Waste Site Reclassification Form

<u>Date Submitted:</u> 08/31/05 <u>Originator:</u> R. A. Carlson <u>Phone:</u> 372-9757	<u>Operable Unit(s):</u> 100-FR-1 <u>Waste Site ID:</u> 182-F <u>Type of Reclassification Action:</u> <div style="display: flex; justify-content: space-between;"> <div>Rejected</div> <div>☐</div> </div> <div style="display: flex; justify-content: space-between;"> <div>Closed Out</div> <div>☐</div> </div> <div style="display: flex; justify-content: space-between;"> <div>Interim Closed Out</div> <div>☒</div> </div> <div style="display: flex; justify-content: space-between;"> <div>No Action</div> <div>☐</div> </div>	<u>Control Number:</u> 2005-025 <u>Lead Agency:</u> EPA
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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 (NPL) of no action, interim closed-out, or closed-out sites will occur at a future date.

Description of current waste site condition:

The 182-F Reservoir was a rectangular-shaped concrete basin consisting of two sections divided by a concrete wall. The reservoir provided reserve water from the Columbia River for reactor cooling water and raw water for the 100 Area and had a storage capacity of 94.6 million liters (25 million gallons). The 182-F Reservoir was later used as a landfill for decontaminated rubble from buildings that were decommissioned in the 100-F Area. In 1997, the site was covered with clean fill. Excavation of portions of the reservoir was performed in May 2005 to inspect the soil and debris disposed at the site to determine if any hazardous/dangerous materials are present at the site and if there is any residual contamination associated with the soil used as backfill material. Sampling and evaluation of the 182-F Reservoir was 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) review of historical information, (2) field inspection of the contents of the reservoir using excavation and sampling, (3) removal of hazardous debris, and (4) proposal of reclassification of the site as interim closed out.

Basis for reclassification:

Field inspection and sampling of the soil at the 182-F Reservoir indicates that the site meets the remedial action objectives specified in the Remaining Sites ROD. The results of the 182-F Reservoir evaluation showed 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 showed 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. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 182-F Reservoir Waste Site* (attached).

D. C. Smith
DOE-RL Assistant Manager

Signature

9/7/05
Date

NA
Ecology Project Manager

Signature

Date

L. E. Gadbois
EPA Project Manager

Signature

9-12-05
Date

**REMAINING SITES VERIFICATION PACKAGE FOR THE
182-F RESERVOIR WASTE SITE**

Attachment to Waste Site Reclassification Form 2005-025

August 2005

REMAINING SITES VERIFICATION PACKAGE FOR THE 182-F RESERVOIR WASTE SITE

EXECUTIVE SUMMARY

The 182-F Reservoir is located within the 100-FR-1 Operable Unit of the Hanford Site approximately 400 m (1,312 ft) due north of the 105-F Reactor Building. The 182-F Reservoir received water from the Columbia River for reactor cooling water and raw water for the 100 Area supply system. The reservoir had a storage capacity of 94.6 million liters (25 million gallons). The reservoir was later used as a landfill for disposal of decontaminated rubble from buildings that were decommissioned in the 100-F Area. In 1997, the site was covered with clean fill.

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) contains provisions for removal, treatment, and disposal of miscellaneous sites not covered under prior RODs and for confirmatory sampling at sites identified as candidates for no action. The 182-F Reservoir is identified in Table A-2 of the Remaining Sites ROD as a candidate site where sufficient information does not exist to determine if remedial action is needed to protect human health and the environment.

For the 182-F Reservoir, a review of historical information concerning the building rubble disposed at the site indicated residual contamination remaining at the site would not pose a risk to human health or the environment. Furthermore, it was decided that development and implementation of a focused sampling design to evaluate worst-case residual contaminant levels or a statistical sampling design to evaluate the average residual contamination would be impractical due to the heterogeneous nature of the materials disposed. Therefore, it was decided to perform excavation at the site to evaluate the type and quantities of material disposed in the reservoir and determine if removal and disposal of these materials would be necessary.

Excavation of the 182-F Reservoir began on March 29, 2005, with removal and stockpiling of debris and soil. Visual observations of soil and debris removed from the southern and eastern portions of the reservoir indicated the presence of inert demolition debris (e.g., concrete, wood, rebar) with a limited amount of lead, asbestos, and some batteries. Excavation of the western portion of the reservoir revealed essentially soil with no debris. Based on the results of the excavation and discussion with the U.S. Department of Energy and U.S. Environmental Protection Agency, it was decided that excavation would stop and sampling would be performed to support a decision if additional excavation was necessary (BHI 2005b, 2005c). Samples of stockpiled material removed from the reservoir and residual soil remaining in the reservoir were collected on April 29, 2005, and analyzed for asbestos, radionuclides, metals, and polychlorinated biphenyls. Additional sampling of soil within the reservoir for polychlorinated biphenyl analysis was performed on May 26, 2005 (BHI 2005d). The sampling results indicated that the remedial action objectives for the 182-F Reservoir are met. A summary of the evaluation for soil results against the applicable criteria is presented in Table ES-1. The results of the sampling are used to make

reclassification decisions for the 182-F Reservoir site in accordance with the TPA-MP-14 (DOE-RL 1998) procedure.

In accordance with this evaluation, the sampling results support a reclassification of this site to interim closed out. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the Remaining Sites ROD (EPA 1999). The results of 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.

Table ES-1. Summary of Remedial Action Goals for the 182-F 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.	There are no radionuclide COCs/COPCs for this site.	Not applicable
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 quotient (0.25) is less than 1.	
	Attain an excess cancer risk of <1 x 10 ⁻⁶ for individual carcinogens.	The excess cancer risk values for individual carcinogens are less than 1 x 10 ⁻⁶ .	
	Attain a cumulative excess cancer risk of <1 x 10 ⁻⁵ for carcinogens.	The total excess cancer risk (4.3 x 10 ⁻⁷) is less than 1 x 10 ⁻⁵ .	
Groundwater/River Protection – Radionuclides	Attain single-COC/COPC groundwater and river protection RAGs.	There are no radionuclide COCs or COPCs for this site.	Not applicable
	Attain national primary drinking water standards: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs. ^a		
	Meet drinking water standards for alpha emitters: the most stringent of 15 pCi/L MCL or 1/25th of the derived concentration guides from DOE Order 5400.5. ^b		
	Meet total uranium standard of 30 µg/L (21.2 pCi/L). ^c		

Table ES-1. Summary of Remedial Action Goals for the 182-F Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Analytical results for total chromium, lead, zinc, Aroclor-1016, Aroclor-1254, and Aroclor-1260 are above groundwater and/or river protection RAGs. However, results of the <i>100 Area Analogous Sites RESRAD Calculations</i> (BHI 2005a) indicate that these constituents will not reach groundwater (and therefore the Columbia River) within 1,000 years. Therefore, their residual concentrations achieve the RAOs for groundwater and river protection.	Yes

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

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

^c Based on the isotopic distribution of uranium in the 100 Areas, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI 2001).

COC = contaminant of concern

COPC = contaminant of potential concern

MCL = maximum contaminant level (drinking water standard)

RAG = remedial action goal

RAO = remedial action objective

REMAINING SITES VERIFICATION PACKAGE FOR THE 182-F RESERVOIR WASTE SITE

STATEMENT OF PROTECTIVENESS

This report demonstrates that the 182-F Reservoir waste site meets the remedial action objectives (RAOs) and remedial action goals (RAGs) 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 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.

GENERAL SITE INFORMATION AND BACKGROUND

The 182-F Reservoir is located within the 100-FR-1 Operable Unit of the Hanford Site approximately 400 m (1,312 ft) due north of the 105-F Reactor Building (Figure 1). The 182-F Reservoir was used to provide reserve water from the Columbia River for reactor cooling water and raw water for the 100 Area and had a storage capacity of 94.6 million liters (25 million gallons). The reservoir was later used as a landfill for disposal of decontaminated rubble from buildings that were decommissioned in the 100-F Area. In 1997, the site was covered with clean fill. According to *Summary of the Hanford Site Decontamination, Decommissioning, and Cleanup FY 1974 Through FY 1990* (WHC 1991), rubble buried in the landfill is associated with the demolished buildings identified in Table 1.

Table 1. Demolished Building Rubble Disposed in the 182-F Waste Site.

