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

14-AMRP-0083

JAN 09 2014

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

Dear Mr. Faulk:

TRANSMITTAL OF APPROVED WASTE SITE RECLASSIFICATION FORM AND SUPPORTING DOCUMENTATION FOR THE 600-371, SEGMENT 4 CHALKY MATERIAL AREA WASTE SITE, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2013-085 and supporting, "Remaining Sites Verification Package for the 600-371, Segment 4 Chalky Material Area Waste Site," Rev. 0. If you have questions, please contact me or your staff may contact Ellwood Glossbrenner, of my staff, at (509) 376-5828.

Sincerely,

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

AMRC:ETG

Attachment

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

cc w/o attach:
S. L. Feaster, WCH
T. Q. Howell, WCH
D. L. Plung, WCH
J. P. Shearer, CHPRC
C. P. Strand, WCH

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-IU-2 **Control No.:** 2013-085

Waste Site Code(s)/Subsite Code(s):

600-371, Segment 4 Chalky Material Area

Reclassification Category: Interim ☒ Final ☐

Reclassification Status: Closed Out ☒ No Action ☐ Rejected ☐

RCRA Postclosure ☐ Consolidated ☐ None ☐

Approvals Needed: DOE ☒ Ecology ☐ EPA ☒

Description of current waste site condition:

The 600-371, Segment 4 Chalky Material Area waste site is located in the 100-IU-2 Operable Unit of the Hanford Site and consisted of multiple spots within one general area of white chalky substance that resembled either grout or bentonite. The site is located 1.4 km (0.9 mi) east of H Avenue and 240 m (787 feet) west of the Columbia River. The 600-371 waste site was added to 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), as a candidate site for confirmatory sampling in the Fact Sheet *100 Area "Plug-In" and Candidate Waste Sites for Calendar Year 2011*, U.S. Department of Energy, Richland, Washington (DOE-RL 2012). This waste site was subsequently recommended for remove, treat, and dispose (RTD) without confirmatory sampling and is being dispositioned as a "plug-in" site in accordance with 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 (100 Area ESD) (EPA 2009).

Remediation of the 600-371 waste site occurred on July 17 and 18, 2013. The remediation resulted in approximately 97.5 bank cubic meters (127.5 bank cubic yards) of material being removed and disposed at the Environmental Restoration Disposal Facility (ERDF). Cleanup verification sampling was performed on July 23, 2013, to determine if the waste site meets remedial action objectives (RAOs) and remedial action goals (RAGs) established by the Remaining Sites ROD (EPA 1999) and the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP), DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland, Washington (DOE-RL 2009). The selected remedy involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at ERDF at the 200 Area of the Hanford Site, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification as Interim Closed Out.

Basis for reclassification:

Cleanup verification sampling results were evaluated in comparison to the RAGs. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-371 waste site to Interim Closed Out. The current site conditions achieve the RAOs and RAGs established by the Remaining Sites ROD (EPA 1999) and the 100 Area RDR/RAWP (DOE-RL 2009). 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 residual contaminant concentrations meet direct exposure cleanup criteria and are protective of groundwater and the Columbia River. The waste site contamination does not extend into the deep zone soils. 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 600-371, Segment 4 Chalky Material Area Waste Site* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-IU-2 **Control No.:** 2013-085

Waste Site Code(s)/Subsite Code(s):

600-371, Segment 4 Chalky Material Area

Regulator comments:

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:

J. P. Neath		12/12/13
DOE Federal Project Director (printed)	Signature	Date
N/A		
Ecology Project Manager (printed)	Signature	Date
C. Guzzetti		12/18/13
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-371, SEGMENT 4 CHALKY MATERIAL AREA WASTE SITE

Attachment to Waste Site Reclassification Forms 2013-085

December 2013

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-371, SEGMENT 4 CHALKY MATERIAL AREA WASTE SITE

EXECUTIVE SUMMARY

The 600-371 waste site is part of the 100-IU-2 Operable Unit and consisted of an area within which multiple locations of a white chalky substance have been observed. This waste site was added to 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) as a candidate site for confirmatory sampling in the Fact Sheet *100 Area "Plug-In" and Candidate Waste Sites for Calendar Year 2011* (DOE-RL 2012). This waste site was subsequently recommended for remove, treat, and dispose without confirmatory sampling based on the observed presence of white chalky material at this site to be dispositioned as a "plug-in" site in accordance with the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (100 Area ESD) (EPA 2009).

Remediation of the 600-371 waste site occurred on July 17 and 18, 2013, and resulted in approximately 97.5 bank cubic meters (127.5 bank cubic yards) of soil and debris being removed for disposal at the Environmental Restoration Disposal Facility. No overburden soil was stockpiled to be used as backfill. Following remediation, verification sampling was performed for the 600-371 waste site on July 23, 2013. These results indicated that residual contaminant concentrations met the remedial action objectives and remedial action goals for the 600-371 waste site.

A summary of the cleanup evaluation for the soil results compared to the applicable cleanup criteria is presented in Table ES-1. The results of the verification sampling are used to make reclassification decisions for the waste site in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011).

In accordance with this evaluation, the verification sampling results support a reclassification of the 600-371 waste 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). 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 600-371 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.

Table ES-1. Summary of Remedial Action Goals for the 600-371 Waste Site.

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain dose rate of <15-mrem/yr above background over 1,000 years.	Radionuclides were not COPCs for the 600-371 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 quotient for boron, the only constituent detected above background levels, is <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient for boron, the only contaminant detected above background levels, is (6.5×10^{-4}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	No carcinogenic constituents met the criteria for evaluation; therefore, no calculations of excess carcinogenic risk were performed.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	No carcinogenic constituents met the criteria for evaluation; therefore, no calculations of excess carcinogenic risk were performed.	
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not COPCs for the 600-371 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.	No residual concentrations of contaminants exceeded the soil RAGs for the protection of groundwater and/or the Columbia River. Therefore, residual concentrations achieve the remedial action objectives for groundwater and river protection.	Yes

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* [CFR] 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
NA = not applicable
RAG = remedial action goal

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 concern, contaminants of potential concern, and other constituents. Those constituents exceeding the ecological screening level in *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were boron and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for manganese and vanadium. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because the detected levels of manganese and vanadium are below Hanford Site background levels, it is believed that the presence of these constituents does not pose a risk to ecological receptors. 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 600-371, SEGMENT 4 CHALKY MATERIAL AREA WASTE SITE

