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Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

11-AMRC-0197

AUG 30 2011

Mr. D. A. Faulk, Program Manager
Office of Environmental Cleanup
Hanford Project Office
U.S. Environmental Protection Agency
309 Bradley Blvd, Suite 115
Richland, Washington 99352

Dear Mr. Faulk:

TRANSMITTAL OF APPROVED WASTE SITE RECLASSIFICATION FORM AND SUPPORTING DOCUMENTATION FOR THE 600-178, 213-J AND 213-K GUARD HOUSE TOILET PIT, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2011-057 and supporting documentation for the "Remaining Sites Verification Package for the 600-178, 213-J and 213-K Guard House Toilet Pit," Revision 0. If you have questions, please contact me or your staff may contact Jamie Zeisloft, of my staff, at (509) 372-0188.

Sincerely,

Mark S. French, Federal Project Director
for the River Corridor Closure Project

AMRC:JHZ

Attachment

cc w/attach:
C. Guzzetti, EPA
Administrative Record, H6-08

cc w/o attach:
S. A. Christman, CHPRC
S. L. Feaster, WCH
T. A. Harris, WCH
M. L. Proctor, WCH

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Date Submitted: 4/17/2011 Originator: M. L. Proctor Phone: 372-9227	**WASTE SITE RECLASSIFICATION FORM** Operable Unit(s): 100-IU-6 Waste Site Code: 600-178 Type of Reclassification Action: Closed Out ☐ Interim Closed Out ☒ No Action ☐ RCRA Postclosure ☐ Rejected ☐ Consolidated ☐	Control Number: 2011-057

This form documents agreement among parties listed authorizing classification of the subject unit as Closed Out, Interim Closed Out, No Action, RCRA Postclosure, Rejected, or Consolidated. This form also authorizes backfill of the waste management unit, if appropriate, for Closed Out and Interim Closed Out units. Final removal from the NPL of No Action and Closed Out waste management units will occur at a future date.

Description of current waste site condition:

The 600-178, 213-J and 213-K Guard House Toilet Pit waste site was a toilet pit opening with a concrete pad that served the guard house and tower located at the front gate to the 213-J and 213-K Plutonium Storage Vaults. The 600-178 waste site is identified for remediation in the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2009).

Remedial action at the 600-178 waste site was performed from November 4 through 16, 2010. The waste material was staged in piles adjacent to the excavation, and waste material was subsequently disposed to the Environmental Restoration Disposal Facility.

Basis for reclassification:

Following remediation, verification sampling was conducted in February 2011. The results demonstrate that residual contaminant concentrations are protective of direct exposure, groundwater, and the Columbia River.

In accordance with this evaluation, the verification sampling results support a reclassification of the 600-178 waste site to Interim Closed Out. The current site conditions achieve the remedial action 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 (EPA 1999). The results of verification sampling 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 analytical results and rationale presented in the attached remaining sites verification package also demonstrate that the 600-178 waste site is protective of groundwater and the Columbia River. The waste site contamination did not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep-zone soil are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 600-178, 213-J and 213-K Guard House Toilet Pit* (attached).

Waste Site Controls:

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

M. S. French DOE Federal Project Director (printed)	Signature	7/19/11 Date
N/A Ecology Project Manager (printed)	Signature	Date
C. Guzzetti EPA Project Manager (printed)	Signature	7/19/11 Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-178, 213-J AND 213-K GUARD HOUSE TOILET PIT

Attachment to Waste Site Reclassification Form 2011-057

June 2011

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-178, 213-J AND 213-K GUARD HOUSE TOILET PIT

EXECUTIVE SUMMARY

The 600-178, 213-J and 213-K Guard House Toilet Pit waste site, located in the 100-IU-6 Operable Unit, was a toilet pit opening within a 4.3- by 4.9-m (14- by 16-ft) concrete pad that was the remains of the 213-J and 213-K Plutonium Storage Vaults guard house. An underlying sewage pit was found beneath this opening, but no septic tank was associated with the waste site. The 213-J and 213-K Plutonium Storage Vaults were protected by a guard house associated with this toilet pit. The guard house and tower were located at the front gate to the vault area.

The 600-178 waste site is identified for remediation in the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (EPA 2009). Remedial action at the 600-178 waste site was performed from November 4 through 16, 2010.

Following remediation, verification sampling was conducted in February 2011. The results indicated that waste removal action achieved compliance with the remedial action objectives (RAOs) and remedial action goals (RAGs) for the 600-178 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 600-178 waste site in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2007).

Table ES-1. Summary of Remedial Action Goals for the 600-178 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain dose rate of less than 15-mrem/yr above background over 1,000 years.	Radionuclides were not COPCs for the 600-178 waste site.	NA
Direct Exposure – Nonradionuclides	Attain individual COPC RAGs.	All individual COPC concentrations are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	The hazard quotients for individual nonradionuclide COPCs are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient for all sampling areas (1.1×10^{-3}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	Excess cancer risk values for individual nonradionuclide COPCs are $<1 \times 10^{-6}$.	

Table ES-1. Summary of Remedial Action Goals for the 600-178 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Risk Requirements – Nonradionuclides	Attain a cumulative excess cancer risk of <1 x 10^{-5} for carcinogens.	The total excess carcinogenic risk for all sampling areas (5.1 x 10^{-9}) is <1 x 10^{-5}.	Yes
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not COPCs for the 600-178 waste site.	NA
	Attain National Primary Drinking Water Regulations: 4 mrem/yr (beta/gamma) dose standard to target receptor/organ [a].		
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide for DOE Order 5400.5 [b].		
	Meet total uranium standard of 21.2 pCi/L [c].		
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and Columbia River cleanup requirements.	4,4'-DDE is present at concentrations slightly above soil RAGs for groundwater and/or Columbia River protection. However, an evaluation based upon RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009) shows that residual concentrations of this constituent are not predicted to migrate within 1,000 years based on the soil-partitioning coefficient (K_d) of 86.4 mL/g. The vadose zone underlying the excavation is approximately 44 m (145 ft) thick. Therefore, residual concentrations of 4,4'-DDE are predicted to be protective 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 Area, 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).

COPC = contaminant of potential concern
DOE = U.S. Department of Energy
MCL = maximum contaminant level
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)

In accordance with this evaluation, the verification sampling results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the RAOs and the corresponding RAGs established in the *Remedial Design Report/Remedial Action Work Plan for*

the 100 Area (DOE-RL 2009) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow-zone soil (i.e., surface to 4.6 m [15 ft]), and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The 600-178 waste site contamination did not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based in part 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 potential concern, and other constituents. Those constituents exceeding the ecological screening level in the *Washington Administrative Code* Chapter 173-340, Table 749-3 were boron and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for manganese and vanadium. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because the maximum detected levels of vanadium were all below Hanford Site background values, it is believed that the presence of these constituents does not pose a risk to ecological receptors. No established background value is available for boron at this time; a final cleanup level for boron, including consideration of background, will be established through the final remedial investigation/feasibility study process. All exceedances will be evaluated in the context of additional lines of evidence for ecological effects as a part of the final closeout decision for the Columbia River corridor portion of the Hanford Site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-178, 213-J and 213-K GUARD HOUSE TOILET PIT

STATEMENT OF PROTECTIVENESS

The 600-178, 213-J and 213-K Guard House Toilet Pit waste site verification sampling data, site evaluation, and supporting documentation demonstrate that this site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2009) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow-zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The waste site contamination did not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