Building Name	Hanford Era Building Use	Building Name	Hanford Era Building Use
141-N	Animal waste retention/collection facility	144-N	Kennels
183-F	Water treatment building and sediment collection basins	144-R	Animal barn
1716-B	Service building used for automotive repair	103-F	Nonirradiated fuel storage
1705-B	Service building used for oil storage	141-G	Hog barns
1722-B	Service building used for a paint shop and rigger's loft	141-H	Isolation barn
1717-B	Service building used for a maintenance shop	182-F	Pumping station
1719-B	Service building used for a first aid facility	141-L	Hay barn
144-F	Facility for radioactive inhalation study	141-F	Sheep barn
141-P	Animal barn building and connecting pens		

Source: WHC (1991).

Figure 1. 182-F Reservoir Site Location Map.

CANDIDATE SITE EVALUATION

The Remaining Sites ROD (EPA 1999) contains provisions for removal, treatment, and disposal of miscellaneous sites not covered under prior RODs and for confirmatory sampling at sites identified as candidates for no action. The 182-F Reservoir is identified in Table A-2 of the Remaining Sites ROD as a candidate site for which sufficient information does not exist to determine if remedial action is needed to protect human health and the environment. The RDR/RAWP (DOE-RL 2005b) and the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2005a) describe the process for using historical information and confirmatory sampling to collect additional data to support a decision if remediation of a candidate site is necessary.

For the 182-F Reservoir, historical information concerning the building rubble disposed at the site indicated residual contamination remaining at the site would not pose a risk to human health or the environment. Furthermore, it was decided that development and implementation of a focused sampling design to evaluate worst-case residual contaminant levels or a statistical sampling design to evaluate the average residual contamination would be impractical due to the heterogeneous nature of the materials disposed; consequently, in lieu of confirmatory sampling, it was decided to perform excavation at the site to evaluate the type and quantities of material disposed in the reservoir and determine if removal and disposal of these materials would be necessary.

FIELD EXCAVATION ACTIVITIES

Excavation of the 182-F Reservoir began on March 29, 2005, with removal and stockpiling of debris and soil. The geophysical survey results are shown in Figure 2 and were used to identify areas within the reservoir that likely contained the highest concentrations of buried debris for excavation (Bergstrom et al. 2004). Visual observations of soil and debris removed from the southern and eastern portions of the reservoir indicated the presence of inert demolition debris (e.g., concrete, wood, rebar). No hazardous materials other than a limited amount of lead, asbestos, and some batteries were found. Excavation of the western portion of the reservoir revealed essentially soil with no debris. Photographs of the excavation of the 182-F Reservoir are provided in Appendix A. Based on the results of the excavation and discussion with the U.S. Department of Energy, Richland Operations Office and the U.S. Environmental Protection Agency (EPA) (BHI 2005b, 2005c), it was determined that excavation would stop and sampling would be performed to evaluate the stockpiled material and to determine if further excavation of the soil remaining in the reservoir would be required.

During excavation, process samples of stockpiled material were collected as necessary to support waste management decisions. The results of these waste characterization samples are provided in Table B-1 of Appendix B and were not used for evaluation of the stockpiles for compliance with RAGs. Subsequent sampling of the stockpiles to support site closeout was performed as agreed to with the EPA and as described in the following section of this document.

Figure 2. 182-F Reservoir Geophysical Interpretation Map.

SAMPLING ACTIVITIES

Sampling was performed in two phases. The following subsections describe the sample design and the associated results for each sampling phase. The samples were analyzed using analytical methods approved by the EPA (DOE-RL 2005a), and the results were compared against the cleanup criteria specified in the RDR/RAWP (DOE-RL 2005b). The laboratory results are stored in the Environmental Restoration project-specific database prior to archiving in the Hanford Environmental Information System and are included in Appendix B.

Phase I Sample Design

Based on discussions with the DOE and the EPA Project Managers, it was decided to collect samples to evaluate the materials removed from the reservoir (located in two large soil stockpiles) and the residual soil remaining in the reservoir to support a decision of terminating excavation (BHI 2005b, 2005c). The sampling strategy consisted of collection of soil samples for laboratory analysis of polychlorinated biphenyls (PCBs), inductively coupled plasma (ICP) metals, mercury, hexavalent chromium, carbon-14, tritium, gamma energy analysis, gross alpha activity, gross beta activity, and asbestos, and performing radiological surveys of the exposed concrete floor in the basin. The data were collected using the following approach:

1. One soil sample from each of two large stockpiles of soil and debris (i.e., east stockpile and west stockpile) removed from the southern and eastern portions of the reservoir was collected by taking 30 aliquots of soil distributed across the surface of the pile to a height of approximately 1.5 m (5 ft) and combining into 1 sample for laboratory analysis. The soil removed from the western portion of the reservoir was not required to be sampled because it was agreed to be clean fill material (BHI 2005c).
2. One soil sample was collected from the soil exposed in the side walls of the excavation within the reservoir. The sample consisted of 30 aliquots of soil distributed across the side walls of the excavation and combined into 1 sample for laboratory analysis.
3. A field radiological survey of the exposed concrete floor in the reservoir was performed to verify that radiological contamination was not present.

Table 2 provides a summary of the samples collected for Phase I sampling.

Phase I Sample Results

The field radiological survey results indicated no radiological contamination present above background on the concrete floor of the 182-F Reservoir. A map of the survey results is provided in Figure 3.

The Phase I sampling for the two stockpiles and for the soil remaining inside the reservoir was performed on April 29, 2005. Laboratory results for the Phase I sampling indicated that the stockpiles meet the cleanup criteria for all contaminants of potential concern (COPCs). However, the analytical results for the sample collected from within the reservoir indicated Aroclor-1254

slightly above the cleanup value. Discussion with the EPA resulted in a decision to perform additional sampling (Phase II) of the remaining soil within the reservoir (BHI 2005d) to further evaluate the distribution and concentration of PCBs. Based on the analytical data, the two stockpile areas were considered clean and can be used as backfill. The Phase I soil sample results are provided in Appendix B (Table B-2).

Table 2. Phase I Sample Summary.

Sample Location	Sample Media	HEIS Number	Sample Analysis
East stockpile	Soil	J03342	GEA, gross alpha activity, gross beta activity, tritium, carbon-14, ICP metals, mercury, hexavalent chromium, PCBs, and asbestos
West stockpile	Soil	J03343	GEA, gross alpha activity, gross beta activity, tritium, carbon-14, ICP metals, mercury, hexavalent chromium, PCBs, and asbestos
Excavation	Soil	J03344	GEA, gross alpha activity, gross beta activity, tritium, carbon-14, ICP metals, mercury, hexavalent chromium, PCBs, and asbestos

GEA = gamma energy analysis

HEIS = Hanford Environmental Information System

ICP = inductively coupled plasma

PCB = polychlorinated biphenyl

Phase II Sample Design

As previously discussed, the only COPC identified within the soil remaining in the reservoir was Aroclor-1254. The data indicated a value of 0.8 mg/kg, slightly above the 0.5 mg/kg cleanup value for direct exposure. Therefore, in order to further evaluate the distribution of PCBs within the reservoir, additional sampling for PCB analysis was performed. Discussions with the EPA Project Manager determined that the exposed side slopes within the reservoir would be divided into four sample areas (BHI 2005d). Within each sample area, four soil aliquots were randomly located and collected on the side slopes and then combined into one sample for each area resulting in a total of four soil samples. Figure 4 provides a map of the four sample areas and the approximate locations of each soil aliquot collected within each area. Once the individual sample coordinates were approximately located, the height of sample collection on the side slope was adjusted by the sampler as needed to allow for safe collection of the soil aliquot. Table 3 provides a summary of the Phase II sample locations. Each sample was analyzed for PCBs and the data were evaluated to determine if additional remedial action was necessary. All soil sampling was performed in accordance with BHI-EE-01, *Environmental Investigations Procedures*.

Phase II Sample Results

Phase II sampling of the soil remaining in the reservoir was performed on May 29, 2005. The laboratory results for the Phase II analysis indicate that the cleanup criteria for PCBs have been met. The results of the Phase II PCB analysis are provided in Appendix B (Table B-3).

The combined sample results for Phase I and Phase II sampling were used to support evaluation of COPCs with the cleanup criteria for each of the soil stockpiles and for the remaining soil in the excavation. These results are discussed in detail below.

