0101477

Date Submitted: 09/26/11 Originator: M. L. Proctor Phone: 372-9227	**WASTE SITE RECLASSIFICATION FORM** Operable Unit(s): 100-FR-2 Waste Site Code: 600-351 Type of Reclassification Action: Closed Out ☐ Interim Closed Out ☒ No Action ☐ RCRA Postclosure ☐ Rejected ☐ Consolidated ☐	Control Number: 2011-087

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

Description of current waste site condition:

The 600-351, Stained Areas Outside of 100-F Area consisted of two stained soil areas. The northern area consisted of stained and crusted soil measuring 4 m (13.2 ft) in diameter. The southern area consisted of petroleum-based material released to the ground surface. There were oil cans lying at the site and the surrounding area. The site is located within historic pre-Hanford orchard areas where lead and arsenic contamination due to the use of lead arsenate pesticide prior to the Manhattan Project is present in concentrations exceeding soil cleanup criteria. However, as agreed by the Tri-Parties *Federal Facility Agreement and Consent Change Control Form*, TPA-CN-401, U.S. Department of Energy, Richland Operations Office, Richland, Washington (TPA-CN-401) (DOE-RL 2010), lead and arsenic contamination that resulted from pesticide use before the Manhattan Project are excluded as contaminants of concern and will be discussed in a future *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) document. Remediation, verification sampling, and comparison of residual contaminant concentrations against cleanup levels have been performed in accordance with the remedial action objectives (RAOs) and remedial action goals (RAGs) established by the *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 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, 100-1U-2, 100-1U-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington. The selected remedy involved (1) excavation and removal of debris and stained soil, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility 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:

The sample results were evaluated in comparison to the RAGs. In accordance with this evaluation, the verification sampling results support a reclassification of this site to Interim Closed Out. With the exception of lead and arsenic concentrations, the current site conditions achieve the RAOs and the corresponding RAGs established in the Remaining Sites ROD (EPA 1999). As agreed by the Tri-Parties (TPA-CN-401), lead and arsenic contamination that resulted from pesticide use prior to the Manhattan Project are excluded as contaminants of concern and will be discussed in a future CERCLA document. The results of verification sampling show that residual contaminant concentrations (with the exception of lead and arsenic) do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow-zone soils (i.e., surface to 4.6 m [15 ft] deep). The results (with the exception of arsenic) also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. However, because arsenic and lead contamination is present in surface soil, an administrative institutional control will be required until a final decision concerning historic orchard pesticide use is made. Additionally, the results of verification sampling indicate that residual waste site contamination originating from Hanford Site or Manhattan Project activities does not extend into deep-zone soils (below 4.6 m [15 ft] deep). Therefore, institutional controls to prevent uncontrolled drilling into the deep zone are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 600-351, Stained Areas Outside of 100-F Area Waste Site* (attached).

Waste Site Controls:

Engineered Controls: Yes ☐ No ☒ Institutional Controls: Yes ☐ No ☒ O&M Requirements: Yes ☐ No ☒

If any of the Waste Site Controls are checked Yes, specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents.

M. S. French DOE Federal Project Director (printed)	Signature	1/8/12 Date
N/A Ecology Project Manager (printed)	Signature	Date
C. Guzzetti EPA Project Manager (printed)	Signature	1/10/12 Date

Attached to: 0101476

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REMAINING SITES VERIFICATION PACKAGE FOR THE 600-351, STAINED AREAS OUTSIDE OF 100-F AREA

Attachment to Waste Site Reclassification Form 2011-087

September 2011

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-351, STAINED AREAS OUTSIDE OF 100-F AREA

EXECUTIVE SUMMARY

The 600-351, Stained Areas Outside of 100-F Area waste site is located in the 100-FR-2 Operable Unit of the Hanford Site, approximately 76 m (250 ft) south of F Avenue North. The 600-351 waste site consisted of two stained soil areas. The northern area, measuring approximately 4 m (13.2 ft), consisted of stained and crusted soil. The southern area consisted of petroleum-based material released to the ground surface and the underlying soils. The soil appeared crusted and no vegetation was growing in the affected area. There were oil cans lying at the site and the surrounding area. Areas of stained soil and stressed vegetation have subsequently been determined to be due to the use of lead arsenate pesticide applications on historic Hanford orchards.

Remediation of the 600-351 waste site was initiated and completed on March 10, 2011. The deepest part of the excavation extends to 1.8 m (6 ft). The excavation activities included removal of approximately 60.4 bank cubic meters (BCM) (79.0 bank cubic yards [BCY]) of stained soil for disposal at the Environmental Restoration Disposal Facility (ERDF). In addition, less than 1 BCM (1.308 BCY) of debris, consisting of miscellaneous steel cans and wire, was removed to ERDF.

Verification sampling was conducted at the 600-351 waste site June 6 through August 8, 2011, to support a determination that residual contaminant concentrations in the soil meet cleanup criteria specified 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). The results indicated that the waste removal action achieved compliance with the remedial action objectives (RAOs) and remedial action goals (RAGs) for the 600-351 waste site, with acknowledgment that residual lead and arsenic contamination that resulted from pesticide use previous to the Manhattan Project are excluded from the contaminants of concern (COCs) and will instead be discussed in a future *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) document. A summary of the cleanup evaluation for the sample 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 600-351 waste site in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2007).

Table ES-1. Summary of Remedial Action Goals for the 600-351 Waste Site.

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain dose rate of less than 15-mrem/yr dose rate above background over 1,000 years.	Radionuclides are not COPCs at this waste site.	NA
Direct Exposure – Nonradionuclides	Attain individual COPC RAGs.	All individual COPC concentrations are below the direct exposure RAGs with the exception of arsenic and lead. As agreed by the Tri-Party Project managers, arsenic and lead associated with pesticide use in pre-Hanford historic orchards are not COPCs (TPA CN-401 [DOE-RL 2010]).	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	All hazard quotients are less than 1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient (3.3×10^{-2}) is less than 1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	No carcinogenic nonradionuclide COPCs were detected above background levels; therefore, the excess cancer risk for individual carcinogens is zero.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	No carcinogenic nonradionuclide COPCs were subject to the excess cancer risk calculation; therefore, the total excess carcinogenic risk for all sampling areas is zero.	
Groundwater/River Protection – Radionuclides	Attain single-COPC groundwater and river protection RAGs.	Radionuclides are not COPCs.	NA
	Attain national primary drinking water standards[a]: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.		
	Meet drinking water standards for alpha emitters: the most stringent of 15 pCi/L MCL or 1/25th of the derived concentration guides from DOE Order 5400.5[b].		
	Meet total uranium standard of 30 µg/L (21.2 pCi/L)[c].		
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Arsenic, lead, and MCPP are present at concentrations exceeding soil RAGs for groundwater and/or Columbia River protection. However, an evaluation based upon RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b) shows that with the exception of arsenic, residual concentrations of these constituents are predicted to be protective of groundwater and the river. As agreed by the Tri-Party Project managers, arsenic and lead associated with pesticide use in pre-Hanford historic orchards are not COPCs (DOE-RL 2010)[d].	Yes

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

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

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

[d] Based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b), the residual concentrations of MCPP are not expected to migrate more than 1 m (3.3 ft) vertically in 1,000 years (based on the distribution coefficient of MCPP, 48.5 mL/g). The vadose zone underlying the soil below the site is approximately 5.55 m (18.21 ft). Therefore, residual concentrations of MCPP are predicted to be protective of groundwater and the Columbia River. Arsenic and lead contamination that resulted from pesticide use previous to the Manhattan Project is excluded as COPCs and will instead be discussed in a future CERCLA document (DOE-RL 2010).

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act*
COPC = contaminant of potential concern
DOE = U.S. Department of Energy
MCL = maximum contaminant level
MCPP = 2-(2-methyl-4-chlorophenoxy) propionic acid
NA = not applicable
RAG = remedial action goal
RESRAD = RESidual RADioactivity
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*

In accordance with this evaluation, the verification sampling results support a reclassification of 600-351 waste site to Interim Closed Out. With the exception of lead and arsenic, the current site conditions achieve the RAOs and the corresponding RAGs established in the 100 Area RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999). The results of verification sampling show that residual contaminant concentrations (with the exception of lead and arsenic) do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow-zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations (with the exception of lead and arsenic) are protective of groundwater and the Columbia River. As agreed by the Tri-Parties in TPA-CN-401 (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 in a future CERCLA document. However, since this contamination is present in surface soil, an administrative institutional control will be required until a final decision concerning historic pesticide use is made. The results of the verification sampling also indicate that residual waste site contamination originating from Hanford Site or Manhattan Project activities does not extend into deep-zone soils. Therefore, institutional controls to prevent uncontrolled drilling into the deep-zone are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the ROD, a comparison against ecological risk screening levels has been made for the site contaminants of potential concern and other constituents. Those constituents exceeding the ecological screening level in the *Washington Administrative Code* (WAC), Chapter 173-340, Table 749-3 (WAC 173-340) were arsenic, boron, lead, selenium, and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, arsenic, lead, manganese, selenium, vanadium, and zinc. A table comparing concentrations of these constituents to ecological screening levels and background levels is provided in Appendix A. Exceeding screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of antimony, manganese, vanadium, and zinc are below Hanford Site background values or Washington State background values, 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. Arsenic and lead concentrations associated with historic pesticide use previous to the Manhattan Project will be excluded from the COCs/contaminants of potential concern (COPCs) and will instead be discussed in a future CERCLA document (DOE-RL 2010).

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-351, STAINED AREAS OUTSIDE OF 100-F AREA

STATEMENT OF PROTECTIVENESS

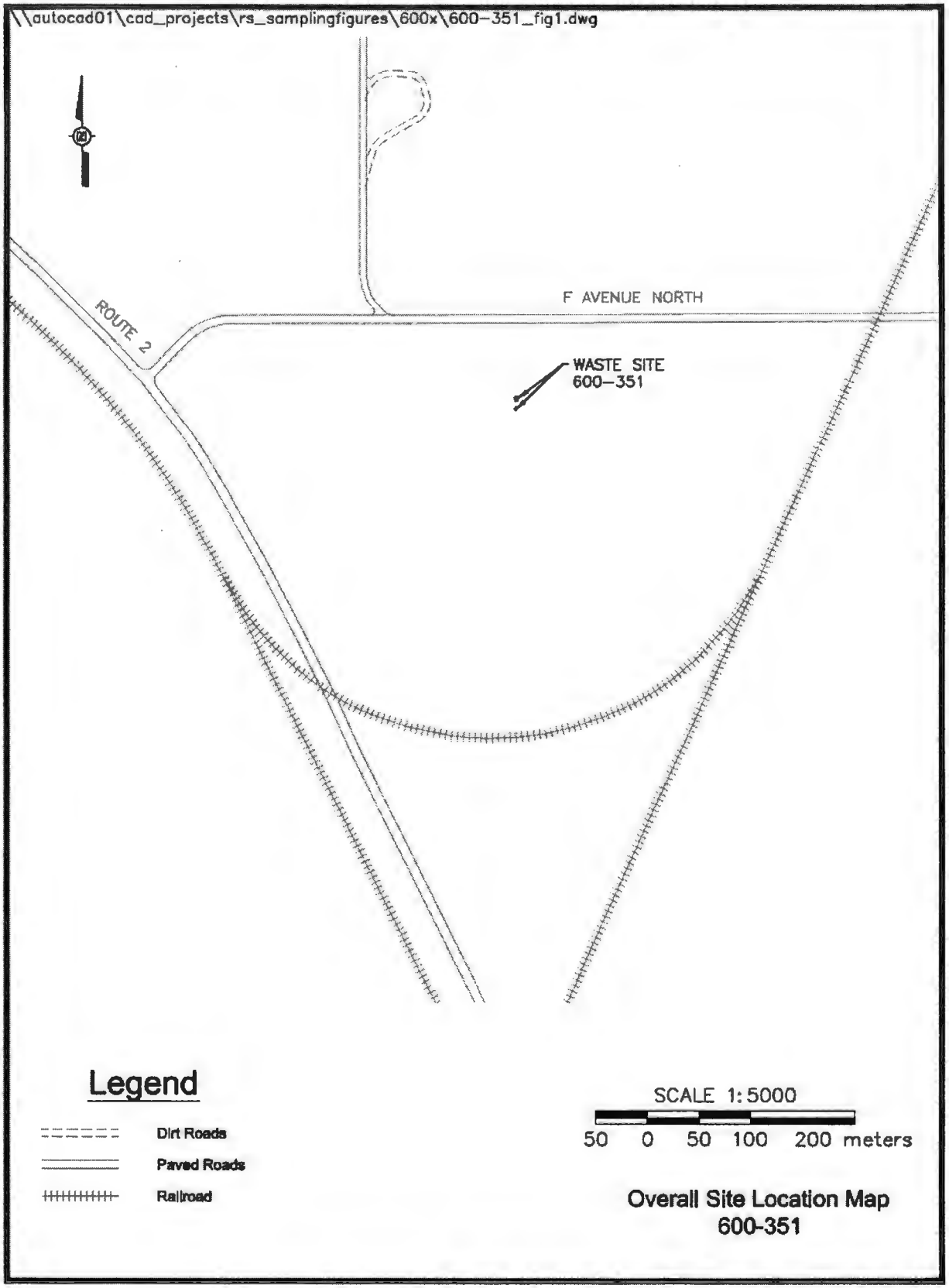
This report demonstrates that the 600-351, Stained Areas Outside of 100-F Area waste site meets the objectives for Interim Closed Out as established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of Decision 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). With the exception of lead and arsenic, the results of verification sampling show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow-zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that with the exception of lead and arsenic, residual contaminant concentrations are protective of groundwater and the Columbia River and institutional controls to prevent uncontrolled drilling are not required. As agreed by the Tri-Parties in TPA-CN-401 (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 in a future *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) document. However, since this contamination is present in surface soil above direct exposure cleanup levels, an administrative institutional control will be required until a final decision concerning historic pesticide use is made.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the ROD, a comparison against ecological risk screening levels has been made for the site contaminants of potential concern and other constituents. Those constituents exceeding the ecological screening level in the *Washington Administrative Code* (WAC), Chapter 173-340, Table 749-3 (WAC 173-340) were arsenic, boron, lead, selenium, and vanadium. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for antimony, arsenic, lead, manganese, selenium, vanadium, and zinc. A table comparing concentrations of these constituents to ecological screening levels and background levels is provided in Appendix A. Exceeding screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of antimony, manganese, vanadium, and zinc are below Hanford Site background values or Washington State background values, 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. Arsenic and lead concentrations associated with historic pesticide use previous to the Manhattan Project will be excluded from the contaminants of concern/contaminants of potential concern (COCs/COPCs) and will instead be discussed in a future CERCLA document (DOE-RL 2010).

