U	360	350	U	350	370	U	370
Acenaphthylene	350	U	350	360	U	360	350	U	350	370	U	370
Anthracene	350	U	350	360	U	360	350	U	350	370	U	370
Benzo(a)anthracene	350	U	350	360	U	360	350	U	350	370	U	370
Benzo(a)pyrene	350	U	350	360	U	360	350	U	350	370	U	370
Benzo(b)fluoranthene	350	U	350	360	U	360	350	U	350	370	U	370
Benzo(g,h,i)perylene	350	U	350	360	U	360	350	U	350	370	U	370
Benzo(k)fluoranthene	350	U	350	360	U	360	350	U	350	370	U	370
bis(2-Chloro-1-methylethyl)ether	350	U	350	360	U	360	350	U	350	370	U	370
bis(2-Chloroethoxy)methane	350	U	350	360	U	360	350	U	350	370	U	370
bis(2-Chloroethyl) ether	350	U	350	360	U	360	350	U	350	370	U	370
bis(2-Ethylhexyl) phthalate	660	U	660	660	U	660	660	U	660	660	U	660

Attachment	1	Sheet No.	7 of 10
Originator	J. M. Capron B. S. Wiegman	Date	04/10/06
Checked	T. M. Blakley	Date	
Calc. No.	0100F-CA-V0244	Rev. No.	0

Attachment 1. 100-F-33 Verification Sampling Results.

Constituent	J111V0 Sample Location 7 Sample Date 1/24/06			J111V1 Sample Location 8 Sample Date 1/24/06			J111V2 Sample Location 9 Sample Date 1/24/06			J111V3 Sample Location 10 Sample Date 1/24/06		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Compounds (continued)												
Butylbenzylphthalate	350	U	350	360	U	360	350	U	350	370	U	370
Carbazole	350	U	350	360	U	360	350	U	350	370	U	370
Chrysene	350	U	350	360	U	360	350	U	350	370	U	370
Dibenz(a,h)anthracene	350	U	350	360	U	360	350	U	350	370	U	370
Dibenzofuran	350	U	350	360	U	360	350	U	350	370	U	370
Diethylphthalate	350	U	350	360	U	360	350	U	350	370	U	370
Dimethylphthalate	350	U	350	360	U	360	350	U	350	370	U	370
Di-n-butylphthalate	350	U	350	19	J	360	350	U	350	370	U	370
Di-n-octylphthalate	350	U	350	360	U	360	350	U	350	370	U	370
Fluoranthene	350	U	350	360	U	360	350	U	350	370	U	370
Fluorene	350	U	350	360	U	360	350	U	350	370	U	370
Hexachlorobenzene	350	U	350	360	U	360	350	U	350	370	U	370
Hexachlorobutadiene	350	U	350	360	U	360	350	U	350	370	U	370
Hexachlorocyclopentadiene	350	U	350	360	U	360	350	U	350	370	U	370
Hexachloroethane	350	U	350	360	U	360	350	U	350	370	U	370
Indeno(1,2,3-cd)pyrene	350	U	350	360	U	360	350	U	350	370	U	370
Isophorone	350	U	350	360	U	360	350	U	350	370	U	370
Naphthalene	350	U	350	360	U	360	350	U	350	370	U	370
Nitrobenzene	350	U	350	360	U	360	350	U	350	370	U	370
N-Nitroso-di-n-dipropylamine	350	U	350	360	U	360	350	U	350	370	U	370
N-Nitrosodiphenylamine	350	U	350	360	U	360	350	U	350	370	U	370
Pentachlorophenol	870	U	870	900	U	900	870	U	870	920	U	920
Phenanthrene	350	U	350	360	U	360	350	U	350	370	U	370
Phenol	350	U	350	360	U	360	350	U	350	370	U	370
Pyrene	350	U	350	360	U	360	350	U	350	370	U	370

Attachment	1	Sheet No.	8 of 10
Originator	J. M. Capron B. S. Wiegman	Date	04/10/06
Checked	T. M. Blakley	Date	
Calc. No.	0100F-CA-V0244	Rev. No.	0

Attachment 1. 100-F-33 Verification Sampling Results.