Figure 3. Results of Radiological Survey of the 182-F Reservoir Concrete Floor.

Figure 4. Phase II Sample Locations.

Table 3. Phase II Sample Location Coordinates.

HEIS Number	Sample Location	X Coordinate	Y Coordinate	HEIS Number	Sample Location	X Coordinate	Y Coordinate
J03704	A1	580422	148172	J03703	C1	580506	148229
	A2	580419	148183		C2	580506	148251
	A3	580392	148211		C3	580506	148272
	A4	580389	148222		C4	580506	148294
J03705	B1	580394	148237	J03702	D1	580446	148166
	B2	580394	148257		D2	580472	148189
	B3	580394	148276		D3	580479	148200
	B4	580377	148286		D4	580498	148212

HEIS = Hanford Environmental Information System

East Soil Stockpile Sample Results

Table 3a compares the east soil stockpile sample results for COPCs with the cleanup levels identified in the RDR/RAWP (DOE-RL 2005b). Contaminants that were not detected above practical quantification limits or minimum detectable activities are excluded from Table 3a.

Calculated cleanup levels are not presented in the Model Toxics Control Act Cleanup Levels and Risk Calculations table under *Washington Administrative Code* (WAC) 173-303-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium, and therefore these constituents are not considered COPCs. However, data results for these constituents are presented in Appendix B.

The sample (J03342) was analyzed for gross alpha activity and gross beta activity. The results indicate that alpha and beta isotopes are present at levels below background. Gamma energy analysis was performed with potassium-40, radium-226, and thorium-228 detected in samples but these isotopes are not related to the operational history of the site and were all at levels below statistical background activities (based on an assumption of secular equilibrium, the background activities thorium-228 is equal to the statistical background activity of 1.32 pCi/g for thorium-232 provided in DOE-RL [1996]).

Table 3a. Comparison of the Soil Value to Action Levels for the East Stockpile. (2 Pages)

COC/COPC	Result (mg/kg)	Remedial Action Goals (mg/kg)			Does the Result Exceed RAGS?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Concentration for Groundwater Protection	Soil Concentration for River Protection		
Arsenic	4.7 (<BG)	20 ^a	20 ^a	20 ^a	No	--
Barium	63.7 (<BG)	5,600 ^b	132 ^c	-- ^d	No	--
Beryllium	0.41 (<BG)	10.4 ^e	1.51 ^c	1.51 ^c	No	--
Boron	2.6	16,000 ^b	320	--	No	--
Cadmium	0.29 (<BG)	13.9 ^e	0.81 ^c	0.81 ^c	No	--

Table 3a. Comparison of the Soil Value to Action Levels for the East Stockpile. (2 Pages)

COC/COPC	Result (mg/kg)	Remedial Action Goals (mg/kg)			Does the Result Exceed RAGS?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Concentration for Groundwater Protection	Soil Concentration for River Protection		
Chromium	12.2 (<BG)	120,000 ^b	18.5 ^c	18.5 ^c	No	--
Cobalt	6.1 (<BG)	1,600 ^b	32	--	No	--
Copper	14.2 (<BG)	2,960 ^b	59.2	22.0 ^c	No	--
Hexavalent chromium	0.24	2.1 ^e	4.8	2	No	--
Lead	14	353 ^f	10.2 ^c	10.2 ^c	Yes	Yes ^g
Manganese	266 (<BG)	11,200 ^b	512 ^c	--	No	--
Molybdenum	0.49	400 ^b	8	--	No	--
Nickel	13.4 (<BG)	1,600 ^b	19.1 ^c	27.4	No	--
Vanadium	39.3 (<BG)	560 ^b	85.1 ^c	--	No	--
Zinc	57.4 (<BG)	24,000 ^b	480	67.8 ^c	No	--
Aroclor-1260	0.015	0.5 ^h	0.017 ⁱ	0.017 ⁱ	No	--

^a The cleanup value of 20 mg/kg has been agreed to by Tri-Party project managers. The basis for 20 mg/kg is provided in Section 2.1.2.1 of the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b).

^b Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), Method B, 1996.

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

^d No cleanup level is available from the Ecology Cleanup Levels and Risk Calculations tables, and no toxicity values are available to calculate cleanup levels (Ecology 2001).

^e Carcinogenic cleanup level calculated based on the inhalation exposure pathway; WAC 173-340-750(3) (1996).

^f A WAC 173-340-740(3) (1996) value for lead is not available. This value is based on the *Guidance Manual for the Integrated Exposure Update Biokinetic Model for Lead in Children* (EPA 1994).

^g Based on *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a) by applying a distribution coefficient for lead of 30 ml/g, a groundwater elevation of 114 m (374 ft), and a clean zone from 123.1 m (403.7 ft) down to groundwater.

^h Carcinogenic cleanup level calculated per WAC 173-340-740(3), Method B, 1996.

ⁱ Where cleanup levels are less than the required detection limit (RDL), cleanup levels default to the RDL (WAC 173-340-707[2]) (1996).

-- = not applicable

BG = background

COC = contaminant of concern

COPC = contaminant of potential concern

RAG = remedial action goal

RESRAD = RESidual RADioactivity (dose model)

WAC = Washington Administrative Code

For the nonradionuclide soil data, with the exception of boron, hexavalent chromium, lead, molybdenum, and Aroclor-1260, all constituents were detected at levels below background. There are no Hanford Site or Washington State background values for boron, hexavalent chromium, molybdenum, and Aroclor-1260; however, the result for each of these COPCs was well below the applicable RAGs.

The result for lead (14 mg/kg) exceeded the cleanup criteria of 10.2 mg/kg for groundwater and river protection. However, a distribution coefficient (K_d) evaluation using RESidual RADioactivity (RESRAD) modeling described in *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a) was performed to determine if lead would migrate to groundwater within a 1,000-year time frame based on the K_d of lead and the vertical distance to groundwater assuming the soil stockpile is used as backfill of the 182-F Reservoir. This evaluation was performed to determine if lead poses a long-term risk to groundwater and/or the Columbia River.

To conduct the evaluation, the depth below ground surface at which the soil would be used as backfill was subtracted from the ground surface elevation to determine the depth of application of the sample results. From this elevation, the assumed groundwater elevation under the 100-F Area was subtracted to determine the vertical height of the vadose zone. A lookup table derived from the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a) was then used to determine the minimum K_d value that prevents migration through the vertical distance in a 1,000-year time frame. This K_d value was then compared against the K_d values for each contaminant of concern (as listed in DOE-RL 2005b) to assess which contaminants will reach groundwater.

The assumed groundwater elevation for the 100-F Area is 114 m (373 ft) above mean sea level. The maximum depth below ground surface for placement of the stockpile soil as backfill is 3.96 m (13 ft) deep, at 123 m (404 ft) above mean sea level. The assumed surface elevation for the 182-F Reservoir is 127 m (416.7 ft) above mean sea level. Using these values, the distance from the soil to groundwater is 9.1 m (30 ft), and the minimum K_d that would be protective of groundwater is 8 mL/g. The K_d value for lead is 30 mL/g; therefore, lead passes the analogous RESRAD evaluation and is not predicted to migrate to groundwater within 1,000 years. As groundwater is part of the migration pathway to the Columbia River, this is also protective of the Columbia River.

In summary, analytical results for the east soil stockpile for the 182-F Reservoir found the soil met the direct exposure RAGs and met groundwater and river protection RAGs, with the exception of lead that exceeded groundwater and river protection RAGs; however, application of the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a) shows that lead with a K_d value of 30 mL/g will not reach groundwater within 1,000 years.

West Soil Stockpile Sample Results

Table 3b compares the west soil stockpile sample results for COPCs with the cleanup levels identified in the RDR/RAWP (DOE-RL 2005b). Contaminants that were not detected above practical quantification limits or minimum detectable activities are excluded from Table 3b.

Calculated cleanup levels are not presented in the Model Toxics Control Act Cleanup Levels and Risk Calculations table under WAC 173-303-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium, and therefore these constituents are not considered COCPs. However, data results for these constituents are presented in Appendix B.