STATEMENT OF PROTECTIVENESS

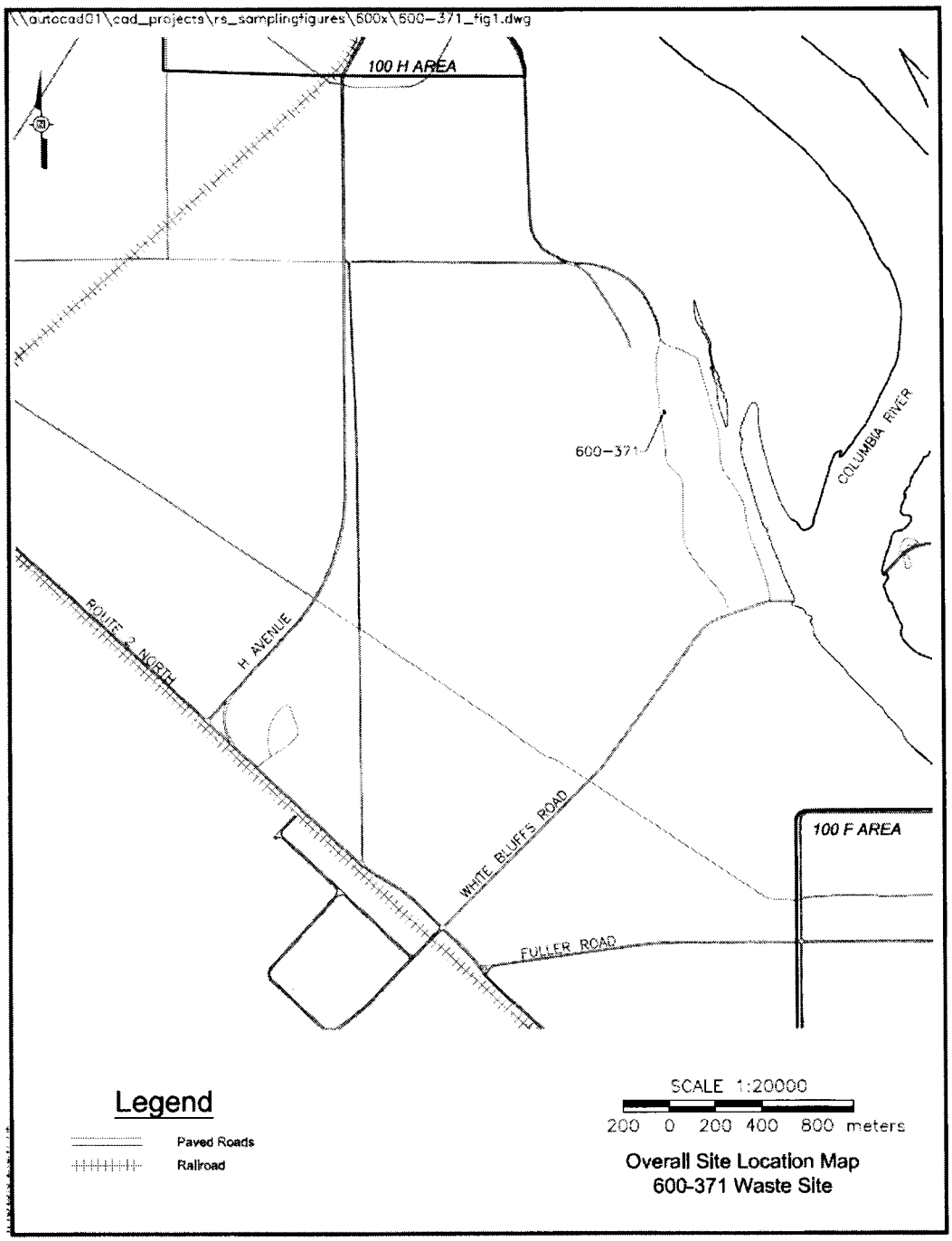
The 600-371, Segment 4 Chalky Material Area verification sampling data, site evaluations, and supporting documentation demonstrate that the waste site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the *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. Contamination from the 600-371 waste site 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.

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 concern, contaminants of potential concern (COPCs), and other constituents. Those constituents exceeding the ecological screening level in *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were boron and vanadium. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for manganese and vanadium. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because the detected levels of manganese and vanadium are below Hanford Site background levels, it is believed that the presence of these constituents does not pose a risk to ecological receptors. 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.

GENERAL SITE INFORMATION AND BACKGROUND

The 600-371 waste site is located within the 100-IU-2 Operable Unit. The 600-371 waste site is reported in the *100-F/IU-2/IU-6 Area – Segment 4 Orphan Sites Evaluation Report* (WCH 2011), under OSE identification number SG4-143, as consisting of a 4.6-m (15-ft)-diameter area of white chalky substance in multiple locations that appears to be either grout or bentonite. There is no process history associated with the 600-371 waste site. The site is located 1.4 km (0.9 mi) east of H Avenue and 240 m (787 ft) west of the Columbia River, centered at Washington State Plane coordinates N 150280.0, E 579060.7 (Figure 1).