GENERAL SITE INFORMATION AND BACKGROUND

The 600-351, Stained Areas Outside of 100-F Area waste site, part of the 100-FR-2 Operable Unit, is located approximately 76 m (250 ft) south of F Avenue North (Figure 1).

Figure 1. The 600-351 Waste Site Location Map.



The 600-351 waste site consisted of two stained soil areas. The first area (north location) consisted of stained, crusted soil, and vegetation measuring 4 m (13.2 ft) in diameter. The second area (south location) consisted of petroleum-based material released to the ground surface and the underlying soils. The soil appeared crusted and no vegetation was growing in the affected area. There were oil cans lying at the site and the surrounding area.

History

The 600-351 waste site was identified during an orphan sites evaluation walkdown on October 1, 2008. These areas are not associated with any particular process. The location of this waste site is within the pre-Hanford farmstead area that is visible in the 1943 baseline Geographical Information System (GIS) imagery (Figure 2). Prior to use by the Hanford Site Manhattan Project, the 600-351 waste site location was part of an historic agricultural site occupying some 202,000 m^2 (50 acres) consisting of five tracts of land used circa 1938 to 1943.

The 600-351 waste site is located in an area that was occupied by orchards prior to the Hanford Site Manhattan Project. A 1943 Benton County Land Plat Map (Figure 3) as presented in *Pre-Hanford Agricultural History: 1900-1943* (BHI 1999) identifies the orchard areas that were created and recorded in the county record. The map shows the plats and tracts that were created for orchards, with the White Bluffs Irrigation Co.'s Town of White Bluffs coinciding with the location of the 600-351 waste site.

In-process and verification soil samples (Appendix B) detected high concentrations of lead and arsenic in surface soil samples from the 600-351 waste site areas. Delistraty and Yokel (2002) report concentrations ranging from 2.9 to 270 mg/kg arsenic and 6.5 to 1,900 mg/kg lead in samples collected from historic orchard soils for the Hanford 100 Areas, with a mean concentration of 30 mg/kg arsenic and 220 mg/kg lead. Lead and arsenic are associated with historic orchards and the use of lead arsenate as an orchard pesticide; they are eliminated as COPCs for verification sampling as agreed to by the regulatory agencies and documented in Tri-Party Agreement Change Notice TPA-CN-401 (DOE-RL 2010).

During the growing season, orchards were sprayed with lead arsenate from the time the trees bloomed until they were harvested (BHI 1999). Orchard sprays were reported to have contained about 0.5 kg (1 lb) of arsenate or lead to 189 L (50 gal) of water for the first brood of coddling moths and 2.7 kg (6 lb) of lead arsenate paste or 2.7 kg (3 lb) of powder to 757 L (200 gal) of water for the second brood of codling moths. Following the second spraying, Winesaps required a spraying every 30 days and Rome Beauties, Spitz, Delicious, and Jonathan's required spraying every 20 days for the remainder of the season. Historic photographs (Figures 4 and 5) show two methods used for application of orchard pesticides. Additional discussion of the agricultural history, including practices for orchard crops, is provided in BHI (1999).

Figure 2. 1943 Aerial Photograph of Orchard Tracts Showing the 600-351 Waste Site Location.

Figure 3. 1943 Benton County Plat Map (BHI 1999).

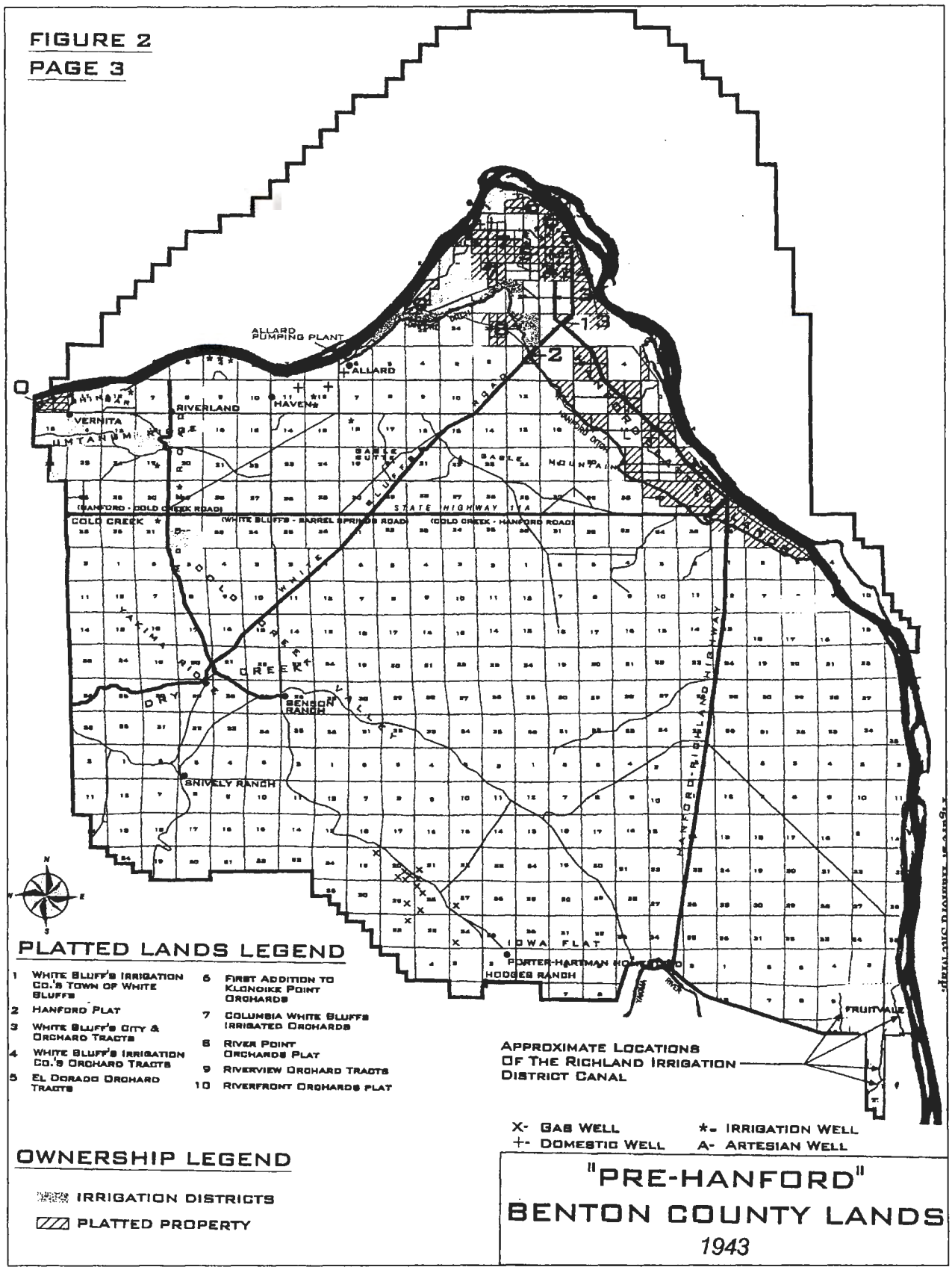


Figure 4. Hand Sprayer used for Application of Pesticides (1932).

Figure 5. Mobile Orchard Spraying Equipment (1932).

Geophysical Survey

A geophysical survey using electromagnetic induction was performed at the 600-351 waste site in October 2010 in support of obtaining an excavation permit (WCH 2010). Some surface metal debris was identified near the second surface stain. No subsurface anomalies were identified to be present at this site. An irrigation canal was identified that runs north-south across both of the stain areas and then turns west at the northern area location (Figure 6).

Ecological and Cultural

Ecological and cultural resources staff evaluated the 600-351 waste site to support remediation activities (WCH 2011b). The waste site is located within an old farm field that is covered with cheatgrass and a few yellow star thistle plants. Care was taken not to track weed seeds on equipment to other sites. There is a potential for nesting bids to use the project area during nesting season, which typically occurs from mid-March through mid-July. A nesting bird survey was required prior to performing work after March 15 and resource protection staff were to be contacted so arrangements for a survey can be performed (WCH 2011b).

According to Cultural and Historic Resources Program staff, the remediation and sampling of the 600-351 waste site had no potential to effect historic properties. Although no impacts to cultural resources were anticipated, all workers were directed to watch for cultural materials (e.g., bones, stone tools, mussel shells, cans, and bottles, etc.) during all work activities (WCH 2011b). Prior to performing verification sampling, the project assured that cultural and ecological reviews were current.

SUMMARY OF REMEDIAL ACTIVITIES

On November 3, 2010, samples for waste characterization (WC) purposes were collected from the stained areas 1 and 2. Waste characterization sample J1CM93 was collected from the northern area, and WC sample J1CM94 was collected from the southern area. Both of the samples were analyzed using gamma energy analysis (GEA), inductively coupled plasma (ICP) metals analysis, volatile organic analysis (VOA), semivolatile organic analysis (SVOA), and analysis for polychlorinated biphenyls (PCBs), pesticides, and herbicides. All the WC results are provided in Appendix B of the verification work instruction (WCH 2011c).

Initial remedial action at the 600-351, Stained Areas Outside of 100-F Area waste site was begun and completed on March 10, 2011. Subsequently, additional remediation (discussed below) was performed on July 12, 2011, and August 4, 2011. Photographs of the waste site prior to remediation are shown in Figures 7 and 8. The initial excavation resulted in the removal of approximately 27.6 bank cubic meters (BCM) (36.1 bank cubic yards [BCY]) of contaminated soil. The excavation activities included removal of less than 1 BCM (1.308 BCY) of debris that consisted of miscellaneous steel cans and wire. All material was direct loaded for disposal at the Environmental Restoration Disposal Facility. The area associated with the 600-351 remediation is shown in Figure 9. Both of the 600-351 stain areas were excavated to an approximate depth of 1 m (3 ft).