Table 3b. Comparison of the Soil Value to Action Levels for the West Stockpile. (2 Pages)

COC/COPC	Result (mg/kg)	Remedial Action Goals (mg/kg)			Does the Result Exceed RAGS?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Concentration for Groundwater Protection	Soil Concentration for River Protection		
Antimony	0.5 (<BG)	32 ^a	5 ^b	5 ^b	No	--
Arsenic	6.4 (<BG)	20 ^c	20 ^c	20 ^c	No	--
Barium	79 (<BG)	5,600 ^a	132 ^b	-- ^d	No	--

Table 3b. Comparison of the Soil Value to Action Levels for the West Stockpile. (2 Pages)

COC/COPC	Result (mg/kg)	Remedial Action Goals (mg/kg)			Does the Result Exceed RAGS?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Concentration for Groundwater Protection	Soil Concentration for River Protection		
Beryllium	0.49 (<BG)	10.4 ^c	1.51 ^b	1.51 ^b	No	--
Boron	3.2	16,000 ^a	320	--	No	--
Cadmium	0.78 (<BG)	13.9 ^c	0.81 ^b	0.81 ^b	No	--
Chromium	22.6	120,000 ^a	18.5 ^b	18.5 ^b	Yes	Yes ^g
Cobalt	6.9 (<BG)	1,600 ^a	32	--	No	--
Copper	18.7 (<BG)	2,960 ^a	59.2	22.0 ^b	No	--
Hexavalent chromium	0.28	2.1 ^c	4.8	2	No	--
Lead	58.7	353 ^f	10.2 ^b	10.2 ^b	Yes	Yes ^g
Manganese	312 (<BG)	11,200 ^a	512 ^b	--	No	--
Mercury	0.04 (<BG)	24 ^a	0.33 ^b	0.33 ^b	No	--
Molybdenum	0.56	400 ^a	8	--	No	--
Nickel	16.8 (<BG)	1,600 ^a	19.1 ^b	27.4	No	--
Vanadium	49.1 (<BG)	560 ^a	85.1 ^b	--	No	--
Zinc	139	24,000 ^a	480	67.8 ^b	Yes	Yes ^g
Aroclor-1254	0.036	0.5 ^h	0.017 ⁱ	0.017 ⁱ	Yes	Yes ^g

^a Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), Method B, 1996.

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

^c The cleanup value of 20 mg/kg has been agreed to by Tri-Party project managers. The basis for 20 mg/kg is provided in Section 2.1.2.1 of the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b).

^d No cleanup level is available from the Ecology Cleanup Levels and Risk Calculations tables, and no toxicity values are available to calculate cleanup levels (Ecology 2001).

^e Carcinogenic cleanup level calculated based on the inhalation exposure pathway; WAC 173-340-750(3) (1996).

^f A WAC 173-340-740(3) (1996) value for lead is not available. This value is based on the *Guidance Manual for the Integrated Exposure Update Biokinetic Model for Lead in Children* (EPA 1994).

^g Based on *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a), with a clean zone from 123.1 m (403.7 ft) down to groundwater and a groundwater elevation of 114 m (373 ft).

^h Carcinogenic cleanup level calculated per WAC 173-340-740(3), Method B, 1996.

ⁱ Where cleanup levels are less than the required detection limit (RDL), cleanup levels default to the RDL (WAC 173-340-707[2]) (1996).

-- = not applicable

BG = background

COC = contaminant of concern

COPC = contaminant of potential concern

RAG = remedial action goal

RESRAD = RESidual RADioactivity (dose model)

WAC = Washington Administrative Code

The sample (J03343) was analyzed for gross alpha activity and gross beta activity. The results indicate that alpha and beta isotopes are present at levels below background. Gamma energy analysis was performed with potassium-40, radium-226, radium-228, thorium-228, and thorium-232 detected in samples however these isotopes are not related to the operational history of the site and are 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]).

For the nonradionuclide soil data, with the exception of boron, chromium, hexavalent chromium, lead, molybdenum, zinc, and Aroclor-1254, all constituents were at levels below background. There are no Hanford Site or Washington State background values for boron, hexavalent chromium, and molybdenum; however, the result for each of these COPCs was well below the applicable RAGs.

The results for lead (58.7 mg/kg), chromium (22.6 mg/kg), and Aroclor-1254 (0.036 mg/kg) exceeded the cleanup criteria for groundwater and river protection of 10.2 mg/kg for lead, 18.5 mg/kg for chromium, and 0.017 mg/kg for Aroclor-1254. The results for zinc (139 mg/kg) exceeded the cleanup criteria for protection of the Columbia River. However, a K_d evaluation using RESRAD modeling described in the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a) was performed to determine if these constituents would migrate to groundwater or the Columbia River within a 1,000-year time frame based on the K_d for these constituents and the vertical distance to groundwater assuming the soil stockpile is used as backfill of the 182-F Reservoir.

To conduct the evaluation, the depth below ground surface at which the soil would be used as backfill was subtracted from the ground surface elevation to determine the depth of application of the sample results. From this elevation, the assumed groundwater elevation under the 100-F Area was subtracted to determine the vertical height of the vadose zone. A lookup table derived from the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a) was then used to determine the minimum K_d value that prevents migration through the vertical distance in a 1,000-year time frame. This K_d value was then compared against the K_d values for each contaminant of concern (as listed in DOE-RL 2005b) to assess which contaminants will reach groundwater.

The assumed groundwater elevation for the 100-F Area is 114 m (373 ft) above mean sea level. The maximum depth below ground surface for placement of the stockpile soil as backfill is 3.96 m (13 ft) deep, at 123 m (404 ft) above mean sea level. The assumed surface elevation for the 182-F Reservoir is 127 m (417 ft) above mean sea level. Using these values, the distance to groundwater is 9.1 m (30 ft), and the lookup value from BHI (2005a) for the minimum K_d is 8 mL/g. The K_d value for lead and zinc is 30 mL/g, the value for chromium is 200 mL/g, and for Aroclor-1254 is 75.6 mL/g; therefore, these constituents pass the analogous RESRAD evaluation and are not predicted to migrate to groundwater within 1,000 years. As groundwater is part of the migration pathway to the Columbia River, this is protective of the Columbia River as well.

In summary, analytical results for the west soil stockpile for the 182-F Reservoir found the soil met the direct exposure RAGs and met or exceeded groundwater or river protection RAGs, but subsequently passed after applying the analogous RESRAD evaluation.

Excavation Sample Results

Table 3c compares the excavation sample results for COPCs with the cleanup levels identified in the RDR/RAWP (DOE-RL 2005b). The sample results consist of the Phase I sampling with the use of Phase II sample results for the PCBs. Contaminants that were not detected above practical quantification limits or minimum detectable activities are excluded from Table 3c.

Calculated cleanup levels are not presented in the Model Toxics Control Act Cleanup Levels and Risk Calculations table under WAC 173-303-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium, and therefore these constituents are not considered COCPs. However, data results for these constituents are presented in Appendix B.

The sample (J03344) was analyzed for gross alpha activity and gross beta activity. The results indicate that alpha and beta isotopes are present at levels below background. Gamma energy analysis was performed with potassium-40, radium-226, and thorium-228 detected in samples but these isotopes are not related to the operational history of the site and were all 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]).

For the nonradionuclide soil data, with the exception of boron, hexavalent chromium, lead, molybdenum, zinc, Aroclor-1016, Aroclor-1254, and Aroclor-1260, all constituents were detected at levels below background. There are no Hanford Site or Washington State background values for boron, hexavalent chromium, and molybdenum; however, the result for each of these COPCs was well below the applicable RAGs.

The results for lead (19.8 mg/kg), Aroclor-1016 (0.02 mg/kg), Aroclor-1254 (0.11 mg/kg), and Aroclor-1260 (0.023 mg/kg) exceeded the cleanup criteria for groundwater and river protection of 10.2 mg/kg for lead and 0.017 mg/kg for the Aroclors. The results for zinc (83.7 mg/kg) exceeded the cleanup criteria for protection of the Columbia River. However, a K_d evaluation using RESRAD modeling described in the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a) was performed to determine if these constituents would migrate to groundwater or the Columbia River within a 1,000-year time frame based on the K_d for these constituents and the vertical distance to groundwater as measured from the base of the 182-F Reservoir.

To conduct the evaluation, the depth below ground surface at which the soil would be used as backfill was subtracted from the ground surface elevation to determine the depth of application of the sample results. From this elevation, the assumed groundwater elevation under the 100-F Area was subtracted to determine the vertical height of the vadose zone. A lookup table derived from the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a) was then used to determine the minimum K_d value that prevents migration through the vertical distance in a 1,000-year time frame. This K_d value was then compared against the K_d values for each contaminant of concern (as listed in DOE-RL 2005b) to assess which contaminants will reach groundwater.

