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CVP-2014-00003
Rev. 0

Cleanup Verification Package for the 600-331, Lime Sulfur Barrel Waste Site

Prepared for the U.S. Department of Energy by Washington Closure Hanford

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EXECUTIVE SUMMARY

This cleanup verification package documents completion of remedial action for the 600-331 waste site. The 600-331 waste site is located in the 100-IU-6 Operable Unit in the 600 Area of the Hanford Site in southeastern Washington State.

The 600-331 waste site was the previous location of a lime sulfur barrel that had deteriorated and collapsed, spilling the contents on the ground. The lime sulfur was used to treat fruit trees for powdery mildew. The site was initially remediated in 1997 (Waste Information Data System site UPR-600-19); however, subsequent sample data indicated that high levels of arsenic and lead remained in the soil at this waste site. In 2009, a new site (600-331) was administratively established to address residual arsenic and lead concentrations in the soil (WCH 2009). Arsenic and lead associated with the use of pesticides previous to the Manhattan Project are excluded as contaminants of concern (COCs) and will be discussed as part of the 100-OL-1 Operable Unit in a future *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* document as agreed to by the Tri-Party Agreement Project Managers in Tri-Party Agreement Change Notice TPA-CN-401 (DOE-RL 2010) and in a site-specific agreement with the lead regulatory agency (EPA 2014a). In 2013, confirmatory samples (WCH 2013b) were taken at the surface and showed arsenic and lead results in much higher concentrations than previous orchard related sites. Therefore, the 600-331 waste site was subsequently recommended for remove, treat, and dispose (WCH 2013a) to lessen the residual arsenic and lead levels.

Remedial action at the 600-331 waste site was performed over an area of 39 m^2 (420 ft^2) on April 2, 2014. The maximum excavation depth was approximately 1.0 m (3.3 ft). All stained and affected soil devoid of vegetation was directly loaded from the excavation into containers for disposal at the Environmental Restoration Disposal Facility. The approximate volume of material removed from the 600-331 waste site was 16 bank cubic meters (21 bank cubic yards). No anomalous materials were

encountered during the excavation. There were no overburden piles or waste staging pile areas associated with the 600-331 waste site.

Cleanup verification sampling was performed on June 3, 2014. The results indicated that with the exception of arsenic and lead, the waste removal action achieved compliance with the remedial action objectives (RAOs) and cleanup levels (CULs) for the 600-331 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 600-331 waste site in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011).

Table ES-1. Summary of Cleanup Verification Results for the 600-331 Waste Site. (2 Pages)

Regulatory Requirement	Cleanup Levels	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain a dose rate of <15 mrem/yr above background over 1,000 years.	Radionuclides were not COCs for the 600-331 waste site.	NA
Direct Exposure – Nonradionuclides	Attain individual COC direct exposure CULs.	With the exception of arsenic and lead [a], all individual COC concentrations are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	With the exception of arsenic and lead [a], the hazard quotients for individual nonradionuclide COCs are <1. One non-COC, silver was detected at a concentration above background. The HQ for silver is 7.13×10^{-4} which is <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	Excluding arsenic and lead [a], all COCs have a cumulative hazard quotient of <1. Silver, the only non-COC detected above background has a cumulative HQ of 7.13×10^{-4} which is <1.	

Table ES-1. Summary of Cleanup Verification Results for the 600-331 Waste Site. (2 Pages)

Regulatory Requirement	Cleanup Levels	Results	Remedial Action Objectives Attained?
	Attain an excess cancer risk of <1 x 10^{-6} for individual carcinogens.	Excluding arsenic, excess cancer risk values for individual nonradionuclide COCs are <1 x 10^{-6}.	
	Attain a cumulative excess cancer risk of <1 x 10^{-5} for carcinogens.	Excluding arsenic [a], there were not any COCs with a carcinogenic CUL. Therefore, the total excess cancer risk for all sampling areas is <1 x 10^{-5}.	
Groundwater/Surface Water Protection – Radionuclides	Attain single COC groundwater and surface water CULs.	Radionuclides were not COCs for the 600-331 waste site.	NA
	Attain National Primary Drinking Water Regulations: 4 mrem/yr (beta/gamma) dose standard to target receptor/organ [b].		
	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 [c].		
	Meet total uranium standard of 21.2 pCi/L [d].		
Groundwater/Surface Water Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and surface water cleanup requirements.	With the exception of arsenic and lead [a], all nonradionuclide COCs were quantified at concentrations less than soil CULs deemed protective of groundwater and surface water.	Yes

[a] Arsenic and lead associated with the use of pesticides previous to the Manhattan Project are excluded as contaminants of concern for the 600-331 waste site as agreed to by the Tri-Party Agreement Project Managers in Tri-Party Agreement Change Notice TPA-CN-401 (DOE-RL 2010) and in a site-specific agreement with the lead regulatory agency (EPA 2014b).

[b] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).

[c] *Radiation Protection of the Public and Environment* (DOE Order 5400.5).

[d] 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).

COC = contaminant concern
CUL = cleanup level
MCL = maximum contaminant level (drinking water standard)
NA = not applicable

The current site conditions achieve the RAOs and the corresponding CULs established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Areas* (100 Area RDR/RAWP) (DOE-RL 2009b) and the *Record of Decision, Hanford Superfund Site, 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units*, Hanford Site, Benton County, Washington (Final Action ROD) (EPA 2014a). These results show that (with the exception of lead and arsenic) 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 surface water. Contamination above direct exposure levels were encountered for arsenic and lead. However, arsenic and lead associated with the use of pesticides previous to the Manhattan Project are excluded as COCs for the 600-331 waste site as agreed to by the Tri-Party Agreement Project Managers in Tri-Party Agreement Change Notice TPA-CN-401 (DOE-RL 2010) and in a site-specific agreement with the lead regulatory agency (EPA 2014b).

The site meets cleanup standards and has been reclassified as Final Closed Out in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) and the Waste Site Reclassification Guideline TPA-MP-14 (RL-TPA-90-0001) (DOE-RL 2011). A copy of the stand-alone waste site reclassification form is included as part of the Executive Summary of this document.