GENERAL SITE INFORMATION AND BACKGROUND

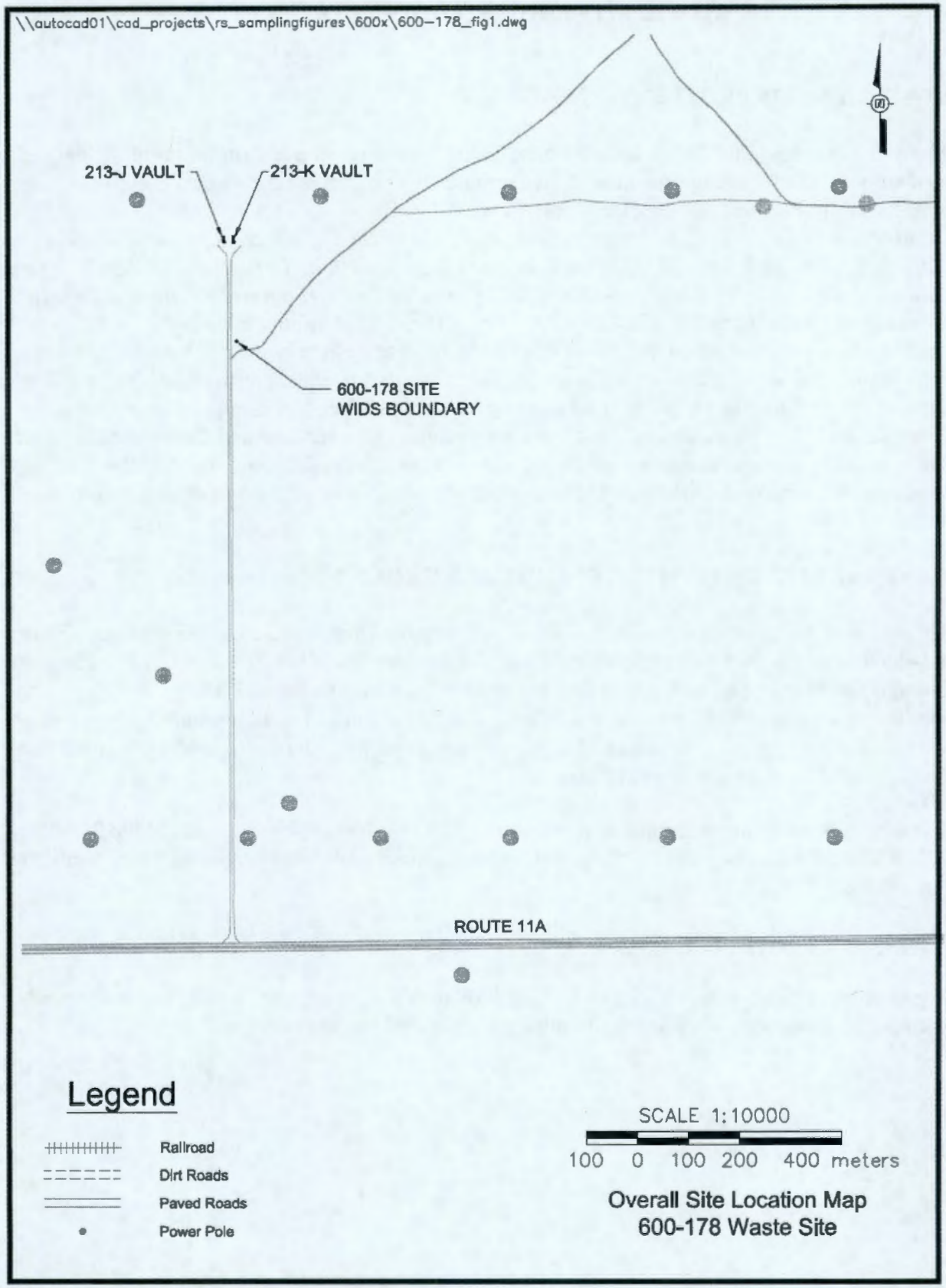
The 600-178 waste site, located in the 100-IU-6 Operable Unit, was a toilet pit opening within a 4.3- by 4.9-m (14- by 16-ft) concrete pad that was the remains of the 213-J and 213-K Plutonium Storage Vaults guard house. An underlying sewage pit was found beneath this opening, but no septic tank was associated with the waste site. The 213-J and 213-K Plutonium Storage Vaults were protected by a guard house associated with this toilet pit. The guard house and tower were located at the front gate to the vault area.

The 600-178 waste site is located north of Route 11A and 150 m (490 ft) south of the 213-J and 213-K Plutonium Storage Vaults (Figure 1), at approximate Washington State Plane coordinates N 139971, E 579287.

Geophysical Survey

A geophysical survey was performed in July 2008 to determine if a drain field was associated with the concrete pad. No linear anomalies were indicated by the survey.

Figure 1. The 600-178 Waste Site Location Map.



Site Walkdown

A site walkdown was performed in June 1999 to identify the waste site location. A lid to the sewage pit was found adjacent to the concrete foundation.

REMEDIATION ACTION SUMMARY

Remediation occurred at the 600-178 waste site on November 4 through 16, 2010. The concrete toilet system was removed entirely, along with a protruding pipe and sludgy material underlying the pipe. The concrete structure had dimensions of approximately 6 by 6 by 1.2 m (20 by 20 by 4 ft). Photographs of the waste site are provided in Appendix A.

The excavated concrete, pipe, and associated soils were staged adjacent to the waste site before disposal to the Environmental Restoration Disposal Facility.

VERIFICATION SAMPLING ACTIVITIES

Verification sampling for the 600-178 waste site was conducted in February 2011 to support a determination that residual contaminant concentrations at this site meet the cleanup criteria specified in the RDR/RAWP (DOE-RL 2009) and the Remaining Sites ROD (EPA 1999). The verification sample results indicate that the waste removal action achieved compliance with the remedial action objectives (RAOs) for the 600-178 waste site. The following subsections provide additional discussion of the information used to develop the verification sampling design. A more detailed discussion of the verification sampling can be found in the *Work Instruction for Verification Sampling of the 600-178, 213-J and 213-K Guard House Toilet Pit* (WCH 2011b).

Contaminants of Potential Concern

According to the Remaining Sites ESD, radiological and chemical contaminants were potential COPCs at the 600-178 waste site. However, field radiological control instruments did not detect any levels above background during remediation, and radiological analysis of composite, in-process soil samples from the staging pile area did not indicate radiological contamination requiring further action, as all detected radionuclides are associated with natural occurrence and do not require remedial action (Appendix B). Therefore, radionuclides were eliminated as COPCs for verification sampling. Because both metals and pesticides were detected in the samples collected from the staging pile, these constituents were added as COPCs for verification sampling. Analyses for the constituents of the inductively coupled plasma (ICP) metals list included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

A summary of all the contaminants analyzed is provided in Table 1.

Table 1. 600-178 Laboratory Analytical Methods.

Analytical Method	Contaminant of Potential Concern
ICP metals [a] – EPA Method 6010	ICP metals
Pesticides – EPA Method 8081	Organochlorine pesticides

[a] Analyses was performed for the expanded list of ICP metals including antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma

Verification Sample Design

This section describes the basis for selection of an appropriate sample design and determination of the number of verification samples that were collected. Professional knowledge and the results of in-process sampling and field surveys were used to develop the verification sampling design for the 600-178 waste site. The 600-178 waste site was divided into three decision units for interim closeout determination; these decision units are the excavation footprint, the waste staging pile area footprint, and the overburden stockpile. In the verification work instruction, only a staging pile area and excavation were delineated; however, a field change was made with the U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy concurrence, and half of the staging pile was sampled as an overburden stockpile, and will be used to backfill the excavation. Due to the small size of the excavation (160 m^2 [1,700 ft^2]) and waste staging pile area and overburden footprint (100 m^2 [1,075 ft^2]), composite samples were collected, consisting of 25 aliquots of soil distributed across the surface of the sampling area. Two composite samples were collected over the footprint of the excavated area, one was collected at the waste staging pile area footprint, and one was collected over the overburden, for a total of four composite verification samples (Figure 2). These samples are described in Table 2.

Verification Sample Results

Verification samples were analyzed using EPA-approved analytical methods. Statistical analysis (e.g., calculation of a 95% upper confidence limit value) is inappropriate to use for evaluation of these types of composite samples; therefore, the sample results for each verification sample are evaluated using the maximum detected activity for each COPC and comparing the value directly to the remedial action goal (RAG) values. Tables 3, 4, and 5 provide a comparison of the maximum result of the composite samples against the cleanup criteria for each decision unit. Individual sample results are provided in Appendix C. If no detections for a given COPC were reported in the data set, then no evaluations were performed for that COPC.