Since lead and arsenic contamination is expected within the former orchard areas, the 600-351 waste site lead and arsenic contamination is believed to be associated with the historical orchard lead arsenate applications, rather than the military camp. Subsequent discussions with the EPA,

Figure 6. Geophysical Investigation Results for the 600-351, Stained Area Outside of 100-F Area.

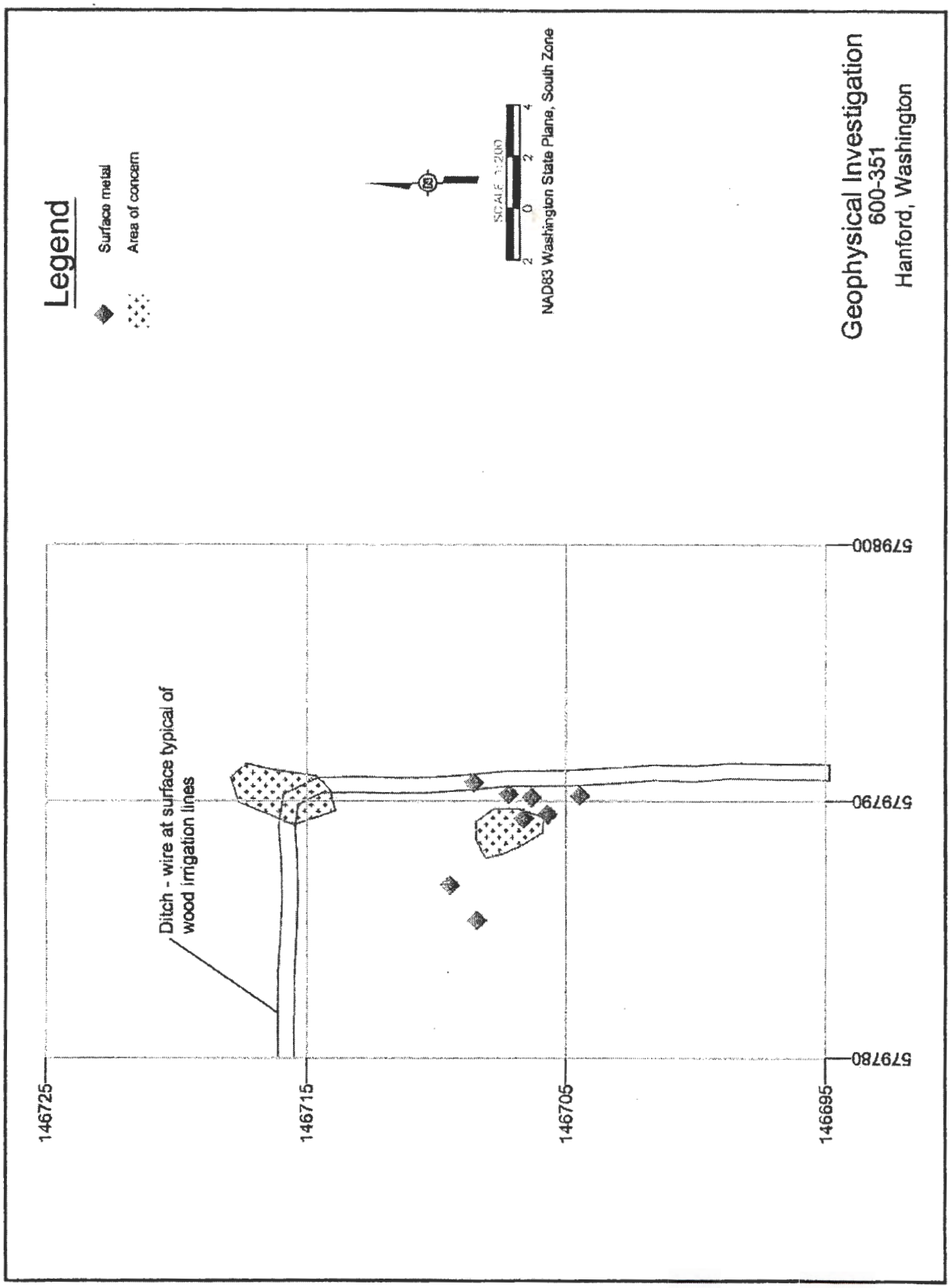
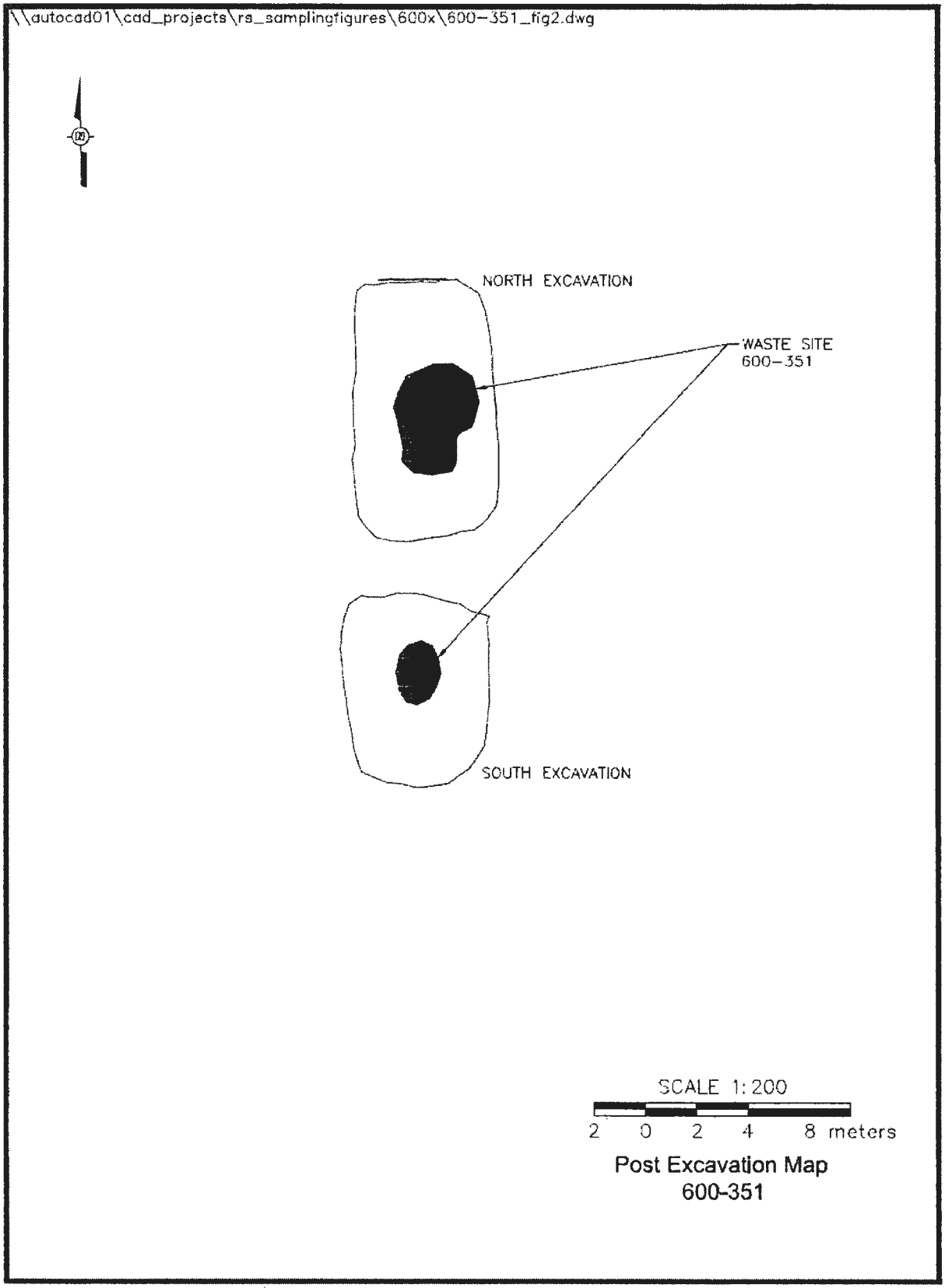


Figure 7. The 600-351 Waste Site North Location Prior to Remediation.

Figure 8. The 600-351 Waste Site South Location Prior to Remediation.

Figure 9. The 600-351 Waste Site Post-Excavation Boundary.



the Washington State Department of Ecology (Ecology), and the U.S. Department of Energy, Richland Operations Office led to a Tri-Party Agreement Change Notice TPA-CN-401 (DOE-RL 2010) dated December 6, 2010, that conditionally excludes lead and arsenic as contaminants of concern for sites demonstrated to have been located within orchard areas.

Additional Remedial Activities

Following initial remediation, verification sampling performed on June 6, 2011, found a sample result that exceeded the direct exposure RAG for total petroleum hydrocarbons (TPH), diesel range at 210 mg/kg. The area with elevated TPH result was mistakenly assumed to be sample location 4. The recommended path forward was to remediate the south excavation further, and re-sample the south excavation.

Additional remediation and re-sampling of the south excavation was performed on July 12, 2011, removing an additional 14.0 BCM (18 BCY) of material from the south half of the south excavation. The results indicated that the waste removal action achieved compliance with the remedial action objectives (RAOs) and remedial action goals (RAGs) for the 600-351 waste site, with acknowledgment that residual lead and arsenic contamination that resulted form pesticide use previous to the Manhattan Project. The mistake in the assumed sample location was observed during careful data evaluation and determined that the previous result that exceeded the direct exposure RAG for TPH was from the sample collected from the northern excavation (location 1, Figure 10). The recommended path forward was to perform further remediation of the northern excavation and to re-sample location 1.

A second round of additional remediation and re-sampling of the north portion of the north excavation was performed on August 4, 2011. The excavation resulted in the removal of approximately 18.7 BCM (24.5 BCY) of contaminated soil. The results indicated that the waste removal action achieved compliance with the RAOs and RAGs for the 600-351 waste site, with acknowledgment that residual lead and arsenic contamination that resulted form pesticide use previous to the Manhattan Project are excluded from the COCs and will instead be discussed in a future CERCLA document.

Accounting for all additional remediation performed at the 600-351 waste site, the excavation resulted in the total removal of approximately 60.4 BCM (79.0 BCY) of contaminated soil. The deepest part of the excavation extends to approximate depth of 1.8 m (6.0 ft) bgs. Figure 11 shows a photograph of the remediated 600-351 waste site.

Figure 10. Sample Locations for the 600-351, Stained Areas Outside of 100-F Area.

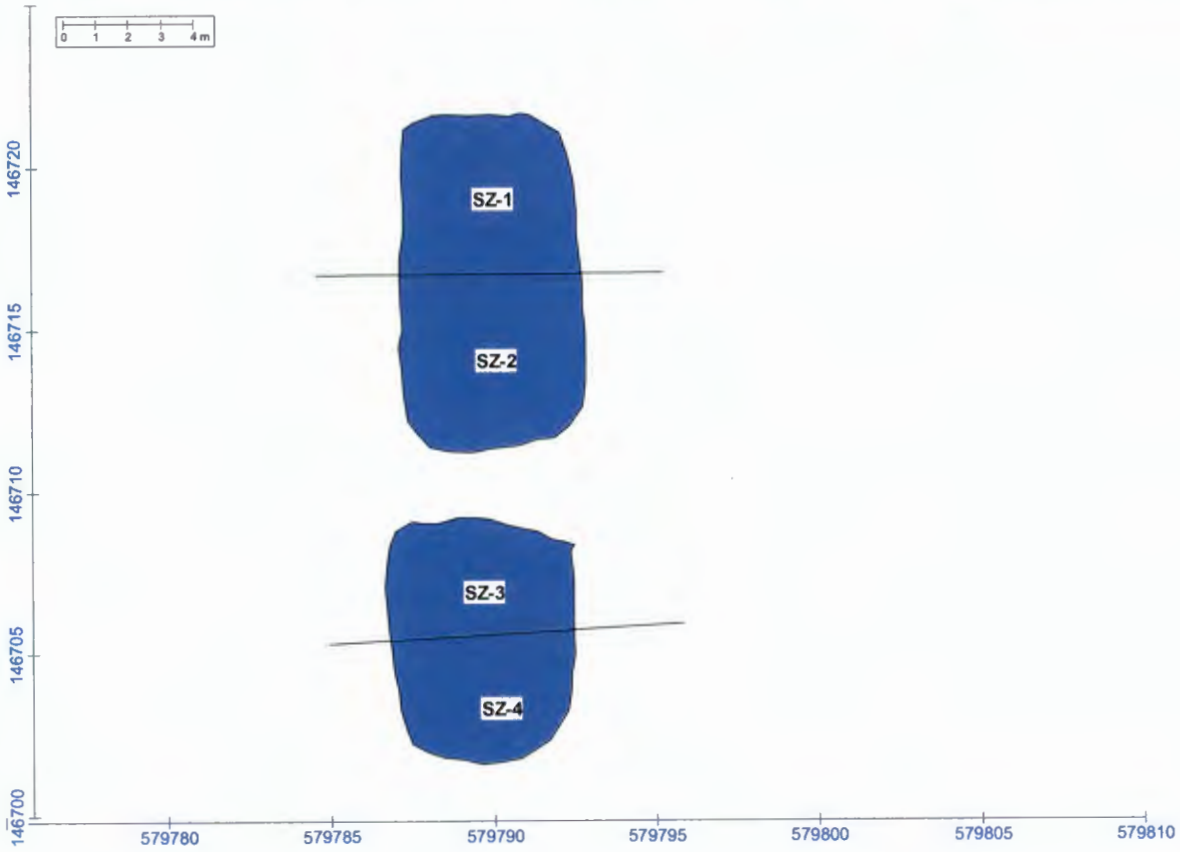


Figure 11. The 600-351 Waste Site Post-Remediation Photograph, Looking Northwest (September, 2011).