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-IU-6 **Control No.:** 2013-114

Waste Site Code(s)/Subsite Code(s): 600-331

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 600-331, Lime Sulfur Barrel Site, part of the 100-IU-6 Operable Unit, was the previous location of a lime sulfur barrel that had deteriorated and collapsed, spilling the contents on the ground. The lime sulfur was used to treat fruit trees for powdery mildew. The site was initially remediated in 1997 (Waste Information Data System site UPR-600-19); however, subsequent sample data indicated that high levels of lead and arsenic remained in the soil at this waste site. In 2009, a new waste site (600-331) was administratively established to address residual lead and arsenic concentrations in the soil. Arsenic and lead associated with the use of pesticides previous to the Manhattan Project are excluded as contaminants of concern (COCs) and will be discussed as part of the 100-OL-1 Operable Unit in a future *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* document as agreed to by the Tri-Party Agreement Project Managers in Tri-Party Agreement Change Notice TPA-CN-401 (DOE-RL 2010) and in a site-specific agreement with the lead regulatory agency (EPA 2014a). The 600-331 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), by 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), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2009) as a candidate site for further evaluation. In 2013, confirmatory samples were taken at the surface and showed arsenic and lead results in much higher concentrations than previous orchard related sites. Therefore, the 600-331 waste site was subsequently recommended for remove, treat, and dispose to lessen the residual arsenic and lead levels.

Remedial action at the 600-331 waste site was performed over an area of 39 m^2 (420 ft^2) on April 2, 2014. The maximum excavation depth was approximately 1.0 m (3.3 ft). All stained and affected soil devoid of vegetation was directly loaded from the excavation into containers for disposal at the Environmental Restoration Disposal Facility (ERDF). The approximate volume of material removed from the 600-331 waste site was 16 bank cubic meters (21 bank cubic yards). No anomalous materials were encountered during the excavation. There were no overburden piles or waste staging pile areas associated with the 600-331 waste site.

Cleanup verification sampling was performed on June 3, 2014, to determine if the 600-331 waste site met remedial action objectives (RAOs) and cleanup levels (CULs) established by the *Remedial Design Report/Remedial Action Work Plan for the 100 Areas* (100 Area RDR/RAWP), DOE/RL-97-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2009b) and the *Record of Decision, Hanford Superfund Site, 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units*, Hanford Site, Benton County, Washington (Final Action ROD) U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2014). 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 in 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 Final Closed Out.

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-IU-6 **Control No.:** 2013-114

Waste Site Code(s)/Subsite Code(s): 600-331

Basis for reclassification:

Cleanup verification sampling results were evaluated in comparison to the CULs. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-331 waste site to Final Closed Out. The current site conditions achieve the RAOs and CULs established by the Final Action ROD (EPA 2014) and the 100 Area RDR/RAWP (DOE-RL 2009b). With the exception of arsenic and lead concentrations, 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). As agreed by the Tri-Parties in Tri-Party Agreement Change Notice TPA-CN-401, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2010), lead and arsenic contamination that resulted from pesticide use prior to the Manhattan Project are excluded as contaminants of concern and will be discussed as part of the 100-OL-1 Operable Unit in a future CERCLA document. The analytical results and rationale presented in the attached cleanup verification package also demonstrate that residual contaminant concentrations (with the exception of arsenic and lead) meet direct exposure cleanup criteria and are protective of groundwater and surface water. Contamination was encountered above direct exposure levels for arsenic and lead. The basis for reclassification is described in detail in the *Cleanup Verification Package for the 600-331, Lime Sulfur Barrel Site*.

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 DOE Federal Project Director (printed)	Signature	4/22/15 Date
NA Ecology Project Manager (printed)	Signature	Date
C. J. Guzzetti EPA Project Manager (printed)	Signature	4/27/15 Date

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ACRONYMS AND ABBREVIATIONS

COC	contaminant of concern
CUL	cleanup level
CVP	cleanup verification package
DQA	data quality assessment
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
RAO	remedial action objective
RDR/RAWP	remedial design report/remedial action work plan
ROD	record of decision
SAP	sampling and analysis plan
UCL	upper confidence limit
WAC	*Washington Administrative Code*

1.0 INTRODUCTION

This cleanup verification package (CVP) documents that the 600-331, Lime Sulfur Barrel waste site was remediated in accordance with the *Record of Decision, Hanford Superfund Site, 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units*, Hanford Site, Benton County, Washington (Final Action ROD) (EPA 2014a). Remedial action objectives (RAOs) and associated cleanup levels (CULs) for this site are documented in the Final Action ROD (EPA 2014a) and the *Remedial Design Report/Remedial Action Work Plan for the 100 Areas* (100 Area RDR/RAWP), DOE/RL-97-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2009b).

The remedy specified in the Final Area ROD (EPA 2014a) and conducted for the 600-331 waste site included excavating the site to the extent required to meet specified soil CULs and disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility (ERDF) in the 200 Area of the Hanford Site. Excavation was driven by RAOs for direct exposure, protection of groundwater, and protection of the surface water.