Figure 2. Verification Sample Design for the 600-178 Waste Site.

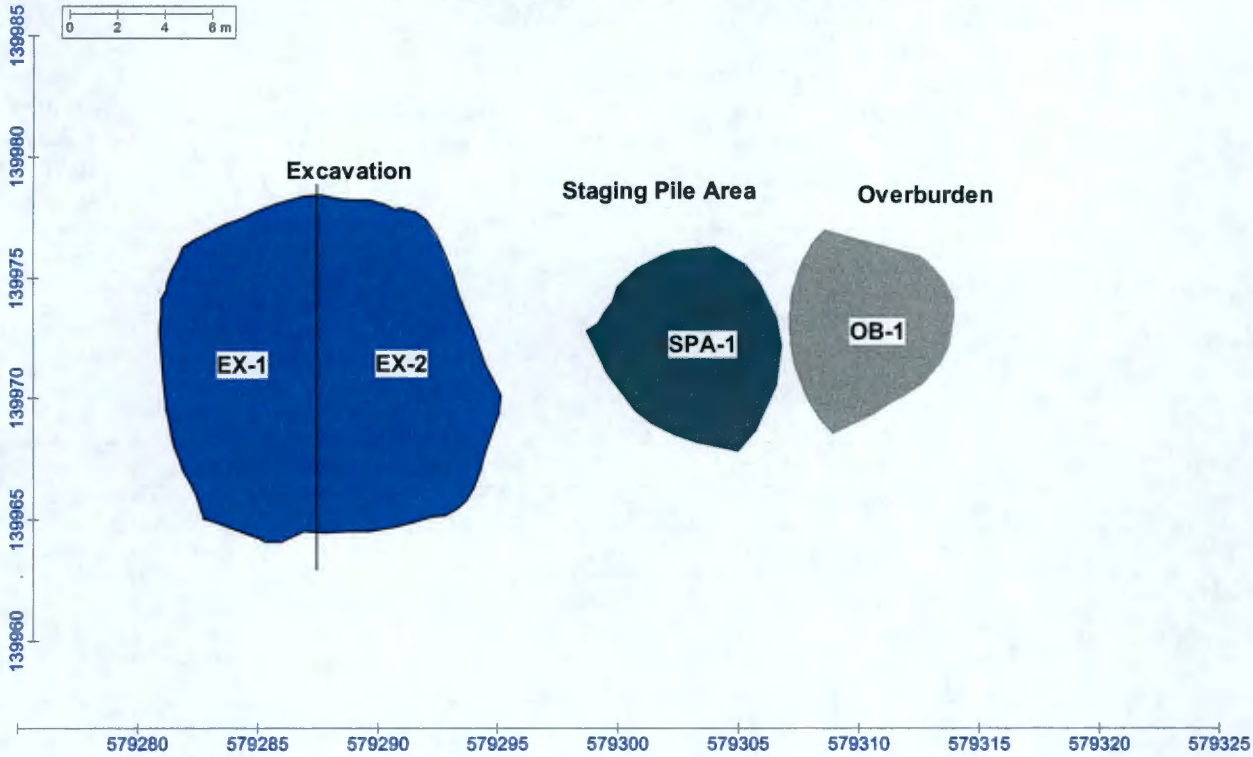


Table 2. 600-178 Verification Sampling Summary Table.

Sample Location	HEIS Number	WSP Coordinates		Sample Analysis
		Northing (m)	Easting (m)	
EX-1 (western half of excavation)	J1FH06	NA	NA	ICP metals [a], pesticides
EX-2 (eastern half of excavation)	J1FH07	NA	NA	
SPA-1	J1FH08	NA	NA	
OB-1	J1FH09	NA	NA	
Duplicate of J1FH06	J1FH10	NA	NA	
Equipment blank	J1FH11	NA	NA	ICP metals [a]

[a] Analysis for the expanded list of ICP metals was performed to include antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
WSP = Washington State Plane

Table 3. Comparison of Maximum Contaminant Concentrations to Remedial Action Goals for the 600-178 Excavation Verification Sampling Data.

COPC	Maximum Result (mg/kg)	Remedial Action Goals [a] (mg/kg)			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	3.12 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	76.1 (<BG)	5,600	200	400	No	--
Beryllium	0.264 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	1.11	7,200	320	-- [e]	No	--
Cadmium [f]	0.131 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium (total)	8.58 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Cobalt	9.25 (<BG)	24	15.7 [b]	-- [e]	No	--
Copper	10.5 (<BG)	2,960	59.2	22.0 [b]	No	--
Lead	5.77 (<BG)	353	10.2 [b]	10.2 [b]	No	--
Manganese	337 (<BG)	3,760	512 [b]	512 [b]	No	--
Molybdenum [d]	0.363	400	8	-- [e]	No	--
Nickel	8.91 (<BG)	1,600	19.1 [b]	27.4	No	--
Vanadium	62.9 (<BG)	560	85.1 [b]	-- [e]	No	--
Zinc	43.0 (<BG)	24,000	480	67.8 [b]	No	--
4,4'-DDE	0.0134	2.94	0.0257	0.0033 [g]	Yes	Yes [h]

[a] RAGs obtained from the RDR/RAWP (DOE-RL 2009) unless otherwise noted.

[b] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009).

[c] 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 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

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

[e] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2010) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], 1996 [Method B for surface waters]).

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

[g] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996).

[h] Based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009), the residual concentrations of 4,4'-DDE are not expected to migrate vertically in 1,000 years (based on the distribution coefficient of 4,4'-DDE of 86.4 mL/g). The vadose zone underlying the excavation is approximately 44 m (145 ft) thick. Therefore, residual concentrations of this constituent are predicted to be protective of groundwater and the Columbia River.

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

Table 4. Comparison of Maximum Contaminant Concentrations to Remedial Action Goals for the 600-178 Staging Pile Area Verification Sampling Data.

COPC	Maximum Result (mg/kg)	Remedial Action Goals [a] (mg/kg)			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	2.82 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	67.6 (<BG)	5,600	200	400	No	--
Beryllium	0.258 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	1.26	7,200	320	-- [e]	No	--
Cadmium [f]	0.108 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium (total)	8.24 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Cobalt	6.13 (<BG)	24	15.7 [b]	-- [e]	No	--
Copper	9.75 (<BG)	2,960	59.2	22.0 [b]	No	--
Lead	4.07 (<BG)	353	10.2 [b]	10.2 [b]	No	--
Manganese	290 (<BG)	3,760	512 [b]	512 [b]	No	--
Molybdenum [d]	0.335	400	8	-- [e]	No	--
Nickel	7.70 (<BG)	1,600	19.1 [b]	27.4	No	--
Vanadium	52.1 (<BG)	560	85.1 [b]	-- [e]	No	--
Zinc	38.9 (<BG)	24,000	480	67.8 [b]	No	--
4,4'-DDE	0.00468	2.94	0.0257	0.0033 [g]	Yes	Yes [h]
4,4'-DDT	0.00167	2.94	0.0257	0.0033 [g]	No	--

[a] RAGs obtained from the RDR/RAWP (DOE-RL 2009) unless otherwise noted.

[b] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009).

[c] 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 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

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

[e] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2010) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], 1996 [Method B for surface waters]).

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

[g] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996).

[h] Based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009), the residual concentrations of 4,4'-DDE are not expected to migrate vertically in 1,000 years (based on the distribution coefficient of 4,4'-DDE of 86.4 mL/g). The vadose zone underlying the excavation is approximately 44 m (145 ft) thick. Therefore, residual concentrations of this constituent are predicted to be protective of groundwater and the Columbia River.

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

Table 5. Comparison of Maximum Contaminant Concentrations to Remedial Action Goals for the 600-178 Overburden Verification Sampling Data.