VERIFICATION SAMPLING ACTIVITIES

Verification sampling was conducted at the 600-351 waste site June 6 through August 8, 2011, 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). A composite sampling design was used to collect verification soil samples from within the excavated areas (WCH 2011c). The following subsections provide additional discussion of the information used to develop the verification sampling design. The results of verification sampling are also summarized to support interim closure of the site.

Contaminants of Potential Concern (COPCs)

The COPCs for the 600-351 waste site were identified based on existing available historical information, waste characterization sampling data, in-process sample results, and visual observations of the waste site. The COPCs include the expanded list of ICP metals, mercury, pesticides, herbicides, PCBs, and TPH. In-process soil samples (Appendix B) detected high concentrations of lead and arsenic in surface soil samples. These constituents are associated with historic orchards and the use of lead arsenate as an orchard pesticide; they are eliminated as COPCs for verification sampling as agreed to by the regulatory agencies and documented in TPA-CN-401 (DOE-RL 2010). Although not COPCs for site closeout, lead and arsenic were evaluated in the verification samples to support assessment of the distribution of these constituents in a future CERCLA decision document per TPA-CN-401 (DOE-RL 2010). Volatile organic compounds (VOCs) were not detected during verification sampling; therefore, VOCs were excluded for verification sampling analysis for the 600-351 waste site.

A summary of the analyses requested for the verification samples is provided in Table 1.

Table 1. 600-351 Laboratory Analytical Methods.

Analytical Method	Contaminant of Potential Concern
ICP metals [a] – EPA Method 6010	Metals
Mercury – EPA Method 7471	Mercury
Pesticides – EPA Method 8081	Pesticides
Herbicides – EPA Method 8151	Herbicides
TPH – NWTPH-Dx	Total petroleum hydrocarbons
PCB – EPA Method 8082	Polychlorinated biphenyl

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

EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma
NWTPH-Dx = Northwest total petroleum hydrocarbons – diesel range organics
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbons

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* (DOE-RL 2009a). Professional knowledge and the laboratory results of waste characterization sampling were used to develop the verification sampling design for the 600-351 waste site. Due to the small size of the 600-351 excavation footprint, a composite sampling approach was applied for verification sampling. One composite sample was collected from each of the four areas delineated in Figure 10. One sample was collected from one-half of each excavated area of the 600-351 (north and south areas), for a total of four verification samples. Each sample consisted of 25 aliquots of soil collected from across the surface of the sample area and combined into one sample. Although the deepest portion of the excavation extended up to 1.8 m (6.0 ft), the majority of the aliquots of soil were collected from within the depth of 1 m (3.3 ft). All soil samples were analyzed for COPCs listed in Table 1. Two field duplicates and two equipment blanks were collected for laboratory analysis.

Additional information related to verification sampling can be found in the field sampling logbook (WCH 2011a). Table 2 provides a summary of the verification samples that were collected. Figure 11 shows the waste site footprint and the sampling locations.

Verification Sampling Results

Verification samples were analyzed using EPA-approved analytical methods. The maximum detected value was used for comparison to RAGs for each analyte for the 600-351 waste site excavation. If no detections for a given COPC were reported in the data set, then no evaluation or calculations were performed for that COPC. Comparisons of the maximum results for COPCs and the site RAGs for the north and south excavations are provided in Table 3.

All verification samples were analyzed using analytical methods approved by the EPA (DOE-RL 2009b). The analytical methods that were performed for each verification sample are provided in Table 1. The verification data tables and the hazard quotient calculations are provided in Appendix B.

Comparisons of the statistical and maximum results for COPCs against the industrial site RAGs for the footprint of the 600-351 waste site excavations are summarized in Table 3. Contaminants that were not detected by laboratory analysis are excluded from this table, but are reported in Appendix B. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2011) under *Washington Administrative Code* (WAC) 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund* (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 these tables.

Table 2. 600-351, Stained Areas Outside of 100-F Area Sample Summary.

Sample Location	HEIS Sample Number	WSP Coordinates		Sample Analysis
		Northing	Easting	
SZ-1	J1JDK4	146719	579790	ICP metals [a], mercury, pesticides, herbicides, TPH, PCBs
SZ-2	J1JDK5	146714	579790	
SZ-3	J1JDK6	146707	579790	
SZ-3 Re-sample	J1K4M7	146707	579790	
SZ-4	J1JDK7	146703	579790	
SZ-4 Re-sample	J1K4W0	146703	579790	
Duplicate of J1JDK4	J1JDK8	146719	579790	
Duplicate of J1K4W0	J1K4W1	146703	579790	
Equipment blank	J1JDK9/ J1K4W2	NA	NA	ICP metals [a], mercury, VOA

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

HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbons
VOA = volatile organic analysis
WSP = Washington State Plane

Table 3. Comparison of Maximum Contaminant Concentrations to Remedial Action Goals for the 600-351, North and South Excavations Verification Sampling Data. (2 Pages)

COPC	Maximum Result (mg/kg)	Remedial Action Goals [a] (mg/kg)			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Antimony	0.90 (<BG)	32	5 [b]	5 [b]	No	--
Arsenic	250	20 [b]	20 [b]	20 [b]	Yes [c]	-- [c]
Barium	97.1 (<BG)	5,600	200	400	No	--
Beryllium	0.21 (<BG)	10.4 [d]	1.51 [b]	1.51 [b]	No	--
Boron [e]	1.7	7,200	320	-- [f]	No	--
Cadmium [g]	0.34 (<BG)	13.9 [d]	0.81 [b]	0.81 [b]	No	--
Chromium (total)	12.4 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Cobalt	8.4 (<BG)	24	15.7 [b]	-- [f]	No	--
Copper	16.3 (<BG)	2,960	59.2	22.0 [b]	No	--
Lead	805	353	10.2 [b]	10.2 [b]	Yes [c]	Yes [c]
Manganese	364 (<BG)	3,760	512 [b]	512 [b]	No	--
Mercury	0.012 (<BG)	24	0.33 [b]	0.33 [b]	No	--
Molybdenum [e]	0.50	400	8	-- [f]	No	--
Nickel	12.5 (<BG)	1,600	19.1 [b]	27.4	No	--
Selenium [g]	0.92	400	5	1	No	--
Vanadium	48.8 (<BG)	560	85.1 [b]	-- [f]	No	--
Zinc	51.2 (<BG)	24,000	480	67.8 [b]	No	--

Table 3. Comparison of Maximum Contaminant Concentrations to Remedial Action Goals for the 600-351, North and South Excavations Verification Sampling Data. (2 Pages)

COPC	Maximum Result (mg/kg)	Remedial Action Goals [a] (mg/kg)			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
TPH – diesel range	24	200	200	200	No	--
TPH – diesel range extended	48	200	200	200	No	--
MCPP	2.3	80 [h]	1.6 [h]	-- [f]	Yes	Yes [i]
2,4-Db	0.027	640	12.8	-- [f]	No	--

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

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

[c] Lead and arsenic associated with the use of pesticides previous to the Manhattan Project are excluded as COCs for the 600-351 waste site as agreed to by the Tri-party Agreement Project Managers (TPA-CN-401) (DOE-RL 2010). An administrative institutional control identifying the presence of concentrations of lead and arsenic exceeding direct exposure criteria will be established until a decision concerning pre-Hanford historic orchard land is made in a future CERCLA decision document.

[d] 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]).

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

[f] 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]).

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

[h] Lookup values and RAGs obtained from the Cleanup Levels and Risk Calculations Database (Ecology 2011).

[i] Based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b), the residual concentrations of MCPP are not predicted to migrate more than 1 m (3.3 ft) vertically in 1,000 years (based on the coefficient of MCPP of 48.5 mL/g). The vadose zone soil underlying the deepest portion of the excavation is approximately 5.55 m (18.21 ft) thick. Therefore, residual concentrations of MCPP are predicted to be protective of groundwater and the Columbia River.

-- = not applicable
AWQC = ambient water quality criteria
BG = background
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COC = contaminant of concern
COPC = contaminant of potential concern
MCPP = 2-(2-methyl-4-chlorophenoxy) propionic acid
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

DATA EVALUATION

This section demonstrates that remedial actions at the 600-351 waste site have achieved 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 as presented in Table 3, show that all COPCs were quantified below their respective soil RAGs, with the exception of arsenic, lead and 2-(2-methyl-4-chlorophenoxy) propionic acid (MCPP). Of these, arsenic and lead were measured at concentrations exceeding cleanup criteria for direct exposure and protection of groundwater and the Columbia River. However, since arsenic and lead contamination is associated with historic lead arsenate pesticide use at pre-Hanford orchard land, they are excluded as COCs (DOE-RL 2010) and are not evaluated further. Based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005) and modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), residual concentrations of MCPP (having distribution coefficient values exceeding 48.5 mL/g) are predicted to not migrate more than 1 m (3.3 ft) vertically in 1,000 years. The thickness of the vadose zone below the waste site excavation is approximately 5.55 m (18.21 ft) thick. All other COPCs were either not detected or were quantified below the RAGs.

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 600-351 waste site is determined by calculation of the direct contact hazard quotient and carcinogenic (excess cancer) risk values for nonradionuclides. These calculations are located in Appendix B. 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}. These risk values were conservatively calculated using maximum values (Appendix B) from the samples collected at the 600-351 waste site. Risk values are not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. The calculations indicate that all individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 600-351 waste site is 3.3×10^{-2}. None of the detected nonradionuclide constituents (other than arsenic) contribute to the cancer risk; therefore, the sum of the excess cancer risk value is zero. Therefore, nonradionuclide risk requirements are met.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach, the field logbook (WCH 2011a), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications. The DQA for the 600-351 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 Environmental Restoration (ENRE) project-specific database for data evaluation prior to its archival in the Hanford Environmental Information System (HEIS) and are summarized in Appendix B. The detailed DQA is presented in Appendix C.

SUMMARY FOR INTERIM CLOSURE

The 600-351 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 with the exception of arsenic and lead, the residual concentrations of COPCs at this site meet the RAOs for direct exposure, groundwater protection, and river protection. However, as agreed by the Tri-Parties in TPA-CN-401 (DOE-RL 2010), lead and arsenic contamination that resulted from pesticide use prior to the Manhattan Project are excluded as COCs and will be discussed in a future CERCLA document. An administrative institutional control will be required until a final decision concerning historic pesticide contamination is made. The results of verification sampling indicate that residual waste site contamination originating from Hanford Site or Manhattan Project activities does not extend into deep-zone soils. Therefore, institutional controls to prevent uncontrolled drilling into the deep zone (below 4.6 m [15 ft]) are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-351 waste site to Interim Closed Out.