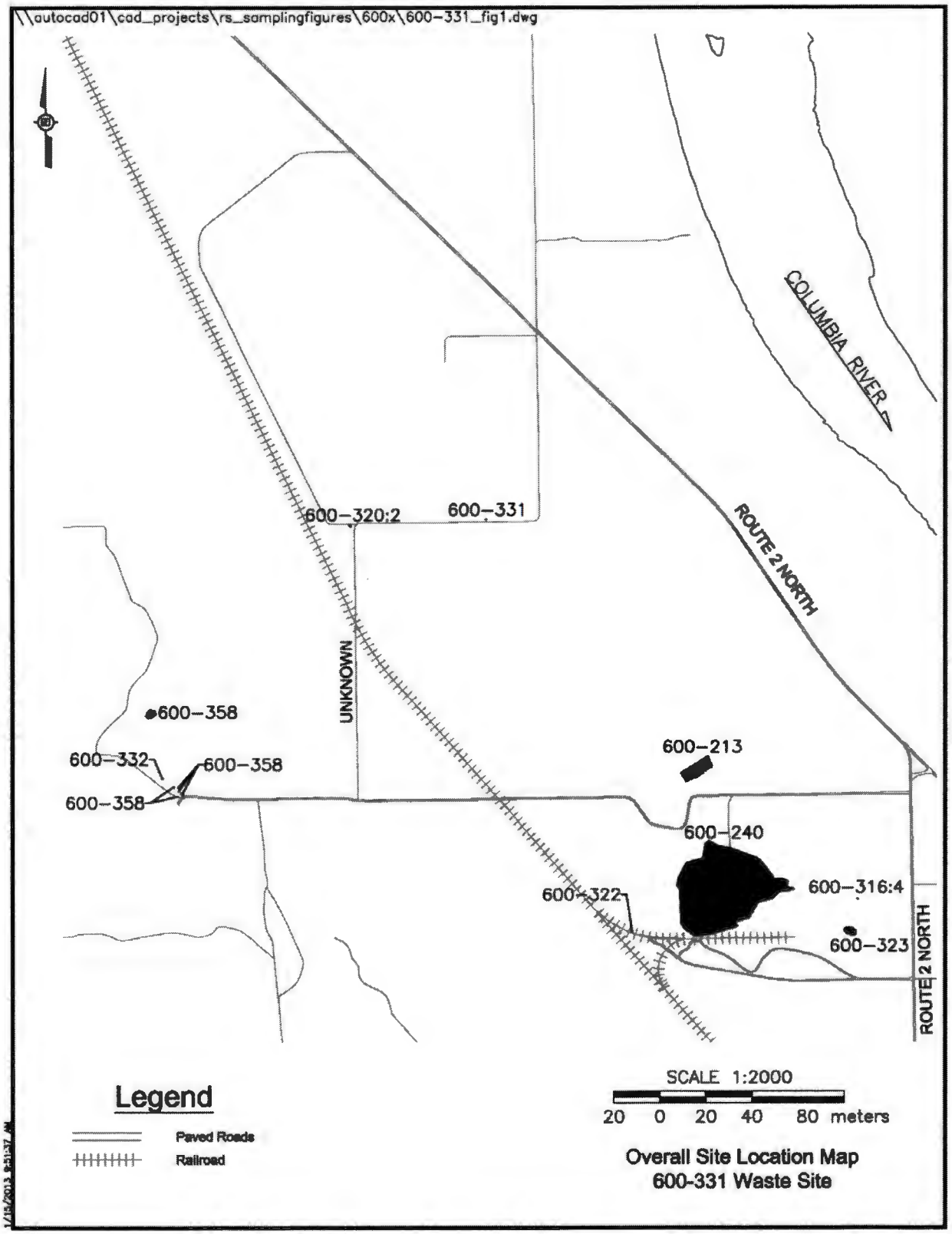
Per the *Work Instruction for Verification Sampling of the 600-331, Lime Sulfur Barrel Site* (WCH 2014b), cleanup verification sampling was performed on June 3, 2014, to determine if the 600-331 waste site met remedial action objectives (RAOs) and cleanup levels (CULs) established by the Final Action ROD (EPA 2014a) and the 100 Area RDR/RAWP (DOE-RL 2009b). The results indicated that (with the exception of arsenic and lead) the waste removal action achieved compliance with the RAOs and CULs for the 600-331 waste site.

2.0 SITE DESCRIPTION AND SUPPORTING INFORMATION

2.1 SITE DESCRIPTION

The site is located in the 600 Area in the 100-IU-6 Operable Unit, 402 m (1,320 ft) west of Route 2 North and approximately 183 m (600 ft) south of mile marker 3 as seen in Figure 1. The lime sulfur barrel was located about 0.91 m (3 ft) off the access road at the old Herriford (Buckholdt Ranch) home site, approximately located in front of the house foundation and southeast of the well house foundation. The Washington State Plane coordinates for the site are N 142072.1, E 582488.3.

Figure 1. The 600-331 Waste Site Location Map.



2.2 HISTORY

The 600-331 waste site is the previous location of a lime sulfur barrel that had deteriorated and collapsed, spilling the contents onto the ground (Figure 2) causing loss of vegetation in that area (Figure 3). The lime sulfur was used to treat fruit trees for powdery mildew. The site, formerly WIDS site UPR-600-19, was cleaned up and the site was reclassified as rejected in 1997. In 2009, a new site (600-331) was administratively established to address residual lead and arsenic concentrations in soil (WCH 2009). Arsenic and lead associated with the use of pesticides previous to the Manhattan Project are excluded as contaminants of concern (COCs) and will be discussed as part of the 100-OL-1 Operable Unit in a future *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* document as agreed to by the Tri-Party Agreement Project Managers in Tri-Party Agreement Change Notice TPA-CN-401 (DOE-RL 2010) and in a site-specific agreement with the lead regulatory agency (EPA 2014a). In 2013, confirmatory samples (WCH 2013b) were taken at the surface and showed arsenic and lead results in much higher concentrations than previous orchard related sites. Therefore, the 600-331 waste site was subsequently recommended for remove, treat, and dispose (WCH 2013a) to lessen the residual arsenic and lead levels.

3.0 REMEDIAL ACTION FIELD ACTIVITIES

3.1 EXCAVATION AND DISPOSAL

Remedial action at the 600-331 waste site was performed over an area of 39 m^2 (420 ft^2) on April 2, 2014. The maximum excavation depth was approximately 1.0 m (3.3 ft). All stained and affected soil devoid of vegetation was directly loaded from the excavation into containers for disposal at ERDF. The approximate volume of material removed from the 600-331 waste site was 16 bank cubic meters (21 bank cubic yards). No anomalous materials were encountered during the excavation. There were no overburden piles or waste staging pile areas associated with the 600-331 waste site.