COPC	Maximum Result (mg/kg)	Remedial Action Goals [a] (mg/kg)			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	2.78 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	62.6 (<BG)	5,600	200	400	No	--
Beryllium	0.230 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	0.905	7,200	320	-- [e]	No	--
Cadmium [f]	0.121 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium (total)	6.70 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Cobalt	6.56 (<BG)	24	15.7 [b]	-- [e]	No	--
Copper	9.87 (<BG)	2,960	59.2	22.0 [b]	No	--
Lead	3.82 (<BG)	353	10.2 [b]	10.2 [b]	No	--
Manganese	307 (<BG)	3,760	512 [b]	512 [b]	No	--
Molybdenum [d]	0.359	400	8	-- [e]	No	--
Nickel	6.93 (<BG)	1,600	19.1 [b]	27.4	No	--
Vanadium	66.0 (<BG)	560	85.1 [b]	-- [e]	No	--
Zinc	43.6 (<BG)	24,000	480	67.8 [b]	No	--
4,4'-DDE	0.00778	2.94	0.0257	0.0033 [g]	Yes	Yes [h]
4,4'-DDT	0.00152	2.94	0.0257	0.0033 [g]	No	--

[a] RAGs obtained from the RDR/RAWP (DOE-RL 2009) unless otherwise noted.

[b] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009).

[c] 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 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

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

[e] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2010) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], 1996 [Method B for surface waters]).

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

[g] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996).

[h] Based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009), the residual concentrations of 4,4'-DDE are not expected to migrate vertically in 1,000 years (based on the distribution coefficient of 4,4'-DDE of 86.4 mL/g). The vadose zone underlying the excavation is approximately 44 m (145 ft) thick. Therefore, residual concentrations of this constituent are predicted to be protective of groundwater and the Columbia River.

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

The laboratory-reported data results for all constituents are stored in the Environmental Restoration (ENRE) project-specific database prior to provision to the Hanford Environmental Information System (HEIS) and are presented as an attachment to the direct contact hazard quotient and relative percent difference calculation in Appendix C.

DATA EVALUATION

This section demonstrates that contaminant concentrations at the 600-178 waste site achieve the applicable RAGs developed to support unrestricted land use at the 100 Area as established in the Remaining Sites ROD (EPA 1999) and documented in the RDR/RAWP (DOE-RL 2009).

Nonradionuclide Soil RAGs for Direct Exposure and Groundwater and River Protection Attained

Tables 3, 4, and 5 compare the cleanup verification sample values to the applicable soil RAGs for direct exposure, protection of groundwater, and protection of the Columbia River. All cleanup verification data values pass in direct comparison to the applicable RAGs, with the exception of 4,4'-DDE, which was quantified at concentrations exceeding soil protection RAGs for groundwater and/or river protection within all three decision units. Data were not collected on the vertical extent of this contaminant, but an evaluation based upon RESidual RADioactivity modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009) shows that residual concentrations of this constituent are not expected to migrate vertically in 1,000 years given the soil-partitioning coefficient (K_d) of 86.4 mL/g. The vadose zone underlying the deepest part of the excavation is approximately 44 m (145 ft) thick; therefore, residual concentrations of these constituents are predicted to be protective of groundwater. The only pathway for contaminant migration to the Columbia River is via groundwater; therefore, residual concentrations of this contaminant are also predicted to be protective of the Columbia River. All other cleanup verification data values pass in direct comparison to the applicable RAGs.

Nonradionuclide Hazard Quotient and Carcinogenic Risk RAGs Attained

Calculation of the 600-178 waste site direct contact hazard quotient and carcinogenic risk is presented in Appendix C. 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 600-178 waste site, these risk values were not calculated for constituents that were either not detected or were detected at concentrations below Hanford Site or Washington State background levels. All individual hazard quotients for noncarcinogenic constituents were less than 1.0. The cumulative hazard quotient for those noncarcinogenic constituents above background or detected levels is 1.1×10^{-3}. The total carcinogenic risk is 5.1×10^{-9}. Based on the nonradionuclide groundwater and river protection RAGs shown in Tables 3, 4, and 5, the residual concentrations of the nonradionuclide contaminants are protective of groundwater and the Columbia River.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach (WCH 2011b), the field logbook (WCH 2011a), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications. The DQA for the 600-178 waste site established that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The cleanup verification sample analytical data are stored in the ENRE project-specific database for data evaluation prior to archival in the HEIS and are provided as an attachment to the relative percent difference and direct contact hazard quotient calculation in Appendix C. The detailed DQA is presented in Appendix D.

SUMMARY FOR INTERIM CLOSURE

The 600-178 waste site has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2009). Verification sampling was performed, and the analytical results indicate that the residual concentrations of COPCs at this site meet the RAOs for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-178 waste site to Interim Closed Out. The waste site contamination does not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

REFERENCES

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WDOH, 1997, *Hanford Guidance for Radiological Cleanup*, WDOH/320-015, Rev. 1, Washington State Department of Health, Olympia, Washington.

APPENDIX A

PHOTOGRAPHS

Figure A-1. The 600-178 Waste Site Prior to Remediation (October 14, 2009).

Figure A-2. Excavation at the 600-178 Waste Site (November 4, 2010).

Figure A-3. The 600-178 Waste Site After Remediation (January 10, 2011).

APPENDIX B

IN-PROCESS SAMPLING RESULTS

Table B-1. In-Process Sampling Data for the 600-178 Waste Site. (7 Pages)

Sample Location	HEIS Number	Sample Date	Gross alpha			Gross beta			Americium-241 GEA			Cesium-137			Cobalt-60		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Eastern section of stockpile	J1C456	11/22/2010	5.8		3.46	16.8		4.92	0.076	U	0.076	0.058	U	0.06	0.062	U	0.06
Northwestern section of stockpile	J1C457	11/22/2010	6.26		3.68	19.1		5.57	0.169	U	0.169	0.054	U	0.05	0.048	U	0.05
Southwestern section of stockpile	J1C458	11/22/2010	2.62	U	3.4	13.5		8.04	0.131	U	0.131	0.052	U	0.05	0.048	U	0.05

Sample Location	HEIS Number	Sample Date	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
Eastern section of stockpile	J1C456	11/22/2010	0.157	U	0.16	0.187	U	0.19	0.132	U	0.132	11.8		0.81	0.463		0.13
Northwestern section of stockpile	J1C457	11/22/2010	0.157	U	0.16	0.167	U	0.17	0.151	U	0.151	12.9		0.46	0.456		0.11
Southwestern section of stockpile	J1C458	11/22/2010	0.124	U	0.12	0.166	U	0.17	0.12	U	0.12	10.5		0.41	0.431		0.09

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
Eastern section of stockpile	J1C456	11/22/2010	0.331	U	0.34	0.742		0.11	0.331	U	0.342	0.339	U	0.34	7.56	U	7.56
Northwestern section of stockpile	J1C457	11/22/2010	0.72		0.2	0.564		0.08	0.72		0.202	0.364	U	0.36	6.46	U	6.46
Southwestern section of stockpile	J1C458	11/22/2010	0.544		0.22	0.526		0.06	0.544		0.219	0.263	U	0.26	6.12	U	6.12

Table B-1. In-Process Sampling Data for the 600-178 Waste Site. (7 Pages)

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Eastern section of stockpile	J1C456	11/22/2010	6820		4.24	0.509	U	0.51	2.75		0.85	73.6		0.42	0.272		0.17
Northwestern section of stockpile	J1C457	11/22/2010	6060		4.62	0.555	U	0.56	2.51		0.93	68.1		0.46	0.254		0.19
Southwestern section of stockpile	J1C458	11/22/2010	5970		4.18	0.502	U	0.5	2.29		0.84	69.5		0.42	0.254		0.17

Sample Location	HEIS Number	Sample Date	Boron			Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Eastern section of stockpile	J1C456	11/22/2010	1.13	B	1.7	0.096	B	0.17	3790		84.8	7.28		0.17	5.67		1.7
Northwestern section of stockpile	J1C457	11/22/2010	0.913	B	1.85	0.09	B	0.19	3780		92.5	6.87		0.19	5.41		1.85
Southwestern section of stockpile	J1C458	11/22/2010	0.94	B	1.67	0.095	B	0.17	4120		83.6	6.23		0.17	5.97		1.67