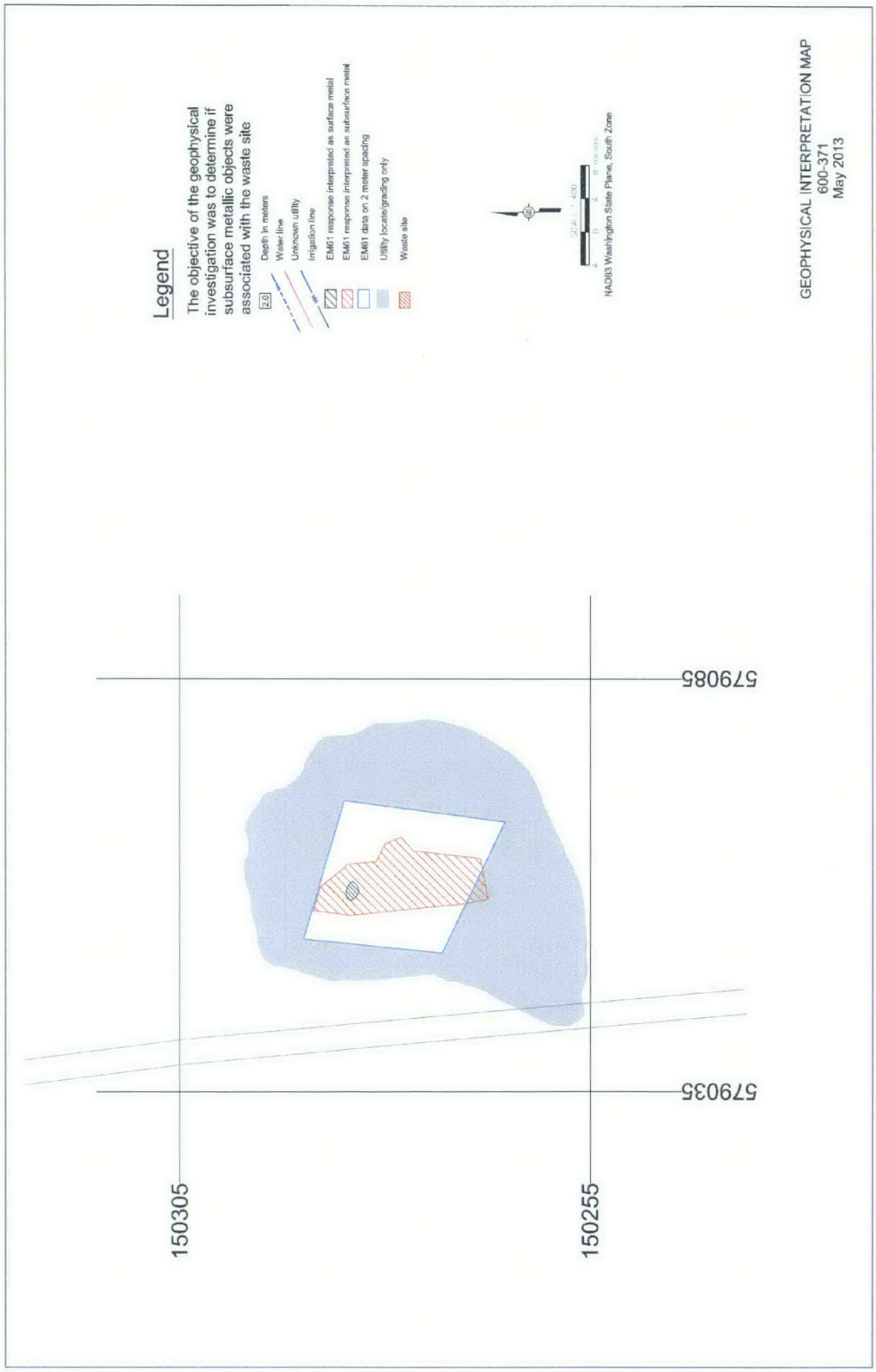
Figure 1. The 600-371 Waste Site Location Map.



Geophysical Survey

The objective of the geophysical survey was to determine if any utilities were located in the area of the 600-371 waste site. The geophysical interpretation map is included in Figure 2. No geophysical anomalies or utility lines were identified by the geophysical investigation.

Figure 2. Geophysical Interpretation Map for the 600-371 Waste Site.



Waste Characterization Sampling

Waste characterization sampling was performed for waste disposal purposes. The resulting data was used to support the determination of the contaminants of potential concern for 600-371 waste site waste and to guide remedial efforts. The waste characterization sample summary is provided in Table 1 and the sampling data is included in Appendix A.

Table 1. 600-371 Waste Characterization Soil Samples.

Location	HEIS Sample Number	Sample Date
600-371 WC	J1RD42	1/23/2013
600-371 WC	J1RD43	1/23/2013

HEIS = Hanford Environmental Information System
WC = waste characterization

REMEDIAL ACTION SUMMARY

The 600-371 waste site was recommended for remediation without confirmatory sampling based on the observed presence of stained soils, stressed vegetation, and barren ground at this site (WCH 2013a).

Remedial Action

Remediation of the 600-371 waste site occurred on July 17 and 18, 2013, and resulted in approximately 97.5 bank cubic meters (127.5 bank cubic yards) of soil and debris being removed for disposal at the Environmental Restoration Disposal Facility. Waste materials included white chalky substance from the surface of the waste site and the underlying soil. All waste site materials were direct loaded, and no soil staging pile area or overburden areas were utilized. The waste site was excavated to an approximate depth of 0.6 m (2 ft). Photographs of the 600-371 waste site excavation are included in Figures 3 and 4.

VERIFICATION SAMPLING ACTIVITIES

Verification sampling was performed at the 600-371 waste site on July 23, 2013. Sampling was conducted to support a determination that residual contaminant concentrations in the soil meet cleanup criteria specified in the 100 Area RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999).

The verification sample results are provided in Appendix B and indicate that the waste removal action achieved compliance with the remedial action objectives and remedial action goals (RAGs) for the 600-371 waste site. The following subsections provide additional discussion of the information used to develop the verification sampling design. The maximum results of verification sampling are summarized to support interim closure of the site.

Figure 3. Photograph of the 600-371 Waste Site Excavation - Looking South (July 22, 2013).

Figure 4. Photograph of the 600-371 Waste Site Excavation (July 23, 2013).

A more detailed discussion of the verification sampling can be found in the *Work Instruction for Verification Sampling of the Combined 600 Area Waste Sites; 600-368, 600-369, 600-370, 600-371, 600-372, 600-373, 600-374, 600-375, 600-376, 600-377, 600-379* (WCH 2013c).

Contaminants of Potential Concern

The COPCs identified for the 600-371 waste site were based on field observations and the waste site description, the results of waste characterization sampling, and professional judgment. The technical basis for the COPC determination at the 600-371 waste site is detailed in Table 2. Analytes that were detected near or above RAGs during waste characterization sampling (Appendix A) were included as COPCs for verification sampling. The COPCs for verification sampling and the laboratory analytical methods are identified in Table 3.

Table 2. Verification Sampling Contaminants of Potential Concern.