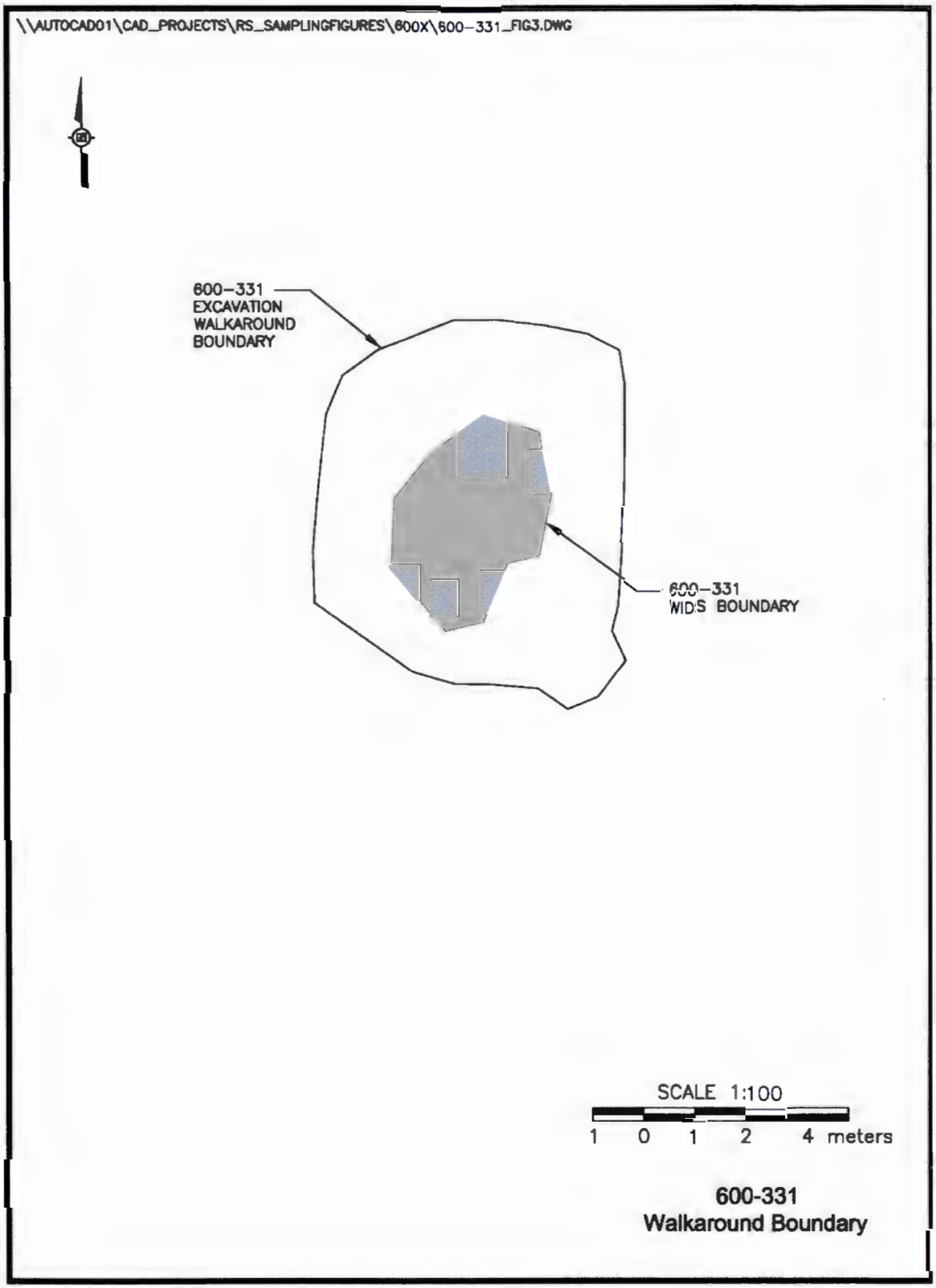
A post-remediation photograph is provided in Figure 4 and a boundary survey is provided in Figure 5.

Figure 2. Location of 600-331 Waste Site Deteriorated Lime Sulfur Barrel (1994).

Figure 3. Vegetation Loss at the 600-331 Waste Site (2007).

Figure 4. 600-331 Post-Excavation Photograph (April 22, 2014).

Figure 5. 600-331 Post-Remediation Boundary Surveys.



4.0 VERIFICATION SAMPLING ACTIVITIES

Cleanup verification sampling was performed at the 600-331 waste site on June 3, 2014, per the *Work Instruction for Verification Sampling of the 600-331, Lime Sulfur Barrel Site* (WCH 2014b). 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 Final Action ROD (EPA 2014a). These verification samples also show the concentrations of arsenic and lead to be consistent with other orchard related waste sites.

The verification sample results are provided in Appendix A and indicate that (with the exception of arsenic and lead) the waste removal action achieved compliance with the RAOs and CULs for the 600-331 waste site.

4.1 CONTAMINANTS OF CONCERN FOR VERIFICATION SAMPLING

Based on the historical use of the area as an orchard, the COCs include lead and arsenic. Although not considered COCs, antimony, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc were evaluated by performing the expanded inductively coupled plasma metals analytical list. The analytical methods that were performed to evaluate the site COCs are provided in Table 1.

Table 1. 600-331 Laboratory Analytical Methods and Contaminants of Concerns.

Analysis	Analytical Method	Contaminant of Concern
ICP metals [a]	EPA Method 6010	Arsenic and lead

[a] Analysis were performed for the expanded list of ICP metals to include 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

4.2 VERIFICATION SAMPLING DESIGN SELECTION AND BASIS

This section describes the basis for selection of an appropriate sample design and determination of the number of verification samples that were collected. The excavation area footprint is the only decision unit identified for the 600-331 waste site for verification sampling.

4.2.1 Verification Sampling Design

The number of discrete samples was determined based on the size of the remediated area of the waste site as described in the *Work Instruction for Verification Sampling of the 600-331, Lime Sulfur Barrel Waste Site* (WCH 2014b) and is outlined in Table 2.

Table 2. 600-331 Sample Summary.

Sample Location	HEIS Sample Number	Washington State Plane Coordinates		Sample Analysis
		Northing	Easting	
COMP-1	J1TRP3	142073.3 [a]	582488.5 [a]	ICP metals [b]
Duplicate [c]	J1TRP4	142073.3 [a]	582488.5 [a]	
Equipment blank	J1TRP5	NA	NA	