Sample Location	HEIS Number	Sample Date	Copper			Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Eastern section of stockpile	J1C456	11/22/2010	10.1		0.85	20600		17	3.99		0.42	3870		63.6	300		4.24
Northwestern section of stockpile	J1C457	11/22/2010	9.65		0.93	19500		18.5	3.74		0.46	3760		69.4	271		4.62
Southwestern section of stockpile	J1C458	11/22/2010	10.6		0.84	20000		16.7	3.61		0.42	3770		62.7	296		4.18

Table B-1. In-Process Sampling Data for the 600-178 Waste Site. (7 Pages)

Sample Location	HEIS Number	Sample Date	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
Eastern section of stockpile	J1C456	11/22/2010	0.027	U	0.03	0.345	B	1.7	7.56		3.39	1400		339	0.254	U	0.25
Northwestern section of stockpile	J1C457	11/22/2010	0.027	U	0.03	0.313	B	1.85	7.24		3.7	1370		370	0.277	U	0.28
Southwestern section of stockpile	J1C458	11/22/2010	0.028	U	0.03	0.424	B	1.67	7.01		3.35	1200		335	0.251	U	0.25

Sample Location	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Eastern section of stockpile	J1C456	11/22/2010	598		1.7	0.17	U	0.17	178		42.4	52.5		2.12	41.6		8.48
Northwestern section of stockpile	J1C457	11/22/2010	569		1.85	0.185	U	0.19	189		46.2	49.8		2.31	42.1		9.25
Southwestern section of stockpile	J1C458	11/22/2010	611		1.67	0.167	U	0.17	197		41.8	51.3		2.09	39.5		8.36

Sample Location	HEIS Number	Sample Date	Percent Solids	pH Measurement
Eastern section of stockpile	J1C456	11/22/2010	93.6	8.47
Northwestern section of stockpile	J1C457	11/22/2010	91.6	8.79
Southwestern section of stockpile	J1C458	11/22/2010	94.9	8.8

Table B-1. In-Process Sampling Data for the 600-178 Waste Site. (7 Pages)

Constituent	Class	J1C456			J1C457			J1C458		
		11/22/2010			11/22/2010			11/22/2010		
		Eastern section of stockpile			Northwestern section of stockpile			Southwestern section of stockpile		
		µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Aroclor-1016	PCB	14.1	U	14.1	14.1	U	14.1	13.8	U	13.8
Aroclor-1221	PCB	14.1	U	14.1	14.1	U	14.1	13.8	U	13.8
Aroclor-1232	PCB	14.1	U	14.1	14.1	U	14.1	13.8	U	13.8
Aroclor-1242	PCB	14.1	U	14.1	14.1	U	14.1	13.8	U	13.8
Aroclor-1248	PCB	14.1	U	14.1	14.1	U	14.1	13.8	U	13.8
Aroclor-1254	PCB	14.1	U	14.1	14.1	U	14.1	13.8	U	13.8
Aroclor-1260	PCB	14.1	U	14.1	14.1	U	14.1	13.8	U	13.8
Aldrin	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
Alpha-BHC	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
alpha-Chlordane	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
beta-BHC	PEST	1.41	UD	1.41	1.59	JD	1.41	1.65	JD	1.38
Delta-BHC	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
4,4'-DDD	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
4,4'-DDE	PEST	34.6	D	1.41	13	D	1.41	6.75	JD	1.38
4,4'-DDT	PEST	1.41	UD	1.41	4.25	JD	1.41	1.48	JD	1.38
Dieldrin	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
Endosulfan I	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
Endosulfan II	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
Endosulfan sulfate	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
Endrin	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
Endrin aldehyde	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
Endrin ketone	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
Gamma-BHC (Lindane)	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
gamma-Chlordane	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
Heptachlor	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
Heptachlor epoxide	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
Methoxychlor	PEST	1.41	UD	1.41	1.41	UD	1.41	1.38	UD	1.38
Toxaphene	PEST	21.2	UD	21.2	21.2	UD	21.2	20.7	UD	20.7
1,1,1-Trichloroethane	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
1,1,2,2-Tetrachloroethane	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
1,1,2-Trichloroethane	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
1,1-Dichloroethane	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
1,1-Dichloroethene	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
1,2-Dichloroethane	VOA	6.41	U	6.41	6.06	U	6.06	5.97	U	5.97
1,2-Dichloroethene(Total)	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
1,2-Dichloropropane	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
2-Butanone	VOA	12.8	U	12.8	12.1	U	12.1	11.9	U	11.9
2-Hexanone	VOA	12.8	U	12.8	12.1	U	12.1	11.9	U	11.9
4-Methyl-2-Pentanone	VOA	12.8	U	12.8	12.1	U	12.1	11.9	U	11.9
Acetone	VOA	12.8	U	12.8	12.1	U	12.1	11.9	U	11.9
Benzene	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
Bromodichloromethane	VOA	6.41	U	6.41	6.06	U	6.06	5.97	U	5.97

Table B-1. In-Process Sampling Data for the 600-178 Waste Site. (7 Pages)

Constituent	Class	J1C456			J1C457			J1C458		
		11/22/2010			11/22/2010			11/22/2010		
		Eastern section of stockpile			Northwestern section of stockpile			Southwestern section of stockpile		
		µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Bromoform	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
Bromomethane	VOA	10.7	U	10.7	10.1	U	10.1	9.94	U	9.94
Carbon disulfide	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
Carbon tetrachloride	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
Chlorobenzene	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
Chloroethane	VOA	10.7	U	10.7	10.1	U	10.1	9.94	U	9.94
Chloroform	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
Chloromethane	VOA	10.7	U	10.7	10.1	U	10.1	9.94	U	9.94
cis-1,2-Dichloroethylene	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
cis-1,3-Dichloropropene	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
Dibromochloromethane	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
Ethylbenzene	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
Methylenechloride	VOA	3.13	BJ	6.41	3.15	BJ	6.06	3	BJ	5.97
Styrene	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
Tetrachloroethene	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
Toluene	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
trans-1,2-Dichloroethylene	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
trans-1,3-Dichloropropene	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
Trichloroethene	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97
Vinyl chloride	VOA	10.7	U	10.7	10.1	U	10.1	9.94	U	9.94
Xylenes (total)	VOA	5.34	U	5.34	5.05	U	5.05	4.97	U	4.97

Table B-1. In-Process Sampling Data for the 600-178 Waste Site. (7 Pages)

Constituent	Class	J1C456			J1C457			J1C458		
		11/22/2010			11/22/2010			11/22/2010		
		Eastern section of stockpile			Northwestern section of stockpile			Southwestern section of stockpile		
		µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	353	U	353	359	U	359	336	U	336
1,2-Dichlorobenzene	SVOA	353	U	353	359	U	359	336	U	336
1,3-Dichlorobenzene	SVOA	353	U	353	359	U	359	336	U	336
1,4-Dichlorobenzene	SVOA	353	U	353	359	U	359	336	U	336
2,4,5-Trichlorophenol	SVOA	353	U	353	359	U	359	336	U	336
2,4,6-Trichlorophenol	SVOA	353	U	353	359	U	359	336	U	336
2,4-Dichlorophenol	SVOA	353	U	353	359	U	359	336	U	336
2,4-Dimethylphenol	SVOA	353	U	353	359	U	359	336	U	336
2,4-Dinitrophenol	SVOA	1760	U	1760	1800	U	1800	1680	U	1680
2,4-Dinitrotoluene	SVOA	353	U	353	359	U	359	336	U	336
2,6-Dinitrotoluene	SVOA	353	U	353	359	U	359	336	U	336
2-Chloronaphthalene	SVOA	353	U	353	359	U	359	336	U	336