Table 3c. Comparison of the Soil Value to Action Levels for Excavation. (2 Pages)

COC/COPC	Result (mg/kg)	Remedial Action Goals (mg/kg)			Does the Result Exceed RAGS?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Concentration for Groundwater Protection	Soil Concentration for River Protection		
Antimony	0.25 (<BG)	32 ^a	5 ^b	5 ^b	No	--
Arsenic	7.1 (<BG)	20 ^c	20 ^c	20 ^c	No	--

Table 3c. Comparison of the Soil Value to Action Levels for Excavation. (2 Pages)

COC/COPC	Result (mg/kg)	Remedial Action Goals (mg/kg)			Does the Result Exceed RAGS?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Concentration for Groundwater Protection	Soil Concentration for River Protection		
Barium	78.6 (<BG)	5,600 ^a	132 ^b	-- ^d	No	--
Beryllium	0.44 (<BG)	10.4 ^e	1.51 ^b	1.51 ^b	No	--
Boron	2.4	16,000 ^a	320	--	No	--
Cadmium	0.39 (<BG)	13.9 ^e	0.81 ^b	0.81 ^b	No	--
Chromium	13 (<BG)	120,000 ^a	18.5 ^b	18.5 ^b	No	--
Cobalt	6.3 (<BG)	1,600 ^a	32	--	No	--
Copper	16 (<BG)	2,960 ^a	59.2	22.0 ^b	No	--
Hexavalent chromium	0.34	2.1 ^e	4.8	2	No	--
Lead	19.8	353 ^f	10.2 ^b	10.2 ^b	Yes	Yes ^g
Manganese	286 (<BG)	11,200 ^a	512 ^b	--	No	--
Molybdenum	0.49	400 ^a	8	--	No	--
Nickel	11.6 (<BG)	1,600 ^a	19.1 ^b	27.4	No	--
Vanadium	40.2 (<BG)	560 ^a	85.1 ^b	--	No	--
Zinc	83.7	24,000 ^a	480	67.8 ^b	Yes	Yes ^g
Aroclor-1016	0.020	5.6 ^a	0.125	0.017 ⁱ	Yes	Yes ^g
Aroclor-1254	0.110	0.5 ^h	0.017 ⁱ	0.017 ⁱ	Yes	Yes ^g
Aroclor-1260	0.023	0.5 ^h	0.017 ⁱ	0.017 ⁱ	Yes	Yes ^g

^a Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), Method B, 1996.

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

^c The cleanup value of 20 mg/kg has been agreed to by Tri-Party project managers. The basis for 20 mg/kg is provided in Section 2.1.2.1 of the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b).

^d No cleanup level is available from the Ecology Cleanup Levels and Risk Calculations tables, and no toxicity values are available to calculate cleanup levels (Ecology 2001).

^e Carcinogenic cleanup level calculated based on the inhalation exposure pathway; WAC 173-340-750(3) (1996).

^f A WAC 173-340-740(3) (1996) value for lead is not available. This value is based on the *Guidance Manual for the Integrated Exposure Update Biokinetic Model for Lead in Children* (EPA 1994).

^g Based on *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a), with a clean zone from 123.1 m (403.7 ft) down to groundwater and a groundwater elevation of 114 m (373 ft).

^h Carcinogenic cleanup level calculated per WAC 173-340-740(3), Method B, 1996.

ⁱ Where cleanup levels are less than the required detection limit (RDL), cleanup levels default to the RDL (WAC 173-340-707[2]) (1996).

-- = not applicable

BG = background

COC = contaminant of concern

COPC = contaminant of potential concern

RAG = remedial action goal

RESRAD = RESidual RADioactivity (dose model)

WAC = Washington Administrative Code

The assumed groundwater elevation for the 100-F Area is 114 m (373 ft) above mean sea level. The maximum depth below ground surface for the base of the excavation is 3.96 m (13 ft) deep, at 123 m (404 ft) above mean sea level. The assumed surface elevation for the 182-F Reservoir is 127 m (417 ft) above mean sea level. Using these values, the distance to groundwater is 9.1 m (30 ft), and the lookup value from BHI (2005a) for the minimum K_d is 8 mL/g. The K_d value for lead and zinc is 30 mL/g; the K_d values for Aroclor-1016, Aroclor-1254, and Aroclor-1260 are 107 mL/g, 75.6 mL/g, and 530 mL/g, respectively. Therefore, these constituents pass the

analogous RESRAD evaluation and are not predicted to migrate to groundwater within 1,000 years. As groundwater is part of the migration pathway to the Columbia River, this is protective of the Columbia River as well.

In summary, analytical results for the remaining soil in the 182-F Reservoir met the direct exposure RAGs and met or exceeded groundwater or river protection RAGs, but subsequently passed after applying the analogous sites RESRAD evaluation.

DATA EVALUATION

In accordance with the focused sampling approach and WAC 173-340-740(7)(d)(iii), direct comparison of the sample results with the RAGs is an acceptable method to evaluate compliance with cleanup objectives for the 182-F Reservoir. As discussed above, the sampling results for the west stockpile, east stockpile, and the remaining soil in the 182-F Reservoir met the direct exposure RAGs and met or exceeded groundwater or river protection RAGs, but subsequently passed after applying the analogous sites RESRAD evaluation.

Nonradionuclide risk requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6} , and a cumulative carcinogenic risk of less than 1×10^{-5} . For the 182-F Reservoir, these risk values were not calculated for constituents that were either not detected or detected at concentrations below Hanford Site or Washington State background. All individual hazard quotients for noncarcinogenic constituents (boron, hexavalent chromium, lead, molybdenum, zinc, Aroclor-1016, Aroclor-1254, and Aroclor-1260) were less than 1.0. The cumulative hazard quotient for the noncarcinogenic constituents above background levels is 2.5×10^{-1} . All individual carcinogenic risk values for hexavalent chromium, Aroclor-1016, Aroclor-1254, and Aroclor-1260 were less than 1×10^{-6} . The cumulative carcinogenic risk is 4.3×10^{-7} , which is below 1×10^{-5} . The hazard quotient and cancer risk calculations for 182-F are included in Appendix C.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) review was performed to compare the confirmatory sampling approach and analytical data with the sampling and data requirements specified by the project objectives. 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 [EPA 2000]). The assessment review completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data process.

This DQA review was performed in accordance with BHI-EE-01, *Environmental Investigations Procedures*. Specific data quality objectives for the site are found in the SAP (DOE-RL 2005a). All samples were collected per agreements with the EPA (BHI 2005c, BHI 2005d). The data quality requirements in the SAP are used for assessing data from statistical sampling and do not specifically apply to the data sets resulting from the focused sampling performed for the 182-F Reservoir. However, to ensure quality data sets, the SAP data assurance requirements as well as

the validation procedures detailed in *Data Validation Procedure for Chemical Analysis* (BHI 2000a) and *Data Validation Procedure for Radiochemical Analysis* (BHI 2000b) for chemical and radiochemical analysis are followed where appropriate. Three sample delivery groups (SDGs) were generated by confirmation sampling at the 182-F Reservoir. The relevant SDGs are H3142, D00579, and H3190.

SDG H3142 consists of three samples, J03342, J03343, and J03344, which were analyzed for PCBs, ICP metals, hexavalent chromium, gross alpha, gross beta, gamma energy analysis, tritium, and carbon-14. This SDG was sent out for third-party validation. No major deficiencies were found. All of the data were found to be useable for decision-making purposes. Minor deficiencies were found in the analyses of PCBs, ICP metals, and hexavalent chromium.

In the PCB analysis for SDG H3142, a continuing calibration verification standard was found to be above the acceptance criteria range on one of the analytical columns. The samples were quantitated using the confirmatory column. The data are acceptable. The analytical batch for PCBs contained 23 samples (only 3 of which were from SDG 3142) with only 1 set of quality assurance/quality control samples (method blanks and spikes). The contract required rate for quality assurance/quality control samples is 1 set per 20 samples. The laboratory is aware of the deficiency and is taking action to prevent a recurrence. There is no impact on the sample data, which are acceptable for decision-making purposes. Also in the PCB analysis for SDG H3142, a matrix spike recovery was below criteria at 59%. Third-party validation assigned "J" flags to all three samples in this SDG for all of the Aroclors except Aroclor-1260 because of the low matrix spike recovery. Data qualified as estimates, with "J" flags, are useable for decision-making purposes.