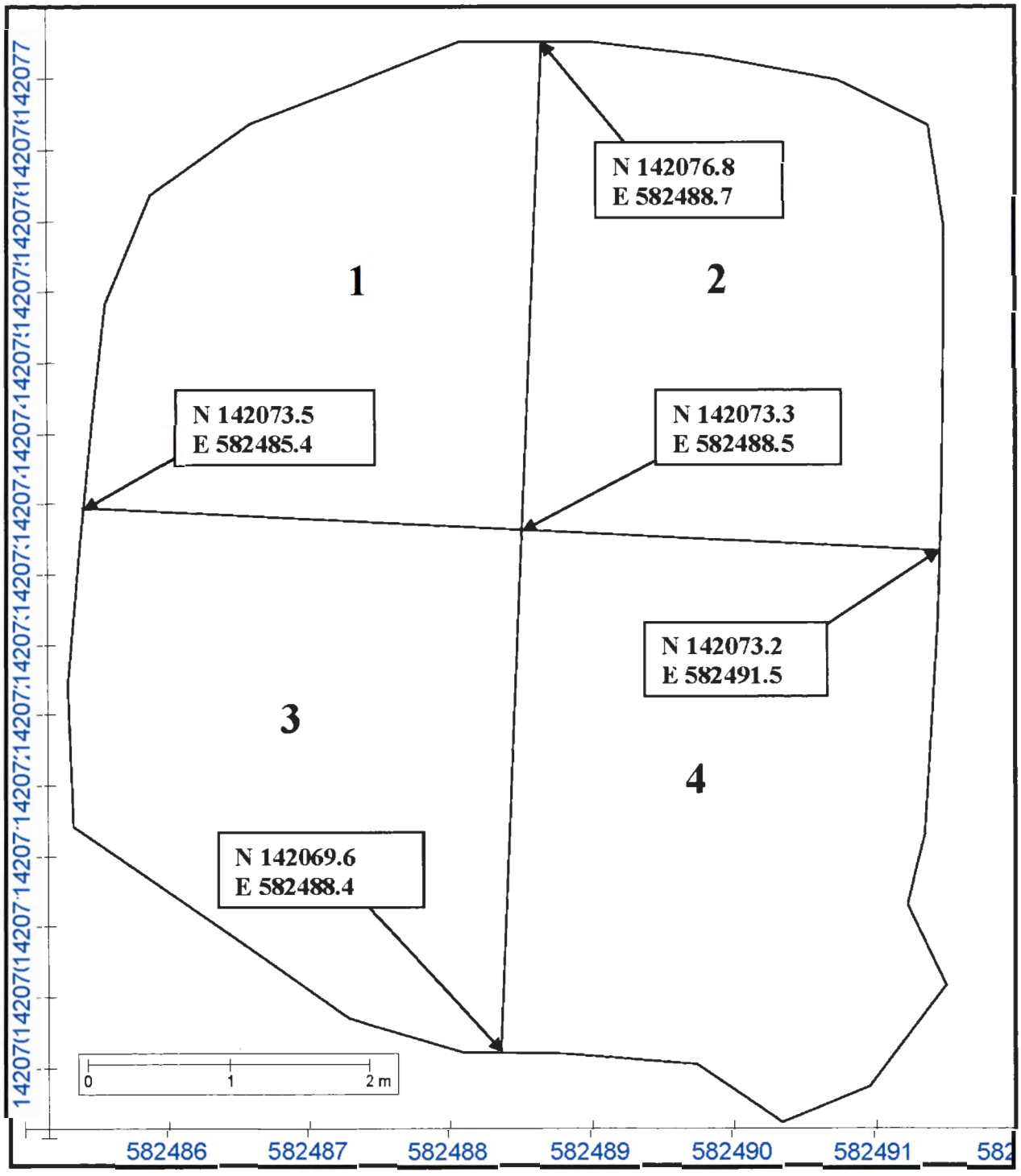
[a] The coordinates provided are the approximate center of the waste site.
[b] The expanded list of ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.
[c] One duplicate soil sample was collected from the 600-331 waste site at a location selected at the project analytical lead's discretion.
HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable

The 600-331 excavation was divided into four quadrants as shown in Figure 6. One composite soil sample and a duplicate were collected from the entire 600-331 waste site by combining single focused samples taken from each quadrant at 0 to 0.15 m (0 to 6 in.) bgs. An aliquot of soil collected from each quadrant was combined into the composite samples (main and duplicate) for analysis.

The Hanford Environmental Information System (HEIS) numbers for each sample are also provided in Table 2. All sampling was performed in accordance with ENV-1, *Environmental Monitoring & Management*, to fulfill the requirements of the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2009a). Additional information related to verification sampling can be found in the field sampling logbook (WCH 2014a).

The decision rule for demonstrating compliance with the cleanup criteria requires comparison of the true population mean, as estimated by the 95% UCL on the sample mean, with the CUL. In this case, one composite and one duplicate sample was taken. Therefore, the maximum result for each COC will be compared against the associated CUL. The Washington State Department of Ecology (Ecology) publication *Guidance on Sampling and Data Analysis Methods* (Ecology 1995) recommends that systematic sampling with sample locations distributed over the entire study area be used. This sampling approach is referred to by Ecology as "area-wide sampling". All sampling was performed in accordance with ENV-1, *Environmental Monitoring & Management*, to fulfill the requirements of the *100 Area Remedial Action Sampling and Analysis Plan* (100 Area SAP) (DOE-RL 2009).

Figure 6. Verification Sample Design for the 600-331 Waste Site Excavation.



Field quality control samples consisted of one equipment blank sample and one field duplicate. All samples were submitted for full protocol laboratory analysis.

5.0 SAMPLING RESULTS

This section presents the evaluation of the 600-331 waste site cleanup verification data for comparison with the data quality criteria and CULs. The verification samples were submitted to offsite laboratories for analysis using approved U.S. Environmental Protection Agency (EPA) analytical methods as required per the 100 Area SAP (DOE-RL 2009).

5.1 VERIFICATION SAMPLE RESULTS

The laboratory-reported verification data results for all constituents are stored in the Environmental Restoration project-specific database prior to archival in the Hanford Environmental Information System and are presented as Attachment 1 of the 600-331 RPD/HQ (Appendix A).

The 600-331 waste site consisted of one decision unit (the excavation footprint) for verification sampling. The verification data from the excavation footprint were evaluated by comparing the maximum focused sample results to the 100 Area CULs. These calculations are provided in Appendix A. If no detections for a given COC were reported in the data set, then no comparisons to CULs were performed for that COC.

Contaminants of concern for the 100-IU-2/6 and 100-F Areas were selected in the Final Action ROD (EPA 2014a). In the event that contaminants are discovered during remediation for which CULs were not established in the ROD, the information will be presented to the U.S. Department of Energy and EPA project managers for determination of a path forward. Contamination above human health levels were encountered for arsenic and lead. However, arsenic and lead associated with the use of pesticides previous to the Manhattan Project are excluded as COCs for the 600-331 waste site as agreed to by the Tri-Party Agreement Project Managers in Tri-Party Agreement Change Notice TPA-CN-401 (DOE-RL 2010) and in a site-specific agreement with the lead regulatory agency (EPA 2014b).

5.2 DATA QUALITY ASSESSMENT PROCESS

A data quality assessment (DQA) was performed to compare the verification sampling approach (WCH 2014b), the field logbook (WCH 2014a), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 600-331 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 WCH project-specific database for data evaluation prior to archival in HEIS and are summarized in Appendix A. The detailed DQA is presented in Appendix B.

6.0 CLEANUP VERIFICATION DATA EVALUATION

This section demonstrates that contaminant concentrations at the 600-331 waste site achieve the applicable CULs developed to support unrestricted land use at the 100-F/IU Area as established in the Final Action ROD (EPA 2014a) and documented in the 100 Area RDR/RAWP (DOE-RL 2009b).