Site Description	Suggested COPCs in RTD Memo	Waste Characterization Analysis	Constituents Above Direct Exposure	Constituents Above Groundwater and River Protection	Other COPCs to Consider	COPCs for Verification Sampling
600-371, Segment 4 Chalky Material Area						
Multiple locations within one general area containing white chalky substance that resembles either grout or bentonite	ICP metals and SVOCs	ICP metals, mercury	None	None	SVOCs	ICP metals, SVOCs

COPC = contaminant of potential concern
ICP = inductively coupled plasma
RTD = remove, treat, and dispose
SVOC = semivolatile organic compound

Table 3. 600-371 Laboratory Analytical Methods.

Analytical Method	Contaminant of Potential Concern
ICP metals [a] – EPA Method 6010	Metals [a]
Mercury – EPA Method 7471	Mercury
SVOA – EPA Method 8270	Semivolatile organic compounds

[a] The expanded list of ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc in the analytical results package.

EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma
SVOA = semivolatile organic analysis

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. All sampling was performed in accordance with the *100 Area Remedial Action Sampling and Analysis Plan* (100 Area SAP) (DOE-RL 2009a). The number of composite samples was determined based on the size of the remediated area of the waste site in accordance with Table 4.

Table 4. Verification Sampling Design Based on Waste Site Surface Area.

Surface Area	Sample Design
<100 m^2	One composite sample
100 - 500 m^2	Two composite samples (halves)
500 - 1000 m^2	Four composite samples (quadrants)
>1,000 m^2	Statistical design using Visual Sample Plan

Table 5 includes the estimated waste site dimensions from the verification sampling instruction, (WCH 2013c) as well as the actual dimensions of the waste site following remediation and the number of samples to be collected. The 600-371 waste site remediation was larger than originally estimated; therefore, additional composite samples were added to the sample design.

Table 5. Waste Site Dimension Information.

Waste Site	Site Description	Washington State Plane Coordinates		Estimated Remediation Dimensions L x W x D (m)	Estimated Surface Area (m^2)	Actual Remediation Dimensions L x W x D (m)	Actual Surface Area (m^2)	Actual Sample Design
		Northing	Easting					
600-371, Segment 4 Chalky Material Area								
600-371	Multiple locations within one general area containing white chalky substance that resembles either grout or bentonite	150280.0	579060.73	21 x 8 x 1	168	12 x 42 x 1	504	Four composites

The original sample design (WCH 2013c) identified two composite samples based on the estimated remediation dimensions. However, remediation of the white chalky substance increased these dimensions from two composite samples to four. Figure 5 shows the waste site excavation footprints and the sampling locations. All sampling was performed in accordance with ENV-1, *Environmental Monitoring & Management*, to fulfill the requirements of the 100 Area SAP (DOE-RL 2009a). Additional information related to verification sampling can be found in the field sampling logbook (WCH 2013b). A summary of the verification samples collected and laboratory analyses performed is provided in Table 6.

Figure 5. The 600-371 Waste Site Post-Excavation Boundary With Verification Sampling Locations.

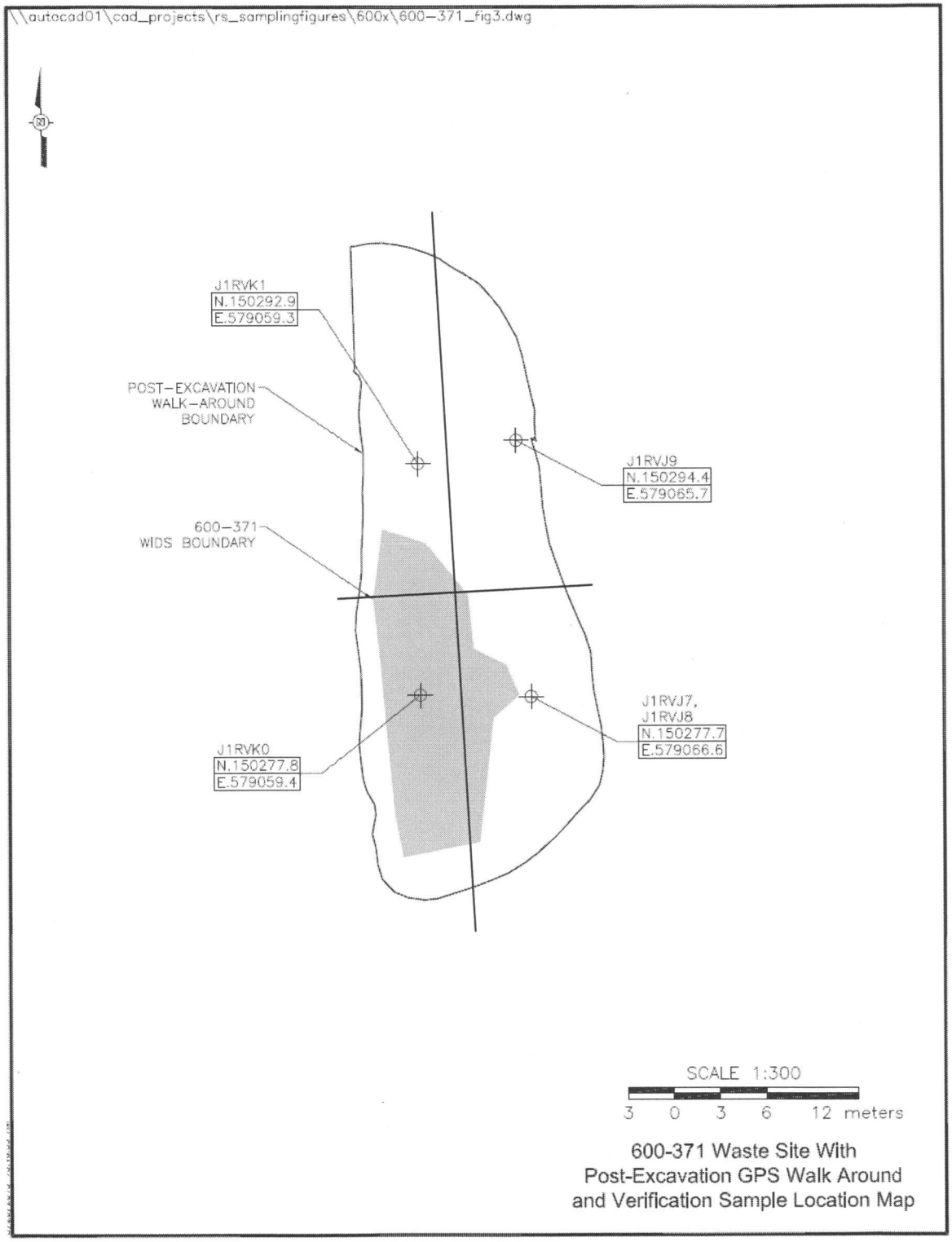


Table 6. Sample Summary Table for the 600-371 Waste Site.