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APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Contaminants Exceeding Ecological Screening Levels for the 600-351 Waste Site [a]

Hazardous Substance		2007 WAC 173-340 Table 749-3			EPA Ecological Soil Screening Levels [b]				Waste Site Analyses
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [c]	Mammalian [c]	
Metals (mg/kg):									
	Background								
Antimony	5	5	--	--	--	78	--	0.27	0.90 (<BG)
Arsenic III	6.5 [d]	--	--	7	18	--	43	46	250
Arsenic V	6.5 [d]	10	60	132					
Boron [e]	--	0.5	--	--	--	--	--	--	1.7
Lead	10.2	50	500	118	120	1,700	11	56	805
Manganese	512	1,100 [f]	--	1,500	220	450	4,300	4,000	364 (<BG)
Selenium	0.78	1	70	0.3	0.52	4.1	1.2	0.63	0.92
Vanadium	85.1	2	--	--	--	--	7.8	280	48.8 (<BG)
Zinc	67.8	86 [f]	200	360	160	120	46	79	51.2 (<BG)

[a] Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. All exceedances must be evaluated in the context of additional lines of evidence for ecological effects following a baseline risk assessment for the river corridor portion of the Hanford Site which will include a more complete quantitative ecological risk assessment.

[b] Available on the internet at <www.epa.gov/ecotox/ecossl.>

[c] Wildlife.

[d] The Hanford Site background for arsenic is 6.5 mg/kg. An 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 *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.

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

[f] Benchmark replaced by Washington State natural background concentration from *Natural Background Soil Metals Concentrations in Washington State*, Publication 94-115, Washington State Department of Ecology, Olympia, Washington (Ecology 1994).

-- = not available
BG = background
EPA = U.S. Environmental Protection Agency
WAC = *Washington Administrative Code*

APPENDIX B

RELATIVE PERCENT DIFFERENCE (RPD)

AND

DIRECT CONTACT HAZARD QUOTIENT AND CARCINOGENIC RISK CALCULATIONS FOR THE 600-351 WASTE SITE

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-FR-2 Field Remediation **Job No. 14655**

Area: 600

Discipline: Environmental Calculation No: 0600X-CA-V0128

Subject: 600-351 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 = 7 Attachment 1 = 6 Total = 14	I. B. Berezovskiy	N. Kobayashi	T. E. Queen	D. F. Obenauer	8/31/11

SUMMARY OF REVISION

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

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	8/30/2011	Calc. No.:	0600X-CA-V0128	Rev.:	0
Project:	100-FR-2 Field Remediation	Job No:	14655	Checked:	N. Kobayashi N.K.	Date:	8/30/2011
Subject:	600-351 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 7	

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 600-351 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009a), the following criteria must be met:

1) An HQ of <1.0 for all individual noncarcinogens
2) A cumulative HQ of <1.0 for noncarcinogens
3) An excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens
4) A cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.

Also, calculate the relative percent difference (RPD) for primary-duplicate sample pairs from 600-351 verification sampling, as necessary.

GIVEN/REFERENCES:

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

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

3) EPA, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013. U.S. Environmental Protection Agency, Washington, D.C.

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

5) WCH, 2011, *Remaining Sites Verification Package for the 600-351, Stained Areas Outside of 100-F Area,* Attachment to Waste Site Reclassification Form 2011-087, Washington Closure Hanford, Inc., Richland, Washington.

SOLUTION:

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

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

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

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Subject:	600-351 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 7	

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

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

METHODOLOGY:

The 600-351 waste site was comprised of one decision unit for verification sampling. The direct contact hazard quotient and carcinogenic risk calculations for the 600-351 waste site were conservatively calculated for the entire waste site using the four composite, verification soil samples (WCH 2011). Of the contaminants of potential concern (COPCs) for this site, selenium requires an HQ and risk calculations because this analyte was detected above the background value. In addition, boron, molybdenum, and herbicides (2, 4-DB and MCPP) require HQ and risk calculations because these analytes were detected and a Washington state or Hanford Site background value is not available. 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. Although total petroleum hydrocarbons (diesel range extended) were detected and no background value is available, the risk associated with total petroleum hydrocarbons do not contribute to the cumulative toxicity calculation. Additionally, arsenic was detected above background; however, the arsenic standard in not toxicity based. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1). For example, the maximum value for boron is 1.7 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 2.4×10^{-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 3.3×10^{-2}. 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}. However, because arsenic, boron, lead, molybdenum, selenium, herbicides (2, 4-DB and MCPP), and TPH - diesel range extended do not contribute to the cancer risk, the criterion of $<1.0 \times 10^{-6}$, is met. The sum of the excess cancer risk value is zero. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

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

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Subject:	600-351 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 7	

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

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

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

RESULTS:

1) List individual noncarcinogens and corresponding HQs >1.0: None
2) List the cumulative noncarcinogenic HQ >1.0: None
3) List individual carcinogens and corresponding excess cancer risk >1 x 10^{-6}: None
4) List the cumulative excess cancer risk for carcinogens >1 x 10^{-5}: None

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

Table 2 shows the results of the RPD calculations for the 600-351 waste site. The evaluation of the QA/QC duplicate RPD calculations is performed within the data quality assessment section of the RSVP.

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Originator:	I. B. Berezovskiy	Date:	8/30/2011	Calc. No.:	0600X-CA-V0128	Rev.:	0
Project:	100-FR-2 Field Remediation	Job No:	14655	Checked:	N. Kobayashi N.K.	Date:	8/30/2011
Subject:	600-351 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 4 of 7	

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 600-351 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					
Arsenic[c]	250	24	--	0.667	--
Boron	1.7	7,200	2.4E-04	--	--
Lead[d]	805	353	--	--	--
Molybdenum	0.50	400	1.3E-03	--	--
Selenium	0.92	400	2.3E-03	--	--
Herbicides					
2,4-DB	0.027	640	4.2E-05	--	--
MCPP	2.3	80	2.9E-02	--	--
Total Petroleum Hydrocarbons					
Diesel range - extended[e]	48	200	--	--	--
Totals					
Cumulative Hazard Quotient:			**3.3E-02**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:

[a] = From WCH (2011).

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

[c] = The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009a).

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

[e] = The risk associated with total petroleum hydrocarbons do not contribute to the cumulative toxicity calculation.

-- = not applicable

RAG = remedial action goal

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	8/30/2011	Calc. No.:	0600X-CA-V0128	Rev.:	0
Project:	100-FR-2 Field Remediation	Job No:	14655	Checked:	N. Kobayashi N.K.	Date:	8/30/2011
Subject:	600-351 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 5 of 7	

Table 2. Relative Percent Difference Calculations for the 600-351 Waste Site. (3 pages)

600-351 Duplicate Analysis - Initial Verification Sampling

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-1	J1JDK4	6/6/11	10100		1.5	363	M	0.64	93.1		0.073	0.24		0.032
Duplicate of J1JDK4	J1JDK8	6/6/11	9450		1.4	500	J	0.60	89.1		0.069	0.19		0.030

Analysis:

TDL		5	10	2	0.5
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	6.6%	31.7%	4.4%	
	Difference > 2 TDL?	Not applicable	Not applicable	Not applicable	No - acceptable

600-351 Duplicate Analysis - Initial Verification Sampling

Sampling Area	HEIS Number	Sample Date	Boron			Cadmium			Calcium			Chromium		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-1	J1JDK4	6/6/11	1.3	B	0.95	0.82	M	0.040	4140		13.6	13.2		0.056
Duplicate of J1JDK4	J1JDK8	6/6/11	1.5	B	0.89	1.3		0.037	3930		12.8	11.8		0.053

Analysis:

TDL		2	0.2	100	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop	No-Stop	Yes (calc RPD)	Yes (calc RPD)
	RPD			5.2%	11.2%
	Difference > 2 TDL?	No - acceptable	Yes - assess	Not applicable	Not applicable

600-351 Duplicate Analysis - Initial Verification Sampling

Sampling Area	HEIS Number	Sample Date	Cobalt			Copper			Iron			Lead		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-1	J1JDK4	6/6/11	8.0	X	0.097	17.6		0.21	21600		3.7	1390	J	0.26
Duplicate of J1JDK4	J1JDK8	6/6/11	7.8	X	0.091	15.1		0.20	20500		3.4	1910	J	0.24

Analysis:

TDL		2	1	5	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD		15.3%	5.2%	31.5%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	Not applicable

600-351 Duplicate Analysis - Initial Verification Sampling

Sampling Area	HEIS Number	Sample Date	Magnesium			Manganese			Mercury			Nickel		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-1	J1JDK4	6/6/11	4780		3.6	323	X	0.097	0.024	M	0.0056	12.9	X	0.12
Duplicate of J1JDK4	J1JDK8	6/6/11	4280		3.3	318	X	0.091	0.0075	BM	0.0054	12.3	X	0.11

Analysis:

TDL		75	5	0.2	4
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop
	RPD	11.0%	1.6%		
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable

Gray cell indicates not applicable or data will not be used for closeout and is presented for information only.
B = estimated result. Result is less than the RL but greater than the MDL.
J = estimated result.
HEIS = Hanford Environmental Information System
M = sample duplicate precision not met
N = Recovery exceeds upper and lower control limits
PQL = practical quantitation limit.
Q = qualifier.
RPD = relative percent difference.
TDL = target detection limit
X = serial dilution in the analytical batch indicates that physical and chemical interferences are present (metals)

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	8/30/2011	Calc. No.:	0600X-CA-V0128	Rev.:	0
Project:	100-FR-2 Field Remediation	Job No:	14655	Checked:	N. Kobayashi N.K.	Date:	8/30/2011
Subject:	600-351 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 6 of 7	

Table 2. Relative Percent Difference Calculations for the 600-351 Waste Site. (3 pages)

600-351 Duplicate Analysis - Initial Verification Sampling

Sampling Area	HEIS Number	Sample Date	Potassium			Silicon			Sodium			Vanadium		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-1	J1JDK4	6/6/11	1620		39.6	279	NJ	5.5	266		57.0	49.3		0.091
Duplicate of J1JDK4	J1JDK8	6/6/11	1640		37.5	269	J	5.1	239		53.4	45.9		0.085

Analysis:

TDL		400	2	50	2.5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		3.6%		7.1%
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable

600-351 Duplicate Analysis - Initial Verification Sampling

Sampling Area	HEIS Number	Sample Date	Zinc			TPH - diesel range			TPH - diesel range extended		
			mg/kg	Q	MDL	ug/kg	Q	MDL	ug/kg	Q	MDL
SZ-1	J1JDK4	6/6/11	64.5		0.38	56000		660	91000		980
Duplicate of J1JDK4	J1JDK8	6/6/11	67.8		0.36	160000		650	210000		960

Analysis:

TDL		1	5000	5000
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD	5.0%	96.3%	79.1%
	Difference > 2 TDL?	Not applicable	Not applicable	Not applicable

600-351 Duplicate Analysis - Re-sampling

Sampling Area	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-4 Re-sample[a]	J1K4W0	7/12/11	10700	X	1.4	0.52	B	0.34	64.7		0.58	90.2		0.067
Duplicate of J1K4W0	J1K4W1	7/12/11	9960	X	1.5	0.61		0.37	62.2		0.64	89.0		0.074

Analysis:

TDL		5	10	10	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	7.2%		3.9%	1.3%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable

600-351 Duplicate Analysis - Re-sampling

Sampling Area	HEIS Number	Sample Date	Boron			Cadmium			Calcium			Chromium		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-4 Re-sample[a]	J1K4W0	7/12/11	1.7	B	0.86	0.26		0.036	4090	X	12.4	11.9		0.051
Duplicate of J1K4W0	J1K4W1	7/12/11	1.7	B	0.95	0.23		0.040	4250	X	13.7	11.4		0.057

Analysis:

TDL		2	0.2	100	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD			3.8%	4.3%
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	Not applicable

600-351 Duplicate Analysis - Re-sampling

Sampling Area	HEIS Number	Sample Date	Cobalt			Copper			Iron			Lead		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-4 Re-sample[a]	J1K4W0	7/12/11	7.1	X	0.088	15.7		0.19	21700	X	3.4	72.2	X	0.24
Duplicate of J1K4W0	J1K4W1	7/12/11	7.0	X	0.097	16.3		0.21	21400	X	3.7	117	X	0.26