Table B-1. In-Process Sampling Data for the 600-178 Waste Site. (7 Pages)

Constituent	Class	J1C456			J1C457			J1C458		
		11/22/2010			11/22/2010			11/22/2010		
		Eastern section of stockpile			Northwestern section of stockpile			Southwestern section of stockpile		
		µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
2-Chlorophenol	SVOA	353	U	353	359	U	359	336	U	336
2-Methylnaphthalene	SVOA	353	U	353	359	U	359	336	U	336
2-Methylphenol (cresol, o-)	SVOA	353	U	353	359	U	359	336	U	336
2-Nitroaniline	SVOA	1760	U	1760	1800	U	1800	1680	U	1680
2-Nitrophenol	SVOA	353	U	353	359	U	359	336	U	336
3,3'-Dichlorobenzidine	SVOA	705	U	705	718	U	718	671	U	671
3+4 Methylphenol (cresol, m+p)	SVOA	353	U	353	359	U	359	336	U	336
3-Nitroaniline	SVOA	1760	U	1760	1800	U	1800	1680	U	1680
4,6-Dinitro-2-methylphenol	SVOA	353	U	353	359	U	359	336	U	336
4-Bromophenylphenyl ether	SVOA	353	U	353	359	U	359	336	U	336
4-Chloro-3-methylphenol	SVOA	353	U	353	359	U	359	336	U	336
4-Chloroaniline	SVOA	353	U	353	359	U	359	336	U	336
4-Chlorophenylphenyl ether	SVOA	353	U	353	359	U	359	336	U	336
4-Nitroaniline	SVOA	1760	U	1760	1800	U	1800	1680	U	1680
4-Nitrophenol	SVOA	1760	U	1760	1800	U	1800	1680	U	1680
Acenaphthene	SVOA	353	U	353	359	U	359	336	U	336
Acenaphthylene	SVOA	353	U	353	359	U	359	336	U	336
Anthracene	SVOA	353	U	353	359	U	359	336	U	336
Benzo(a)anthracene	SVOA	353	U	353	359	U	359	336	U	336
Benzo(a)pyrene	SVOA	353	U	353	359	U	359	336	U	336
Benzo(b)fluoranthene	SVOA	353	U	353	359	U	359	336	U	336
Benzo(ghi)perylene	SVOA	353	U	353	359	U	359	336	U	336
Benzo(k)fluoranthene	SVOA	353	U	353	359	U	359	336	U	336
Bis(2-chloro-1-methylethyl)ether	SVOA	353	U	353	359	U	359	336	U	336
Bis(2-Chloroethoxy)methane	SVOA	353	U	353	359	U	359	336	U	336
Bis(2-chloroethyl) ether	SVOA	353	U	353	359	U	359	336	U	336
Bis(2-ethylhexyl) phthalate	SVOA	353	U	353	359	U	359	336	U	336
Butylbenzylphthalate	SVOA	353	U	353	359	U	359	336	U	336
Carbazole	SVOA	353	U	353	359	U	359	336	U	336
Chrysene	SVOA	353	U	353	359	U	359	336	U	336
Dibenz[a,h]anthracene	SVOA	353	U	353	359	U	359	336	U	336
Dibenzofuran	SVOA	353	U	353	359	U	359	336	U	336
Diethyl phthalate	SVOA	353	U	353	359	U	359	336	U	336
Dimethyl phthalate	SVOA	353	U	353	359	U	359	336	U	336
Di-n-butylphthalate	SVOA	353	U	353	359	U	359	336	U	336
Di-n-octylphthalate	SVOA	353	U	353	359	U	359	336	U	336
Fluoranthene	SVOA	353	U	353	359	U	359	336	U	336
Fluorene	SVOA	353	U	353	359	U	359	336	U	336
Hexachlorobenzene	SVOA	353	U	353	359	U	359	336	U	336
Hexachlorobutadiene	SVOA	353	U	353	359	U	359	336	U	336
Hexachlorocyclopentadiene	SVOA	353	U	353	359	U	359	336	U	336
Hexachloroethane	SVOA	353	U	353	359	U	359	336	U	336

Table B-1. In-Process Sampling Data for the 600-178 Waste Site. (7 Pages)

Constituent	Class	J1C456			J1C457			J1C458		
		11/22/2010			11/22/2010			11/22/2010		
		Eastern section of stockpile			Northwestern section of stockpile			Southwestern section of stockpile		
		µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Indeno(1,2,3-cd)pyrene	SVOA	353	U	353	359	U	359	336	U	336
Isophorone	SVOA	353	U	353	359	U	359	336	U	336
Naphthalene	SVOA	353	U	353	359	U	359	336	U	336
Nitrobenzene	SVOA	353	U	353	359	U	359	336	U	336
N-Nitroso-di-n-dipropylamine	SVOA	353	U	353	359	U	359	336	U	336
N-Nitrosodiphenylamine	SVOA	353	U	353	359	U	359	336	U	336
Pentachlorophenol	SVOA	1760	U	1760	1800	U	1800	1680	U	1680
Phenanthrene	SVOA	353	U	353	359	U	359	336	U	336
Phenol	SVOA	353	U	353	359	U	359	336	U	336
Pyrene	SVOA	353	U	353	359	U	359	336	U	336

B = method blank contamination
D = result was reported from a dilution
GEA = gamma energy analysis
HEIS = Hanford Environmental Information System
J = estimated value
MDA = minimum detectable activity
PCB = polychlorinated biphenyl
PEST = pesticide
PQL = practical quantitation limit
Q = qualifier
SVOA = semivolatile organic analysis
U = undetected
VOA = volatile organic analysis

APPENDIX C

DIRECT CONTACT HAZARD QUOTIENT AND RELATIVE PERCENT DIFFERENCE (RPD) CALCULATIONS

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-IU-2/6 Field Remediation **Job No. 14655**

Area: 100-IU-6

Discipline: Environmental Calculation No: 0600X-CA-V0122

Subject: 600-178 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = 6 Attachment 1 = 2 Total = 9	I. B. Berezovskiy	T.E. Queen	J. D. Skoglie	D. F. Obenauer	6/14/11

SUMMARY OF REVISION

WCH-DE-018 (05/08/2007)

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	5/19/2011	Calc. No.:	0600X-CA-V0122	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	T. E. Queen	Date:	5/19/2011
Subject:	600-178 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 6	

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 600-178 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009a), 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.

Also, calculate the relative percent difference (RPD) for primary-duplicate sample pairs from the 600-178 verification sampling, as necessary.

GIVEN/REFERENCES:

1) DOE-RL, 2009a, *Remedial Design Report/Remedial Action Work Plan for the 100 Area,* DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2) DOE-RL, 2009b, *100 Area Remedial Action Sampling and Analysis Plan,* DOE/RL-96-22, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

3) 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.

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

5) WCH, 2011, *Remaining Sites Verification Package for the 600-178, 213-J and 213-K Guard House Toilet Pit*, Attachment to Waste Site Reclassification Form 2011-057, Washington Closure Hanford, Inc., Richland, Washington.

SOLUTION:

1) Generate an HQ for each noncarcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL 2009a).

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

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the excess cancer risk of $<1 \times 10^{-6}$ (DOE-RL 2009a).

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	5/19/2011	Calc. No.:	0600X-CA-V0122	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	T. E. Queen	Date:	5/19/2011
Subject:	600-178 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 6	

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

5) Use data from WCH (2011) to perform the RPD calculations for primary-duplicate sample pairs, as required.

METHODOLOGY:

The 600-178 waste site is comprised of an excavation, staging pile area and an overburden stockpile for verification sampling. The direct contact hazard quotient and carcinogenic risk calculations for the 600-178 waste site was conservatively calculated for the entire waste site using the greatest of the maximum verification soil sample results (WCH 2011). Of the contaminants of potential concern (COPCs) for this site, boron, molybdenum, 4,4-DDE and 4,4-DDT require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 1.26 mg/kg, divided by the noncarcinogenic RAG value of 7,200 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 1.8×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be 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 is 1.1×10^{-3}. Comparing this value 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 1.0×10^{-6}. For example, the maximum value for 4,4-DDE is 0.0134 mg/kg, divided by 2.94 mg/kg, and multiplied as indicated, is 4.6×10^{-9}. Comparing this value, and all other individual values, to the requirement of $<1 \times 10^{-6}$, this criterion is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual cancer risk values prior to rounding are used for this calculation. The sum of the excess cancer risk values is 5.1×10^{-9}. Comparing these values to the requirement of $<1 \times 10^{-5}$, this criterion is met.