6.1 NONRADIONUCLIDE EVALUATION OF RISK STANDARDS

Table 3 compares the cleanup verification sample values for the 600-331 waste site excavation to the applicable soil CULs for direct exposure, protection of groundwater, and protection of surface water. With the exception of arsenic and lead, all COCs were quantified below protection of human health CULs. With the exception of arsenic and lead, all COCs were quantified below groundwater and surface water soil CULs.

Table 3. Comparison of Maximum Contaminant Concentrations to Action Levels for the 600-331 Waste Site Verification Soil Samples.

COC	Maximum Result [b] (mg/kg)	Cleanup Levels (mg/kg) [a]			Does the Result Exceed CULs?	May the Site be Reclassified as Final Closed Out?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for Surface Water		
Arsenic	123	20	--	--	Yes	Yes [c]
Lead	354	250	--	--	Yes	Yes [c]
Mercury	0.0107 (<BG)	24	--	--	No	--

[a] CULs obtained from the Final Action ROD (EPA 2014a).
[b] Maximum result of all subsites as described in the *600-331 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations* (Appendix B).
[c] Per email concurrence (EPA 2014b). Lead and arsenic associated with the use of pesticides previous to the Manhattan Project are excluded as contaminants of concern as agreed to by the Tri-Party Agreement Project Managers in Tri-Party Agreement Change Notice TPA-CN-401 (DOE-RL 2010).

-- = not applicable
BG = background
CUL = cleanup level
COC = contaminant of concern
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
WAC = *Washington Administrative Code*

6.1.1 Attainment of Nonradionuclide Noncarcinogenic and Carcinogenic Risk Standards

Assessment of the risk requirements for the 600-331 waste site was determined by calculation of the hazard quotient and excess carcinogenic risk. The requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. The hazard quotient and excess carcinogenic risk calculations (Appendix B) for protection of human health were conservatively performed for the 600-331 waste site using the highest of the focused

sample analyses from all decision units. Risk values were not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. Arsenic and lead were excluded from evaluation based upon the orchard lands agreement and regulator concurrence. All other COCs were not detected or were detected below background values. Therefore, all individual COC hazard quotients are less than 1.0. The cumulative hazard quotient is less than 1.0. There were no COCs associated with carcinogenic CULs; therefore, the individual and cumulative excess cancer risk criteria of 1×10^{-6} and 1×10^{-5}, respectively, are met. One non-COC, silver was detected at a concentration above background. The HQ for silver is 7.13×10^{-4} which is less than 1. The cumulative HQ for silver was also 7.13×10^{-4} which is less than 1. Silver does not have a carcinogenic CUL, therefore the requirements of $<1 \times 10^{-6}$, and a cumulative excess carcinogenic risk of less than 1×10^{-5} are met.

7.0 STATEMENT OF PROTECTIVENESS

The 600-331 waste site has been evaluated in accordance with the Final Action ROD (EPA 2014a) and the 100 Area RDR/RAWP (DOE-RL 2009b). Verification sampling was performed and the analytical results indicate that (with the exception of arsenic and lead) the residual concentrations of COCs met the CULs and associated RAOs for protection of human health, groundwater protection, and surface water protection. Contamination above human health levels were encountered for arsenic and lead. However, arsenic and lead associated with the use of pesticides previous to the Manhattan Project are excluded as COCs for the 600-331 waste site as agreed to by the Tri-Party Agreement Project Managers in Tri-Party Agreement Change Notice TPA-CN-401 (DOE-RL 2010) and in a site-specific agreement with the lead regulatory agency (EPA 2014b). In accordance with this evaluation, the verification sampling results support a reclassification of the 600-331 waste site to Final Closed Out.

8.0 REFERENCES

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APPENDIX A

CALCULATIONS

APPENDIX A

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. These calculations have been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculations," Washington Closure Hanford, Richland, Washington. The following calculations are provided in this appendix:

300-331 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations, 0600X-CA-V0182, Rev. 1, Washington Closure Hanford, Richland, Washington A-3

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: 600 Area Closure Operations **Job No. 14655**

Area: 600 Area

Discipline: Environmental *Calculation No: 0600X-CA-V0182

Subject: 600-331 Waste Site Verification Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations

Computer Program: Excel Program No: Excel 2010

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 Total = 8	J. D. Skoglie	I. B. Berezovskiy	J. M. Capron	S. G. Wilkinson	Signed 8/6/14
1	Cover = 1 Summary = 6 Attachment = 1 Total = 8	J. D. Skoglie	I. B. Berezovskiy	NA	S. G. Wilkinson	12/8/14

SUMMARY OF REVISION

1	Revision based on new cleanup levels from the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Final Action Record of Decision.
WC H-DE-018 (05/08/2007)	*Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/4/2014	Calc. No.:	0600X-CA-V0182	Rev.:	1
Project:	600 Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	12/4/2014
Subject:	600-331 Waste Site Verification 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 calculations for the 600-331 waste site. In accordance with the cleanup levels (CUL) in the Final Action Record of Decision (ROD) for the 100-F/IU Area (EPA 2014), 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 600-331 verification sampling, as necessary.

GIVEN/REFERENCES:

1) DOE-RL, 2009, *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) 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.

3) EPA, 2014, *Record of Decision, Hanford 100 Area Superfund Site, 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units*, September 2014, U. S. Environmental Protection Agency, Region 10, Seattle, Washington.

4) WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, 2007.

5) WCH, 2014, *Remaining Sites Verification Package for the 600-331, Lime Barrel Sulfur Site*, Attachment to Waste Site Reclassification Form 2013-114, Washington Closure Hanford, Richland, Washington.

SOLUTION:

Values of the cleanup levels in Table 5 of the Final Action ROD for the 100-F/IU Area (EPA 2014) were used for the 600-331 contaminants of concern (COCs). For the non-COCs the formula and reference dose (RfD) from WAC 173-340 were used.

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 (EPA 2014).

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

Washington Closure Hanford CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/4/2014	Calc. No.:	0600X-CA-V0182	Rev.:	1
Project:	600 Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	12/4/2014
Subject:	600-331 Waste Site Verification Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 6	

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 $<1 \times 10^{-6}$ (EPA 2014).

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 (2014) to perform the RPD calculations for primary-duplicate sample pairs, as required.