Analysis:

TDL		2	1	5	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD		3.8%	1.4%	47.4%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	Not applicable

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	8/30/2011	Calc. No.:	0600X-CA-V0128	Rev.:	0
Project:	100-FR-2 Field Remediation	Job No:	14655	Checked:	N. Kobayashi N.K.	Date:	8/30/2011
Subject:	600-351 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 7 of 7	

Table 2. Relative Percent Difference Calculations for the 600-351 Waste Site. (3 pages)

600-351 Duplicate Analysis - Re-sampling

Sampling Area	HEIS Number	Sample Date	Magnesium			Manganese			Nickel			Potassium		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-4 Re-sample[a]	J1K4W0	7/12/11	4430		3.3	351	X	0.088	11.5	X	0.11	1930		36.2
Duplicate of J1K4W0	J1K4W1	7/12/11	4500		3.6	346	X	0.097	11.4	X	0.12	1620		39.9

Analysis:

TDL		75	5	4	400
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop	No-Stop (acceptable)
	RPD	1.6%	1.4%		
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable

600-351 Duplicate Analysis - Re-sampling

Sampling Area	HEIS Number	Sample Date	Silicon			Sodium			Vanadium			Zinc		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-4 Re-sample[a]	J1K4W0	7/12/11	446	X	5.0	238		52.0	45.0		0.083	44.1		0.35
Duplicate of J1K4W0	J1K4W1	7/12/11	441	X	5.5	254		57.5	48.1		0.092	43.9		0.39

Analysis:

TDL		2	50	2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	1.1%		6.7%	0.5%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable

600-351 Duplicate Analysis - Re-sampling

Sampling Area	HEIS Number	Sample Date	TPH - diesel range			TPH - diesel range extended		
			ug/kg	Q	MDL	ug/kg	Q	MDL
SZ-4 Re-sample[a]	J1K4W0	7/12/11	4800		720	8800		1100
Duplicate of J1K4W0	J1K4W1	7/12/11	6900		680	13000		1000

Analysis:

TDL		5000	5000
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)
	RPD		
	Difference > 2 TDL?	No - acceptable	No - acceptable

CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 600-351 waste site meets the requirements for the hazard quotients and carcinogenic (excess cancer) risk and RPDs, respectively, as identified in the RDR/RAWP (DOE-RL 2009a) and SAP (DOE-RL 2009b). The hazard quotients and carcinogenic (excess cancer) risk and RPD calculations are for use in the RSVP for this site.

Attachment 1. 600-351 Waste Site Verification Sample Results (Metals).

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-1	J1JDK4	6/6/11	10100		1.5	0.39	BJ	0.37	363	MJ	0.64	93.1		0.073	0.24		0.032
Duplicate of J1JDK4	J1JDK8	6/6/11	9450		1.4	0.34	UJ	0.34	500	J	0.60	89.1		0.069	0.19		0.030
SZ-1 Re-sample[a]	J1KNF4	8/8/11	10100	X	1.4	0.69		0.35	250	XN	0.60	87.3		0.070	0.30		0.030
SZ-2	J1JDK5	6/6/11	10400		1.5	0.36	UJ	0.36	131	J	0.63	97.1		0.072	0.21		0.031
SZ-3	J1JDK6	6/6/11	7830		1.5	0.38	UJ	0.38	45.1	J	0.65	64.6		0.075	0.15	B	0.033
SZ-3 Re-sample[a]	J1K4M7	7/12/11	10000	X	1.4	0.90	M	0.34	49.0		0.60	85.5		0.069	0.030	U	0.030
SZ-4	J1JDK7	6/6/11	9660		1.5	0.36	UJ	0.36	92.8	J	0.63	93.0		0.072	0.18	B	0.031
SZ-4 Re-sample[a]	J1K4W0	7/12/11	10700	X	1.4	0.52	B	0.34	64.7		0.58	90.2		0.067	0.046	B	0.029
Duplicate of J1K4W0	J1K4W1	7/12/11	9960	X	1.5	0.61		0.37	62.2		0.64	89.0		0.074	0.032	U	0.032
Equipment Blank 1	J1JDK9	6/6/11	226		1.5	0.36	UJ	0.36	0.62	UJ	0.62	2.1		0.072	0.031	U	0.031
Equipment Blank 2	J1K4W2	7/12/11	195	X	1.5	0.37	U	0.37	0.64	U	0.64	2.0		0.074	0.036	B	0.032

Sample Location	HEIS Number	Sample Date	Boron			Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-1	J1JDK4	6/6/11	1.3	B	0.95	0.82	M	0.040	4140		13.6	13.2		0.056	8.0	X	0.097
Duplicate of J1JDK4	J1JDK8	6/6/11	1.5	B	0.89	1.3		0.037	3930		12.8	11.8		0.053	7.8	X	0.091
SZ-1 Re-sample[a]	J1KNF4	8/8/11	1.5	B	0.90	0.10	B	0.038	4850	XM	12.9	11.6	X	0.053	7.3	X	0.092
SZ-2	J1JDK5	6/6/11	1.3	B	0.93	0.34		0.039	4120		13.4	12.4		0.055	8.4	X	0.095
SZ-3	J1JDK6	6/6/11	1.1	B	0.97	0.16	B	0.041	5050		14.0	10.7		0.057	6.7	X	0.099
SZ-3 Re-sample[a]	J1K4M7	7/12/11	1.7	B	0.89	0.21		0.037	4120	X	12.8	11.8		0.052	6.7	X	0.090
SZ-4	J1JDK7	6/6/11	1.8	B	0.93	0.29		0.039	4130		13.4	11.7		0.055	8.4	X	0.095
SZ-4 Re-sample[a]	J1K4W0	7/12/11	1.7	B	0.86	0.26		0.036	4090	X	12.4	11.9		0.051	7.1	X	0.088
Duplicate of J1K4W0	J1K4W1	7/12/11	1.7	B	0.95	0.23		0.040	4250	X	13.7	11.4		0.057	7.0	X	0.097
Equipment Blank 1	J1JDK9	6/6/11	0.92	U	0.92	0.039	U	0.039	43.1	B	13.3	0.16	B	0.055	0.11	BX	0.094
Equipment Blank 2	J1K4W2	7/12/11	0.95	U	0.95	0.040	U	0.040	40.9	BX	13.7	0.13	B	0.056	0.097	UX	0.097

[a] Due to RAG exceedances and/or further excavation, re-samples were taken.
Gray cell indicates not applicable or data will not be used for closeout and is presented for information only.
B = estimated result; result is less than the RL but greater than the MDL
C = detected in both sample and blank
HEIS = Hanford Environmental Information System
J = estimated result
M = sample duplicate precision not met
N = Recovery exceeds upper and lower control limits
PQL = practical quantitation limit
Q = qualifier
X = serial dilution in the analytical batch indicates that physical and chemical interferences are present (metals)
More than 40% difference between columns, lower result reported (organics)
R = data unusable
U = undetected

Attachment	1	Sheet No.	1 of 6
Originator	I. B. Berezovskiy	Date	8/30/11
Checked	N. Kobayashi	Date	8/30/11
Calc. No.	0600X-CA-V0128	Rev. No.	0

Attachment 1. 600-351 Waste Site Verification Sample Results (Metals).

Sample Location	HEIS Number	Sample Date	Copper			Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-1	J1JDK4	6/6/11	17.6		0.21	21600		3.7	1390	J	0.26	4780		3.6	323	X	0.097
Duplicate of J1JDK4	J1JDK8	6/6/11	15.1		0.20	20500		3.4	1910	J	0.24	4280		3.3	318	X	0.091
SZ-1 Re-sample[a]	J1KNF4	8/8/11	15.6		0.20	20300	X	3.5	805	X	0.25	4530	X	3.4	337	X	0.092
SZ-2	J1JDK5	6/6/11	15.5		0.21	22200		3.6	251	J	0.26	4960		3.5	364	X	0.095
SZ-3	J1JDK6	6/6/11	15.1		0.21	17300		3.8	132	J	0.27	4540		3.7	288	X	0.099
SZ-3 Re-sample[a]	J1K4M7	7/12/11	15.6		0.20	20900	X	3.4	104	X	0.24	4620		3.3	329	X	0.090
SZ-4	J1JDK7	6/6/11	14.9		0.21	21700		3.6	384	J	0.26	4570		3.5	366	X	0.095
SZ-4 Re-sample[a]	J1K4W0	7/12/11	15.7		0.19	21700	X	3.4	72.2	X	0.24	4430		3.3	351	X	0.088
Duplicate of J1K4W0	J1K4W1	7/12/11	16.3		0.21	21400	X	3.7	117	X	0.26	4500		3.6	346	X	0.097
Equipment Blank 1	J1JDK9	6/6/11	0.21	B	0.20	261		3.6	0.57	J	0.25	24.7		3.5	5.0	X	0.094
Equipment Blank 2	J1K4W2	7/12/11	0.21	U	0.21	273	X	3.7	0.26	UX	0.26	23.4		3.6	4.9	X	0.097

Sample Location	HEIS Number	Sample Date	Mercury			Molybdenum			Nickel			Potassium			Selenium		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-1	J1JDK4	6/6/11	0.024	M	0.0056	0.25	U	0.25	12.9	X	0.12	1620		39.6	0.83	U	0.83
SZ-1 Re-sample[a]	J1KNF4	8/8/11	0.0075	BM	0.0054	0.25	B	0.24	12.3	X	0.11	1640		37.5	0.79	U	0.79
Duplicate of J1JDK4	J1JDK8	6/6/11	0.012	B	0.0049	0.24	U	0.24	11.1	X	0.11	1870		37.1	0.78	U	0.78
SZ-2	J1JDK5	6/6/11	0.0080	B	0.0053	0.25	U	0.25	12.5	X	0.12	1710		39.0	0.82	U	0.82
SZ-3	J1JDK6	6/6/11	0.0068	B	0.0050	0.26	U	0.26	11.1	X	0.12	1120		40.6	0.85	U	0.85
SZ-3 Re-sample[a]	J1K4M7	7/12/11	0.0054	U	0.0054	0.50	B	0.24	11.5	X	0.11	1710		37.1	0.92		0.78
SZ-4	J1JDK7	6/6/11	0.014	B	0.0049	0.25	U	0.25	11.3	X	0.12	2050		39.0	0.82	U	0.82
SZ-4 Re-sample[a]	J1K4W0	7/12/11	0.0055	B	0.0053	0.23	U	0.23	11.5	X	0.11	1930		36.2	0.76	U	0.76
Duplicate of J1K4W0	J1K4W1	7/12/11	0.0054	U	0.0054	0.25	U	0.25	11.4	X	0.12	1620		39.9	0.84	U	0.84
Equipment Blank 1	J1JDK9	6/6/11	0.0054	U	0.0054	0.25	U	0.25	0.14	BX	0.12	49.6	B	38.7	0.81	U	0.81
Equipment Blank 2	J1K4W2	7/12/11	0.0055	U	0.0055	0.25	U	0.25	0.12	BX	0.12	63.5	B	39.8	0.83	U	0.83

Sample Location	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium			Zinc		
			mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL	mg/kg	Q	MDL
SZ-1	J1JDK4	6/6/11	279	NJ	5.5	0.15	U	0.15	266		57.0	49.3		0.091	64.5		0.38
Duplicate of J1JDK4	J1JDK8	6/6/11	269	J	5.1	0.14	U	0.14	239		53.4	45.9		0.085	67.8		0.36
SZ-1 Re-sample[a]	J1KNF4	8/8/11	351	X	5.2	0.15	U	0.15	271		54.0	46.6		0.086	51.2	X	0.36
SZ-2	J1JDK5	6/6/11	439	J	5.4	0.15	U	0.15	262		56.1	48.8		0.089	45.1		0.38
SZ-3	J1JDK6	6/6/11	278	J	5.6	0.16	U	0.16	222		58.4	42.3		0.093	39.3		0.39
SZ-3 Re-sample[a]	J1K4M7	7/12/11	377	XN	5.1	0.14	U	0.14	258		53.4	45.6		0.085	43.3		0.36
SZ-4	J1JDK7	6/6/11	227	J	5.4	0.15	U	0.15	248		56.2	49.7		0.090	52.9		0.38
SZ-4 Re-sample[a]	J1K4W0	7/12/11	446	X	5.0	0.14	U	0.14	238		52.0	45.0		0.083	44.1		0.35
Duplicate of J1K4W0	J1K4W1	7/12/11	441	X	5.5	0.16	U	0.16	254		57.5	48.1		0.092	43.9		0.39
Equipment Blank 1	J1JDK9	6/6/11	132		5.3	0.15	U	0.15	55.7	U	55.7	0.35	B	0.089	1.2		0.38
Equipment Blank 2	J1K4W2	7/12/11	141	X	5.5	0.16	U	0.16	57.3	U	57.3	0.30	B	0.091	1.0		0.39