5) The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method and is listed for certain analytes in Table II-1 of the SAP (DOE-RL 2009b). Other analytes will have their own pre-determined constituents and will have their own TDLs based on the laboratory and method used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	5/19/2011	Calc. No.:	0600X-CA-V0122	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	T. E. Queen	Date:	5/19/2011
Subject:	600-178 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 6	

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

where, M = main sample value D = duplicate sample value

When an analyte is detected in the primary or duplicate sample, but was quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate results exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. This assessment is provided in the data quality assessment section of the RSVP.

For quality assurance/quality control (QA/QC) duplicate RPD calculations, a value less than 30% indicates the data compare favorably. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed. No split samples were collected for cleanup verification of the subject site. Additional discussion is provided in the data quality assessment section of the applicable RSVP (WCH 2011), as necessary.

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 x 10^{-6}: None
4) List the cumulative excess cancer risk for carcinogens >1 x 10^{-5}: None

Table 1 shows the results of the hazard quotient and excess cancer risk calculations.

Table 2 shows the results of the RPD calculations for the 600-178 waste site. The evaluation of the QA/QC duplicate RPD calculations is performed within the data quality assessment section of the RSVP.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	5/19/2011	Calc. No.:	0600X-CA-V0122	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	T. E. Queen	Date:	5/19/2011
Subject:	600-178 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 4 of 6	

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 600-178 Waste Site.

Contaminants of Potential Concern	Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	1.26	7,200	1.8E-04	--	--
Molybdenum	0.363	400	9.1E-04	--	--
Pesticides					
DDE, 4,4'-	0.0134	--	--	2.94	4.6E-09
DDT, 4,4'-	0.00167	40	4.2E-05	2.94	5.7E-10
Totals					
Cumulative Hazard Quotient:			**1.1E-03**		
Cumulative Excess Cancer Risk:					**5.1E-09**

Notes:

[a] = From WCH (2011).

[b] = Value obtained from the RDR/RAWP (DOE-RL 2009a) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.

-- = not applicable RAG = remedial action goal

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	5/19/2011	Calc. No.:	0600X-CA-V0122	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	T. E. Queen	Date:	5/19/2011
Subject:	600-178 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 5 of 6	

Table 2. Relative Percent Difference Calculations for the 600-178 Waste Site (2 Pages).

600-178 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EX-1 (Western half of excavation)	J1FH06	3/1/2011	6780	J	4.42	2.39		0.883	69.2		0.442	0.244		0.177
Duplicate of J1FH06	J1FH10	3/1/2011	7220	J	3.56	2.52		0.713	76.1		0.356	0.257		0.143

Analysis:

TDL		5	10	2	0.2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	6.3%		9.5%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable

600-178 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Boron			Cadmium			Calcium			Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EX-1 (Western half of excavation)	J1FH06	3/1/2011	1.11	B	1.77	0.131	B	0.177	4570	J	88.3	8.28		0.177
Duplicate of J1FH06	J1FH10	3/1/2011	0.978	B	1.43	0.126	B	0.143	4760	J	71.3	8.58		0.143

Analysis:

TDL		2	0.2	100	1
Duplicate Analysis	Both > PQL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)
	Both >5xTDL?			Yes (calc RPD)	Yes (calc RPD)
	RPD			4.1%	3.6%
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	Not applicable

600-178 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Cobalt			Copper			Iron			Lead		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EX-1 (Western half of excavation)	J1FH06	3/1/2011	9.25		1.77	10.5		0.883	21500		17.7	5.77		0.442
Duplicate of J1FH06	J1FH10	3/1/2011	6.93		1.43	10.4		0.713	21500		14.3	4.11		0.356

Analysis:

TDL		2	1	5	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD		1.0%	0.0%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	5/19/2011	Calc. No.:	0600X-CA-V0122	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	T. E. Queen	Date:	5/19/2011
Subject:	600-178 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 6 of 6	

Table 2. Relative Percent Difference Calculations for the 600-178 Waste Site (2 Pages).

600-178 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Magnesium			Manganese			Molybdenum			Nickel		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EX-1 (Western half of excavation)	J1FH06	3/1/2011	4000		66.3	321		4.42	0.363	B	1.77	8.91		3.53
Duplicate of J1FH06	J1FH10	3/1/2011	4070		53.5	337		3.56	0.342	B	1.77	8.46		2.85

Analysis:

TDL		75	5	2	4
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)
	RPD	1.7%	4.9%		
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable

600-178 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Potassium			Silicon			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EX-1 (Western half of excavation)	J1FH06	3/1/2011	1400		353	464		1.77	317		44.2	62.9		2.21
Duplicate of J1FH06	J1FH10	3/1/2011	1480		285	389		1.43	342		35.6	59.9		1.78

Analysis:

TDL		400	2	50	2.5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD		17.6%	7.6%	4.9%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	Not applicable

600-178 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Zinc		
			mg/kg	Q	PQL
EX-1 (Western half of excavation)	J1FH06	3/1/2011	41.9		8.83
Duplicate of J1FH06	J1FH10	3/1/2011	43.0		7.13

Analysis:

TDL		1
Duplicate Analysis	Both > PQL?	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)
	RPD	2.6%
	Difference > 2 TDL?	Not applicable

Note: Gray cells indicate not applicable.

B = estimated result. Result is less than the RL but greater than the MDL.
HEIS = Hanford Environmental Information System
J = estimated result.
PQL = practical quantitation limit.
Q = qualifier.
RPD = relative percent difference.
TDL = target detection limit

CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 600-178 waste site meets the requirements for the hazard quotients and carcinogenic (excess cancer) risk and RPDs, respectively, as identified in the RDR/RAWP (DOE-RL 2009a) and SAP (DOE-RL 2009b). The hazard quotients and carcinogenic (excess cancer) risk and RPD calculations are for use in the RSVP for this site.

Attachment 1. 600-178 Waste Site Verification Sampling Results (Metals).

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
EX-1 (Western half of excavation)	J1FH06	3/1/2011	6780	J	4.42	0.530	UJ	0.530	2.39		0.883	69.2		0.442	0.244		0.177	1.11	B	1.77
Duplicate of J1FH06	J1FH10	3/1/2011	7220	J	3.56	0.428	UJ	0.428	2.52		0.713	76.1		0.356	0.257		0.143	0.978	B	1.43
EX-2 (Eastern half of excavation)	J1FH07	3/1/2011	7500	J	3.76	0.452	UJ	0.452	3.12		0.753	71.2		0.376	0.264		0.151	1.10	B	1.51
SPA-1	J1FH08	3/1/2011	7560	J	4.53	0.543	UJ	0.543	2.82		0.906	67.6		0.453	0.258		0.181	1.26	B	1.81
OB-1	J1FH09	3/1/2011	6220	J	3.52	0.422	UJ	0.422	2.78		0.704	62.6		0.352	0.230		0.141	0.905	B	1.41
Equipment blank	J1FH11	3/1/2011	247	J	3.63	0.435	UJ	0.435	0.726	U	0.726	2.05		0.363	0.145	U	0.145	1.45	U	1.45