SDG H3190 consists of four samples, J03702, J03703, J03704, and J03705, which were analyzed for PCBs. This SDG was sent out for third-party validation. No major deficiencies were found. All of the data were found to be useable for decision-making purposes. A minor deficiency was found in the PCB analyses. A continuing calibration verification standard was found to be above the acceptance criteria range on one of the analytical columns. The samples were quantitated using the confirmatory column. The data are acceptable.

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 182-F site found the results to be accurate within the standard errors associated with the methods, including sampling and sample handling. The DQA review for the 182-F site concludes 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 Environmental Restoration project-specific database prior to archiving in the Hanford Environmental Information System and are summarized in Appendix B.

SUMMARY FOR INTERIM CLOSURE

The 182-F Reservoir waste site has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2005b). The sampling results were used to demonstrate the site meets the cleanup objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the sampling results and observations of the excavated material support a reclassification of the 182-F Reservoir to interim closed out in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) and the Waste Site Reclassification Guideline TPA-MP-14 (DOE-RL 1998). This site does not have a deep zone; therefore, no deep zone institutional controls are required. A summary of the evaluation of the site against the applicable RAGs is presented in Table ES-1.

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APPENDIX A
PHOTOGRAPHS
(3 Pages)

Photo 1. Northeast Corner of the 182-F Excavation.

Photo 2. 182-F Reservoir Excavation.

Photo 3. Stockpiled Debris and Soil.

APPENDIX B
182-F RESERVOIR SAMPLE RESULTS

Table B-1. 182-F Reservoir Waste Characterization Sample Results. (4 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
Stockpile	J030N6	04/12/05	0.19	U	0.19	1.34	U	5.5	0.087		0.047	0.058	U	0.058	0.14	U	0.14	0.22	U	0.22
Stockpile	J030N7	04/12/05	0.37	U	0.37	0.177	U	4.7	0.136		0.099	0.11	U	0.11	0.26	U	0.26	0.31	U	0.31

Sample Location	HEIS Number	Sample Date	Europium-155			Nickel-63			Plutonium-238			Plutonium-239/240			Potassium-40			Radium-226		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Stockpile	J030N6	04/12/05	0.13	U	0.13	0.292	U	2.4	0	U	0.34	0.134	U	0.34	15.2		0.59	0.481		0.1
Stockpile	J030N7	04/12/05	0.23	U	0.23	0.827	U	2.5	0.045	U	0.34	0.045	U	0.34	12.2		0.97	0.459		0.22

Sample Location	HEIS Number	Sample Date	Radium-228			Silver-108m			Thorium-228 GEA			Thorium-232 GEA			Total beta radiostrontium			Tritium		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Stockpile	J030N6	04/12/05	0.887		0.27	0.034	U	0.034	0.762		0.061	0.887		0.27	0.042	U	0.24	1.12	U	3.8
Stockpile	J030N7	04/12/05	0.726		0.41	0.06	U	0.06	0.65		0.099	0.726		0.41	0.041	U	0.25	-0.389	U	3.3

Sample Location	HEIS Number	Sample Date	Uranium-235 GEA			Uranium-238 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA
Stockpile	J030N6	04/12/05	0.2	U	0.2	8	U	8
Stockpile	J030N7	04/12/05	0.33	U	0.33	11	U	11

Acronyms apply to all of the tables in this appendix.

B = blank contamination (organic constituents)

HEIS = Hanford Environmental Information System

J = estimate

MDA = minimum detectable activity

PQL = practical quantification limit

Q = qualifier

SVOA = semivolatile organic analyte

TCLP = Toxic Characteristic Leaching Procedure

U = undetected

Table B-1. 182-F Reservoir Waste Characterization Sample Results. (4 Pages)

Sample Location	HEIS Number	Sample Date	Arsenic			Barium			Cadmium			Chromium			Lead			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Stockpile	J030N6	04/12/05	4.2		0.29	80.2		0.02	0.19		0.04	15.4		0.04	12.9		0.19	0.017	U	0.02
Stockpile	J030N7	04/12/05	4.6		0.27	79.4		0.02	0.46		0.04	15		0.04	14.5		0.18	0.049		0.02

Sample Location	HEIS Number	Sample Date	Selenium			Silver			Cyanide			Sulfide			pH
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	
Stockpile	J030N6	04/12/05	0.49		0.41	0.05	U	0.05	0.527	U	0.52	32.8	U	32.8	8.37
Stockpile	J030N7	04/12/05	0.38	U	0.38	0.05	U	0.05	0.52	U	0.52	28.7	U	28.7	8.1

TCLP Metals

Sample Location	HEIS Number	Sample Date	Arsenic			Barium			Cadmium			Chromium			Lead			Mercury		
			µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL	µg/L	Q	PQL
Stockpile	J030N6	04/12/05	17.4	U	17.4	424	C	1.2	5.8		2.4	2.4	U	2.4	11.4	U	11.4	0.1	U	0.1
Stockpile	J030N7	04/12/05	35.5		17.4	638	C	1.2	13.5		2.4	34		2.4	11.4	U	11.4	0.1	U	0.1

Sample Location	HEIS Number	Sample Date	Selenium			Silver		
			µg/L	Q	PQL	µg/L	Q	PQL
Stockpile	J030N6	04/12/05	24	U	24	3	U	3
Stockpile	J030N7	04/12/05	24	U	24	3	U	3

TCLP SVOA

Sample Location	HEIS Number	Sample Date	1,4-Dichlorobenzene			2,4,5-Trichlorophenol			2,4,6-Trichlorophenol			2,4-Dinitrotoluene			2-Methylphenol (cresol, o-)			3+4 Methylphenol (cresol, m+p)		
			mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL
Stockpile	J030N6	04/12/05	0.05	U	0.05	0.12	U	0.12	0.05	U	0.05	0.05	U	0.05	0.05	U	0.05	0.05	U	0.05
Stockpile	J030N7	04/12/05	0.05	U	0.05	0.12	U	0.12	0.05	U	0.05	0.05	U	0.05	0.05	U	0.05	0.05	U	0.05

Sample Location	HEIS Number	Sample Date	Hexa-chlorobenzene			Hexa-chlorobutadiene			Hexa-chloroethane			Nitrobenzene			Penta-chlorophenol			Pyridine		
			mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL
Stockpile	J030N6	04/12/05	0.05	U	0.05	0.05	U	0.05	0.05	U	0.05	0.05	U	0.05	0.12	U	0.12	0.05	U	0.05
Stockpile	J030N7	04/12/05	0.05	U	0.05	0.05	U	0.05	0.05	U	0.05	0.05	U	0.05	0.12	U	0.12	0.05	U	0.05

Table B-1. 182-F Reservoir Waste Characterization Sample Results. (4 Pages)

Constituent	J030N6 Stockpile Sample Date 04/12/05			J030N7 Stockpile Sample Date 04/12/05		
	µg/kg	Q	PQL	µg/kg	Q	PQL
Aroclor-1016	15	U	15	14	U	14
Aroclor-1221	15	U	15	14	U	14
Aroclor-1232	15	U	15	14	U	14
Aroclor-1242	15	U	15	14	U	14
Aroclor-1248	15	U	15	14	U	14
Aroclor-1254	15	U	15	14	U	14
Aroclor-1260	36		15	41		14
1,2,4-Trichlorobenzene	370	U	370	360	U	360
1,2-Dichlorobenzene	370	U	370	360	U	360
1,3-Dichlorobenzene	370	U	370	360	U	360
1,4-Dichlorobenzene	370	U	370	360	U	360
2,4,5-Trichlorophenol	920	U	920	900	U	900
2,4,6-Trichlorophenol	370	U	370	360	U	360
2,4-Dichlorophenol	370	U	370	360	U	360
2,4-Dimethylphenol	370	U	370	360	U	360
2,4-Dinitrophenol	920	U	920	900	U	900
2,4-Dinitrotoluene	370	U	370	360	U	360
2,6-Dinitrotoluene	370	U	370	360	U	360
2-Chloronaphthalene	370	U	370	360	U	360
2-Chlorophenol	370	U	370	360	U	360
2-Methylnaphthalene	370	U	370	360	U	360
2-Methylphenol (cresol, o-)	370	U	370	360	U	360
2-Nitroaniline	920	U	920	900	U	900
2-Nitrophenol	370	U	370	360	U	360
3+4 Methylphenol (cresol, m+p)	370	U	370	360	U	360
3,3'-Dichlorobenzidine	370	U	370	360	U	360
3-Nitroaniline	920	U	920	900	U	900
4,6-Dinitro-2-methylphenol	920	U	920	900	U	900
4-Bromophenylphenyl ether	370	U	370	360	U	360
4-Chloro-3-methylphenol	370	U	370	360	U	360
4-Chloroaniline	370	U	370	360	U	360
4-Chlorophenylphenyl ether	370	U	370	360	U	360
4-Nitroaniline	920	U	920	900	U	900
4-Nitrophenol	920	U	920	900	U	900
Acenaphthene	370	U	370	360	U	360
Acenaphthylene	370	U	370	360	U	360
Anthracene	370	U	370	360	U	360
Benzo(a)anthracene	370	U	370	24.3	J	360
Benzo(a)pyrene	370	U	370	360	U	360