Attachment	1	Sheet No.	2 of 6
Originator	I. B. Berezovskiy	Date	8/30/11
Checked	N. Kobayashi	Date	8/30/11
Calc. No.	0600X-CA-V0128	Rev. No.	0

Attachment 1. 600-351 Waste Site Verification Sampling Results (TPH and Physical)

Sample Location	HEIS Number	Sample Date	TPH - diesel range			TPH - diesel range extended			Percent Moisture		
			ug/kg	Q	PQL	ug/kg	Q	PQL	%	Q	PQL
SZ-1	J1JDK4	6/6/11	56000		660	91000		980	1.4		0.10
Duplicate of J1JDK4	J1JDK8	6/6/11	160000		650	210000		960	1.4		0.10
SZ-1 Re-sample[a]	J1KNF4	8/8/11	24000		650	48000		950	3.3		0.10
SZ-2	J1JDK5	6/6/11	5700		690	9800		1000	3.5		0.10
SZ-3	J1JDK6	6/6/11	2500	J	690	4400		1000	1.9		0.10
SZ-3 Re-sample[a]	J1K4M7	7/12/11	7200		700	12000		1000	3.1		0.10
SZ-4	J1JDK7	6/6/11	47000		680	120000		1000	2.8		0.10
SZ-4 Re-sample[a]	J1K4W0	7/12/11	4800		720	8800		1100	5.5		0.10
Duplicate of J1K4W0	J1K4W1	7/12/11	6900		680	13000		1000	5.8		0.10
Equipment Blank 1	J1JDK9	6/6/11							0.10	U	0.10
Equipment Blank 2	J1K4W2	7/12/11							0.10	U	0.10

Attachment	1	Sheet No.	3 of 6
Originator	I. B. Berezovskiy	Date	8/30/11
Checked	N. Kobayashi	Date	8/30/11
Calc. No.	0600X-CA-V0128	Rev. No.	0

Attachment 1. 600-351 Waste Site Verification Sample Results (Organics).

Constituents	Class	J1JDK4, SZ-1			J1JDK8, Duplicate of J1JDK4			J1KNF4, SZ-1 Re-sample*			J1JDK5, SZ-2			J1JDK6, SZ-3		
		6/6/11			6/6/11			8/8/11			6/6/11			6/6/11		
		ug/kg	Q	MDL	ug/kg	Q	MDL	ug/kg	Q	MDL	ug/kg	Q	MDL	ug/kg	Q	MDL
2-(2,4,5-Trichlorophenoxy)propionic acid	HERB	1.4	U	1.4	1.4	U	1.4	1.4	U	1.4	1.4	U	1.4	1.4	U	1.4
2-(2-methyl-4-chlorophenoxy) propionic acid	HERB	2000	U	2000	2000	JX	2000	2200	JX	2100	2000	U	2000	2000	U	2000
2,4,5-Trichlorophenoxyacetic acid	HERB	2.3	U	2.3	2.3	U	2.3	2.4	U	2.4	2.3	U	2.3	2.3	U	2.3
2,4-Dichlorophenoxyacetic acid	HERB	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14
2-Methyl-4 chlorophenoxyacetic acid	HERB	2000	U	2000	2000	U	2000	2100	U	2100	2000	U	2000	2000	U	2000
2-secButyl-4,6-dinitrophenol(DNBP)	HERB	1.4	UJ	1.4	1.4	UNJ	1.4	1.4	UN	1.4	1.4	UJ	1.4	1.4	UJ	1.4
4-(2,4-Dichlorophenoxy)butanoic acid	HERB	4.8	JX	2.8	2.8	U	2.8	27	J	2.9	9.1	JX	2.9	15	J	2.8
Dalapon	HERB	1.4	U	1.4	1.4	U	1.4	1.4	U	1.4	1.4	U	1.4	1.4	U	1.4
Dicamba	HERB	1.4	U	1.4	1.4	U	1.4	1.4	U	1.4	1.4	U	1.4	1.4	U	1.4
Dichloroprop	HERB	3.2	U	3.2	3.2	U	3.2	3.3	U	3.3	3.3	U	3.3	3.2	U	3.2
Aroclor-1016	PCB	2.7	U	2.7	2.6	U	2.6	2.7	U	2.7	2.6	U	2.6	2.6	U	2.6
Aroclor-1221	PCB	7.9	U	7.9	7.6	U	7.6	7.9	U	7.9	7.6	U	7.6	7.7	U	7.7
Aroclor-1232	PCB	2.0	U	2.0	1.9	U	1.9	2.0	U	2.0	1.9	U	1.9	1.9	U	1.9
Aroclor-1242	PCB	4.6	U	4.6	4.4	U	4.4	4.6	U	4.6	4.4	U	4.4	4.5	U	4.5
Aroclor-1248	PCB	4.6	U	4.6	4.4	U	4.4	4.6	U	4.6	4.4	U	4.4	4.5	U	4.5
Aroclor-1254	PCB	2.6	U	2.6	2.5	U	2.5	2.6	U	2.6	2.5	U	2.5	2.5	U	2.5
Aroclor-1260	PCB	2.6	U	2.6	2.5	U	2.5	2.6	U	2.6	2.5	U	2.5	2.5	U	2.5

Constituents		J1K4M7, SZ-3 Re-sample*			J1JDK7, SZ-4			J1K4W0, SZ-4 Re-sample*			J1K4W1, Duplicate of J1K4W0		
		7/12/11			6/6/11			7/12/11			7/12/11		
		ug/kg	Q	MDL	ug/kg	Q	MDL	ug/kg	Q	MDL	ug/kg	Q	MDL
2-(2,4,5-Trichlorophenoxy)propionic acid	HERB	1.4	U	1.4	1.4	U	1.4	1.4	U	1.4	1.5	U	1.5
2-(2-methyl-4-chlorophenoxy) propionic acid	HERB	2300	J	2100	3500	JX	2000	2200	J	2000	2100	U	2100
2,4,5-Trichlorophenoxyacetic acid	HERB	2.4	U	2.4	2.3	U	2.3	2.3	U	2.3	2.4	U	2.4
2,4-Dichlorophenoxyacetic acid	HERB	14	U	14	14	U	14	14	U	14	15	U	15
2-Methyl-4 chlorophenoxyacetic acid	HERB	2100	U	2100	2000	U	2000	2000	U	2000	2100	U	2100
2-secButyl-4,6-dinitrophenol(DNBP)	HERB	1.4	UN	1.4	4.5	J	1.4	1.4	U	1.4	1.5	U	1.5
4-(2,4-Dichlorophenoxy)butanoic acid	HERB	2.9	U	2.9	35	J	2.9	3.0	JX	2.8	3.0	U	3.0
Dalapon	HERB	1.4	U	1.4	1.4	U	1.4	1.4	U	1.4	1.5	U	1.5
Dicamba	HERB	1.4	U	1.4	1.4	U	1.4	1.4	U	1.4	1.5	U	1.5
Dichloroprop	HERB	3.3	U	3.3	3.3	U	3.3	3.2	U	3.2	3.4	U	3.4
Aroclor-1016	PCB	2.7	U	2.7	2.7	U	2.7	2.8	U	2.8	2.8	U	2.8
Aroclor-1221	PCB	7.9	U	7.9	7.8	U	7.8	8.2	U	8.2	8.1	U	8.1
Aroclor-1232	PCB	2.0	U	2.0	2.0	U	2.0	2.0	U	2.0	2.0	U	2.0
Aroclor-1242	PCB	4.6	U	4.6	4.5	U	4.5	4.8	U	4.8	4.7	U	4.7
Aroclor-1248	PCB	4.6	U	4.6	4.5	U	4.5	4.8	U	4.8	4.7	U	4.7
Aroclor-1254	PCB	2.5	U	2.5	2.5	U	2.5	2.7	U	2.7	2.6	U	2.6
Aroclor-1260	PCB	2.5	U	2.5	2.5	U	2.5	2.7	U	2.7	2.6	U	2.6

Attachment 1
Originator I. B. Berezovskiy
Checked N. Kobayashi
Calc. No. 0600X-CA-V0128

Sheet No. 4 of 6
Date 8/30/11
Date 8/30/11
Rev. No. 0

Attachment 1, 600-351 Waste Site Verification Sample Results (Organics).

Constituents	Class	J1JDK4, SZ-1			J1JDK8, Duplicate of J1JDK4			J1KNF4, SZ-1 Re-sample*			J1JDK3, SZ-2			J1JDK6, SZ-3		
		6/6/11			6/6/11			8/8/11			6/6/11			6/6/11		
		ug/kg	Q	MDL	ug/kg	Q	MDL	ug/kg	Q	MDL	ug/kg	Q	MDL	ug/kg	Q	MDL
Aldrin	PEST	0.24	U	0.24	0.25	UJ	0.25	0.26	U	0.26	0.26	U	0.26	0.25	U	0.25
Alpha-BHC	PEST	0.21	U	0.21	0.21	UJ	0.21	0.22	U	0.22	0.22	U	0.22	0.21	U	0.21
alpha-Chlordane	PEST	0.31	U	0.31	0.32	UJ	0.32	0.33	U	0.33	0.33	U	0.33	0.32	U	0.32
beta-1,2,3,4,5,6-Hexachlorocyclohexane	PEST	0.64	U	0.64	0.65	UJ	0.65	0.68	U	0.68	0.68	U	0.68	0.65	U	0.65
Delta-BHC	PEST	0.39	U	0.39	0.39	UJ	0.39	0.41	U	0.41	0.41	U	0.41	0.39	U	0.39
Dichlorodiphenyldichloroethane	PEST	0.53	UN	0.53	0.53	UJ	0.53	0.56	U	0.56	0.56	U	0.56	0.54	U	0.54
Dichlorodiphenyldichloroethylene	PEST	0.23	U	0.23	0.23	UJ	0.23	0.24	U	0.24	0.24	U	0.24	0.23	U	0.23
Dichlorodiphenyltrichloroethane	PEST	0.57	U	0.57	0.58	UJ	0.58	0.60	U	0.60	0.60	U	0.60	0.58	U	0.58
Dieldrin	PEST	0.20	U	0.20	0.21	UJ	0.21	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21
Endosulfan I	PEST	0.17	U	0.17	0.17	UJ	0.17	0.18	U	0.18	0.18	U	0.18	0.17	U	0.17
Endosulfan II	PEST	0.28	U	0.28	0.28	UJ	0.28	0.29	U	0.29	0.29	U	0.29	0.28	U	0.28
Endosulfan sulfate	PEST	0.27	U	0.27	0.27	UJ	0.27	0.28	U	0.28	0.28	U	0.28	0.27	U	0.27
Endrin	PEST	0.29	U	0.29	0.30	UJ	0.30	0.31	U	0.31	0.31	U	0.31	0.30	U	0.30
Endrin aldehyde	PEST	0.16	U	0.16	0.17	UJ	0.17	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17
Endrin ketone	PEST	0.47	UN	0.47	0.48	UJ	0.48	0.50	U	0.50	0.50	U	0.50	0.48	U	0.48
Gamma-BHC (Lindane)	PEST	0.45	U	0.45	0.45	UJ	0.45	0.47	U	0.47	0.47	U	0.47	0.45	U	0.45
gamma-Chlordane	PEST	0.26	U	0.26	0.26	UJ	0.26	0.27	U	0.27	0.27	U	0.27	0.26	U	0.26
Heptachlor	PEST	0.21	U	0.21	0.21	UJ	0.21	0.22	U	0.22	0.22	U	0.22	0.21	U	0.21
Heptachlor epoxide	PEST	0.41	U	0.41	0.42	UJ	0.42	0.43	U	0.43	0.43	U	0.43	0.42	U	0.42
Methoxychlor	PEST	0.43	U	0.43	0.44	UJ	0.44	0.46	U	0.46	0.46	U	0.46	0.44	U	0.44
Toxaphene	PEST	15	UJ	15	15	UJ	15	16	U	16	16	UJ	16	15	UJ	15