Sample Location	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper			Iron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EX-1 (Western half of excavation)	J1FH06	3/1/2011	0.131	B	0.177	4570	J	88.3	8.28		0.177	9.25		1.77	10.5		0.883	21500		17.7
Duplicate of J1FH06	J1FH10	3/1/2011	0.126	B	0.143	4760	J	71.3	8.58		0.143	6.93		1.43	10.4		0.713	21500		14.3
EX-2 (Eastern half of excavation)	J1FH07	3/1/2011	0.122	B	0.151	4300	J	75.3	7.77		0.151	6.19		1.51	10.1		0.753	22300		15.1
SPA-1	J1FH08	3/1/2011	0.108	B	0.181	4150	J	90.6	8.24		0.181	6.13		1.81	9.75		0.906	20100		18.1
OB-1	J1FH09	3/1/2011	0.121	B	0.141	4560	J	70.4	6.70		0.141	6.56		1.41	9.87		0.704	22500		14.1
Equipment blank	J1FH11	3/1/2011	0.145	U	0.145	41:7	BJ	72.6	0.155		0.145	1.45	U	1.45	0.726	U	0.726	298		14.5

Sample Location	HEIS Number	Sample Date	Lead			Magnesium			Manganese			Molybdenum			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EX-1 (Western half of excavation)	J1FH06	3/1/2011	5.77		0.442	4000		66.3	321		4.42	0.363	B	1.77	8.91		3.53	1400		353
Duplicate of J1FH06	J1FH10	3/1/2011	4.11		0.356	4070		53.5	337		3.56	0.342	B	1.43	8.46		2.85	1480		285
EX-2 (Eastern half of excavation)	J1FH07	3/1/2011	4.07		0.376	3990		56.4	314		3.76	0.351	B	1.51	7.65		3.01	1420		301
SPA-1	J1FH08	3/1/2011	4.07		0.453	3710		67.9	290		4.53	0.335	B	1.81	7.70		3.62	1620		362
OB-1	J1FH09	3/1/2011	3.82		0.352	3840		52.8	307		3.52	0.359	B	1.41	6.93		2.81	1280		281
Equipment blank	J1FH11	3/1/2011	0.403		0.363	25.3	B	54.4	5.49		3.63	1.45	U	1.45	2.90	U	2.90	53.4	B	290

Sample Location	HEIS Number	Sample Date	Selenium			Silicon			Silver			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EX-1 (Western half of excavation)	J1FH06	3/1/2011	0.265	U	0.265	464		1.77	0.177	U	0.177	317		44.2	62.9		2.21	41.9		8.83
Duplicate of J1FH06	J1FH10	3/1/2011	0.214	U	0.214	389		1.43	0.143	U	0.143	342		35.6	59.9		1.78	43.0		7.13
EX-2 (Eastern half of excavation)	J1FH07	3/1/2011	0.226	U	0.226	418		1.51	0.151	U	0.151	307		37.6	61.1		1.88	42.0		7.53
SPA-1	J1FH08	3/1/2011	0.272	U	0.272	471		1.81	0.181	U	0.181	288		45.3	52.1		2.26	38.9		9.06
OB-1	J1FH09	3/1/2011	0.211	U	0.211	323		1.41	0.141	U	0.141	281		35.2	66.0		1.76	43.6		7.04
Equipment blank	J1FH11	3/1/2011	0.218	U	0.218	149		1.45	0.145	U	0.145	7.28	B	36.3	0.367	B	1.81	1.46	B	7.26

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

Gray cells indicate not applicable.

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

B = estimated result, less than the RL but greater than the MDL

D = identified in an analysis at a secondary dilution factor

HEIS = Hanford Environmental Information System

J = estimated

PQL = practical quantitation limit

Q = qualifier

U = undetected

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Attachment 1. 600-178 Waste Site Verification Sample Results (Organics)

Constituent	Class	EX-1 (Western half of excavation)			Duplicate of J1FH06			EX-2 (Eastern half of excavation)			SPA-1			OB-1			Equipment blank		
		J1FH06			J1FH10			J1FH07			J1FH08			J1FH09			J1FH11		
		3/1/2011			3/1/2011			3/1/2011			3/1/2011			3/1/2011			3/1/2011		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Aldrin	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
Alpha-BHC	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
alpha-Chlordane	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
beta-BHC	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
Delta-BHC	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
4,4'-DDD	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
4,4'-DDE	PEST	1.34	UD	1.34	1.31	UD	1.31	13.4	D	1.31	4.68	JD	1.32	7.78	D	1.28			
4,4'-DDT	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.67	JD	1.32	1.52	JD	1.28			
Dieldrin	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
Endosulfan I	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
Endosulfan II	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
Endosulfan sulfate	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
Endrin	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
Endrin aldehyde	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
Endrin ketone	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
Gamma-BHC (Lindane)	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
gamma-Chlordane	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
Heptachlor	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
Heptachlor epoxide	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
Methoxychlor	PEST	1.34	UD	1.34	1.31	UD	1.31	1.31	UD	1.31	1.32	UD	1.32	1.28	UD	1.28			
Toxaphene	PEST	13.4	UDJ	13.4	13.1	UDJ	13.1	13.1	UDJ	13.1	13.2	UDJ	13.2	12.8	UDJ	12.8			

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APPENDIX D

DATA QUALITY ASSESSMENT

APPENDIX D

DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2011b). This DQA was performed in accordance with site specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2009).

A review of the sample design (WCH 2011b), the field logbook (WCH 2011a), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical analysis (BHI 2000) 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 2006).

Verification sample data collected at the 600-178 waste site were provided by the laboratories in sample delivery group (SDG) K3230. SDG K3230 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 600-178 data set, as follows below. If no comments are made about a specific analysis, it should be assumed that no deficiencies affecting the quality of the data were found.

SDG K3230

This SDG comprises five verification soil samples (J1FH06-J1FH10) including a field duplicate pair (J1FH06/J1FH10). These samples were analyzed for inductively coupled plasma (ICP) metals and pesticides. An equipment blank (J1FH11) was analyzed for ICP metals. SDG K3230 was submitted for third-party validation. Minor deficiencies are as follows:

In the ICP metals analysis, all aluminum results were qualified as estimates and flagged "J" due to a laboratory control sample (LCS) analysis above quality control limits at 160%. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries were out of project acceptance criteria for five analytes (aluminum, calcium, iron, manganese, and antimony). For aluminum, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. Antimony and calcium did not have mismatched spike and native concentrations in the original MS. The original MS recoveries for antimony and calcium were

39% and 132%, respectively. All antimony and calcium data for SDG K3230 were considered estimated and flagged "J" by third-party validation due to the MS recoveries outside the quality control (QC) limits. Estimated data are useable for decision-making purposes.

In the pesticides analysis, all of the toxaphene data in SDG K3230 were qualified by third-party validation as estimated with "J" flags, due to lack of an MS, matrix spike duplicate (MSD), and LCS analysis. Estimated, or "J"-flagged, data are acceptable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

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

Field quality assurance (QA)/QC measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples, listed in the field logbook (WCH 2011a), are the excavation primary and duplicate samples (J1FH06/J1FH10). The main and QA/QC sample results are presented in Appendix B.

Field duplicate samples are collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the sample/duplicate pair(s) for each contaminant of potential concern (COPC). RPDs are not calculated for analytes that are not detected in both the main and duplicate sample at more than 5 times the target detection limit (TDL). RPDs of analytes detected at low concentrations (less than 5 times the detection limit) are not considered to be indicative of the analytical system performance. The calculation brief in Appendix B provides details on duplicate pair evaluation and RPD calculation.

No RPDs are above the acceptance criteria of 30%. A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than 5 times the TDL, including undetected analytes. In these cases, a control limit of ± 2 times the TDL is used (Appendix C) to indicate that a visual check of the data is required by the reviewer. No data required this check. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are useable for decision-making purposes.

Summary

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above, are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 600-178 waste site verification sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for 600-178 waste site concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. The analytical data were found acceptable for

decision-making purposes. The verification sample analytical data are stored in the Environmental Restoration (ENRE) project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System (HEIS) database. The verification sample analytical data are also summarized in Appendix C.

REFERENCES

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WCH, 2011a, *IU-2/6 Remaining Sites Sampling and Field Activities*, Logbook EL-1643-04, pp. 35-39, Washington Closure Hanford, Richland, Washington.

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