Table B-1. 182-F Reservoir Waste Characterization Sample Results. (4 Pages)

Constituent	J030N6 Stockpile Sample Date 04/12/05			J030N7 Stockpile Sample Date 04/12/05		
	µg/kg	Q	PQL	µg/kg	Q	PQL
Benzo(b)fluoranthene	370	U	370	360	U	360
Benzo(ghi)perylene	370	U	370	360	U	360
Benzo(k)fluoranthene	370	U	370	18.36	J	360
Bis(2-chloro-1-methylethyl)ether	370	U	370	360	U	360
Bis(2-Chloroethoxy)methane	370	U	370	360	U	360
Bis(2-chloroethyl) ether	370	U	370	360	U	360
Bis(2-ethylhexyl) phthalate	28.134	JBC	370	37.98	JBC	360
Butylbenzylphthalate	370	U	370	360	U	360
Carbazole	370	U	370	360	U	360
Chrysene	370	U	370	32.94	J	360
Di-n-butylphthalate	370	U	370	23.202	J	360
Di-n-octylphthalate	370	U	370	360	U	360
Dibenz[a,h]anthracene	370	U	370	360	U	360
Dibenzofuran	370	U	370	360	U	360
Diethylphthalate	370	U	370	360	U	360
Dimethyl phthalate	370	U	370	360	U	360
Fluoranthene	370	U	370	35.586	J	360
Fluorene	370	U	370	360	U	360
Hexachlorobenzene	370	U	370	360	U	360
Hexachlorobutadiene	370	U	370	360	U	360
Hexachlorocyclopentadiene	370	U	370	360	U	360
Hexachloroethane	370	U	370	360	U	360
Indeno(1,2,3-cd)pyrene	370	U	370	360	U	360
Isophorone	370	U	370	360	U	360
N-Nitroso-di-n-dipropylamine	370	U	370	360	U	360
N-Nitrosodiphenylamine	370	U	370	360	U	360
Naphthalene	370	U	370	360	U	360
Nitrobenzene	370	U	370	360	U	360
Pentachlorophenol	920	U	370	900	U	900
Phenanthrene	370	U	370	39.762	J	360
Phenol	370	U	370	360	U	360
Pyrene	370	U	370	37.26	J	360

Table B-2. 182-F Reservoir Phase I Sample Results. (3 Pages)

Sample Location	HEIS Number	Sample Date	Gross alpha			Gross beta			Carbon-14			Tritium			Americium-241			Cesium-137		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
East Stockpile	J03342	04/29/05	6.64		4.5	17.3		6.6	-0.687	U	4.7	-0.087	U	5.5	0.25	U	0.25	0.11	U	0.11
West Stockpile	J03343	04/29/05	3.35	U	5.1	17		6.2	-0.422	U	5.2	0.798	U	6.4	0.32	U	0.32	0.111	U	0.09
Excavation	J03344	04/29/05	8.26		4.9	19.8		6.6	-2.92	U	5.1	-0.73	U	5.8	0.28	U	0.28	0.12	U	0.12

Sample Location	HEIS Number	Sample Date	Cobalt-60			Europium-152			Europium-154			Europium-155			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
East Stockpile	J03342	04/29/05	0.08	U	0.08	0.24	U	0.24	0.24	U	0.24	0.22	U	0.22	6.82		0.77	0.397	J	0.11
West Stockpile	J03343	04/29/05	0.087	U	0.087	0.23	U	0.23	0.27	U	0.27	0.20	U	0.20	12.8		0.68	0.414	J	0.14
Excavation	J03344	04/29/05	0.13	U	0.13	0.27	U	0.27	0.45	U	0.45	0.25	U	0.25	10		1.5	0.557	J	0.24

Sample Location	HEIS Number	Sample Date	Radium-228			Thorium-228			Thorium-232			Uranium-235			Uranium-238		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
East Stockpile	J03342	04/29/05	0.61	U	0.61	0.661		0.12	0.61	U	0.61	0.31	U	0.31	8.7	U	8.7
West Stockpile	J03343	04/29/05	0.86		0.32	0.618		0.1	0.86		0.32	0.29	U	0.29	11	U	11
Excavation	J03344	04/29/05	1.1	U	1.1	0.633		0.13	1.1	U	1.1	0.35	U	0.35	12	U	12

Table B-2. 182-F Reservoir Phase I Sample Results. (3 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
East Stockpile	J03342	04/29/05	6340		0.88	0.21	UJ	0.21	4.7		0.27	63.7	C	0.02	0.41		0.01	2.6	C	0.16
West Stockpile	J03343	04/29/05	7900		0.87	0.5	J	0.2	6.4		0.27	79	C	0.02	0.49		0.01	3.2	C	0.16
Excavation	J03344	04/29/05	7200		0.95	0.25	J	0.22	7.1		0.29	78.6	C	0.02	0.44		0.01	2.4	C	0.17

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
East Stockpile	J03342	04/29/05	0.29		0.04	4060		0.73	12.2	C	0.04	6.1		0.07	14.2	C	0.05	0.24		0.05
West Stockpile	J03343	04/29/05	0.78		0.04	5090		0.72	22.6	C	0.04	6.9		0.06	18.7	C	0.05	0.28		0.05
Excavation	J03344	04/29/05	0.39		0.04	7130		0.79	13	C	0.04	6.3		0.07	16	C	0.05	0.34		0.05

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
East Stockpile	J03342	04/29/05	16,900		0.79	14		0.18	4060		0.54	266		0.02	0.02	U	0.02	0.49		0.16
West Stockpile	J03343	04/29/05	20,500		0.78	58.7		0.18	4630		0.53	312		0.02	0.04		0.02	0.56		0.16
Excavation	J03344	04/29/05	18,200		0.85	19.8		0.19	4100		0.58	286		0.02	0.02	U	0.02	0.49		0.17

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
East Stockpile	J03342	04/29/05	13.4		0.09	1320		0.79	0.38	U	0.38	344	J	0.55	0.05	UC	0.05	187		0.14
West Stockpile	J03343	04/29/05	16.8		0.09	1560		0.78	0.37	U	0.37	258	J	0.54	0.05	UC	0.05	289		0.14
Excavation	J03344	04/29/05	11.6		0.1	1500		0.85	0.4	U	0.4	291	J	0.59	0.05	UC	0.05	167		0.15

Sample Location	HEIS Number	Sample Date	Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL
East Stockpile	J03342	04/29/05	39.3		0.06	57.4		0.05
West Stockpile	J03343	04/29/05	49.1		0.06	139		0.05
Excavation	J03344	04/29/05	40.2		0.05	83.7		0.05

Sample Location	HEIS Number	Sample Date	Asbestos Result
East Stockpile	J03345	04/29/05	Trace
West Stockpile	J03346	04/29/05	Trace
Excavation	J03347	04/29/05	Not Detected

Table B-2. 182-F Reservoir Phase I Sample Results. (3 Pages)

Constituent	J03342 East Stockpile Sample Date 04/29/05			J03343 West Stockpile Sample Date 04/29/05			J03344 Excavation Sample Date 04/29/05		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Aroclor-1016	14	UJ	14	14	UJ	14	140	UDJ	140
Aroclor-1221	14	UJ	14	14	UJ	14	140	UDJ	140
Aroclor-1232	14	UJ	14	14	UJ	14	140	UDJ	140
Aroclor-1242	14	UJ	14	14	UJ	14	140	UDJ	140
Aroclor-1248	14	UJ	14	14	UJ	14	140	UDJ	140
Aroclor-1254	14	UJ	14	36	J	14	830	DJ	140
Aroclor-1260	15		14	14	U	14	140	UD	140

Table B-3. 182-F Reservoir Phase II Sample Results.