Constituent	J111V4 Sample Location 11 Sample Date 1/24/06			J111V7 Waste Staging Pile Sample Date 1/24/06		
	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls						
Aroclor-1016	14	U	14	15	U	15
Aroclor-1221	14	UJ	14	15	UJ	15
Aroclor-1232	14	UJ	14	15	UJ	15
Aroclor-1242	14	UJ	14	15	UJ	15
Aroclor-1248	14	UJ	14	15	UJ	15
Aroclor-1254	14	UJ	14	48	J	15
Aroclor-1260	14	UJ	14	15	UJ	15
Semivolatile Organic Compounds						
1,2,4-Trichlorobenzene	350	U	350	360	U	360
1,2-Dichlorobenzene	350	U	350	360	U	360
1,3-Dichlorobenzene	350	U	350	360	U	360
1,4-Dichlorobenzene	350	U	350	360	U	360
2,4,5-Trichlorophenol	880	U	880	910	U	910
2,4,6-Trichlorophenol	350	U	350	360	U	360
2,4-Dichlorophenol	350	U	350	360	U	360
2,4-Dimethylphenol	350	U	350	360	U	360
2,4-Dinitrophenol	880	UJ	880	910	UJ	910
2,4-Dinitrotoluene	350	U	350	360	U	360
2,6-Dinitrotoluene	350	U	350	360	U	360
2-Chloronaphthalene	350	U	350	360	U	360
2-Chlorophenol	350	U	350	360	U	360
2-Methylnaphthalene	350	U	350	360	U	360
2-Methylphenol (cresol, o-)	350	U	350	360	U	360
2-Nitroaniline	880	U	880	910	U	910
2-Nitrophenol	350	U	350	360	U	360
3,3'-Dichlorobenzidine	350	U	350	360	U	360
4-Methylphenol (p-cresol)	350	U	350	360	U	360
3-Nitroaniline	880	U	880	910	U	910
4,6-Dinitro-2-methylphenol	880	UJ	880	910	UJ	910
4-Bromophenyl-phenylether	350	U	350	360	U	360
4-Chloro-3-methylphenol	350	U	350	360	U	360
4-Chloroaniline	350	U	350	360	U	360
4-Chlorophenyl-phenylether	350	U	350	360	U	360
4-Nitroaniline	880	U	880	910	U	910
4-Nitrophenol	880	U	880	910	U	910
Acenaphthene	350	U	350	360	U	360
Acenaphthylene	350	U	350	360	U	360
Anthracene	350	U	350	360	U	360
Benzo(a)anthracene	350	U	350	360	U	360
Benzo(a)pyrene	350	U	350	360	U	360
Benzo(b)fluoranthene	350	U	350	360	U	360
Benzo(g,h,i)perylene	350	U	350	360	U	360
Benzo(k)fluoranthene	350	U	350	360	U	360
bis(2-Chloro-1-methylethyl)ether	350	U	350	360	U	360
bis(2-Chloroethoxy)methane	350	U	350	360	U	360
bis(2-Chloroethyl) ether	350	U	350	360	U	360
bis(2-Ethylhexyl) phthalate	660	U	660	660	U	660

Attachment	1	Sheet No.	9 of 10
Originator	J. M. Capron B. S. Wiegman	Date	04/10/06
Checked	T. M. Blakley	Date	
Calc. No.	0100F-CA-V0244	Rev. No.	0

Attachment 1. 100-F-33 Verification Sampling Results.