Sample Location	HEIS Number	Sample Analysis
600-371, southeast quadrant	J1RVJ7	ICP metals, mercury, SVOCs
600-371, northeast quadrant	J1RVJ9	
600-371, southwest quadrant	J1RVK0	
600-371, northwest quadrant	J1RVK1	
Duplicate of J1RVJ7	J1RVJ8	
Equipment blank	J1RVJ6	ICP metals [a], mercury

[a] Analysis for the expanded list of ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc in the analytical results package.

HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
SVOC = semivolatile organic compound

Verification Sample Results

All verification samples were analyzed using analytical methods approved by EPA (DOE-RL 2009b). Evaluation of the verification data from the 600-371 waste site was performed by direct comparison of the maximum sample results for each COPC against cleanup criteria. The *600-371 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation* is provided in Appendix B.

Comparisons of the results for site COPCs with the RAGs for the 600-371 decision unit are listed in Table 7. Contaminants that were not detected by laboratory analysis are excluded from this table. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2011) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A)* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered site COPCs and are also not included in this table. The laboratory-reported data results for all constituents are stored in a Washington Closure Hanford (WCH) project-specific database prior to archival in the Hanford Environmental Information System, and are presented in the calculations (Appendix B).

Table 7. Comparison of Maximum Contaminant Concentrations to Remedial Action Goals for the 600-371 Excavation Verification Sampling Data.

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	4.17 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	65.6 (<BG)	5,600	200	400	No	--
Beryllium	0.282 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	4.66	7,200	320	-- [e]	No	--
Cadmium [f]	0.314 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium (total)	10.8 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Cobalt	5.82 (<BG)	24	15.7 [b]	-- [e]	No	--
Copper	10.2 (<BG)	2,960	59.2	22.0 [b]	No	--
Lead	8.16 (<BG)	353	10.2 [b]	10.2 [b]	No	--
Manganese	250 (<BG)	3,760	512 [b]	512 [b]	No	--
Mercury	0.00411 (<BG)	24	0.33	0.33	No	--
Nickel	10.0 (<BG)	1,600	19.1 [b]	27.4	No	--
Silver	0.285 (<BG)	400	8	0.73	No	--
Vanadium	46.7 (<BG)	560	85.1 [b]	-- [e]	No	--
Zinc	36.1 (<BG)	24,000	480	67.8 [b]	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).

[b] Where cleanup levels are less than background, cleanup levels default to background per 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 100 Area RDR/RAWP (DOE-RL 2009b).

[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 2011) 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. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity
WAC = *Washington Administrative Code*

VERIFICATION SAMPLE DATA EVALUATION

This section demonstrates that contaminant concentrations at the 600-371 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 100 Area RDR/RAWP (DOE-RL 2009b).

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

Evaluation of the verification sampling results in Table 7 shows that all direct exposure, groundwater protection, and Columbia River protection RAGs are met for the 600-371 waste site.

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 600-371 waste site was determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix B).

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 600-371 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.

The hazard quotient for boron, the only constituent detected above background levels, is 6.5×10^{-4}, which is less than 1.0. No carcinogenic constituents met the criteria for evaluation of direct exposure at the 600-371 waste site; therefore, no calculations of excess carcinogenic risk were performed. Thus, the individual contaminant carcinogenic risk requirement of less than 1×10^{-6} is met and the cumulative carcinogenic risk of less than 1×10^{-5} is met. The 600-371 waste site meets the requirements for the direct contact hazard quotient and excess carcinogenic risk as identified in the 100 Area RDR/RAWP (DOE-RL 2009b). Calculation of the 600-371 waste site direct contact hazard quotient and carcinogenic risk is presented in Appendix B.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach (WCH 2013c), the field logbooks (WCH 2013b), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 600-371 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 a WCH project-specific database for data evaluation prior to archival in the Hanford Environmental Information System and are summarized in an attachment to the relative percent difference calculation in Appendix B. The detailed DQA is presented in Appendix C.

SUMMARY FOR INTERIM CLOSURE

The 600-371 waste site has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the 100 Area RDR/RAWP (DOE-RL 2009b). Verification sampling was performed, and the analytical results indicate that the residual concentrations of COPCs at this site meet the RAGs and associated remedial action objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-371 waste site to Interim Closed Out. The 600-371 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.

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APPENDIX A

WASTE CHARACTERIZATION SAMPLING RESULTS

Table A-1. 600-371 Waste Site Characterization Data - Metals. (1 Page)

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-371	J1RD42	1/23/13	8440		16.0	1.92	U	1.92	8.88		3.2	105		1.6
600-371	J1RD43	1/23/13	1610		52.6	2.63	U	2.63	1.53	B	2.63	19.0		1.32

Sample Location	HEIS Number	Sample Date	Beryllium			Boron			Cadmium			Calcium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-371	J1RD42	1/23/13	0.273	B	0.64	5.27	B	6.4	0.64	U	0.64	111000		320
600-371	J1RD43	1/23/13	0.526	U	0.526	3.87	B	5.26	0.234	B	0.658	168000		211

Sample Location	HEIS Number	Sample Date	Chromium			Cobalt			Copper			Iron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-371	J1RD42	1/23/13	11.7		0.64	4.15	B	6.4	17.9		3.2	15000		64.0
600-371	J1RD43	1/23/13	2.09	B	2.63	7.89	U	7.89	4.11	B	5.26	2990		52.6

Sample Location	HEIS Number	Sample Date	Lead			Magnesium			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-371	J1RD42	1/23/13	6.52		1.6	4410		240	219		16.0	0.0324	U	0.0324
600-371	J1RD43	1/23/13	2.78		2.63	959		13.2	55.0		2.63	0.0281	U	0.0281

Sample Location	HEIS Number	Sample Date	Molybdenum			Nickel			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-371	J1RD42	1/23/13	1.11	B	6.4	10.0	B	12.8	1560		1280	0.96	U	0.96
600-371	J1RD43	1/23/13	2.63	U	2.63	1.9	B	6.58	480		263	2.63	U	2.63

Sample Location	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-371	J1RD42	1/23/13	236		6.4	0.64	U	0.64	245		160	37.4		8.0
600-371	J1RD43	1/23/13	404		15.8	2.63	U	2.63	101	B	132	8.15		2.63

Sample Location	HEIS Number	Sample Date	Zinc		
			mg/kg	Q	PQL
600-371	J1RD42	1/23/13	54.2		32.0
600-371	J1RD43	1/23/13	24.4		7.89

APPENDIX B

CALCULATIONS

APPENDIX B

CALCULATIONS

The calculations in this appendix are kept in the active Washington Closure Hanford project files and are available upon request. When the project is completed, the files will be stored in a U.S. Department of Energy, Richland Operations Office, repository. The calculations have been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculation," Washington Closure Hanford, Richland, Washington. The following calculations are provided in this appendix:

600-371 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation, 0600X-CA-V0148, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

The calculations provided in this appendix have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents.