Constituent	J03704 Excavation /Quadrant A Sample Date 05/26/05			J03705 Excavation /Quadrant B Sample Date 05/26/05			J03703 Excavation /Quadrant C Sample Date 05/26/05			J03702 Excavation / Quadrant D Sample Date 05/26/05		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Aroclor-1016	14	U	14	14	U	14	13	U	13	20		20
Aroclor-1221	14	U	14	14	U	14	13	U	13	14	U	14
Aroclor-1232	14	U	14	14	U	14	13	U	13	14	U	14
Aroclor-1242	14	U	14	14	U	14	13	U	13	14	U	14
Aroclor-1248	14	U	14	14	U	14	13	U	13	14	U	14
Aroclor-1254	14	U	14	14	U	14	110		13	20		14
Aroclor-1260	23		14	14	U	14	13	U	13	14	U	14

APPENDIX C

**182-F HAZARD QUOTIENT AND CARCINOGENIC
RISK CALCULATION**

CALCULATION COVER SHEET

Project Title 100-F Area Remaining Sites **Job No.** 22192
Area 100-F
Discipline Environmental ***Calc. No.** 0100F-CA-V0237
Subject 182-F Reservoir Hazard Quotient and Carcinogenic Risk Calculation
Computer Program Excel **Program No.** Excel 2003

The attached calculations have been generated to document compliance with established cleanup levels. These 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 Summary = 3	J. M. Capron	T. M. Blakley	L. M. Dittmer	R. A. Carlson	
	Total = 4	<i>J. M. Capron</i> 8/18/05	<i>T. M. Blakley</i> 8/18/05	<i>L. M. Dittmer</i> 8/18/05	<i>R. A. Carlson</i>	8/18/05

SUMMARY OF REVISION

*Obtain Calc. No. from DIS

DE01437.03 (12/09/2004)

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator:	J. M. Capron	Date:	08/18/05	Calc. No.:	0100F-CA-V0237	Rev.:	0
Project:	100-F Area Remaining Sites	Job No:	22192	Checked:	T. M. Blakley	Date:	8/18/05
Subject:	182-F Reservoir Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and excess carcinogenic risk for the *Remaining Sites Verification Package for the 182-F Reservoir Waste Site* (BHI 2005). In accordance with the remedial action goals (RAGs) in the *Remedial Design Report/Remedial Action Work Plan for the 100 Areas* (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 x 10⁻⁶ for individual carcinogens
- 4) A cumulative excess cancer risk of <1 x 10⁻⁵ for carcinogens.

GIVEN/REFERENCES:

- 1) BHI, 2005, Waste Site Reclassification Form 2005-025, and Attachment *Remaining Sites Verification Package for the 182-F Reservoir Waste Site*, Bechtel Hanford, Inc., Richland, Washington.
- 2) 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.
- 3) EPA, 1994, *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children*, EPA/540/R-93/081, Publication No. 9285.7-15-1, U.S. Environmental Protection Agency, Washington, D.C.
- 4) WAC 173-340, "Model Toxics Control Act - Cleanup," *Washington Administrative Code*, 1996.

SOLUTION:

- 1) Generate an HQ for each noncarcinogenic constituent detected above background or the required detection limit/practical quantitation limit and compare it to the individual HQ requirement of <1.0 (DOE-RL 2005).
- 2) Sum the HQs and compare this value to the cumulative HQ requirement of <1.0.
- 3) Generate an excess cancer risk value for each carcinogenic constituent detected above background or the required detection limit/practical quantitation limit and compare it to the excess cancer risk requirement of <1 x 10⁻⁶ (DOE-RL 2005).
- 4) Sum the excess cancer risk values and compare to the cumulative cancer risk requirement of <1 x 10⁻⁵.

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator:	J. M. Capron <i>JMC</i>	Date:	08/18/05	Calc. No.:	0100F-CA-V0237	Rev.:	0
Project:	100-F Area Remaining Sites	Job No:	22192	Checked:	T. M. Blakley <i>TMB</i>	Date:	8/18/05
Subject:	182-F Reservoir Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	2 of 3

1 **METHODOLOGY:**

2
3 Hazard quotient and carcinogenic risk calculations were computed using the data from Table 3 (BHI
4 2005). Of the contaminants of potential concern for the site, boron and molybdenum require the HQ
5 calculations because these analytes were detected and a Washington State or Hanford Site background
6 value is not available. Chromium, lead, and zinc are included because they were detected at a
7 concentration above their respective Washington State or Hanford Site background value. Hexavalent
8 chromium and three polychlorinated biphenyls are included because they were detected by laboratory
9 analysis and cannot be attributed to natural occurrence. An example of the HQ and risk calculations is
10 presented below:

- 11
- 12 1) For example, the maximum value for boron is 3.2 mg/kg, divided by the noncarcinogenic RAG
- 13 value of 16,000 mg/kg (boron is identified as a noncarcinogen in WAC 173-340-740[3]), is
- 14 2.0×10^{-4} . Comparing this value, and all other individual values, to the requirement of <1.0 , this
- 15 criterion is met.
- 16
- 17 2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ is obtained by
- 18 summing the individual values. The sum of the HQ values is 2.5×10^{-1} . Comparing this value to the
- 19 requirement of <1.0 , this criterion is met.
- 20
- 21 3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value,
- 22 then multiplied by 1×10^{-6} . For example, the maximum value for aroclor-1016 is 0.02 mg/kg;
- 23 divided by 14.3 mg/kg, multiplied as indicated is 1.4×10^{-9} . Comparing this value, and all other
- 24 individual values, to the requirement of $<1 \times 10^{-6}$, this criterion is met.
- 25
- 26 4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer
- 27 risk can be obtained by summing the individual values. The sum of the excess cancer risk values is
- 28 4.3×10^{-7} . Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.
- 29
- 30

31 **RESULTS:**

- 32
- 33 1) List individual noncarcinogens and corresponding HQs >1.0 : None
- 34 2) List the cumulative noncarcinogenic HQ: 0.25
- 35 3) List individual carcinogens and corresponding excess cancer risk $>1 \times 10^{-6}$: None
- 36 4) List the cumulative excess cancer risk: 4.3×10^{-7}
- 37

38 Table 1 shows the results of the calculations.

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Bechtel Hanford, Inc.

CALCULATION SHEET

Originator:	J. M. Capron	Date:	08/18/05	Calc. No.:	0100F-CA-V0237	Rev.:	0
Project:	100-F Area Remaining Sites	Job No:	22192	Checked:	T. M. Blakley	Date:	8/18/05
Subject:	182-F Reservoir Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	3 of 3

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 182-F Reservoir Waste Site.

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	3.2	16,000	2.0E-04	--	--
Chromium, total	22.6	120,000	1.9E-04		
Chromium, hexavalent ^c	0.34	240	1.4E-03	2.1	1.6E-07
Lead ^d	58.7	353	1.7E-01	--	--
Molybdenum	0.56	400	1.4E-03	--	--
Zinc	139	24,000	5.8E-03	--	--
Polychlorinated Biphenyls					
Aroclor-1016	0.02	5.6	3.6E-03	14.3	1.4E-09
Aroclor-1254	0.11	1.6	6.9E-02	0.5	2.2E-07
Aroclor-1260	0.023	--	--	0.5	4.6E-08
Total:					
Cumulative Hazard Quotient:			2.5E-01		
Cumulative Excess Cancer Risk:					4.3E-07

Notes:

RAG = remedial action goal

-- = not applicable

^a = From BHI (2005).^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 EPA (1994).

CONCLUSION:

This calculation demonstrates that the 182-F Reservoir Waste Site meets the requirements for the hazard quotients and excess carcinogenic risk as identified in the RDR/RAWP (DOE-RL 2005).