Constituent	J111V4 Sample Location 11 Sample Date 1/24/06			J111V7 Waste Staging Pile Sample Date 1/24/06		
	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Compounds (continued)						
Butylbenzylphthalate	350	U	350	360	U	360
Carbazole	350	U	350	360	U	360
Chrysene	350	U	350	360	U	360
Dibenz(a,h)anthracene	350	U	350	360	U	360
Dibenzofuran	350	U	350	360	U	360
Diethylphthalate	350	U	350	360	U	360
Dimethylphthalate	350	U	350	360	U	360
Di-n-butylphthalate	350	U	350	30	J	360
Di-n-octylphthalate	350	U	350	360	U	360
Fluoranthene	350	U	350	360	U	360
Fluorene	350	U	350	360	U	360
Hexachlorobenzene	350	U	350	360	U	360
Hexachlorobutadiene	350	U	350	360	U	360
Hexachlorocyclopentadiene	350	U	350	360	U	360
Hexachloroethane	350	U	350	360	U	360
Indeno(1,2,3-cd)pyrene	350	U	350	360	U	360
Isophorone	350	U	350	360	U	360
Naphthalene	350	U	350	360	U	360
Nitrobenzene	350	U	350	360	U	360
N-Nitroso-di-n-dipropylamine	350	U	350	360	U	360
N-Nitrosodiphenylamine	350	U	350	360	U	360
Pentachlorophenol	880	U	880	910	U	910
Phenanthrene	350	U	350	360	U	360
Phenol	350	U	350	360	U	360
Pyrene	350	U	350	360	U	360

Attachment	1	Sheet No.	10 of 10
Originator	J. M. Capron B. S. Wiegman	Date	04/10/06
Checked	T. M. Blakley	Date	
Calc. No.	0100F-CA-V0244	Rev. No.	0

APPENDIX C

HAZARD QUOTIENT AND CARCINOGENIC RISK CALCULATIONS

CALCULATION COVER SHEET

Project Title 100-F Field Remediation **Job No.** 14655
Area 100-F
Discipline Environmental *__Calc. No.__ 0100F-CA-V0248
Subject 100-F-33 Hazard Quotient and Carcinogenic Risk Calculations
Computer Program Excel **Program No.** Excel 2003

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

Committed Calculation ☒ **Preliminary** ☐ **Superseded** ☐ **Voided** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = 4 Total = 5	B. S. Wiegman 6/5/06	K. A. Anselm 6/5/06	T. M. Blakley 6/6/06	S. W. Callison 6-7-06	6-7-06

SUMMARY OF REVISION

WCH-DE-018 (04/14/2006) *Obtain Calc. No. from R&DC and Form from Intranet

Washington Closure Hanford CALCULATION SHEET

Originator:	B. S. Wiegman	Date:	6/5/06	Calc. No.:	0100F-CA-V0248	Rev.:	0
Project:	100-F Field Remediation	Job No:	14655	Checked:	K. A. Anselm	Date:	6/5/06
Subject:	100-F-33 Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	1 of 4

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and carcinogenic (excess cancer) risk values for the 100-F-33 Aquatic Biology Fish Ponds site remedial action. 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, 2006, Waste Site Reclassification Form 2006-021, and Attachment *Remaining Sites Verification Package for 100-F-33, 146-F Aquatic Biology Fish Ponds*, Washington Closure Hanford, Richland, Washington.

SOLUTION:

1) Calculate an HQ for each noncarcinogenic constituent detected above background and compare it to the individual HQ of <1.0 (DOE-RL 2005).

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

3) Calculate an excess cancer risk value for each carcinogenic constituent detected above background and compare it to the individual excess cancer risk criterion of $<1 \times 10^{-6}$ (DOE-RL 2005).

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

METHODOLOGY:

Hazard quotient and carcinogenic risk calculations were computed separately for the waste site and staging pile footprints using the data from WCH (2006). Hazard quotient and carcinogenic risk calculations were performed for the waste site footprint using the higher of the maximum confirmatory sample results for the southern portion of the site and the northern remediation footprint statistical value for each analyte detected above background.

Washington Closure Hanford CALCULATION SHEET

Originator:	B. S. Wiegman	Date:	6/5/06	Calc. No.:	0100F-CA-V0248	Rev.:	0
Project:	100-F Field Remediation	Job No:	14655	Checked:	K. A. Anselm	Date:	6/5/06
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Of the contaminants of potential concern for the waste site footprint, copper, hexavalent chromium, lead, and zinc require the HQ and risk calculations because they were detected above background. Additionally, boron, molybdenum, aroclor-1254, indeno(1,2,3-cd)pyrene, 2-methylnapthalene, di-n-butylphthalate, naphthalene, phenol, and phenanthrene require the HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Of the contaminants of potential concern for the staging pile footprint, mercury requires the HQ and risk calculations because it was detected above background. Additionally, boron, molybdenum, aroclor-1254, and di-n-butylphthalate require the HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron in the waste site footprint is 3.1 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 1.9×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criteria is met.