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 600 Area

Discipline: Environmental Calculation No: 0600X-CA-V0148

Subject: 600-371 Waste Site 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 = 4 Attachment 1 = 3 Total = 8	I. B. Berezovskiy IB Berezovskiy	N. K. Schiffern N K Schiffern	C. H. Dobie C H Dobie	D. F. Obenauer D. F. Obenauer	12/3/13

SUMMARY OF REVISION

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

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	9/3/2013	Calc. No.:	0600X-CA-V0148	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	9/3/2013
Subject:	600-371 Waste Site RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 4	

PURPOSE:

Using sample data from Attachment 1, provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 600-371 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009b), 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 pair from 600-371 waste site verification sampling, as necessary.

GIVEN/REFERENCES:

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

2) DOE-RL, 2009b, *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.

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, 2013, *Remaining Sites Verification Package for the 600-371, Segment 4 Chalky Material Area Waste Site,* Attachment to Waste Site Reclassification Form 2013-085, 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 2009b).

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 2009b).

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	9/3/2013	Calc. No.:	0600X-CA-V0148	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	9/3/2013
Subject:	600-371 Waste Site RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 4	

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 Attachment 1 to perform the RPD calculations for primary-duplicate sample pairs, as required.

METHODOLOGY:

The 600-371 waste site underwent composite sampling. Four samples and one duplicate were collected from the 600-371 waste site. The direct contact hazard quotient and carcinogenic risk calculations for the 600-371 waste site were conservatively calculated using the greatest of the maximum soil sample results from Attachment 1. Of the contaminants of potential concern (COPCs) for this site, boron requires HQ and risk calculations because it was 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 4.66 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 6.5×10^{-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 6.5×10^{-4}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, then multiplied by 1.0×10^{-6}. No carcinogenic constituents met the criteria for evaluation in direct exposure at the 600-371 waste site; therefore, no calculations of excess carcinogenic risk were performed. The requirement of $<1 \times 10^{-6}$ is met.

4) The cumulative excess cancer risk can be obtained by summing the individual values. The sum of the excess cancer risk values is zero. Comparing this value 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 2009a). 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:

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

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	9/3/2013	Calc. No.:	0600X-CA-V0148	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	9/3/2013
Subject:	600-371 Waste Site RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 4	

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 the verification sampling of the subject site. Additional discussion is provided in the data quality assessment section of the applicable RSVP (WCH 2013), 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 for the 600-371 waste site.

5) The evaluation of the QA/QC duplicate RPD calculations are performed within the data quality assessment section of the RSVP.

Table 2 shows the results of the RPD calculations for the 600-371 waste site.

Table 1. Direct Contact HQ and Excess Cancer Risk Results for the 600-371 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	4.66	7,200	6.5E-04	--	--
Totals					
Cumulative Hazard Quotient:			**6.5E-04**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:

[a] = From Attachment 1.

[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:	9/3/2013	Calc. No.:	0600X-CA-V0148	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	9/3/2013
Subject:	600-371 Waste Site RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 4 of 4	

Table 2. Relative Percent Difference Calculations for the 600-371 Waste Site.

600-371 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SE Quadrant	J1RVJ7	7/23/13	5660	NJ	6.74	4.17		0.495	56.3		0.0991	0.263	B	0.099	3.80	B	0.991
Duplicate of J1RVJ7	J1RVJ8	7/23/13	5610	NJ	6.16	3.51		0.453	56.9		0.0905	0.266	B	0.091	2.27	B	0.905

Analysis:

TDL		5	10	2	0.2	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	0.9%		1.1%		
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable

600-371 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SE Quadrant	J1RVJ7	7/23/13	0.217	B	0.0991	4640		7.92	10.8		0.149	5.81	D	1.49	9.85		0.297
Duplicate of J1RVJ7	J1RVJ8	7/23/13	0.186	B	0.0905	4760		7.24	9.56		0.136	5.67	D	1.36	10.2		0.272

Analysis:

TDL		0.2	100	1	2	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		2.6%	12.2%		3.5%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable

600-371 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese			Nickel		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SE Quadrant	J1RVJ7	7/23/13	17300	NJ	7.92	7.35	BD	3.27	3770		8.42	245		0.198	10.3		0.149
Duplicate of J1RVJ7	J1RVJ8	7/23/13	16900	NJ	7.24	6.80	BD	2.99	3520		7.70	232		0.181	9.17		0.136

Analysis:

TDL		5	5	75	5	4
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	2.3%		6.9%	5.5%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable

600-371 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Potassium			Silicon			Silver			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SE Quadrant	J1RVJ7	7/23/13	1500		6.34	427	MN	1.49	0.206	B	0.0991	114		6.93	42.8	D	0.991
Duplicate of J1RVJ7	J1RVJ8	7/23/13	1410		5.80	314	MN	1.36	0.214	B	0.0905	135		6.34	44.5	D	0.905

Analysis:

TDL		400	2	0.2	50	2.5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		30.5%			3.9%
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable

600-371 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Zinc		
			mg/kg	Q	PQL
SE Quadrant	J1RVJ7	7/23/13	35.4	D	3.96
Duplicate of J1RVJ7	J1RVJ8	7/23/13	35.0	D	3.62

Analysis:

TDL		1.0
Duplicate Analysis	Both > PQL?	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)
	RPD	1.1%
	Difference > 2 TDL?	Not applicable

CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 600-371 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 2009b) and SAP (DOE-RL 2009a). The hazard quotients and carcinogenic (excess cancer) risk and RPD calculations are for use in the RSVP for this site.