Constituents		J1K4M7, SZ-3 Re-sample*			J1JDK7, SZ-4			J1K4W0, SZ-4 Re-sample*			J1K4W1, Duplicate of J1K4W0		
		7/12/11			6/6/11			7/12/11			7/12/11		
		ug/kg	Q	MDL	ug/kg	Q	MDL	ug/kg	Q	MDL	ug/kg	Q	MDL
Aldrin	PEST	0.25	U	0.25	0.25	U	0.25	0.26	U	0.26	0.26	U	0.26
Alpha-BHC	PEST	0.22	U	0.22	0.21	U	0.21	0.22	U	0.22	0.22	U	0.22
alpha-Chlordane	PEST	0.32	U	0.32	0.32	U	0.32	0.33	U	0.33	0.33	U	0.33
beta-1,2,3,4,5,6-Hexachlorocyclohexane	PEST	0.67	U	0.67	0.65	U	0.65	0.68	U	0.68	0.68	U	0.68
Delta-BHC	PEST	0.40	U	0.40	0.39	U	0.39	0.41	U	0.41	0.41	U	0.41
Dichlorodiphenyldichloroethane	PEST	0.55	U	0.55	0.53	U	0.53	0.56	U	0.56	0.56	U	0.56
Dichlorodiphenyldichloroethylene	PEST	0.24	U	0.24	0.23	U	0.23	0.24	U	0.24	0.24	U	0.24
Dichlorodiphenyltrichloroethane	PEST	0.59	U	0.59	0.58	U	0.58	0.60	U	0.60	0.60	U	0.60
Dieldrin	PEST	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21	0.22	U	0.22
Endosulfan I	PEST	0.18	U	0.18	0.17	U	0.17	0.18	U	0.18	0.18	U	0.18
Endosulfan II	PEST	0.29	U	0.29	0.28	U	0.28	0.29	U	0.29	0.29	U	0.29
Endosulfan sulfate	PEST	0.28	U	0.28	0.27	U	0.27	0.28	U	0.28	0.28	U	0.28
Endrin	PEST	0.31	U	0.31	0.30	U	0.30	0.31	U	0.31	0.31	U	0.31
Endrin aldehyde	PEST	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17	0.18	U	0.18
Endrin ketone	PEST	0.49	U	0.49	0.48	U	0.48	0.50	U	0.50	0.50	U	0.50
Gamma-BHC (Lindane)	PEST	0.47	U	0.47	0.45	U	0.45	0.47	U	0.47	0.48	U	0.48
gamma-Chlordane	PEST	0.27	U	0.27	0.26	U	0.26	0.27	U	0.27	0.27	U	0.27
Heptachlor	PEST	0.22	U	0.22	0.21	U	0.21	0.22	U	0.22	0.22	U	0.22
Heptachlor epoxide	PEST	0.43	U	0.43	0.42	U	0.42	0.43	U	0.43	0.44	U	0.44
Methoxychlor	PEST	0.45	U	0.45	0.44	U	0.44	0.46	U	0.46	0.46	U	0.46
Toxaphene	PEST	16	U	16	15	UJ	15	16	U	16	16	U	16

Attachment	1	Sheet No.	5 of 6
Originator	I. B. Berezovskiy	Date	8/30/11
Checked	N. Kobayashi	Date	8/30/11
Calc. No.	0600X-CA-V0128	Rev. No.	0

Attachment 1. 600-351 Waste Site Verification Sample Results (TCLP - Metals)

Sample Location	HEIS Number	Sample Date	Arsenic			Barium			Cadmium			Chromium		
			mg/L	Q	MDL	mg/L	Q	MDL	mg/L	Q	MDL	mg/L	Q	MDL
SZ-1	J1JDK4	6/6/11												
Duplicate of J1JDK4	J1JDK8	6/6/11	0.49		0.0044	1.12	B	0.00040	0.0019	B	0.00040	0.00060	U	0.00060
SZ-1 Re-sample*	J1KNF4	8/8/11												
SZ-2	J1JDK5	6/6/11												
SZ-3	J1JDK6	6/6/11	0.14		0.0044	0.078	B	0.00040	0.0041	B	0.00040	0.00071	B	0.00060
SZ-3 Re-sample*	J1K4M7	7/12/11												
SZ-4	J1JDK7	6/6/11	0.22		0.0044	0.084	B	0.00040	0.0006	B	0.00040	0.00060	U	0.00060
SZ-4 Re-sample*	J1K4W0	7/12/11												
Duplicate of J1K4W0	J1K4W1	7/12/11												

Sample Location	HEIS Number	Sample Date	Lead			Mercury			Selenium			Silver		
			mg/L	Q	MDL	mg/L	Q	MDL	mg/L	Q	MDL	mg/L	Q	MDL
SZ-1	J1JDK4	6/6/11												
Duplicate of J1JDK4	J1JDK8	6/6/11	0.66		0.0026	0.000030	U	0.000030	0.0048	U	0.0048	0.00080	U	0.00080
SZ-1 Re-sample*	J1KNF4	8/8/11												
SZ-2	J1JDK5	6/6/11												
SZ-3	J1JDK6	6/6/11	0.057	B	0.0026	0.000030	U	0.000030	0.0048	U	0.0048	0.00080	U	0.00080
SZ-3 Re-sample*	J1K4M7	7/12/11												
SZ-4	J1JDK7	6/6/11	0.13		0.0026	0.000030	U	0.000030	0.0048	U	0.0048	0.00080	U	0.00080
SZ-4 Re-sample*	J1K4W0	7/12/11												
Duplicate of J1K4W0	J1K4W1	7/12/11												

Attachment	1	Sheet No.	6 of 6
Originator	I. B. Berezovskiy	Date	8/30/11
Checked	N. Kobayashi	Date	8/30/11
Calc. No.	0600X-CA-V0128	Rev. No.	0

APPENDIX C

DATA QUALITY ASSESSMENT

APPENDIX C

DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING

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

A review of the sample design (WCH 2011b), the field logbook (WCH 2011a), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical analysis (BHI 2000) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2006).

Verification sample data collected at the 600-351 waste site were provided by the laboratories in three sample delivery groups (SDGs): SDG J01109, SDG J01169, and SDG JP0262. SDG J01109 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 600-351 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 J01109

This SDG comprises five composite soil samples (J1JDK4 through J1JDK8) from the excavation. This SDG includes a field duplicate pair (J1JDK4/J1JDK8). These samples were analyzed for inductively coupled plasma (ICP) metals, mercury, pesticides, herbicides, volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), and polychlorinated biphenyls (PCBs). In addition, one equipment blank (J1JDK9) was collected and analyzed for ICP metals, mercury, and VOCs. Minor deficiencies are as follows:

In the herbicide analysis, all dinoseb results were qualified as estimated and flagged "J" by third-party validation, due to a matrix spike (MS) and matrix spike duplicate (MSD) recovery of 18% and 0%, respectively. In addition, the laboratory control sample (LCS) recovery was below the quality control (QC) criteria at 8%. Estimated data are usable for decision-making purposes.

In the pesticides analysis, all of the toxaphene data in SDG J01109 were qualified by third-party validation as estimated with "J" flags, due to lack of an MS, MSD, and LCS analysis. Estimated, or "J"-flagged, data are acceptable for decision-making purposes.

In the pesticides analysis, all results for sample J1JDK8 were qualified as estimated and flagged "J" by third-party validation due to a surrogate recovery below the QC criteria. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for seven analytes (aluminum, arsenic, iron, lead, manganese, antimony, and silicon). For aluminum, arsenic, iron, lead, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the original MS. The original MS recoveries for antimony and silicon were 39% and 10%, respectively. All antimony and silicon data for SDG J01109 were considered estimated and flagged "J" by third-party validation due to the MS recoveries outside the QC limits. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, all silicon results were qualified as estimates and flagged "J" by third-party validation, due to an LCS below QC limits at 14%. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, all arsenic and lead results may be considered estimated due to relative percent difference (RPD) values above QC limits at 35% and 38%, respectively. Estimated data are usable for decision-making purposes.

SDG J01169

This SDG comprises three composite soil samples (J1K4M7, J1K4W0, and J1K4W1), collected to replace sample J1JDK6 at location SZ-3 and sample J1JDK7 at location SZ-4, following further excavation. This SDG includes a field duplicate pair (J1K4W0/J1K4W1). The samples were analyzed for ICP metals, mercury, pesticides, herbicides, VOCs, TPH, and PCBs. In addition, one equipment blank (J1K4W2) was collected and analyzed for ICP metals, mercury, and VOCs. Minor deficiencies are as follows:

In the herbicide analysis, all dinoseb results may be considered estimated due to MS and MSD recoveries of 0% and 3%, respectively. In addition, the LCS recovery was below the QC criteria at 8%. Estimated data are usable for decision-making purposes.

In the pesticides analysis, the toxaphene data in SDG J01169 may be considered estimated due to lack of an MS, MSD, and LCS analysis. Estimated data are acceptable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for five analytes (aluminum, iron, manganese, antimony, and silicon). For aluminum, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the

sample. Antimony and silicon did not have mismatched spike and native concentrations in the original MS. The original MS recoveries for antimony and silicon were 43% and 19%, respectively. All antimony and silicon data for SDG J01169 may be considered estimated due to the MS recoveries outside the QC limits. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, all silicon results may be considered estimated due to an LCS below QC limits at 14%. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the antimony results may be considered estimated due to an RPD above QC limits at 58%. Estimated data are usable for decision-making purposes.

SDG JP0262

This SDG comprises a composite soil sample (J1KNF4), collected to replace sample J1JDK4 at location SZ-1, following further excavation. The sample was analyzed for ICP metals, mercury, pesticides, herbicides, VOCs, TPH, and PCBs. Minor deficiencies are as follows:

In the herbicide analysis, the dinoseb result may be considered estimated due to MS and MSD recoveries of 0% and 4%, respectively. In addition, the LCS recovery was below the QC criteria at 10%. Estimated data are usable for decision-making purposes.

In the pesticides analysis, the toxaphene data in SDG JP0262 may be considered estimated due to lack of an MS, MSD, and LCS analysis. Estimated data are acceptable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for five analytes (aluminum, iron, lead, antimony, and silicon). For aluminum, iron, and lead, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the original MS. The original MS recoveries for antimony and silicon were 47% and 33%, respectively. All antimony and silicon data for SDG JP0262 may be considered estimated due to the MS recoveries outside the QC limits. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the silicon result may be considered estimated due to an LCS below QC limits at 20%. Estimated data are usable for decision-making purposes.

In the mercury analysis, the result may be considered estimated due to an RPD above QC limits at 143%. 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 2011a), are the primary and duplicate samples (J1JDK4/J1JDK8) from location SZ-1, collected during the original sampling event. In addition, there are the primary and duplicate samples (J1K4W0/J1K4W1) from location SZ-4 taken following further excavation (WCH 2011a). The main and QA/QC sample results are presented in Appendix B.

Field duplicate samples are collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the sample/duplicate pair(s) for each contaminant of potential concern (COPC). RPDs are not calculated for analytes that are not detected in both the main and duplicate sample at more than 5 times the target detection limit (TDL). RPDs of analytes detected at low concentrations (less than 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 for arsenic (31.7%), lead (31.5%), TPH-diesel (96.3%), and TPH-diesel extended range (79.1%) in the duplicate sample (J1JDK8) from location SZ-1 and for lead (47.4%) in the duplicate (J1K4W0) from location SZ-4 are above the acceptance criteria of 30%. A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than 5 times the TDL, including undetected analytes. In these cases, a control limit of ± 2 times the TDL is used (Appendix B) to indicate that a visual check of the data is required by the reviewer. Cadmium in the SZ-1 location 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 600-351 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 600-351 waste site concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. The analytical data were found acceptable for decision-making purposes. The verification sample analytical data are stored in the Environmental Restoration (ENRE) project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System (HEIS) database. The verification sample analytical data are also summarized in Appendix B.

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