2) After the HQ calculations are completed for the appropriate analytes, the cumulative HQ is obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The sum of the HQ values in the waste site footprint is 2.9×10^{-1}. The sum of the HQ values in the staging pile footprint is 4.7×10^{-2}. Comparing these values to the requirement of <1.0, this criterion 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 aroclor-1254 in the waste site footprint is 0.36 mg/kg; divided by 0.5 mg/kg, and multiplied as indicated, is 7.2×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-6}$, this criteria is met. The cumulative excess cancer risk for the waste site footprint is 8.6×10^{-7}. Aroclor-1254 is the sole carcinogenic analyte for the staging pile footprint; therefore the individual and cumulative excess cancer risk is 9.6×10^{-8}. Comparing these values 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 calculation for the waste site footprint, and Table 2 shows the results of the calculation for the staging pile footprint:

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Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-F-33 Aquatic Biology Fish Ponds Waste Site Footprint.

Contaminants of Potential Concern[a]	Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	3.1	16,000	1.9E-04	--	--
Chromium, hexavalent[c]	0.277	240	1.2E-03	2.1	1.3E-07
Copper	44.2	2,960	1.5E-02	--	--
Lead[d]	14.7	353	4.2E-02	--	--
Molybdenum	1.4	400	3.5E-03	--	--
Zinc	131	24,000	5.5E-03	--	--
Semivolatiles					
Di-n-butylphthalate	0.030	8,000	3.8E-06	--	--
Indeno(1,2,3-cd) pyrene	0.017	--	--	1.37	1.2E-08
Methylnapthalene; 2-	0.031	320	9.7E-05	--	--
Naphthalene	0.022	1,600	1.4E-05	--	--
Phenanthrene[e]	0.014	24,000	5.8E-07	--	--
Phenol	0.019	24,000	7.9E-07	--	--
Polychlorinated Biphenyls					
Aroclor-1254	0.36	1.6	2.3E-01	0.5	7.2E-07
Totals					
Cumulative Hazard Quotient:			**2.9E-01**		
Cumulative Excess Cancer Risk:					**8.6E-07**

Notes:

-- = not applicable

RAG = remedial action goal

[a] = From Tables 2 and 5a (WCH 2006).

[b] = Value obtained from *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.

[d] = Value for the noncarcinogen RAG obtained from *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children*, EPA/540/R-93/081, Publication No. 9285.7, U.S. Environmental Protection Agency, Washington, D.C.

[e] = Value for the noncarcinogen RAG based on surrogate chemical anthracene.

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Table 2. Hazard Quotient and Excess Cancer Risk Results for the 100-F-33 Aquatic Biology Fish Ponds Staging Pile Footprint.

Contaminants of Potential Concern[a]	Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	2.0	16,000	1.3E-04	--	--
Mercury	0.38	24	1.6E-02	--	--
Molybdenum	0.28	400	7.0E-04	--	--
Semivolatiles					
Di-n-butylphthalate	0.030	8,000	3.8E-06	--	--
Polychlorinated Biphenyls					
Aroclor-1254	0.048	1.6	3.0E-02	0.5	9.6E-08
Totals					
Cumulative Hazard Quotient:			**4.7E-02**		
Cumulative Excess Cancer Risk:					**9.6E-08**

Notes:
-- = not applicable
RAG = remedial action goal
[a] = From Table 5b (WCH 2006).
[b] = Value obtained from *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.

CONCLUSION:

This calculation demonstrates that the 100-F-33 Aquatic Biology Fish Ponds waste site meets the requirements for the hazard quotients and carcinogenic (excess cancer) risk as identified in the RDR/RAWP (DOE-RL 2005).