METHODOLOGY:

The 600-331 waste site excavation is comprised of one composite and one duplicate verification sample. The direct contact hazard quotient and carcinogenic risk calculations for the 600-331 waste site were conservatively calculated for the entire waste site using the greatest of the maximum verification soil sample results from Attachment 1. Because this site is located in a former orchard area, lead and arsenic concentrations are discussed in the context of an orchard area in the RSVP. Lead and arsenic concentrations are presented here, but no further calculations are performed. Lead was detected above background; however, lead does not have a reference dose for calculation of a hazard quotient because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake. All other site nonradionuclide COCs were not detected or were quantified below background levels. Non-COCs were calculated but are for information purposes only. An example of the HQ and risk calculations is presented below:

1) There were no detected constituents with a noncarcinogenic CUL. However, one non-COC, silver was detected at a concentration above background. The HQ for silver was calculated in Table 1 using the following formula and reference dose (RfD) from the WAC 173-340: HQ = (Concentration) x (Dialy Intake Factor) / (RfD). Where the Daily Intake Factor is 1.25 E-05 and the concentration and RfD are presented in Table 1. The HQ for silver and the total cumulative HQ is 7.13 E -04 which is less than 1. Therefore, the requirement of <1.0 has been met and the criterion (<1.0) for cumulative HQ is also met.

2) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic CUL value, and then multiplied by 1.0×10^{-6}. There were no detected constituents with a carcinogenic CUL, therefore, the criterion for excess cancer risk is met. Consequently, the criterion for cumulative excess cancer risk (1.0×10^{-5}) for carcinogens is also met.

3) 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 2009). 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:

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

Washington Closure Hanford CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/4/2014	Calc. No.:	0600X-CA-V0182	Rev.:	1
Project:	600 Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	12/4/2014
Subject:	600-331 Waste Site Verification Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 6	

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 2014), 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 600-331 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 CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/4/2014	Calc. No.:	0600X-CA-V0182	Rev.:	1
Project:	600 Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	12/4/2014
Subject:	600-331 Waste Site Verification 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 600-331 Waste Site.

COCs	Maximum Value [a] (mg/kg)	Oral Reference Dose (RfD) [b] (mg/kg-day)	Hazard Quotient	Cancer Potency (Slope) Factor [b] (mg/kg-day) -1	Cancer Risk	Source of COC
Metals (mg/kg)						
Arsenic [c]	123	NA	--	NA	--	Final ROD
Lead [d]	354	NA	--	NA	--	Final ROD
COCs Cumulative Hazard Quotient:			**0.00E+00**			
COCs Cumulative Excess Cancer Risk:					**0.00E+00**	

[a] = Analytes detected below background are not included in risk calculations
[b] = Values obtained from the ROD (EPA 2014) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 2007, unless otherwise noted.
[c] = Arsenic cleanup level is not toxicity based. Therefore HQ and cancer risk calculations for arsenic are not performed.
[d] = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather
-- = not calculated
COC = contaminant of concern
NA = not applicable

Non-COCs	Maximum Value [a] (mg/kg)	Oral Reference Dose (RfD) [b] (mg/kg-day)	Hazard Quotient	Cancer Potency (Slope) Factor [b] (mg/kg-day) -1	Cancer Risk	Source of Non-COC
Metals (mg/kg)						
Silver	0.312	5.00E-03	7.13E-04	--	--	RI/FS
Non-COCs Cumulative Hazard Quotient:			**7.13E-04**			
Non-COCs Cumulative Excess Cancer Risk:					**0.00E+00**	

Total Cumulative Hazard Quotient:	**7.13E-04**	
Total Cumulative Excess Cancer Risk:		**0.00E+00**

[a] = Analytes detected below background are not included in risk calc
[b] = Values obtained from the ROD (EPA 2014) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 2007, unless otherwise noted.
-- = not applicable
COC = contaminant of concern

Washington Closure Hanford CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/4/2014	Calc. No.:	0600X-CA-V0182	Rev.:	1
Project:	600 Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	12/4/2014
Subject:	600-331 Waste Site Verification 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 600-331 Waste Site (2 Pages).

600-331 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
Comp-1	J1TRP3	6/3/14	9340		6.71	123	JN	0.493	95.9		0.099	1.00		0.0986
Duplicate of J1TRP3	J1TRP4	6/3/14	8800		5.96	95.7	JN	0.438	90.4		0.088	0.994		0.0876

Analysis:

TDL		5	10	2	0.2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	No-Stop
	RPD	6.0%	25.0%	5.9%	
	Difference > 2 TDL?	Not applicable	Not applicable	Not applicable	No - acceptable

600-331 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Boron			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Comp-1	J1TRP3	6/3/14	2.43	B	0.986	4390		7.89	14.3		0.148	8.91	D	0.740
Duplicate of J1TRP3	J1TRP4	6/3/14	2.05	B	0.876	4260		7.01	13.4		0.131	9.31	D	0.657

Analysis:

TDL		2	100	1	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop	Yes (calc RPD)	Yes (calc RPD)	No-Stop
	RPD		3.0%	6.5%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable

600-331 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Copper			Iron			Lead			Magnesium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Comp-1	J1TRP3	6/3/14	17.4		0.296	26200	M	7.89	354	D	1.63	4950		8.38
Duplicate of J1TRP3	J1TRP4	6/3/14	18.0		0.263	25800	M	7.01	256	D	1.45	5010		7.45

Analysis:

TDL		1	5	5	75
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD	3.4%	1.5%	32.1%	1.2%
	Difference > 2 TDL?	Not applicable	Not applicable	Not applicable	Not applicable

600-331 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Manganese			Mercury			Molybdenum			Nickel		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Comp-1	J1TRP3	6/3/14	369		0.197	0.0107	B	0.00402	0.329	B	0.197	12.5		0.148
Duplicate of J1TRP3	J1TRP4	6/3/14	363		0.175	0.00579	B	0.00404	0.341	B	0.175	13.0		0.131

Analysis:

TDL		5	0.2	2	4
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop	No-Stop
	RPD	1.6%			
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	No - acceptable

Washington Closure Hanford CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/4/2014	Calc. No.:	0600X-CA-V0182	Rev.:	1
Project:	600 Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	12/4/2014
Subject:	600-331 Waste Site Verification 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 600-331 Waste Site (2 Pages).