Attachment 1. 600-371 Waste Site Verification Sample Results (Metals).

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SE Quadrant	J1RVJ7	7/23/13	5660	NJ	6.74	3.27	DU	3.27	4.17		0.495	56.3		0.0991	0.263	B	0.0991	3.80	B	0.991	0.217	B	0.0991
Duplicate of J1RVJ7	J1RVJ8	7/23/13	5610	NJ	6.16	2.99	DU	2.99	3.51		0.453	56.9		0.0905	0.266	B	0.0905	2.27	B	0.905	0.186	B	0.0905
NE Quadrant	J1RVJ9	7/23/13	5530	NJ	6.34	3.07	DU	3.07	3.84		0.466	65.6		0.0932	0.273	B	0.0932	4.66		0.932	0.314	B	0.0932
SW Quadrant	J1RVK0	7/23/13	5720	NJ	6.63	3.22	DU	3.22	3.79		0.488	58.7		0.0976	0.279	B	0.0976	3.25	B	0.976	0.238	B	0.0976
NW Quadrant	J1RVK1	7/23/13	5950	NJ	6.63	3.22	DU	3.22	3.62		0.487	59.0		0.0975	0.282	B	0.0975	2.99	B	0.975	0.264	B	0.0975
Equipment Blank	J1RVJ6	7/23/13	143	NJ	6.67	0.324	U	0.324	0.490	U	0.490	2.04		0.0980	0.0980	U	0.0980	0.980	U	0.980	0.0980	U	0.0980

Sample Location	HEIS Number	Sample Date	Calcium			Chromium			Cobalt			Copper			Iron			Lead			Magnesium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SE Quadrant	J1RVJ7	7/23/13	4640		7.92	10.8		0.149	5.81	D	1.49	9.85		0.297	17300	NJ	7.92	7.35	BD	3.27	3770		8.42
Duplicate of J1RVJ7	J1RVJ8	7/23/13	4760		7.24	9.56		0.136	5.67	D	1.36	10.2		0.272	16900	NJ	7.24	6.80	BD	2.99	3520		7.70
NE Quadrant	J1RVJ9	7/23/13	11300		7.45	10.2		0.140	5.36	D	1.40	9.69		0.280	16900	NJ	7.45	8.16	BD	3.07	3480		7.92
SW Quadrant	J1RVK0	7/23/13	5370		7.81	10.2		0.146	5.82	D	1.46	9.94		0.293	17400	NJ	7.81	5.79	BD	3.22	3710		8.29
NW Quadrant	J1RVK1	7/23/13	2910		7.80	10.4		0.146	5.73	D	1.46	9.67		0.292	17600	NJ	7.80	6.64	BD	3.22	3410		8.28
Equipment Blank	J1RVJ6	7/23/13	40.8		7.84	0.194	B	0.147	0.149	B	0.147	0.294	U	0.294	282	NJ	7.84	0.742	BCUJ	0.324	20.5	B	8.33

Sample Location	HEIS Number	Sample Date	Manganese			Mercury			Molybdenum			Nickel			Potassium			Selenium			Silicon		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SE Quadrant	J1RVJ7	7/23/13	245		0.198	0.00413	U	0.00413	0.198	U	0.198	10.3		0.149	1500		6.34	0.495	U	0.495	427	MNJ	1.49
Duplicate of J1RVJ7	J1RVJ8	7/23/13	232		0.181	0.00404	U	0.00404	0.181	U	0.181	9.17		0.136	1410		5.80	0.453	U	0.453	314	MNJ	1.36
NE Quadrant	J1RVJ9	7/23/13	242		0.186	0.00411	B	0.00405	0.186	U	0.186	8.32		0.140	1540		5.96	0.466	U	0.466	560	MNJ	1.40
SW Quadrant	J1RVK0	7/23/13	248		0.195	0.00396	U	0.00396	0.195	U	0.195	10.0		0.146	1330		6.24	0.488	U	0.488	279	MNJ	1.46
NW Quadrant	J1RVK1	7/23/13	250		0.195	0.00398	U	0.00398	0.195	U	0.195	8.86		0.146	1370		6.24	0.487	U	0.487	345	MNJ	1.46
Equipment Blank	J1RVJ6	7/23/13	7.61		0.196	0.00383	U	0.00383	0.196	U	0.196	0.246	B	0.147	51.6		6.28	0.490	U	0.490	183	MNJ	1.47

Sample Location	HEIS Number	Sample Date	Silver			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SE Quadrant	J1RVJ7	7/23/13	0.206	B	0.0991	114		6.93	42.8	D	0.991	35.4	D	3.96
Duplicate of J1RVJ7	J1RVJ8	7/23/13	0.214	B	0.0905	135		6.34	44.5	D	0.905	35.0	D	3.62
NE Quadrant	J1RVJ9	7/23/13	0.163	B	0.0932	106		6.52	46.7	D	0.932	36.1	D	3.73
SW Quadrant	J1RVK0	7/23/13	0.144	B	0.0976	128		6.83	45.2	D	0.976	34.2	D	3.90
NW Quadrant	J1RVK1	7/23/13	0.285	B	0.0975	116		6.82	45.7	D	0.975	33.8	D	3.90
Equipment Blank	J1RVJ6	7/23/13	0.0980	U	0.0980	9.02	B	6.86	0.327	B	0.0980	1.33	CUJ	0.392

Acronyms and notes apply to all of the tables in this attachment.
Note: Data qualified with B, C, D, J, M and/or N are considered acceptable values.
B = estimated (inorganic)
C = detected in both the sample and the QC blank, and the concentration was <= 5X the blank concentration.
D = results are reported from a dilution
HEIS=Hanford Environmental Information System
J = estimated
M = sample duplicate
N = recovery exceeds

PQL = practical quantitation limit
Q = qualifier
SVOA = semivolatile organic analysis
U = undetected
UJ = undetected, and due to a minor QC deficiency, the associated quantification limit is an estimate.