600-331 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Potassium			Silicon			Silver			Sodium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Comp-1	J1TRP3	6/3/14	2110		6.31	1370	*NJ	1.48	0.265	B	0.099	183		6.90
Duplicate of J1TRP3	J1TRP4	6/3/14	1970		5.61	363	*NJ	1.31	0.312	B	0.088	152		6.13

Analysis:

TDL		400	2	0.2	50
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	No-Stop	**Yes (calc RPD)**	No-Stop	No-Stop
	RPD		*116.2%*		
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	No - acceptable

600-331 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Zinc		
			mg/kg	Q	PQL
Comp-1	J1TRP3	6/3/14	54.0	D	1.97
Duplicate of J1TRP3	J1TRP4	6/3/14	58.9	D	1.75

Analysis:

TDL		1
Duplicate Analysis	Both > PQL?	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**
	RPD	8.7%
	Difference > 2 TDL?	Not applicable

CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 600-331 waste site meets the requirements for the hazard quotient, carcinogenic (excess cancer) risk and RPDs, respectively, as identified in the ROD (EPA 2014) and SAP (DOE-RL 2009). The hazard quotient, carcinogenic (excess cancer) risk, and RPD calculations are for use in the RSVP for this site.

Attachment 1. 600-331 Waste Site Verification Sample Results (Metals).

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
Comp-1	J1TRP3	6/3/14	9340		6.71	1.63	UD	1.63	123	JN	0.493	95.9		0.0986	1.00		0.0986
Duplicate of J1TRP3	J1TRP4	6/3/14	8800		5.96	1.45	UD	1.45	95.7	JN	0.438	90.4		0.0876	0.994		0.0876
Equipment Blank	J1TRP5	6/3/14	68.4		6.45	0.313	U	0.313	0.474	UNJ	0.474	1.09		0.0949	0.0949	U	0.0949

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
Comp-1	J1TRP3	6/3/14	2.43	B	0.986	0.0986	U	0.0986	4390		7.89	14.3		0.148	8.91	D	0.740
Duplicate of J1TRP3	J1TRP4	6/3/14	2.05	B	0.876	0.0876	U	0.0876	4260		7.01	13.4		0.131	9.31	D	0.657
Equipment Blank	J1TRP5	6/3/14	0.949	U	0.949	0.0949	U	0.0949	16.6	B	7.59	0.167	B	0.142	0.142	U	0.142

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
Comp-1	J1TRP3	6/3/14	17.4		0.296	26200	M	7.89	354	D	1.63	4950		8.38	369		0.197
Duplicate of J1TRP3	J1TRP4	6/3/14	18.0		0.263	25800	M	7.01	256	D	1.45	5010		7.45	363		0.175
Equipment Blank	J1TRP5	6/3/14	0.341	B	0.285	149	M	7.59	0.313	U	0.313	12.4	B	8.06	2.43		0.190

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
Comp-1	J1TRP3	6/3/14	0.0107	B	0.00402	0.329	B	0.197	12.5		0.148	2110		6.31	0.322	UD	0.322
Duplicate of J1TRP3	J1TRP4	6/3/14	0.00579	B	0.00404	0.341	B	0.175	13.0		0.131	1970		5.61	0.302	UD	0.302
Equipment Blank	J1TRP5	6/3/14	0.00390	U	0.00390	0.190	U	0.190	0.142	U	0.142	29.9		6.07	0.319	UD	0.319

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
Comp-1	J1TRP3	6/3/14	1370	*NJ	1.48	0.265	B	0.0986	183		6.90	63.7	UJD	0.493	54.0	D	1.97
Duplicate of J1TRP3	J1TRP4	6/3/14	363	*NJ	1.31	0.312	B	0.0876	152		6.13	67.4	UJD	0.438	58.9	D	1.75
Equipment Blank	J1TRP5	6/3/14	108	*NJ	1.42	0.0949	U	0.0949	6.64	U	6.64	0.210	UJB	0.0949	0.603	BC	0.380

Note: Gray cells indicate not applicable.

* = duplicate analysis not within control limits.

B = estimated result; result is less than the RL but greater than the MDL

C = sample concentration <= 5x blank concentration

D = results are reported from a diluted aliquot of sample.

HEIS = Hanford Environmental Information System

J = estimated result

M = duplicate precision not met

N = recovery is outside control limits.

PQL = practical quantitation limit

Q = qualifier

U = undetected

Attachment	1	Sheet No.	1 of 1
Originator	J. D. Skoglie	Date	12/4/14
Checked	I. B. Berezovskiy	Date	12/4/14
Calc. No.	0600X-CA-V0182	Rev. No.	1

APPENDIX B

DATA QUALITY ASSESSMENT

APPENDIX B

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 2014b). 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 2014b), the field logbook (WCH 2014a), 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 600-331 waste site were provided by the laboratory in one sample delivery group (SDG): SDG XP0097. SDG XP0097 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 600-331 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 XP0097

This SDG comprises one composite soil sample (J1TRP3), a duplicate of that sample (J1TRP4), and an equipment blank (J1TRP5) collected from the 600-331 waste site excavation. This SDG includes one field duplicate pair (J1T973/J1T978). These samples were analyzed for inductively coupled plasma (ICP) metals and mercury. Minor deficiencies are as follows.

In the ICP metals analysis, zinc was detected at a low concentration in the laboratory method blank and at a similar concentration in the equipment blank (J1TRP5). Third-party validation qualified the zinc result in sample J1TRP5 as undetected with "UJ" flags. The data are usable for decision-making purposes.

In the ICP metals analysis, matrix spike recoveries for arsenic (66.8%) and silicon (0%) are outside the quality control (QC) limits. Third-party validation qualified all arsenic and

silicon results for SDG XP0097 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the relative percent difference (RPD) calculated for silicon (116.2%) in the field duplicate pair (J1TRP3/J1TRP4), by the validator, is outside QC limits. Third-party validation noted this deficiency and determined that no qualification was required. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. The data are usable for decision-making purposes.

The formal evaluation of the field quality samples is also presented in the next section.

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 2014a), include a field duplicate sample pairs as indicated in Table B-1. The detailed sample results are presented in Appendix B.

Table B-1. Field Quality Assurance/Quality Control Samples.

Sample Location	Main Sample	Duplicate Sample
600-331	J1TRP3	J1TRP4

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. 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 RPDs calculated for lead (32.1%) and silicon (116.2%%) for the field duplicate pair (J1TRP3/J1TRP4) are above the acceptance criteria of 30%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the

sample matrix. There is no indication that the analytical system was operating out of control. The data are usable for decision-making purposes.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than five times the TDL, including undetected analytes. In these cases, a control limit of ±2 times the TDL is used (Appendix A) to indicate that a visual check of the data is required by the reviewer. None of the data in the 600-331 data set exceeded this control limit. 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 600-331 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 600-331 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 A.

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