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Attachment 1. 600-371 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1RVJ7, SE Quadrant			J1RVJ8, Duplicate of J1RVJ7			J1RVJ9, NE Quadrant			J1RVK0, SW Quadrant			J1RVK1, NW Quadrant		
		07/23/13			07/23/13			07/23/13			07/23/13			07/23/13		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
1,2-Dichlorobenzene	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
1,3-Dichlorobenzene	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
1,4-Dichlorobenzene	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
2,4,5-Trichlorophenol	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
2,4,6-Trichlorophenol	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
2,4-Dichlorophenol	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
2,4-Dimethylphenol	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
2,4-Dinitrophenol	SVOA	685	UJ	103	687	UJ	103	683	UJ	102	681	UJ	102	673	UJ	101
2,4-Dinitrotoluene	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
2,6-Dinitrotoluene	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
2-Chloronaphthalene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
2-Chlorophenol	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
2-Methylnaphthalene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
2-Methylphenol (cresol, o-)	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
2-Nitroaniline	SVOA	343	U	113	343	U	113	342	U	113	340	U	112	336	U	111
2-Nitrophenol	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
3,3'-Dichlorobenzidine	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
3+4 Methylphenol (cresol, m+p)	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
3-Nitroaniline	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
4,6-Dinitro-2-methylphenol	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
4-Bromophenylphenyl ether	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
4-Chloro-3-methylphenol	SVOA	343	U	137	343	U	137	342	U	137	340	U	136	336	U	135
4-Chloroaniline	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
4-Chlorophenylphenyl ether	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
4-Nitrophenol	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Acenaphthene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Acenaphthylene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Anthracene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Benzo(a)anthracene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Benzo(a)pyrene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Benzo(b)fluoranthene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Benzo(ghi)perylene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1

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Attachment 1. 600-371 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1RVJ7, SE Quadrant			J1RVJ8, Duplicate of J1RVJ7			J1RVJ9, NE Quadrant			J1RVK0, SW Quadrant			J1RVK1, NW Quadrant		
		07/23/13			07/23/13			07/23/13			07/23/13			07/23/13		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Benzo(k)fluoranthene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Bis(2-chloro-1-methylethyl)ether	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Bis(2-Chloroethoxy)methane	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Bis(2-chloroethyl) ether	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Bis(2-ethylhexyl) phthalate	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Butylbenzylphthalate	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Carbazole	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Chrysene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Dibenz[a,h]anthracene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Dibenzofuran	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Diethylphthalate	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Dimethyl phthalate	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Di-n-butylphthalate	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Di-n-octylphthalate	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Diphenylamine	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Fluoranthene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Fluorene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Hexachlorobenzene	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Hexachlorobutadiene	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Hexachlorocyclopentadiene	SVOA	343	UJ	103	343	UJ	103	342	UJ	102	340	UJ	102	336	UJ	101
Hexachloroethane	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Indeno(1,2,3-cd)pyrene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Isophorone	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Naphthalene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Nitrobenzene	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
N-Nitroso-di-n-dipropylamine	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Pentachlorophenol	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Phenanthrene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1
Phenol	SVOA	343	U	103	343	U	103	342	U	102	340	U	102	336	U	101
Pyrene	SVOA	34.3	U	10.3	34.3	U	10.3	34.2	U	10.2	34.0	U	10.2	33.6	U	10.1

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APPENDIX C

DATA QUALITY ASSESSMENT

APPENDIX C

DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING DATA QUALITY ANALYSIS

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 2013b). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (100 Area SAP) (DOE-RL 2009).

A review of the sample design (WCH 2013b), the field logbooks (WCH 2013a), 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 100 Area 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 600-371waste site were provided by the laboratory in sample delivery group (SDG): SDG XP0001. This SDG was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 600-371 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 XP0001

This SDG comprises four composite soil samples (J1RVJ7, J1RVJ9, J1RVK0, and J1RVK1) collected from the 600-371 waste site excavation. This SDG includes one field duplicate pair (J1RVJ7/J1RVJ8). These samples were analyzed for inductively coupled plasma (ICP) metals, mercury, and semivolatile organic compounds (SVOCs). In addition, a field equipment blank sample (J1RVJ6) was collected and analyzed for ICP metals and mercury. SDG XP0001 was submitted for third-party validation. Minor deficiencies are as follows.

In the ICP metals analysis, lead and zinc were detected in the method blank (MB). Due to MB contamination, third-party validation qualified all lead and zinc results in equipment blank sample J1RVJ6 as undetected with "UJ" flags. The data are usable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries are out of project acceptance criteria for three analytes (aluminum, iron, and silicon). The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample.

Aluminum (172%), iron (184%), and silicon (139%) did not have mismatched spike and native concentrations in the MS. All aluminum, iron, and silicon results for SDG XP0001 were qualified as estimated by third-party validation with "J" flags. Estimated data are usable for decision-making purposes.

In the SVOC analysis, the matrix spike duplicate analysis for hexachlorocyclopentadiene is slightly below the project acceptance criteria at 49.2%. Third-party validation qualified all hexachlorocyclopentadiene results as estimates with "J" flags. Estimated data are usable for decision-making purposes.

In the SVOC analysis, the laboratory control sample is below the project quality control (QC) limits for 2,4-dinitrophenol (21.3%) and hexachlorocyclopentadiene (48.4%). All 2,4-dinitrophenol and hexachlorocyclopentadiene results for SDG XP0001 were qualified as estimates by third-party validation with "J" flags. Estimated data are usable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

Relative percent difference 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 2013a), are the 600-371 primary and duplicate samples (J1RVJ7/J1RVJ8). 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 relative percent difference (RPD) of the sample/duplicate pair(s) for each contaminant of potential concern. Relative percent differences are not calculated for analytes that are not detected in both the main and duplicate sample at more than five times the target detection limit (TDL). Relative percent differences of analytes detected at low concentrations (less than five 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.

The RPD for silicon (30.5%) is 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 five times the TDL, including undetected analytes. In these cases, a control limit of ±2 times the TDL is used (Appendix B) to indicate that a visual check of the data is required by the reviewer. None of the 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 usable 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 600-371 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 600-371 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 project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database. The verification sample analytical data are also summarized in Appendix B.

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WCH, 2013b, *Work Instruction for Verification Sampling of the Combined 600 Area Waste Sites, 600-368, 600-369, 600-370, 600-371, 600-372, 600-373, 600-374, 600-375, 600-376, 600-377, 600-379,* 0600X-WI-G0074, Rev. 0, Washington Closure Hanford, Richland, Washington.